FEASIBILITY STUDY
DRAFT FINAL REPORT

FOR

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
AND
COORDINATING COUNCIL OF THE PHILIPPINE ASSISTANCE PROGRAM

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

VOLUME I - CHAPTERS 1 TO 7

Prepared by:

LOUIS BERGER INTERNATIONAL, INC.

in association with

LOCKWOOD GREENE INTERNATIONAL, INC.

GLOBETROTTERS ENGINEERING CORPORATION

TRANS-ASIA (PHILS.)INC.

CONSULTANT MANAGEMENT SERVICES,INC.

ERNST & YOUNG

Under
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)UIS BERGER INTERNATIONAL, INC.
TM 8910, Mile Long Center
Amorsolo St., Legaspi Village
Makati, Metro Manila, PHILIPPINES

Architects • Engineers • Economists • Planners

Telephone 63 (2) 88 06 80
88-06-90
817-0405
Teletax 63 (2) 819-3965

No. KOL/PAPS/91-1807/eb

September 18, 1991

Mr. Alex Sundermann, P.E.
Project Officer/Office of Capital Projects
USAID/Manila
18F, Ramon Magsaysay Center
1680 Roxas Boulevard
Manila, Philippines

Subject: **DRAFT FINAL REPORT**

Project: **DELIVERY ORDER NO. LBII-05**
FEASIBILITY STUDY ON AURORA ROADS
INFRASTRUCTURE DEVELOPMENT PROJECT
CONTRACT NO. 492-0452-C-00-0099-00

Dear Mr. Sundermann:

Pursuant to Section V.D. of the Terms of Reference of the subject Delivery Order Contract, we are pleased to submit herewith for your review and comment ten (10) copies of the Draft Final Report for the Aurora Roads Infrastructure Development Project Feasibility Study. In accordance with our previous discussions, we are concurrently distributing copies of this report as follows:

	Name	Agency	No. of Copies
1.	Mr. Rogelio L. Singson	Chairman, CODA	3
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8.	Mr. Howard "Pat" Johnson	CCSC-CODA	2
9.	Acting Dir. Delfin J. Ganapin Jr.	DENR/EMB	2

By copy of this letter, we request that the above-named agencies review this report and direct any comments or inquiries to the following office:

Mr. Rogelio L. Singson
Chairman, Committee on Official Development Assistance (CODA)
Room 1400, 14F, Multi-storey Building
Central Bank Complex
A. Mabini Street, Ermita, Manila

We further request to schedule a briefing meeting for this project at your convenience, but preferably within ten (10) days of receipt of this document. It is imperative that we receive comments from reviewers by this date.

Should you have any questions, or require further information, please feel free to contact this office.

Very truly yours,
LOUIS BERGER INTERNATIONAL, INC.

WILLIAM J. PARENTE
PAPS Project Manager

KENT O. LANDE
Team Leader - Aurora Roads

cc: Pat Quinn, Group Vice President, Louis Berger-Wash., D.C.
Ron Kornell, Reg. Vice President, Louis Berger-Bangkok
Joseph Weiss, Home Office Coord., Louis Berger-East Orange
All subconsultants

Encs. Aurora Roads Draft Final Report - 10 copies

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ACRONYMS

AADT	-	Annual Average Daily Traffic
AASHTO	-	American Association of State Highway and Transportation Officials
AC	-	Asphalt Concrete
ADB	-	Asian Development Bank
AH	-	Auger Hole
AIADP	-	Aurora Integrated Area Development Project
AMSL	-	Average Mean Sea Level
ARIDP	-	Aurora Roads Infrastructure Development Project
ASTM	-	American Society of Testing Materials
B-C	-	Benefit-Cost (Ratio)
CBR	-	California Bearing Ratio
CENRO	-	Community Environment and Natural Resources Office
CODA	-	Committee on Official Development Assistance
CWI	-	Critical Watershed Index
DA	-	Department of Agriculture
DBST	-	Double Bituminous Surface Treatment
DENR	-	Department of Environment and Natural Resources
DILG	-	Department of Interior and Local Government
DPWH	-	Department of Public Works and Highways
EA	-	Environmental Assessment
EIS	-	Environmental Impact Statement
EMB	-	Environmental Management Bureau
ESAL	-	Equivalent Standard Axle Load
FAA	-	Foreign Assistance Act
FMB	-	Forest Management Bureau
GIS	-	Geographic Information System
GOP	-	Government of the Philippines
GSC	-	General Santos City Roads Project
HDM	-	Highway Design and Maintenance Model
IBRD	-	International Bank for Reconstruction and Development (World Bank)
IEE	-	Initial Environmental Examination
IPAS	-	Integrated Protected Area System
IRI	-	International Roughness Index
LL	-	Liquid Limit
LMU	-	Land Management Unit
LOS	-	Level of Service
MDD	-	Modified Dry Density
MFL	-	Maximum Flood Level

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ACRONYMS

MLLW	-	Mean Low-Low Water
MSL	-	Mean Sea Level
NAMRIA	-	National Mapping and Resource Information Authority
NCSO	-	National Census and Statistical Office
NEDA	-	National Economic and Development Authority
NGO	-	Non-Governmental Organization
NIA	-	National Irrigation Administration
NPV	-	Net Present Value
NRIP	-	National Road Improvement Project
NTCP	-	National Traffic Counting Program
NTS	-	Not to Scale
O-D	-	Origin-Destination (Surveys)
OMC	-	Optimum Moisture Content
OSSC	-	Office of Southern Cultural Communities
OWL	-	Ordinary Water Level
PAGASA	-	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAWB	-	Parks and Wildlife Bureau
PCCP	-	Portland Cement Concrete Pavement
PENRO	-	Provincial Environment and Natural Resources Office
PI	-	Plasticity Index
PIDS	-	Philippine Institute for Development Studies
PL	-	Plastic Limit
PO	-	People's Organization
RIF	-	Rural Infrastructure Fund Project
RRDP	-	Rural Road Development Project
SALT	-	Sloping Land Agricultural Technology
TBM	-	Temporary Bench Marks
TLA	-	Timber License Agreement
TOR	-	Terms of Reference
TP	-	Test Pit
TRIPS	-	Third Road Improvement Project
TRRL	-	Transportation Road Research Laboratory
TWEL	-	Tail Water Elevation
UNDP	-	United Nations Development Programme
USAID	-	United States Agency for International Development
UNIDO	-	United Nations International Development Organization
VOC	-	Vehicle Operation Costs
ZOI	-	Zone of Influence

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Aurora Province is located on Luzon Island approximately 220 km north and east of Manila. Of all the provinces in Luzon it is arguable that Aurora has the poorest access and the least developed transport systems. In spite of a long coastline, its exposure and remoteness has left the porvince's port locations undeveloped and under-utilized. There's no commercial air service to the province. The local road network is virtually confined to the vicinity of the main towns and there is a poor intra-provincial link between the three main geographical zones in the area.

The Government of the Philippines (GOP) goal is to reinforce the physical foundation of the economy to support several development thrusts. Specifically, the GOP's Department of Public Works and Highways (DPWH) seeks to install and improve essential transport infrastructure, especially in the rural areas. This is being carried out through an infrastructure program focused on a dual role: first, in a supportive capacity to physically interact and provide the basic support facilities needed to facilitate the activities of the leading production sectors; and next, in an active capacity, to induce development in the desired areas.

A major component of this infrastructure program is improvement construction of highway transport facilities which has been, and will continue to be, the dominant mode of transportation in the Philippines.

Rapidly increasing demands for the improvement of transport conditions in Aurora Province caused the GOP to conduct a feasibility study of the transport infrastructures in the province within the Rural Roads Development Program II in 1982. The Third Road Improvement Project T.A., Aurora Final Report, February 1985, also identified roads within the province needing improvement. However, due to financial constraints, very few of these projects were implemented. As a result of poor existing roads and the inability to finance improvements, the Aurora Roads Infrastructure Development Project (ARIDP) was developed by the United States Agency for International Development (USAID).

The objectives of this ARIDP Feasibility Study are to determine the technical and economic feasibility of road improvements, to induce economic development, to remove existing transportation constraints and to assist in achieving the socio-economic objectives inherent in the GOP economic development policy for the country as a whole and for the Aurora Province in particular. Specifically, this study determined the economic feasibility of constructing new road links, and reconstructing and rehabilitating existing roads.

Roads studied within the context of ARIDP included a circumferential road linking Baler, Dipaculao, Maria Aurora and San Luis. A second existing road connecting Palayan City to Dingalan was studied. A third road link, currently non-existant, was studied Dingalan in the south part of the province to San Luis or Baler in the central part of the province. Additionally the Consultant was instructed to look at additional alternatives which might meet the goals and objectives of the ARIDP.

The Terms of Reference identified approximately 191 km of roads for study. After all various alternatives were evaluated, the Consultant actually studied 331 km of roadways.

The economy of the province is significantly based on agriculture and there are indications that much of the total land area is near the limits of sustainable development. Most agricultural level land is already occupied and a considerable proportion of these flatlands have been severely affected by the degradation of watersheds. Coconut and copra are the main exports but its production is already declining due to low yields of aging palms and reduced stands because of coconut lumbering activities. Logging operations have encompassed extensive forest areas and shifting cultivators/hill farmers have contributed to the further degradation of this resource. Fisheries are at a low level of development, with little potential for expansion.

The above considerations emphasize the precarious state of the economy of Aurora Province. Its agricultural development potential is very small and will be negative unless the Department of Environment and Natural Resources (DENR) halts forest destruction. Forest conservation measures that will require large capital investment will be necessary to counter the effect of forest resource destruction in the lowlands where erosion is deposited.

Traffic analyses performed during the study included collection of DPWH control section traffic counts, actual traffic counts at nine locations on project roads, origin-destination surveys, and travel time and delay surveys. Information on axle loads were obtained from the 1985 IBRD-DPWH study of axle loadings. Additional origin-destination surveys of banca (motorized boat) traffic at Dingalan and Baler were taken and factored into traffic results. Traffic projections were then made to the year 2015 based on probable population growth and economic growth. Overall, a traffic growth projection of approximately 4.5 per cent was used for the study.

Field inventories were performed to ascertain the condition of all existing roads and bridges. Geotechnical studies analyzed the condition of road base and pavement structures as well as the availability of materials suitable for construction of roads. Hydrographic and hydrological analyses determined waterway sizes necessary for bridges. Preliminary designs were completed for bridges, box culverts and drainage culverts. Existing bridges were evaluated with respect to repairs which might be necessary for structure as well as for upstream and downstream channel improvements. DPWH design standards were incorporated into the feasibility level preliminary design for all roads. These standards included 6 m wide pavement with 1 m wide shoulders (A 6-1-1 section). Vertical gradients were kept to a 9 percent maximum and horizontal curves were established at 50 m except in urban, built-up areas. Preliminary plan and profile sheets were prepared for the various segments and are included in the report. Pavement sections were designed according to DPWH guidelines with comparisons being made to American Association of State Highway and Transportation Officials (AASHTO) standards and to the standards of Road Note 31, A Guide to the Structural Design of Bitumen-surfaced Roads in Tropical and Sub-tropical Countries. Two alternate pavement structures were considered for each roadway segment based on location, traffic volume and traffic loading.

Existing and projected traffic volumes on the roads within the study area are low although the logging activities cause a somewhat high Equivalent Standard Axle Loading (ESAL) component to be used for pavement design. The existing and projected traffic is too high to consider constructing and maintaining the roads as gravel surfaces, but is too low to consider PCCP surfaces. Only the circumferential road should have PCCP as a pavement surface primarily because of its proximity to the coast and potential inundation by typhoons and tsunamis.

Costing for the project was developed utilizing 1991 DPWH construction costs. Unit prices were determined for each major construction activity. These unit prices were then combined with the estimated units of construction to determine project costs. Both economic costs and financial costs have been developed. Total project costs for each segment studied are summarized in Table ES-1. These costs include construction cost plus 10 percent for contingencies, plus 10 percent for general items, office, vehicles, etc., and 8 per cent for supervision cost.

The proposed ARIDP program must meet certain economic criteria to demonstrate that available investment capital will be well spent. For this reason, an economic evaluation was performed for each traffic section and pavement design option. The evaluation procedure compared project benefits to project costs in terms of net present value (NPV), the internal rate of return (IRR) and the benefit-cost (B-C) ratio.

The economic feasibility of each road section was analyzed using procedures similar to the methodology employed by the consultant on the recently completed Rural Infrastructure Fund (RIF) Project and the 1990 General Santos City (GSC) Road Project. The procedures were modified in some areas (e.g. in shadow pricing) and all costs (vehicle operating costs, maintenance costs, etc.) were estimated in 1991 prices. Development benefits and construction costs were also estimated in 1991 prices. These cost elements were evaluated using the Consultant's spreadsheet based economic model which compares the present value of the difference between "with" and "without" project improvement costs (project benefits) to the present value of the estimated construction costs.

The spreadsheet model estimates vehicle operating costs (VOCs) based on pavement type and condition (standard practice in the Philippines, especially for screening a large number of road projects), but also based on traffic speeds. Thus, if traffic is light, comparable results to the simple screening model are obtained. If traffic levels are heavy or variable, the model will more closely approximate actual operating costs. VOCs are high at low speeds, decline to a minimum, and then rise at high rates of speed.

The spreadsheet model forecasts vehicle operation and time cost savings by type of traffic. Development benefits are calculated separately and are linked to the summary table evaluating the traffic section. Discounting to present value uses the following conventions:

- Project costs are distributed over two years unless staged construction over a longer period is planned;

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- Project costs and benefits are in constant 1991 pesos;
- Project benefits extend for 20 years after construction has been completed;
- Annual costs and benefits are realized at the end of the year; and
- The opportunity cost of capital, after inflation, is 15 per cent.

Other benefits such as tourism benefits, accident reductions, improved access to health care, and income distribution effects are discussed in the context of the traffic section chapter of the report.

The environmental section of the report provides a basis for analyzing the overall environmental impact of any project in the study area with respect to current Philippine law and U.S environmental regulations. It reports on the status and accomplishments of ARIDP in terms of TOR tasks. It reviews the process by which potential ARIDP impacts were identified and presents a summary of potential ARIDP impacts ranked by significance. It describes the results of field studies to assess impacts and presents preliminary findings which suggest that the project, as presently constituted, is not feasible environmentally and would not be recommended for implementation in the ARIDP EA/EIS. It outlines the ARIDP environmental analysis and surveys issues identified for investigation, examination and evaluation in the ARIDP EA/EIS. It reviews Section 118 and 119 of the US Foreign Assistance and the applicability of these statutes to the proposed project. The Consultant finds that proposed ARIDP activities include those for which U.S. assistance must be denied unless a mitigation plan is approved and fully funded.

Finally, it describes remaining ARIDP Environmental Studies Activities including additional consultations to develop and Environmental Plan of Action for ARIDP detailing environmental mitigation, monitoring, and management requirements and activities if warranted by Feasibility Study findings and client comments and recommendations.

The Feasibility Study finds that technically, only the interprovincial link route from Dipaculao - Maria Aurora - KM 38 - Canili - Pantabagan - Rizal or the interprovincial link National Highway route from Bongabon - Calaanan - KM 170 - Km 38 - Maria Aurora - Dipaculao would meet the requirements of a 15 per cent IRR as established by NEDA. The Consultant advises that these two interprovincial routes are mutually exclusive in that if one route is constructed, then the other route will not meet the IRR conditions.

The Consultant recommends the construction of the Bongabon - Calaanan - KM 170 - Km 38 - Maria Aurora - Dipaculao segments subject to meeting all requirements of the environmental laws of the Philippines and the funding agency(ies). The Consultant feels that if tourism is to be fully considered as a potential economic benefit within Aurora Province, then Aurora Memorial Park must be further developed and have access to an all-weather road. This roadway

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alignment can, with proper environmental safeguards, enhance and improve the long-term integrity of the park. The Consultant further recommends that a walking trail system be developed in conjunction with the existing logging roads on the Dingalan - San Luis segment. Again, within the constraints of environmental issues, a walking trail will serve the native population, will potentially enhance tourism, will provide construction jobs to natives in the area by using local materials for construction and could potentially act as a "debt for nature" swap project.

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 PROPOSED PROJECT

The Aurora Roads Infrastructure Development Project (ARIDP) entails performing technical and economic feasibility studies of the investment needs to improve land access to and within Aurora Province in North-East Luzon. The study is carried out as part of the Philippine Assistance Programme Support (PAPS), and is financed by the Unites States Agency for International Development (USAID) as Infrastructure Development Project Contract No. 492-0452.

The Consultants were required to examine existing major highway networks in the Aurora and Nueva Ecija Provinces, and provide recommendations on several identified alternative inter-provincial routes, to determine the most viable route.

Figure 1-1 displays the ARIDP location in the Philippines.

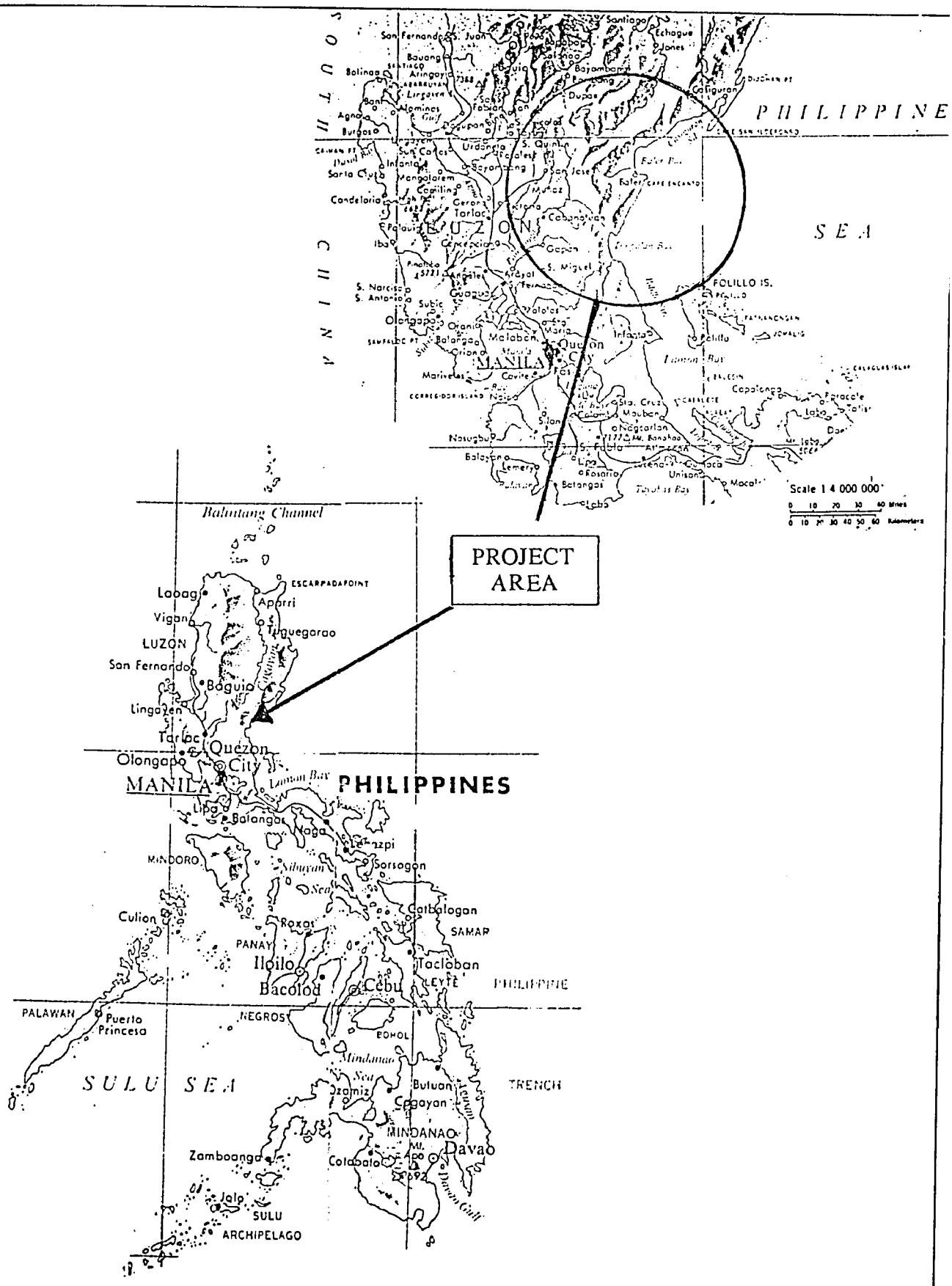
Figure 1-2 illustrates the location of the proposed road sectors in relation to the Provincial road network, and also the two (2) inter-provincial roads studied, together with alternative alignments.

1.2 OVERVIEW

The Feasibility Report contains all pertinent decisions and recommendations, with sufficient discussion to tie all elements of the study together. This includes an examination of all procedures and protocols, including theoretical background discussions of the analysis approaches used in the study.

Chapter I sets out a Description of the Project and discusses the alternatives considered (paragraphs 1.3 and 1.4 below) The economic potential of the Zone of Influence (ZOI) for each sector is discussed in Chapter II (Economic Overview), and traffic forecasts are discussed in Chapter III (Traffic).

The Engineering Surveys, analyses and designs for the Road Sectors, are summarized in Chapter IV (Engineering Design). Preliminary Designs have been prepared for these sectors taking into consideration traffic volumes, present and future road conditions, the need for additional or improved drainage structure, and the geometry of cross-sections and alignments. Data collected and analyzed are discussed concerning surveys, roads, drainage and bridge inventories.



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	PROJECT LOCATION MAP	FIGURE 1-1

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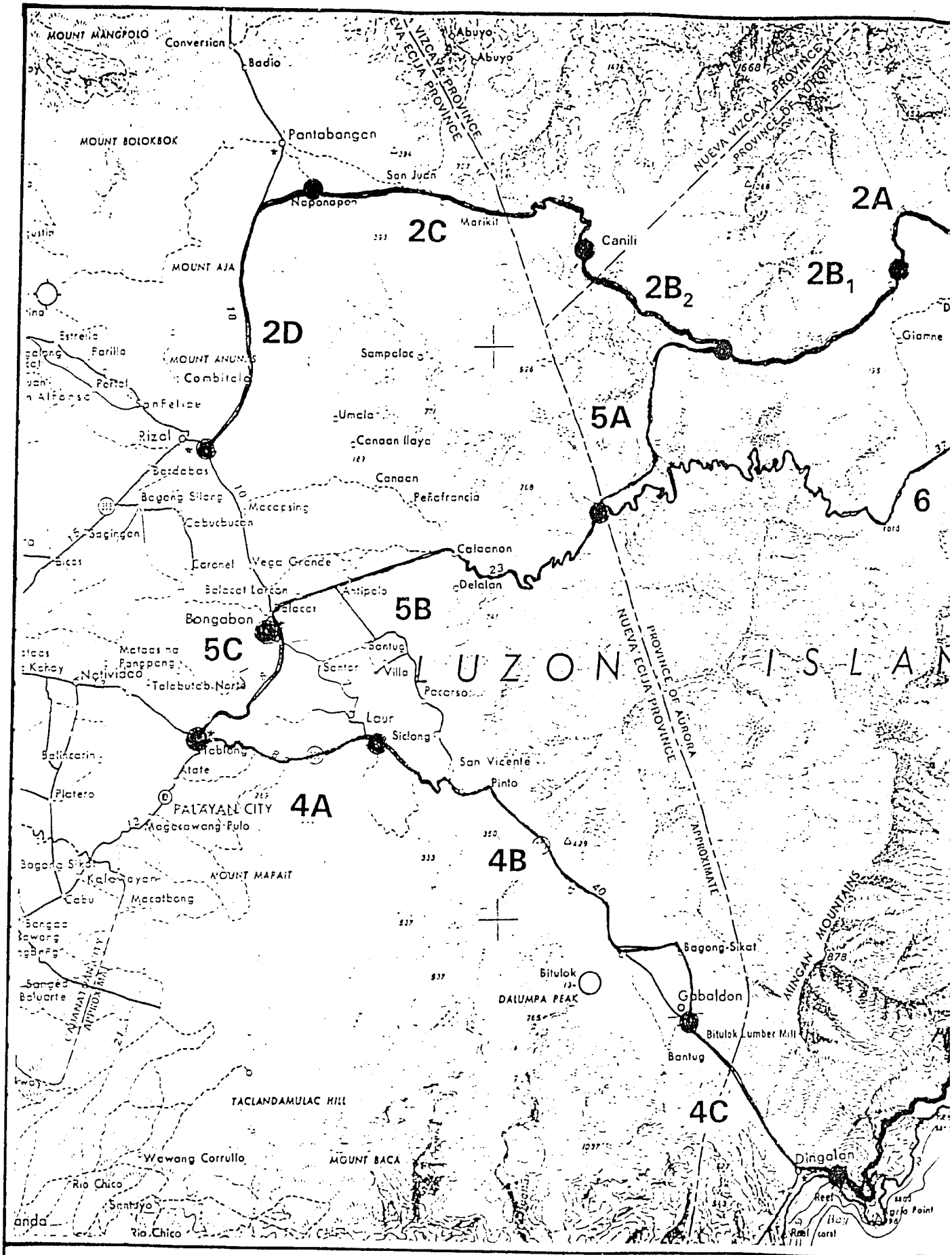

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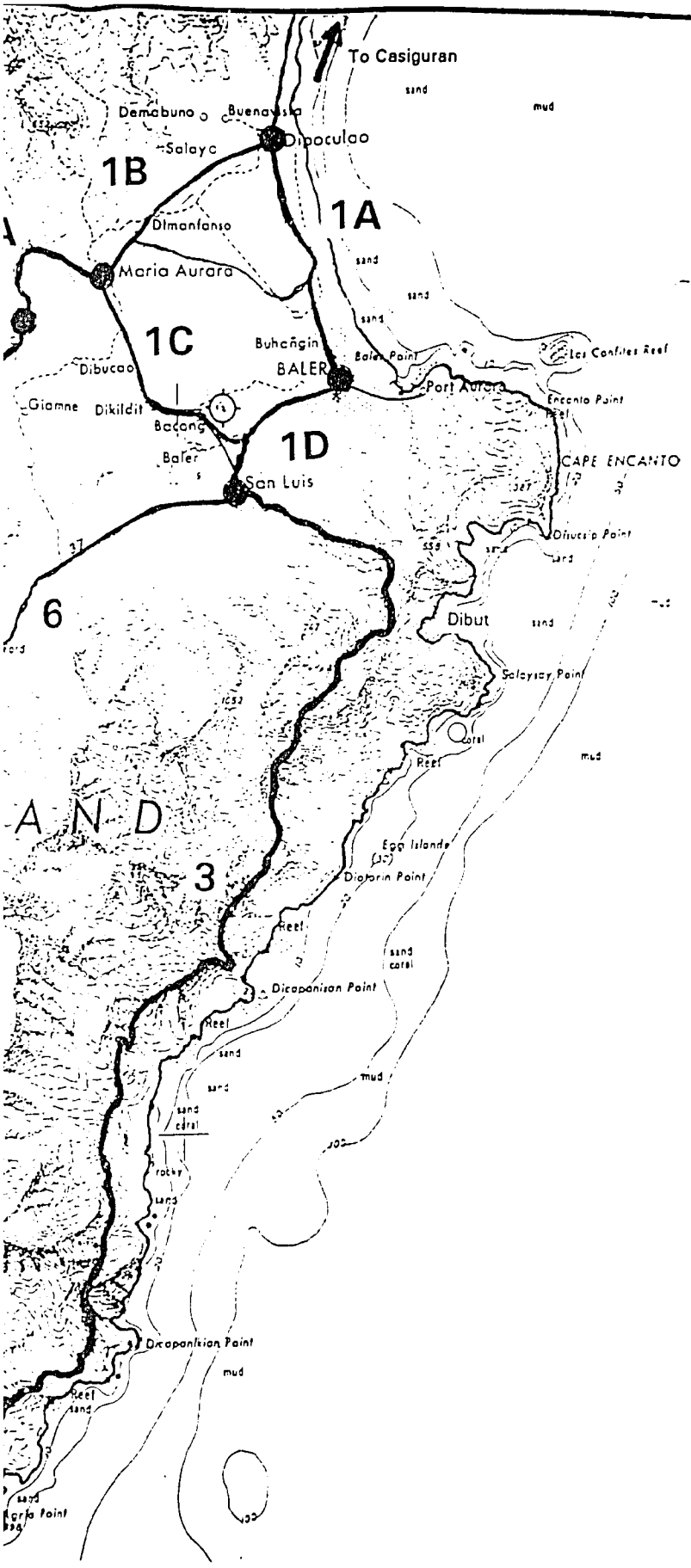

ROGRAM SUPPORT .NATIONAL DEVELOPMENT :-00-0099-00	AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	ROAD SECTOR LOCATION MAP	FIC 1 1-2

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The condition of the existing pavements, and proposed options for improvement, are discussed. The preliminary designs take into account the future traffic and axle loads on the proposed pavement structures, on new pavements and on pavement overlaying.

Quantities and cost estimates for the individual road sectors were prepared and summarized in Chapter V (Costing). These estimates give unit prices and quantities, and calculate construction costs, cost of improvements and maintenance costs.

Chapter VI (Economic Evaluation) analyzes the costs and benefits for the proposed improvements, and includes a sensitivity analysis, and feasibility recommendations.

Chapter VII (Environmental Assessment) summarizes the existing conditions and potential impact of the proposed sector improvements.

1.3 EXISTING ROADS AND TRANSPORT CONDITIONS

1.3.1 Existing Roads

The Existing Roads in the Project Area are:

- a circumferential road linking Baler - Dipaculao - Ma. Aurora - San Luis - Baler, in the central flood-plain (38 km.). This is mainly a gravel road, with short stretches (6.9 km.) of two-lane and one-lane Portland cement concrete pavement (PCCP), and a short asphalt section (5.7 km.)

  The gravel sections are in fair to poor condition, with long stretches subject to flooding during the rainy season, the PCCP is in good condition, and 1.9 km. of the asphalt section has deteriorated.

- Palayan - Bongabon - San Luis - Baler national road (99.5 km.). This road connects Aurora with Nueva Ecija along a tortuous horizontal alignment with many sharp curves and horseshoe bends. It rises to a maximum elevation of about 700 meter AMSL. Back slopes are cut in almost vertical sections and are prone to land slides which close the road to traffic during heavy rains. The geometric conditions make this road hazardous to traffic. Travel times under good driving conditions approach 4 hours.

- Rizal - Pantabangan - Ma. Aurora (70.4 kms.) This road also connects Aurora and Nueva Ecija provinces. It passes mainly flat to rolling terrain, with a mountainous sector of about 22.4 km. rising to a maximum elevation of about 370 AMSL meters, between Bazal and Canili. This section has recently been constructed by the Department of Local Government, while road sections west of Canili were constructed by the N.I.A.. Portions of this road west of Pantabangan were damaged by the 1990 earthquake. The entire road is gravel surface in fair to poor condition. Slope protection and side ditches were not provided on the Bazal - Canili section, which includes six (6) major structures. This section has some vertical gradients of about 14 to 15 percent.

- Palayan - Dingalan (47.4 km.). 39.2 km. is gravel surface in fair to poor condition; PCCP of 7.6 km. is mostly in good condition; 0.6 km. of asphalt pavement is in poor condition. The road passes rolling to flat terrain following the Coronel river valley to the town of Gabaldon. Then from Barangay Sawmill it traverses mountainous terrain to Dingalan. The road crosses a watershed at about 270 meters AMSL dividing the Coronel and Dingalan river valleys. There are 15 waterway crossings on the total road sector. Between Laur and Gabaldon several road sections and three (3) bridges suffered extensive damage in the 1990 earthquake. Current travel time during good driving conditions averages 2 hours.

There are three (3) geographical zones in Aurora province - north around Casiguran, central around Baler and south around Dingalan. Casiguran is connected to Baler by a coastal track, frequently impassable, and has no link with neighboring Quirino province, except a former logging track via Madela. No study is anticipated in this area as part of this report. The Consultant recommends a Phase II study to consider the linking of Casiguran with Baler.

The central Baler zone has two roads linking it to Nueva Ecija province, both of them subject to closure in wet weather, and neither of them suitable for sustained traffic owing to their geometric conditions.

The easterly portion of the southern zone (Dingalan) has no road at all linking it with the central zone. It is linked only to Nueva Ecija by a mostly gravel surface road via Gabaldon, to Palayan City. This road suffered major damage to road sections and structures in the 1990 earthquake. Traffic is frequently interrupted in wet weather due to flooding of the Coronel River whose valley it follows.

1.3.2 Roads Studied

The road sectors studied are located in both Aurora and Nueva Ecija Provinces. All the proposed road improvement projects involve upgrading gravel/earth roads to all weather typhoon-resistant paved roads. The Consultant began by studying the first three sectors specified in the TOR:

- existing road - Palayan - Dingalan (47.4 km)
- existing road - Baler - Dipaculao - Ma. Aurora - San Luis - Baler (38.1 km.)
- non-existing road - Dingalan - San Luis (72.5 km.)

During preliminary studies, it was found that two earlier final reports, Rural Roads Development Program II - Aurora, 1982 and the ADB assisted Third Road Improvement Project - Aurora (1985) considered that upgrading an interprovincial link to Nueva Ecija province was essential to establish the feasibility of an improved road system within Aurora. The TOR instructed the Consultants to consider all previous studies, to analyze existing major highway networks, and propose alternative routes.

Therefore, two inter-provincial links between Nueva Ecija, and the central zone of Aurora in which the capital Baler is situated were incorporated into the study. These are:

- Palayan - Bongabon - San Luis - Baler (85.8 km.) the existing National Highway,

  (a) a northerly alignment which leaves the National Highway at the west boundary of Aurora Province (also west boundary of the Aurora Memorial Park), then follows the Cabatangan and Malupa River valleys and ties in with the Canili - Ma. Aurora Segment. See Figure 1-2.

  (b) the upgrading of the existing alignment through the Aurora Memorial Park. See Figure 1-2.

- Rizal - Pantabangan - Canili - Ma. Aurora (70.2 km.)

The above road sectors are summarized in Table 1-1.

Table 1-1
ROAD SECTORS STUDIED

	LENGTH (km)
EXISTING ROADS	
circumferential road, Baler - Dipaculao - Maria Aurora - San Luis - Baler	38.1
Palayan - Bongabon - San Luis - Baler (national road)	85.8
Rizal - Pantabangan - Maria Aurora (provincial road)	70.2
Palayan - Dingalan	47.4
Three alternative alignments to circumferential road. One alternative section linking the Baler - Bongabon sector to the Maria Aurora - Pantabangan sector, adding about 17 km new road and eliminating about 20 km of the national road.	17.0
NON-EXISTING ROADS	
Dingalan - San Luis	72.5
TOTAL	**331.0 (+ or -) 5.0**

For study purposes the above Road Sectors were sub-divided into Road Segments as shown in Table 1-2.

Table 1-2
ROAD SEGMENTS

EXISTING ROADS (AND NON-EXISTING)		LENGTH (km)
Road Segments		
♦ Circumferential		
Segment	1A Baler - Dipaculao	11.6
	1B Dipaculao - Maria Aurora	8.6
	1C Maria Aurora - San Luis	10.7
	$1C_1$	34.0
	$1C_2$	21.0
	1D San Luis - Baler	7.2
♦ Rizal - Pantabangan - Canili - Maria Aurora		
Segment	2D Rizal - Pantabangan	14.0
	2C Pantanbangan - Canili	26.9
	$2B^2$ Canili - Km 38	11.1
	$2B^1$ Km 38 - Bazal	13.8
	2A Bazal - Maria Aurora	4.4
♦ Dingalan - San Luis		
Segment	3A Km 0 - Km 48 Dicapinisan	48.0
	3B Km 48 - San Luis	24.5
♦ Palayan City - Dingalan		
Segment	4A Tablang - Laur	7.6
	4B Laur - Gabaldon	26.4
	4C Gabaldon - Dingalan	13.4
♦ Palayan City - Maria Aurora		
Segment	5C Tablang - Bongabon	8.3
	5B Bongabon - Km 170 National Highway	24.5
	5A Km 170 National Highway (= Km 0 Segment 5A)	
	- Km 17 (= Km 38 Segment $2B_1$)	17.0
	$2B_1$	13.8
	2A	4.4
♦ Tablang - Bongabon - San Luis		
Segment	5C Tablang - Bongabon	8.3
	5B Bongabon - Km 170 National Highway	24.5
	6 Km 170 - San Luis	53.0

1.4 DISCUSSIONS OF ALTERNATIVES

1.4.1 Circumferential Road (Segments 1A, 1B, 1C, $1C_1$, $1C_2$, & 1D)

Alignment of the existing circumferential road is well established and with the exception of minor adjustments will be left as is. See Figure 1-2. Any improved alignments through the urban areas would require excessive and costly relocations. Three alternate alignments between Maria Aurora and San Luis were evaluated with the express purpose of shortening the length of bridges and ultimate cost of this portion of roadway. A more detailed analysis of these alternate routes is provided in Chapter 4 of this report.

In those segments which follow existing alignments, little if any direct adverse environmental effects will be felt and pavement improvements will produce a positive environmental impact. Two alternate alignments considered would involved some new construction with potential impacts on agricultural lands and forested areas. Indirect impacts associated with mitigation and economic development potentially included by the project, increased access to forest resources, land speculation, insecurity of tenure, and ancestral land claims may also occur.

1.4.2 Inter-provincial Link; Rizal - Pantabangan - Canili - Ma. Aurora (Segments 2A, 2B, $2B_2$, 2C & 2D)

This alternative would consist of improvements to a Local Government road, portions of which are currently being rebuilt. See Figure 1-2. The Department of Local Government is currently making horizontal and vertical improvements and installing some drainage structures between Canili - Maria Aurora and plans have been completed for similar improvements westerly to Pantabangan. Design plans call for some vertical gradients up to 19 percent but discussions with on-site construction representatives reveal that these have now been lowered to less than 15 percent. Numerous horizontal curves between Canili - Bazal have also been constructed which do not meet the recommendations of DPWH (i.e., less than 50 m radius). No adequate slope protection or erosion mitigation measures have been provided on any of the recently constructed works. The existing surface is gravel of rounded (not crushed) river rock with an estimated thickness of 6 cm. Absence of adequate drainage ditches and letdown structures is already causing this surfacing to be washed away. Paving on this segment would need to be accompanied with some additional geometric improvements and erosion mitigation measures consisting of better cross drainage and letdown structures. As mentioned in Chapter 4, a number of bridges along this segment provide only one lane traffic and need to be widened to recommended DPWH standards. Slope protection and erosion mitigation are the greatest environmental concern on this segment but the indirect impacts of increased settlement and increased kaingin practices is also of great concern.

Segment 2A and a portion of 2B are common with the routing of Segment 5.

1.4.3 Dingalan - San Luis (Segment 3)

This segment of roadway is currently nonexistent except for portions which serve as logging trails. See Figure 1-2. These logging trails extend northward from Paltic/Dingalan and southward from Real, San Luis. There are also several trails extending northwesterly up river valleys from the ocean north of, south of and at Dicapinisan. Because of extremely steep mountain slopes between these river valleys, none of these logging trails are interconnected throughout the entire 71+ km. segment. A proposed alignment was developed at 1:20,000 scale from existing topography maps since rugged terrain and forest cover precluded the sending of survey crews into the area as part of this study. Members of the environmental team did walk portions of the proposed route from Real, San Luis southward as far as Dibayabay and reported extremely rugged topography for construction. Population statistics for this segment reveal a total population base of less than 5,000 within the Zone of Influence as defined in Chapter 2. During the presentation of the Inception Report on June 11, 1991, the Consultant indicated that he would do an initial cost analysis of this proposed road segment and based on that preliminary finding continue with the feasibility analysis or redirect his efforts to other proposed roadways. The Consultant determined that heavy grading would be required to construct the road. He also concluded that because of its close proximity to the seacoast and its construction on steep mountain slopes, that Portland Cement Concrete Pavement would be the only effective "typhoon resistant" road construction. Initial cost estimates reflect a total cost of nearly one billion pesos for the 71.5 km. of construction. This equates to nearly 14 million pesos per kilometer as compared to normal construction costs of 4-6 million pesos per kilometer. By observation, the Consultant concluded that costs would be prohibitive as compared to any potential long term economic benefits achieved as a result of the project. A far more feasible alternative to construction might be the development of regular boat service to the barangays along the coast. This alternative will be considered in Chapter 6. Major environmental impacts would also be associated with the proposed road which are summarized in Section 2.1.4.1 and discussed in Chapter 7. During presentation of the Project Preliminary Report to USAID, a request to consider a hiking trail concept along this was made to the Consultant. Discussion of this concept is included in Section 4.2.1.3.

As a result, consideration of a full road in Segment 3 will be dropped as a viable alternative and no further study of road construction will be done. On-going assessment of potential environmental impacts and necessary mitigations will be completed and included in the EA/EIS for future reference and further analysis of environmental impacts of a hiking trail will be addressed.

1.4.4 Palayan City - Dingalan (Segments 4A, 4B, & 4C)

As with the circumferential road, this segment will follow the existing roadway alignment. See Figure 1-2. Portions of this roadway are currently paved and several kilometers between Palayan City - Laur are currently being paved. The July 1990 earthquake caused substantial

damage to portions of the roadway west of Gabaldon and three major bridges were also damaged. The Consultant has determined that special consideration should be given to slope protection especially through areas where soils have been loosened as a result of the earthquake. Extensive deforestation in the Coronel River watersheds and reported illegal logging pose high risks to the proposed improvements. The two damaged bridges must be rehabilitated in an early stage of overall roadway improvements. The third damaged bridge is already being reconstructed near Gabaldon.

Survey traverses and cross sections were obtained on this segment in order that revisions to horizontal and vertical alignments could be made and that grades and curves would meet DPWH standards.

1.4.5 Inter-provincial Link; Tablang - Bongabon - West edge of Aurora Memorial Park Cabatangan/Malupa River Valley - Maria Aurora (Segments 5C, 5B, 5A, $2B_1$, 2A)

This routing alternative became a consideration as a result of discussion at the presentation of the Inception Report on June 11, 1991. See Figure 1-2. This alternative follows the existing National Highway eastward from Bongabon to the boundary between Aurora Province and Nueva Ecija Province. The boundary is also near west boundary of the Aurora Memorial Park, a 5676 ha. National Park administered by DENR. The proposed route then follows the courses of the Cabatangan and the Malupa Rivers and connects to Segment 2B of the Maria Aurora-Canili route. Even though approximately 17 km. of new road would be required from the Provincial boundary to the connection with the Maria Aurora - Canili road, the horizontal and vertical alignments are much more conducive to road construction than trying to improve the National Highway through the Aurora Memorial Park. Two major bridges would have to be constructed, one across the Cabatangan River and the other across the Malupa River. Environmentally, this new route could have major potential negative impacts on forest lands, biodiversity, and other environmental features and would involve as much as a kilometer of new construction within the National Park itself. It would however result in the diversion of major traffic from the current National Highway which bisects the park along its entire length but would totally bypass the National Forest.

Alignments and cross sections for this segment were obtained from 1:20,000 topographic maps as in the case of Segment 3. More detailed design survey and environmental information would be required through later ground and/or aerial field surveys.

1.4.6 Inter-provincial Link; Tablang - Bongabon - through the Aurora Memorial Park - San Luis (Segments 5C, 5B & 6)

This route follows the Existing National Highway from Bongabon through the Aurora Memorial Park to San Luis where it connects with the Circumferential Road (Segment 1D). See Figure 1-2. The existing alignment through the Memorial Park consists of torturous hairpin curves and nearly vertical cross slopes. The road is subject to frequent mudslides which close the road. Opportunities to improve the horizontal alignments would require extensive cuts and fills and the construction of numerous bridges. The negative environmental impact on the existing Memorial Park and forest and biodiversity resources would be significant. Costs to improve the alignment would be high as compared to construction of the proposed new alignment as described in Segment 5A.

1.5 SUMMARY OF ECONOMIC ANALYSIS

The economic analysis compared the present value of roadway user costs "with" and "without" the project to the present value of construction expenditures. The following types of benefits were identified and quantified: normal traffic, cost savings, generated traffic savings, diverted traffic savings, agricultural benefits, tourism benefits and passenger time savings. Diverted traffic benefits were found to significant on the proposed Bongabon - Maria Aurora road.

Upgrading the circumferential road to PCC standards was found to be not economically feasible with IRRs between five and ten percent. Upgrading the Tablang Jct. to Dingalan inter-provincial road was also found to be not economically feasible with IRRs below ten percent.

Two alternatives for providing better access to the Baler area through Maria Aurora were found to be economically feasible. Paving to mostly PCC standards from Bongabon to Maria Aurora and paving to AC standards from Rizal to Maria Aurora are mutually exclusive projects that individually have IRRs above 15 percent.

Both projects are economically feasible with the extension to Dipaculao of PCC pavement. The extension to Dipaculao will facilitate an improved road link to Casiguran in the future. For technical and economic considerations, the upgrade of the Bongabon-Maria Aurora-Dipaculao road is the recommended alternative.

1.6 SUMMARY OF ENVIRONMENTAL ANALYSIS

1.6.1 Status of Environmental Studies

Three (3) of eight (8) major tasks outlined in the ARIDP Environmental Studies Final Work Plan have been completed and one is underway. Completed tasks include the organization of ARIDP Environmental Studies, field studies to profile the existing environment, and the conduct of Scoping Session/Consultations. Field studies assessing potential ARIDP environmental impacts began July 17, 1991. Tasks remaining include environmental analysis and preparation of the Preliminary EA/EIS; design and development of an environmental management, mitigation, and monitoring plan; and preparation of the Draft and Final EA/EIS. Activities and accomplishments are reviewed in Chapter 7.

1.6.2 Identification of Potential Environmental Impacts

The Consultant reviewed the ARIDP TOR, the USAID IEE positive determination, generic impacts of rural road projects, and recent experience in environmental studies of 37 Philippine road projects to prepare an initial matrix of potential ARIDP environmental impacts. This initial identification was re-evaluated in response to comments, recommendations, and submissions received during the Scoping process, findings of initial field studies, helicopter overflights and other sources. This re-evaluation produced a final ranking of potential ARIDP impacts by degree of significance. Appropriate revision of study scope, methodologies, and level of effort. These activities are discussed in detail in Section 7.2.

1.6.3 Applicability of U.S. Foreign Assistance Act Sections 118 and 119

Based on the identification of potential ARIDP impacts and preliminary environmental review of project Alternatives the Consultant finds a significant likelihood that Sections 118(c)(14)(B), 118(c)(16)(B) and (C), and 119(g)(8) and (10) may apply to proposed ARIDP actions. These concerns are discussed in Section 7.5.

1.6.4 Preliminary Environmental Review of Alternatives

The Consultant has initiated an environmental review of proposed ARIDP Alternatives and prepared a preliminary ranking of nine (9) Alternatives by significance of potential environmental impacts associated with each. These findings are presented and discussed in Section 7.3 AND 7.4.

1.6.5 Completion of Environmental Assessment/Environmental Impact Statement

ARIDP Environmental Studies activities remaining to complete the EA/EIS are described in Section 7.6.

1.7 RECOMMENDATIONS

The initial roadway segments identified for study in the Terms of Reference (TOR) consisted of improvements to the circumferential road, the link from Palayan City to Dingalan, and a proposed new roadway from Dingalan to San Luis or Baler.

At the time of the presentation of the Preliminary Report to USAID, the Consultant expressed concern over the high cost of the Dingalan-San Luis segment compared to perceived benefits. As a result, it was agreed that this segment would be dropped from further consideration as a full road concept. Questions were raised by USAID and by local area residents about the potential of a trail system within this segment which could then serve local barangays. The Consultant performed a qualitative analysis and a preliminary cost estimate for such a trail system which would connect to existing logging trails between Dingalan and San Luis. This new trail system would be approximately 20 km in length and would consist of a 1.5 m wide gravel trail with wooden foot bridges constructed of native materials. Small culverts could be constructed of native rock and portland cement. Most construction could be performed by local labor. Costs would be extremely reasonable, damage to the environment would be minimized, and there is a potential that a "debt for nature" swap could be made for the construction and maintenance of this type of trail system in accordance with current US laws. The trail could stimulate tourism in the form of environmentalists and naturalists. A more detailed discussion of the environmental consequences and mitigation needed for this alternative will be found in the environmental section of this report.

The circumferential roads were analyzed in terms of portland cement concrete pavement (PCCP) with the alternative of asphalt concrete (AC). The location of the circumferential roads on the coastal plain, and its probability to being damaged by typhoon and/or tsunami, leads the Consultant to conclude that PCCP should be the desired pavement here. The costs for paving the circumferential road have been broken down into four distinct segments. Overall costs for construction are reasonable on a per km basis except for the segment between Maria Aurora and San Luis. This segment must cross the Malupa River and the Diteki River and structure costs are quite high. The Consultant did evaluate three different river crossing concepts for this segment and present the alternatives to representatives of government in Aurora Province. Provincial officials agreed that the overflow crossing concept similar to the Bato Ferry crossing near Gabaldon would be acceptable now that the new river bridge is open to traffic between Baler-Dipaculao. The Consultant mentioned in the presentation of the Inception Report to

USAID in June 1991, that maximum benefits for improvements to the circumferential road cannot be achieved until an improved "outlet" or inter-provincial link road is available. One option for This improved "outlet" road would be via the existing National Highway from Bongabon to the provincial boundary at KM 170; the road would then follow a new alignment down the Cabatangan River valley and the Malupa River valley to connect with the newly constructed Local Government road west of Maria Aurora and then follow the Local Government road to Maria Aurora. The second option would be to utilize the Local Government road from Maria Aurora, through Canili, through Pantabagan thence to Rizal. Either of these alternatives could be considered although there are positives and negatives to either alternative. The National Highway alternative follows an alignment through a very productive rice farming area between Bongabon and Calaanan and an improved road would enhance the movement of products and services along this route. Large amounts of excavation and embankment between Calaanan and KM 170, creation of an entirely new alignment for 17 km through the river valleys, and proximity of this existing alignment to the Aurora Memorial Park will cause environmental concerns which must be addressed and mitigated before any construction could take place. With proper actions taken by the proper governmental agencies, the construction of this road adjacent to Aurora Memorial Park could enhance the development of this natural preserve and bring about a greater utilization of the park. This route is nearly 40 km shorter than the Canili-Pantabagan route and time savings must be considered when evaluating either alternative. The Canili-Pantabagan alternative would require a complete upgrading of the newly constructed Local Government road. All existing bridges would be widened from the existing one-lane width to two lanes. Extensive drainage and erosion mitigation measures would be required to meet environmental concerns. Concerns have been raised about the ability of the Canili dam to carry the loads of heavy trucks on a sustained basis. As a result the Consultant determined that a bypass road and bridge would be necessary below the dam for traffic routing. Such a road would be subject to inundation and/or destruction should the dam ever fail. This below the dam alternative would be less costly than an approximately 10 km plus bridge alternative above the dam. Little agricultural development exists or is sustainable between Canili and Pantabagan. Initial capital costs for this alternative are lower primarily since the basic grading and structural costs have already been spent and are now considered as sunk costs. Only widening, nominal improvements to horizontal and vertical alignments and drainage/erosion mitigation are necessary. Environmentally, this alternative may pose less initial concerns than the National Highway route. Refer to Chapter 7 for discussion of these environmental concerns.

Technically, the Consultant recommends the construction of the National Highway route, Segments 5B, 5A, $2B_1$, 2A and 1B, between Bongabon and Dipaculao for the following reasons:

- follows an existing route between established population centers and traverses productive agricultural lands
- this route is nearly 40 km shorter than the Canili-Pantabagan route

- this route could enhance the development of the Aurora Memorial Park into a viable national park which could sustain tourist development

- the road if completed to Dipaculao would be the first step in a staged approach to constructing the road to Casiguran, thus linking Casiguran to the rest of Luzon Island

- the existing Bongabon-KM 170 road is narrow in many places; safety would be greatly improved with a widening to a 6-1-1 roadway width

Specifically, the Bongabon - Km Post 170 section is recommended to upgraded to a PCC standard and constructed over three years, and from there, the first 5.0 kilometers of the new road (Km 170 to Km 38) is recommended to be PCC while the remaining 12.0 kilometer to Km Post 38 is recommended to be DBST. The construction phase of this new road is expected to last four years. The Km Post 38 - Maria Aurora section is recommended to be AC, constructed over four years. The Maria Aurora - Dipaculao section is recommended to be PCC, constructed over three years.

If an environmental mitigation plan is not agreed to and funded, the Consultant recommends the upgrading of the Rizal - Canili - Maria Aurora road to AC standards and the construction to PCC standards of the Maria Aurora - Dipaculao section. Construction would take three years.

1.8 ESTIMATED COST OF PROPOSED CONSTRUCTION

The financial cost of improving the Bongabon - Maria Aurora - Dipaculao road to a mostly PCC standard is 663.2 million pesos. The financial cost of the alternative improvements (mostly AC) to the Rizal - Canili - Maria Aurora - Dipaculao road is 400.0 million pesos.

The estimated cost of construction for each segment is shown in Table 1.3. Each roadway segment is identified as shown in Figure 1.2. Costs shown are developed in detail in Chapter 5 and reflect estimates for two different roadway types for each segment. Both economic costs, reflecting foreign exchange and taxes, and financial costs, reflecting actual construction costs are shown.

Rates of return, (IRR's) and sensitivity analysis were performed for each segment and for various composite segments. The Consultant after performing these analyses has determined that only certain road segments meet the IRR criteria of 15 per cent as currently used by NEDA. These include:

- Bongabon-KM 170-KM 38-Maria Aurora-Dipaculao: Segments 5B, 5A, $2B_1$, 2A & 1B

- Rizal-Pantabagan-Canili-KM3 38-Maria Aurora-Dipaculao: Segments 2D, 2C, $2B_2$, $2B_1$, 2A & 1B

All other segments studied as part of the ARIDP were found to have IRR's below 15 per cent.

Table 1–3
SUMMARY OF COST

SEGMENT	DESCRIPTION	L (KM)	ESTIMATED COST									
			PCCP		AC		DBST		MIXED			
									PCCP/DBST		AC/DBST	
			ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS
1A	BALER–DIPACULAO	11.60	44,423,508	51,380,242	30,080,168	36,580,602						
1B	DIPACULAO–MA.AURORA	8.60	37,872,034	44,116,137	28,180,494	34,394,367						
1C	MA.AURORA–SAN LUIS	10.70	101,422,522	115,175,999	87,566,300	101,220,506						
1D	SAN LUIS–BALER	7.13	20,057,687	22,926,409	11,390,831	13,733,798						
	TOTAL		**203,775,751**	**233,598,787**	**157,217,793**	**185,929,273**						
2A	MA.AURORA–BAZAL	4.43			13,368,601	15,967,528	11,940,576	14,291,623				
2B1	BAZAL–KM. 38	13.78			48,657,680	58,120,503	46,463,177	55,589,198				
2B2	CANILI – KM. 38	11.70			75,966,297	92,547,181	74,605,714	91,011,992				
2C	PANTABANGAN – CANILI	26.89			89,277,680	107,654,415	69,593,860	84,183,826				
2D	RIZAL – PANTABANGAN	14.91			69,239,359	81,576,228	58,324,803	68,562,023				
	TOTAL				**296,509,617**	**355,865,855**	**260,928,130**	**313,638,662**				
3	SAN LUIS–DINGALAN	72.50	955,357,210	1,158,859,625	864,348,461	1,068,502,822						
3	SAN LUIS–DINGALAN	20.50	Km. of Walking Trail with Existing Logging Roads				(Walking Trail Only)		7,935,120	11,980,220		
4A	TABLANG–LAUR	7.60			20,609,870	24,469,412	19,873,923	23,953,034				
4B	LAUR–GABALDON	26.40			135,501,597	159,176,950	126,282,172	148,420,561				
4C	GABALDON–DINGALAN	13.43			45,659,365	55,086,097	39,608,410	47,809,212				
	TOTAL				**201,770,832**	**238,732,459**	**185,764,505**	**220,182,807**				
5A	PROVIN'L. BOUNDARY–KM.38	17.00			209,415,552	258,146,807			208,135,256	255,550,148		
5B	BONGABON–PROVIN'L. BDRY.	31.50	244,928,893	289,469,442	205,250,065	250,037,118						
5C	TABLANG–BONGABON	8.30	44,863,246	51,985,975	34,479,151	41,681,773						
	TOTAL		**289,792,139**	**341,455,417**	**449,144,768**	**549,865,698**						

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CHAPTER 2

ECONOMIC OVERVIEW

CHAPTER 2

ECONOMIC OVERVIEW

Aurora was originally part of Nueva Ecija province, being detached in 1853 to form part of Tayabas (now Quezon), and again detached in 1979 as a separate province. Nueva Ecija's origins go back to the beginning of Spanish colonization in the Sixteenth century, with settlement in the fertile Pampanga River valley.

Aurora province consists of three geographical zones. Two of these zones, the northern area around Casiguran and the provincial capital Baler, are linked only by a coastal road providing difficult access in dry weather, and is impassible during the rainy season.

The central flood plain west of Baler, the most productive agricultural area of the province, is linked to Nueva Ecija, the neighboring province by a long and tortuous road crossing the Sierra Madre ranges at a peak elevation of 700 meters AMSL. This road is frequently interrupted by landslides in wet weather.

The southern zone comprising the municipality of Dingalan has no road link to the central zone, but has its own interprovincial road via Gabaldon and Palayan City in Nueva Ecija province.

A rational programme for Aurora, as recommended in the ADB-financed Rural Roads Development Programme II - 1982/1985 would be to provide an all-weather road linking the central zone to Nueva Ecija and the national highway network, while improving transportation between the four municipalities for which the central flood plain provides a high level of agricultural production, supplemented by coastal fisheries. A second phase would link the northern zone of Casiguran to the provincial capital Baler by an all-weather coastal road. This option did not figure in TOR for the present study.

Poor road conditions, and especially the absence of an all-weather link with Central Luzon may have retarded rural economic development in the province. Many of the areas which would be served by improved roads are intensively cultivated with an assured water supply. The agricultural and fishing communities in these production areas, however, have incomes well below the Regional averages. This can be attributed partly to the lack of an all-weather road system, with unreliable high-cost transportation and considerable product spoilage due to poor road conditions.

The province's economy has been traditionally based on forest exploitation (logging and saw-milling), but the government's concern with environmental degradation and the rapidly diminishing forests is likely to reduce considerably the income from logging and saw-milling. The progressive decline in the forest industry in Aurora will cause a substantial loss in employment, and there is likely to be increased immigration of landless families to occupy logged-over areas as hill-farmers.

The main result of government restrictions since 1979 has been to reduce the number of logging companies operating in Aurora to six (6), rather than to reduce the rate of forest destruction.

The annual allowable cut has been reduced in Aurora by DENR from 220,000 M^3 to 125,000 M^3, and all "old growth" Dipterocarp forest, estimated at 24,610 ha. (11% of total forest) will be closed to exploitation from 1 January 1992. At present (1991), only three logging companies operate in Aurora; two of the licensees will have their contracts terminated in 1993, while other companies plan to continue beyond 2000. Three of the six licensees operate in adjoining provinces as well as in Aurora. The World Bank ffARM Study (1989) considers that forest resources will be virtually extinct in this area by the year 2010.

Since Aurora was established as a province in 1979, two comprehensive planning studies have been carried out.

- Aurora Integrated Area Development Project (AIADP): a five year program financed by the European Economic Community (EEC).
- Development Mapping Project prepared by the Foundation for the Development of Marginal Communities.

The AIADP programs cover increased and diversified agricultural production, improved fishery production and processing, with comprehensive watershed and coastal environmental management.

Implementation of these programs, which aim to increase rural income through increased production and environmental protection, obviously requires an improved road system and outlets to Central Luzon. These would be provided for the central and southern geographic zones of Aurora by this proposed road improvement program.

2.1 PROVINCE OF AURORA (REGION IV) AND NUEVA ECIJA (REGION III)

2.1.1 General Background

2.1.1.1 Aurora Province

Aurora province in northeast Luzon lies between latitude 15°-01'-43" and 16°31'00" N and longitudes 121°16'22" and 122°01'30" E. Baler, the provincial capital, is 232 km from Manila by the national highway Cabanatuan-Palayan-Bongabon-Baler. See Figure 1-1 and 1-2.

The province was created in 1979 from the neighboring province of Quezon in the south and stretches for 180 km to the province of Isabela in the north. It is bounded by the Pacific Ocean to the east and by the Sierra Madre mountain range to the west. The average width of the province is about 25 km. The total land area is 308,122 has. (3,081 km^2) of which about 15%, is stated to be under cultivation.

The province is situated in Region IV (Southern Tagalog), and is comprised of 8 municipalities of which 5 are in the project area. The 8 municipalities contain 151 barangays.

2.1.1.2 Topography

The relief and drainage of Aurora are determined by the Sierra Madre range, which runs the length of the province (180 km) rising to elevations of 1700 to 1900 meters AMSL, while the two main passes are between 400 and 700 meters AMSL. The lateral extent of the watershed varies from 30 kms to 5 kms from the coast, while rugged terrain extends right to the shoreline between Baler and Dingalan.

A number of fast-flowing rivers flow from short, steep catchment basins on the eastern slopes of the Sierra Madre. The larger rivers form narrow coastal flood plains and river fans, notably in the central geographic zone between Baler and Ma. Aurora. This central flood plain is drained by a number of rivers converging to form the Aguang river which drains into the Pacific just north of Baler.

The Dingalan river drains the southern zone from the watershed SE of Gabaldon to the Pacific Ocean. The Coronel river flows NW from near Gabaldon to join the Pampanga river in Central Luzon. River courses are unstable and often show wide areas of river wash. It is reported that river courses have become increasingly unstable over the past 25 years because of logging and shifting cultivation which denuded upland watersheds.

Six major rivers are found in Aurora all of which drain into the Pacific. Most of the lowlands are subject to severe seasonal flooding. Erosion surveys carried out in Aurora in 1989 under the AIADP show high rates of erosion despite vegetative cover in the catchment basins, and only 14 percent of the total land area was considered to have negligible erosion. The above conditions of fragile soils, rapid run-off and shifting river courses are of great importance in planning the construction of an improved road system.

2.1.1.3 Climate

Two synoptic stations of the PAGASA have been in continuous operation for 30 years in Aurora. These stations are situated in Baler and Casiguran. Monthly rainfall shows some variation, and though rain can fall during any month in the year, one or more dry months can occur at Baler and Casiguran sometime during the year every nine years out of ten. (Tables 2-1 and 2-2).

Along the coast the mean annual rainfall is about 3300 mm with a tendency for rainfall to increase inland and northwards. Maximum daily rainfall associated with tropical cyclones can reach 675.6 mm (Baler 1963). The maximum recorded fall at Casiguran of 401 mm (1971) does not appear to be associated with a cyclone. The recurrence interval of daily rainfall events of 200 mm or more can occur at about one year in two. Extreme values are of great importance in planning infrastructure.

Aurora province is exposed to intense tropical cyclones with very high wind speeds, and storm surges causing a rise of several meters in sea level. During the period from 1948 to 1988 on an average 19.8 cyclones per year crossed or developed in the Philippines of which 54 percent developed into typhoons. The average frequency of cyclones affecting Aurora between 1970 and 1982 was 2.58 per year. Although the rainy season is between June and December, no month is entirely free of the occurrence of tropical cyclones.

The mean annual temperature at sea level in Aurora Province is around 25.5 degrees C. The diurnal range in temperature is typically 8 to 9 degrees C. The relative humidity rate ranges from 74 to 84 percent throughout the year in Baler, with highest values in November and December.

Table 2-1
AVERAGE MONTHLY RAINFALL IN MM, 1981-1985
AURORA PROVINCE-STATION: BALER

MONTH	YEAR					
	1981	1982	1983	1984	1985	MEAN
January	89.70	47.40	445.60	448.20	70.70	220.32
February	215.00	169.60	44.70	94.60	262.40	157.26
March	82.20	302.70	515.20	319.50	289.82	289.82
April	343.60	248.70	150.40	254.00	357.30	270.80
May	146.40	361.10	285.00	263.40	358.50	282.88
June	229.20	105.60	182.40	382.10	133.40	206.54
July	284.20	352.20	313.80	157.40	351.80	291.88
August	199.30	330.70	304.40	127.40	55.00	203.36
September	231.90	147.30	255.40	246.50	551.60	286.54
October	678.50	280.80	636.30	1,089.20	741.90	685.34
November	604.00	388.30	75.10	157.20	332.80	311.48
December	75.50	444.70	120.10	69.90	126.60	167.36
Mean	264.95	264.90	277.90	300.80	297.60	281.13
Mean Annual Rainfall:						3,373.58 mm

Table 2-2
AVERAGE MONTHLY RAINFALL IN MM, 1981-1985
AURORA PROVINCE-STATION: CASIGURAN

MONTH	YEAR					
	1981	1982	1983	1984	1985	MEAN
January	259.00	93.90	375.20	288.30	85.10	220.30
February	48.20	94.50	94.80	96.00	240.10	115.44
March	44.60	133.00	241.40	173.20	131.50	144.76
April	101.70	182.50	56.80	309.50	208.40	172.18
May	171.10	331.60	239.90	179.00	238.50	232.02
June	161.80	58.30	160.80	277.50	160.10	167.70
July	366.60	789.20	431.20	291.10	382.00	452.02
August	214.80	461.20	122.70	265.30	58.80	224.56
September	327.50	245.90	229.10	72.90	681.10	311.30
October	662.50	111.50	856.80	1,132.00	866.90	725.94
November	751.40	532.90	233.30	106.90	41.80	407.06
December	192.90	653.40	100.70	328.70	176.00	284.34
Mean	275.18	307.50	262.20	293.40	302.40	171.78
Mean Annual Rainfall:						3,458.00 mm

2.1.1.4 Land Use

The major agricultural land uses in Aurora include irrigated and rain-fed paddy, peanut and coconut. Small areas of Robusta coffee are found on river fans along the coast, and in the central zone some commercial citrus (mandarin) plantations exist.

Extensive primary and secondary forest, with areas of bush and grasses make up the remainder. Forest still covers the steeply sloping and inaccessible areas in the mountains between San Luis and Dingalan.

Where the forest cover has been removed by logging followed by shifting cultivation, severe sheet and gully erosions occur locally and contribute to the high incidence of flash-floods, damaging road sections and putting bridges and culverts at risk. Stream bank erosion and extensive river meanders are also observed in the Maria Aurora Flood plain.

The Coronel valley along which the Gabaldon-Palayan section of the Dingalan-Palayan road sector passes, is cultivated to paddy, and maize. The Coronel river bed shows considerable instability with meanders, stream bank erosion, and large areas of gravel river-wash provoked by flash-floods from the catchment basins lying immediately NE of the road section.

Present land use is a main indicator of agricultural potential. Table 2-3 and 2-4 reflect Land Classification and Land Use respectively for Aurora Province. Mapping was done by the Bureau of Soils and Water Management (1986) based on interpretation of aerial photography supplemented by field checks. The major agricultural land uses in Aurora include irrigated and

rainfed paddy/rice, coconut and peanut. Some low-grade Robusta coffee is found on river-fans and other level areas along the coast. The growth potential of Aurora province in relation to the resource base, is examined in greater detail in Appendix B-1.

Table 2-3
LAND CLASSIFICATION (AURORA 1989)

LAND CLASSIFICATON	AREA (has.)	PERCENTAGE (%)
Certified alienable and disposable land	132,008	41
Classified Forest Land	191,946	59
Established Forest Reservation	84,403	
Established Timberland	102,953	
National Parks, GRBS/ Watershed Area	4,190	
Unclassified Forest Land		-
TOTAL	323,954	100

Source: Forestry Statistics, DENR

Table 2-4
LAND USE (AURORA 1990)

LAND USE	AREA (has.)	PERCENTAGE (%)
Agricultural Land	29,600	9
Hill Farms	6,900	2
Forests	244,100	78
Protected Areas [1]	18,300	6
Idle Land	14,700	5
TOTAL	313,600	100

Note: Land Use prepared by the AIADP on the basis of aerial photos and satellite (SPOT) imagery are preliminary measurements, thus the two totals are not yet reconciled.

[1] Including watershed and military reservations, and the Aurora National Park.

2.1.1.5 Nueva Ecija Province

For purposes of this study, data on Nueva Ecija is confined to a brief profile, and to population figures for the six municipalities shown at Table 2-10.

Nueva Ecija is the largest province in Central Luzon, with a total area of 5,507.18 km². The biggest municipality is Carranglan (781 sq. km.) while Cabanatuan City, the provincial capital is 184 sq. km. in land area.

Geographically, the province is situated between longitude 120°42' to 121° E and latitude 13°49' to 16°11' N.

The province is centered on the Pampanga river system and its tributaries flowing NW to the South China Sea. The eastern and the northern parts of the province are bordered by the Sierra Madre mountains.

The climate has two pronounced seasons, wet and dry, with the rains lasting from May to November. Typhoons occur from October to November at an average of six (6) per year. Temperatures range from a minimum of 16°C to a maximum of 38.5°C with a mean temperature of 27.8°C.

Land Classification and Land Use (1989) are shown in Tables 2-5 and 2-6 below:

Table 2-5
LAND CLASSIFICATION
NUEVA ECIJA, 1989

LAND CLASSIFICATION		AREA (has.)	PERCENTAGE (%)
Certified Alienable and Disposable		330,985	60.0
		13,726	2.5
Unclassified Forest Land		206,007	37.5
Classified Forest Land			
Established Forest Reservation	84,500		
Established Timberland	31,679		
National Parks, GRBS/ Watershed Area	3,504		
Military Reservation	61,900		
Civil Reservation	139		
Others	22,285		
TOTAL		550,718	100.00

Source: Forestry Statistics, DENR.

Table 2-6
LAND USE, NUEVA ECIJA

LAND USE	AREA (ha.)	PERCENTAGE (%)
Agricultural Lands	298,742	54.2
Residential, Commercial, Industrial, etc.	31,984	5.8
Timber and Forest Lands	137,257	25.0
Grazing and Pasture Lands	12,140	2.2
Reservation Area	3,504	0.6
Open Lands and Built-up Areas	67,091	12.2
TOTAL	550,718	100.0

Source: Socio-economic Profile.

2.1.2 Population Characteristics

2.1.2.1 Aurora Province

The total population, number of barangays and land areas of each municipality are shown in Table 2-7.

Table 2-7
POPULATION, LAND AREA AND DENSITY BY MUNICIPALITY
AURORA PROVINCE 1990

MUNICIPALITY/GEOGRAPHIC LOCATION	NUMBER OF BARANGAYS	LAND AREA (Km^2)	POPULATION	POPULATION DENSITY/Km^2
NORTH				
Casiguran	24	715.4	18,388	26
Dilasag	11	430.0	11,412	27
Dinalungan	9	367.1	6,770	18
Sub-total		1,512.5	36,573	24
CENTRAL				
Baler	13	85.6	24,689	273
Dipaculao	25	296.8	18,951	71
Maria Aurora	40	338.1	28,378	103
San Luis		675.2	16,740	25
Sub-total	18	1,395.7	88,758	64
SOUTH				
Dingalan	11	317.9	14,475	46
Total for Province	151	3,226.1	139,586	43

Source: National Statistics Office, 1990 Census of Population and Housing.

Of the total provincial population of 139,586, over half (64%) lives in the central Zone, 26% in the north, and 10% in the south. Maria Aurora has the highest population of 28,378 persons, Dinalungan has the lowest with 6,770 persons.

Land areas and population densities of the municipalities show considerable variation. The average population density within the province as a whole is 43 persons per km^2. The central zone has the highest population density with 64 persons per km^2, compared to 46 and 24 persons per km^2 for the southern and northern zones respectively.

Baler and Ma. Aurora municipalities have the highest densities with 273 and 103 persons per km^2, while Dinalungan has a density of only 18 per km^2.

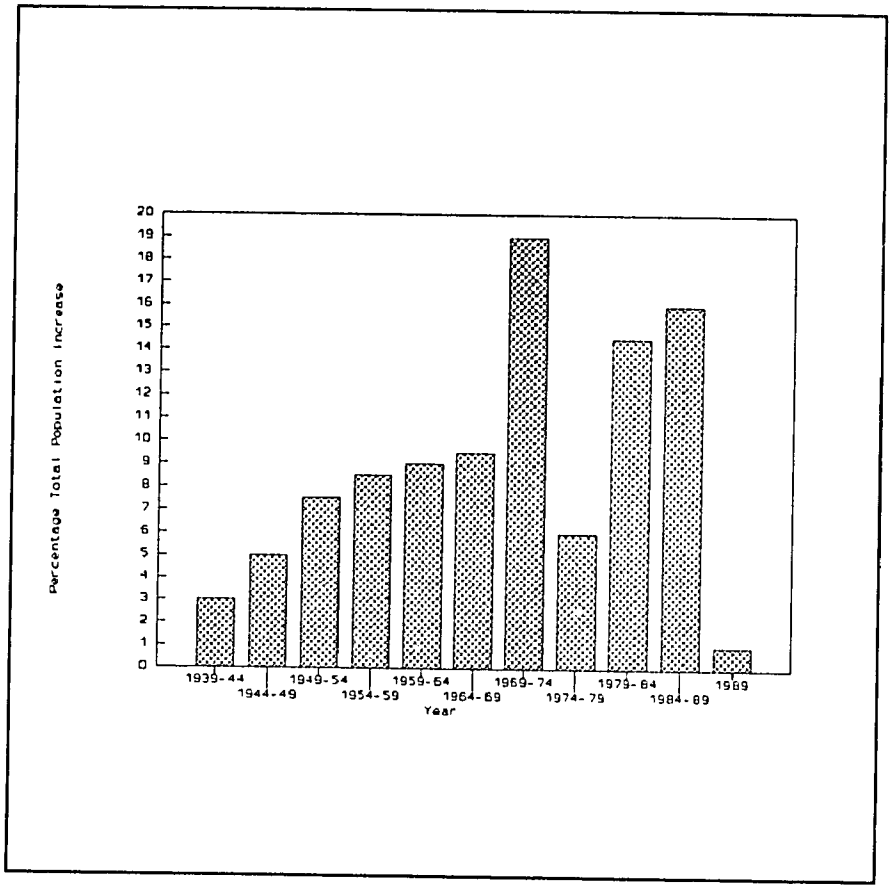
The 1990 population of Aurora is estimated at 139,586, with the number of households at 26,130. Table 2-8 shows the provincial population by municipality for the years 1980, 1985, and 1990, together with average annual growth rates of 2.7% during this period, with extreme municipal variations of 0.6% in Ma. Aurora and 5.2% in Dingalan and Dilasag. A high proportion of the growth is attributed to immigration as shown in Figure 2-1.

Table 2-8
POPULATION AND AVERAGE ANNUAL GROWTH RATE
AURORA 1980-1990

LOCATION MUNICIPALITY GEOGRAPHIC	POPULATION			PERCENT CHANGE (1980-90)	AVERAGE ANNUAL GROWTH RATE (%)
	1980	1985	1990		
NORTH					
Casiguran	13,925	15,822	18,388	+ 32	2.8
Dilasag	6,716	9,449	11,195	+ 67	5.2
Dinalungan	5,242	6 447	6,770	+ 29	2.6
CENTRAL					
Baler	18,349	20,247	24,689	+ 35	3.0
Dipaculao	15,561	18,158	18,951	+ 22	2.0
Maria Aurora	26,822	29,986	28,378	+ 6	0.6
San Luis	11,828	12,503	16,740	+ 42	3.5
SOUTH					
Dingalan	8,702	9,699	14,475	+ 66	5.2
PROVINCE TOTAL/AVERAGE	107,145	122,311	139,586	+ 33	2.7

Source: AIADP, Barangay Level Baseline Survey
NSO, 1990 Census of Population and Housing

Figure 2-1
AURORA IMMIGRATION PROFILE (1939 - 89)



Source: AIADP 1989

Growth rates differed in this period between the northern zone with an annual average population growth of 3.45% compared to 2.03% in the central, and 5.2% in the southern zones.

The total population is shown as 139,586 by the NCSO in the 1990 Census of Population, and as 141,996 in the AIADP Survey. The NCSO enumeration may be lower, since only estimated populations are provided for certain barangays due to critical peace and order conditions. The NCSO population figure is retained in the present study.

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In 1988, 66 percent of the active Aurora population were employed in agriculture, fisheries or forestry, of which 83 percent were farmers, and 8 percent fishermen. Table 2-9 reflects Employment by Economic Sector.

Table 2-9
EMPLOYMENT BY ECONOMIC SECTOR
AURORA 1988

LOCATION MUNICIPALITY GEOGRAPHIC	AGRI-[1] CULTURE/ FISHERIES	FORESTRY	COTTAGE[2] INDUSTRY	CONSTRUCTION	SERVICE WHOLESALE RETAIL	TRANSPORT	OTHER
NORTH							
Casiguran	1,997	158	903	134	877	186	0
Dilasag	2,551	263	86	59	62	52	0
Dinalungan	2,129	246	211	20	68	100	96
CENTRAL							
Baler	3,032		418	95	679	90	1,669
Dipaculao	3,852	309	1,045	55	250	125	285
Maria Aurora	7,988	1,000	1,504	0	600	805	328
San Luis	985	124	266	0	328	260	398
SOUTH							
Dingalan	2,150	248	0	48	287	21	197
TOTAL	24,684	2,348	4,533	411	3,151	1,639	2,973

Source: AIADP, Main Report. 1989.

[1] It is likely that both sectors supplement their income through illegal logging, "carabao" logging and collection of forest products.
[2] Majority of the cottage industry and collection of forest products.

An AIADP study (1990) estimated that there were 5,100 hill farmers in Aurora, practicing shifting cultivation on logged and sloping land, and occupying an estimated area of about 16,470 ha. These families are only partially established and very often must move when soil erosion reduces fertility. They are essentially subsistence farmers with minimal surplus production, and thus are marginal to the cash economy and a potential charge on social services.

In 1988 there were 92,384 persons over the age of 11 years, of which 41,250, or 45% were employed full time, and are thus considered as the active labor force. 55% were either employed part-time, or were housewives, students or retired persons with no gainful employment. Of the total population the rural sector composed 75%, and the urban sector 25%. In this study it is assumed that a percentage of the urban population will also have productive rural activities-agricultural and livestock production, thus the rural sector is taken as 80%.

Aurora has a literacy rate of 86.0 percent (1988) with 23,399 children enrolled in primary schools, and 9,293 pupils in the secondary schools. The drop-out rate in the secondary cycle was estimated at 37 percent. (Socio-economic Profile 1988 - Prov. Planning and Development Office). There are 98 public elementary schools, 25 secondary schools and one college in the province.

2.1.2.2 Nueva Ecija Province

The total provincial population (1990) was 1,312,610 persons. The growth rate from 1975-1980 was 2.55% per annum, and from 1980-1990 was 2.1% per annum. Population density is estimated as 238 persons per km^2.

Table 2-10 shows the growth rates between 1980 and 1990 of the population in municipalities which will be influenced by the proposed Aurora Roads Programme.

Table 2-10
POPULATION AFFECTED BY THE AURORA ROADS PROGRAMME IN NUEVA ECIJA

SECTOR/MUNICIPALITY	POPULATION		ANNUAL GROWTH RATES (%)
	1980	1990	
DINGALAN - PALAYAN			
Gabaldon	17,169	21,744	2.39
Laur	17,729	21,464	1.93
Palayan	14,959	20,393	3.15
MARIA AURORA -PANTABANGAN			
Pantabangan	13,916	18,341	2.80
PALAYAN-Km. 170-MARIA AURORA			
Bongabon	32,451	39,616	2.01
AVERAGE ANNUAL GROWTH RATE	2.36 percent		

Source: NCSO Census of Population

2.1.3 Family Income and Expenditures

When first established in 1979, Aurora was ranked among the five poorest provinces in the Philippines. Aurora ranks below the average family income of ₱ 37,978 for Region IV - Southern Tagalog in which the province is situated, with an estimated average of ₱ 34,141. This figure appears to be too high, and is probably distorted by receipts from logging which will diminish as forests are exhausted. The poorest families are the 5,100 subsistence hill farmers, and the indigenous tribal communities whose cash income is estimated at ₱ 6,550. They are

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situated in the mountainous region between Baler and Dingalan, and elsewhere in the Sierra Madre in the western part of the province.

Higher-income families will be found in the Central Aurora Flood Plain in the four municipalities of Baler, San Luis, Ma. Aurora and Dipaculao.

Family expenditure for food for Aurora averages 53.9 percent of total income, as against the Philippine national average of 50.7 percent, while expenditure on housing is proportionately less at 9.1 percent against the national average of 15.3 percent. Expenditure on transportation is 2.8 per cent against the national average of 4.7 percent.

Approximately 36 percent of families surveyed had annual expenditures of less than ₱20,000, although 64 percent were earning more than this figure and 12 percent were earning ₱ 60,000 and over. NCSO figures for total receipts/disbursements for 1988 show average savings as 10 percent of receipts. A summary of annual family income by main source in Aurora and Nueva Ecija is presented in Table 2-11. The break-down of family expenditures in percent for the provinces is summarized and compared to national averages in Table 2-12.

Table 2-11
MAIN SOURCES OF INCOME FOR AURORA COMPARED WITH REGION IV (S. TAGALOG) AND FOR NUEVA ECIJA COMPARED WITH REGION III (CENTRAL LUZON) AND THE PHILIPPINES
(Percentages)

MAIN SOURCE OF INCOME	AURORA	REGION IV	NUEVA ECIJA	REGION III	PHILIPPINES
Agriculture Wages/Salaries	12.24	9.77	15.45	7.67	44.80
Non-agricultural Wages/Salaries	17.78	38.14	27.78	40.34	
Agricultural Entrepreneurial	37.67	20.71	32.42	17.45	38.80
Non-agricultural Entrepreneurial	20.65	13.84	11.92	13.05	
Other	11.66	17.53	12.43	21.45	16.40
TOTAL	100.00	99.99	100.00	99.96	100.00
FAMILIES (Thousands)	25.43	1,284.40	224.70	1,038.22	10,533.93

Source: NCSO 1988, Family Income and Expenditure Survey
NSCB, Philippine Statistical Year Book.

Table 2-12
FAMILY EXPENDITURES FOR AURORA, NUEVA ECIJA AND THE PHILIPPINES
(Percent)

EXPENDITURE	PHILIPPINES	AURORA	NUEVA ECIJA
Food	50.7	53.9	49.4
Transport	4.7	2.8	4.0
Clothing	4.2	5.3	6.0
Housing	15.3	8.6	10.3
Education	2.9	4.2	2.9
Other	22.2	25.2	27.4

Source: NCSO 1988 Family Income and Expenditure Survey

The AIADP (Main Report 1990) estimated gross family income from various sectors as:

- Gross farm income ₱ 23,679
- Hill farmers ₱ 6,500
- Fishing ₱ 76,283
- Furniture & Cottage Industries ₱ 83,167

All farms had income from non-farm activities and some from fishing. The small number of persons involved in cottage industries and food-processing had some farm activities. It was not possible to estimate the number of families engaged in each type of activity, since the estimate was obtained by sampling.

This population and family income data above will be used in the traffic analysis in Chapter 3.

2.1.4 Structure of the Provincial Economies: Aurora and Nueva Ecija

Owing to its topography and its relative distance from the mainstream of economic activities, the economy of Aurora is significantly dependent on agriculture and agri-based activities. Of this economic sector, forest exploitation had been traditionally the leading source of income because of its vast forest resources. Crop farming and fishing are the other main sources of agricultural income. In 1988, about one half of all the families surveyed in Aurora derived their main income from agriculture-based activities.

Agricultural development in Aurora is limited by the rugged terrain of the eastern Sierra Madre, and is confined to the central Ma. Aurora flood plain, and to isolated coastal river fans. Only about 15 percent of the province's land is under cultivation. Poor road condition, the lack of facilities to support various economic activities, and especially the absence of an all-weather road link to Central Luzon may have retared the economic development in the province.

Markets are limited by a small surplus production of products other than coconuts. With large inputs of capital some production increases might be obtained of food grains, root crops and fruit, if soil and water engineering is carried out in the major watersheds where the cultivated areas are situated. But the condition of barangay roads in an area with a mean annual rainfall in excess of 3,000mm, will keep transport costs high. The distance of many farms from an improved inter-provincial road would probably make any large capital investment in land and water engineering non-viable. The province appears to be self-sufficient in basic food products, and has adequate protein supplies from its coastal fisheries.

Crops in the province of Aurora are sold to buyers either in the field, at the house, within the barangay or outside the barangay. Crops are sold by farmer to the traders outside the barangay where the prices are higher. About two thirds of the goods produced in the northern and central zones are sold outside the barangay. This indicates that farmers in these areas have more choices over where they sell their crops, although the central zone has better access to market as indicated by the shorter average time for marketing outside the barangays. In the southern zone, however, it appears that local traders have strong influence on the market and that there are less options outside the barangay. Table 2-13 presents the Crop Marketing Pattern in the three zones of Aurora.

Table 2-13
CROP MARKETING PATTERN

% OF HOUSEHOLDS SELLING CROPS	CENTRAL ZONE	SOUTHERN ZONE	NORTHERN ZONE
in the field	4.70	12.20	1.60
at the house	17.60	43.90	12.70
in the barangay	10.90	34.10	23.80
outside the barangay	66.80	9.80	61.80
Average time for Marketing trip outside the barangay (hrs.)	1.00	1.25	3.60

Source: Rural Accessibility Planning in Aurora Province, DILG (1991).

Aurora still has extensive areas of forest and degraded woodland on the eastern slopes of the Sierra Madre, but these have been considerably depleted over the past 20 years. Construction of new roads, especially the proposed Baler-Dingalan road, would accelerate forest destruction, and the subsequent migration of hill-farmers to cultivate marginal slopes would increase environmental degradation without providing them with an adequate livelihood.

The forest land cover in Aurora of about 219,951 ha. (AIADP - 1989, 73.4 percent of the total area) is comparable to that of Nueva Ecija of 233,519 ha. which is also fast diminishing. Watershed reserves of Pantabangan, Talavera and Carranglan appear to have been created after nearly all the forest cover was removed from these catchment basins. In Nueva Ecija forest destruction has occurred on the western slopes of the Sierra Madre. With a marked dry season and a lower annual rainfall than Aurora, the regeneration of woody species leading to secondary forest growth is thus much slower. The eastern zone of Nueva Ecija is also readily accessible to migrants from Central Luzon, who complete the destruction of residual vegetation by marginal hill-farming of steep sloping land, aggravating the ecological imbalance.

2.1.4.1 Agriculture

There are indications that under present cultivation practices, much of the total land area of Aurora is near, or has passed the economic limits of sustainable development. The lowland ecozones, including the central Ma. Aurora floodplain, cover 36,975 ha. (12.3 percent of the total land area). These are lands with slopes less than 8%, where irrigation and other rural infrastructure is concentrated, and account for a major proportion of the province's rice and coconut production. These lands are not subject to erosion, but are regularly flooded, and will receive increasing volumes of river-wash from the degraded catchment basins in the Sierra Madre: (e.g. the Malupa and Aguang river systems.)

The upland ecozones begin with slopes to 25 percent bordering the flood-plain, and act as a buffer between the arable plains and the fragile more steeply sloping lands above 300 meters AMSL. These are the main development zones in the municipality of Baler, and are subject to destructive random cultivation. These lands cover 14.4 percent of the provincial area.

Above these ecozones are the hilly mountain ecozones covering 26.6 percent of the province, mainly covered with degraded forest with slopes in excess of 30 percent. Cultivation of these fragile slopes causes severe erosion and landslides. Yields per hectare in the upland zones are less than 30 percent of lowlands for most crops, as a result of poor shallow soils whose fertility is rapidly exhausted. Although upland farmers occupy about 23 percent of total cultivated land, their contribution to aggregate crop production is less than 10 percent. (AIADP-Economic Aspects Report 1990).

The remaining 46.70 percent of the land area is a highland ecozone situated above 500 meters AMSL, still under forest cover. The AIADP (Main Report 1989) from which the above data is taken from, recommends that 71.4 percent of the provincial area should remain as public land where any cultivation would be strictly controlled by the DENR.

The quality of the physical resource base of Aurora determines the limits of sustainable development. Strictly controlled land-use would exclude 18.1 percent of the upland ecozones from random cultivation, limiting development to those areas to which soil and water conservation engineering has been applied, together with sustainable cultivation practices.

This requires massive capital investment and a complete reversal of present practices of hill-farmers, which is unlikely to occur before further environmental degradation takes place.

Unrestricted watershed degradation will diminish the productivity of the lowland cultivated zones. Peaks flows of water courses are constantly enlarged, are more concentrated in time, and carry heavier loads of soil and gravel. This leads to more frequent serious flooding, more rapid siltation of irrigation dams and channels, and increased deposits of gravel in delta areas. Reduced infiltration reduces river flows and lowers water tables. This will occur in the Central Aurora Flood plain, and reduce its long-term output.

It is emphasized that hill-farmer migrants who provoke this destruction are marginal subsistence farmers. Road construction does not affect their production-levels, which provide no surplus to render new roads partially feasible. In fact new roads penetrating ecologically fragile mountain areas, such as the marginal lands of Aurora, are certain to degrade the environment more rapidly, and will have the long-term effect of decreasing production in the lowlands. The AIADP study has identified and mapped about 17,860 ha. (about 6 percent of the total land use) of critical watershed areas of which 60.3 percent are located in the four central municipalities, below which are the main paddy rice producers, all situated in the project area.

The agricultural development potential of Aurora is thus extremely small, and will be negative unless the DENR halts random forest destruction and controls cultivation in the major catchment basins.

Inconsistency of available data on crops generated by several agencies, (Bureau of Soils, NSO, AIADP, Bureau of Agricultural Statistics) is a problem in Aurora. For purposes of analysis and estimating development benefits, the consultants have made their own estimates in an effort to present consistent tables for areas and production. These figures are subject to significant margins of error, and are useful in demonstrating trends rather than absolute values. Estimates of crop areas are shown in Table 2-14. Table 2-15 and 2-16 present the estimated production in Aurora and Nueva Ecija provinces, respectively.

Table 2-14
COMPARATIVE ESTIMATES OF AREAS BY CROP
AURORA 1980, 1988, 1989
(hectares)

ALL CROPS	1980 CENSUS OF AGRICULTURE	1988 BSWM SURVEY	AIADP ESTIMATES [1]		% TOTAL AREA
			I 1989	II 1990	
ALL CROPS	31,229	38,928	32,579	36,500	100.0
Perenial Crops	14,066	24,740	20,132	23,350	64.0
Coconuts	11,303	21,462	17,241	19,350	53.0
Banana	807	2,762	2,000	2,380	6.5
Coffee	1,374	184	723	1,120	3.1
Citrus	154	75	153	150	0.4
Other	428	257	15	350	1.0
Annual Crops					
Paddy Rice (palay)	14,898	13,105	10,234	10,230	28.8
Corn (Maize)	658	301	250	250	0.7
Root Crops	559	84	760	760	2.1
Vegetables	245	91	690	690	1.9
Other	803	607	1,220	1,220	3.3

Source: Census of Agriculture, 1980.
Bureau of Soils and Water Management (BSWM) Surveys, 1989.

[1] AIADP Estimate I was corrected in II based on a land use plan and the results of five watersheds (catchment basin) surveys.

2.1.4.2 Rice

Increased rice production would result from extending irrigation systems allowing multiple annual crops, but the areas to be brought under irrigation are not large. Out of a total area of 7,263 ha. of paddy-rice irrigated (Central Zone 1988-89), 1,016 ha. were rain-fed. Probably less than 50% of this area, (508 ha.) might be brought under irrigation. Production would also be increased by improved post-harvest practices, reducing losses below the present 20 percent. But watershed degradation will reduce the effect of irrigation, by flooding, siltation of canals, and spread of river-wash gravel.

Rice-cultivation techniques involving planting in line, weed and pest control, fertilization and water control appear to be good in the central Aurora flood plain. Improved roads may lower the price of some farm inputs, but transport to the main road is still by unimproved barangay roads for most farmers. During the period 1980 to 1988 the area planted to paddy-rice decreased from 17,770 ha. to 13,105 ha., while yields increased from 1.88 to 2.31 MT/ha. with a decline of 1,714 MT in total production.

Table 2–15
ESTIMATED CROP, LIVESTOCK AND
FISHERY PRODUCTION (M.T.)
AURORA 1981, 1988, 1990

	1981	1988	1990	ANNUAL GROWTH RATE (%)
CROPS				
Perennial Crops				
Coconut	75,806	86,242	73,817	–0.29
Banana	474	852	476	0.0004
Coffee	390	592	346	1.32
Sub–total	76,670	87,686	74,639	–0.29
Annual Crops				
Paddy rice (palay)	29,685	37,291	52,989	6.65
Corn (maize)	n.a.	115	32	– –
Root crops	551	1,014	958	6.34
Vegetables	66	104	107	5.51
Other	606	3,056	4,194	24.98
Sub–total	30,908	41,580	58,280	7.30
LIVESTOCK				
Carabao	98 [1]	134	28 [2]	–14.49
Cattle	258 [1]	455	366 [2]	4.47
Pigs	612 [1]	705	651 [2]	0.77
Poultry	n.a.	n.a.	n.a.	
Sub–total	968	1,294	1,045	0.96
FISHERIES				
Municipal	2,008	4,821	4,609	9.67
Aquaculture	34	4	– –	– –
Sub–total	2,042	4,825	4,609	9.67
TOTAL	109,620 [3]	135,385	137,528 [3]	2.55 [4]

Source: Bureau of Agriculture Statistics.

Note: [1] – 1982 Production
[2] – Preliminary Estimates
[3] – Excluding Livestock
[4] – Growth Rate Excluding Livestock/Poultry

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Table 2–16
ESTIMATED CROP, LIVESTOCK AND
FISHERY PRODUCTION (M.T.)
NUEVA ECIJA

	1981	1988	1990	ANNUAL GROWTH RATE (%)
CROPS				
Perennial Crops				
Coconut	170	193	110	−4.72
Banana	8,640	6,533	6,235	−3.56
Coffee	26	12	10	−10.07
Mango	3,632	3700	4243	1.74
Sub–total	12,468	10,438	10,598	−1.79
Annual Crops				
Paddy rice (palay)	763,200	501,909	971,763	2.72
Corn (maize)	1,745	5,289	4,044	9.79
Root crops	12,327	3,838	3,017	−14.48
Vegetables	44,674	26,651	27,220	−5.35
Other Crops	20,690	35,550	44,648	8.92
Sub–total	842,636	574,237	1,050,692	2.48
LIVESTOCK				
Carabao	892 [1]	437	311	−12.34 [3]
Cattle	562 [1]	455	592	0.65 [3]
Hogs	8,772 [1]	9,694	10,704	3 [3]
Goat	11 [1]	22	19	7.07 [3]
Poultry	17 [2]	84	16	−1.00 [4]
Sub–total	n.a.	10,692	11,642	n.a.
FISHERIES				
Municipal	57	1,459	1,588	44.73
Aquaculture	5,828	512	n.a.	n.a.
Sub–total	5,885	1,971	1,588	44.73
TOTAL	860,989 [5]	597,338	1,062,878 [5]	2.55 [6]

Source: Bureau of Agriculture Statistics.

Note:
[1] – 1982 Data
[2] – 1984 Data
[3] – Growth Rates are for period 1982 – 90
[4] – Growth Rates are for period 1984 – 90
[5] – Excluding Poultry and Livestock
[6] – Growth Rate excluding Poultry and Livestock

Table 2-17 shows levels of paddy/rice production in 1988/89 with calculated consumption levels and the theoretical surplus.

Table 2-17
PADDY: PRODUCTION, CONSUMPTION, SURPLUS
(AURORA 1988-1989)

LOCATION	PRODUCTION (M.T.)			
	PADDY [1]	RICE [2]	CONSUMPTION	SURPLUS
North	21,394	10,783	5,489	+ 5,294
Central	32,361	16,310	13,736	+ 2,574
South	444	223	1,648	- 1,425
TOTAL	54,199	27,316	20,873	- 6,443

[1] 20% Post Harvest Loss.

[2] milled at 63%

Source: AIADP, Main Report, 1989.

About 39 percent of paddy sold by dealers reportedly goes to millers outside the province, mainly in Nueva Ecija. This is transported on either of the existing inter-provincial roads, the Ma. Aurora-Pantabangan or the San Luis-Bongabon link.

The largest areas of irrigated paddy-rice, which produce 2 crops annually, are found in Ma. Aurora municipality, where 2,843 ha. are cultivated. (26 percent of the total provincial irrigated paddy-rice area). Ma. Aurora also has the largest area of rainfed paddy-rice with 871 ha. or 54 percent of the provincial area for this crop. IRRI series and C-4 high-yielding rice varieties are most commonly used by farmers occupying irrigated land. Dipaculao has 1,797 ha or 17% of total. In Baler, San Luis, and Dingalan irrigated paddy-rice is not a major crop, having only 1,607 ha. or 15% of total. The three municipalities of the northern zone, Casiguran, Dilasag and Dinalungan, are not included in the current roads programm, but make a significant contribution to provincial rice production from 4529 ha. or 42 percent of the total provincial area.

2.1.4.3 Coconut

The chief exports of Aurora are fresh coconuts and copra. Coconut plantations cover approximately 53 percent of the total crop area. Nuts are traded mainly with Nueva Ecija, and copra is transported directly to oil-expressing plants in Manila. Primitive methods of drying copra have led to the presence of aflatoxin which has considerably reduced this market.

Large coconut plantations exist in the four central municipalities, Baler, Ma. Aurora, San Luis and Dipaculao. In 1982 the three municipalities of the northern geographic zone centered on Casiguran had about three times the area of coconuts than the central zones. But as a result of destructive cyclones, the area of coconut palms actually in production in the north appears to have been much reduced, although most of the palms themselves have survived.

The Philippine Coconut Authority (PCA) reports some replanting with Philippine Tall hybrids developed in Davao. The palms in plantations observed in the four central municipalities were mostly more than 50 years old, with production declining as they reach the limit of their useful life. Although national output of coconuts and coconut products was reported by the PCA to have increased by 1.6% in 1989, there is little replanting nationally of ageing palms, and increased coconut lumbering is reducing total stands. Exports have met problems of aflatoxin found in Philippine copra, and competition of Malaysian palm kernel oil for coconut oils. Although a domestic market will be maintained, no large increases in farm income from coconuts are likely for Aurora. Total production is expected to decline.

2.1.4.4 Other Perennial Crops

Apart from coconut, other perennial crops grown on a significant scale include bananas and coffee. Both are cash crops. Banana production in 1989 was estimated at 919 MT. (BAS) of which about 78% were grown in lowland areas. In the lowlands about 90% of production is sold (AIADP) and will be transported by road to markets.

Coffee is grown mainly as a backyard crop, and no properly maintained plantations were observed in the central zone. Poor-quality Robusta coffee are produced from trees which are neither pruned nor fertilized. This is a relatively high value commercial crop which can be grown as an inter-crop under coconuts, as can black pepper of which small patches grow in the municipality of San Luis. There is a considerable potential for increased planting of banana, coffee and black pepper on lower slopes bordering the central flood plain, provided soil conservation engineering is carried out first before planting. If these protective measures were carried out,the AIADP (Economic Report 1990) considered that increases in production for banana, coffee, and pepper could be obtained by the year 2010.

2.1.4.5 Livestock

Livestock production in the province is mainly small-scale. Very few larger production units exist. There are considerable differences between the livestock population estimates supplied by the Department of Agriculture, based on Municipal Profiles, and surveys carried out by the AIADP. These figures are shown in Table 2-18 below. It is concluded that no appreciable production increase will affect road traffic.

Table 2-18
LIVESTOCK SURVEY RESULTS, 1985-1989

TYPE OF LIVESTOCK	AIADP 1985	DEPARTMENT OF AGRICULTURE (1987)	AIADP BARANGAY SURVEY (1988) (Farm only)	AIADP LIVESTOCK SURVEY (1989)	AIADP WATERSHED SURVEY (1989)
Cattle	1,723	1,917	3,910	1,374	900
Carabao	11,024	4,454	5,187	984	4,300
Pig	8,139	6,031	6,333	n.a.	15,400
Goat	9,510	2,750	3,274	1,830	13,000
Chicken	17,239	21,535	18,592	n.a.	
Duck	3,688	499	n.a.	n.a.	78,000
Turkey			2,163	n.a.	

2.1.4.6 Fisheries

The coastline of Aurora is very open and exposed. The narrow shelf and steep incline from the 183 meter to 1830 meter mark means that the coastal waters are more oceanic in character.

The current status of coastal, demersal and pelagic fisheries in Aurora province has been assessed by consultants to the AIADP (1989). The report concludes that the fisheries are at a low level of development. There are indications that catches are diminishing, due partly to overfishing of the offshore and coastal stocks. Little evidence arises from the consultants' survey to suggest that Aurora is a high productivity area with a potential for expansion.

The estimated annual catch (1989) for motorized and non-motorized fisherman was 2,696 MT valued at ₱ 52.02 million, of which catches recorded for three coastal municipalities linked by the circumferential road were as shown on Table 2-19. About 30 percent of fish from Dingalan/Paltic is sold in Cabanatuan (AIADP Main Report, 1989).

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Table 2-19
FISHERIES: VOLUME OF CATCH
(Aurora) 1989

Baler Dipaculao Dingalan	1,123 MT 425 MT 302 MT	₱ 26.194 million ₱ 6.867 million ₱ 5.67 million
TOTAL	1,850 MT	₱ 38.731 million

1982 - 1989						
YEAR	1982	1983	1984	1985	1986	1989
Marine Fish	2,340	4,002	1,908	2,985	3,304	2,696
Crustaceans	299	71	12	89	136	
Molluscs	-	-	19	23	2	

Source: Bureau of Fisheries and Aquatic Resources.

While admitting that expansion could occur in some coastal areas, the study concluded that this would only occur as a result of substantial capital investment, and the introduction of sound management practices. Since the majority of fisherman are non-motorized, and fish close in-shore with small-mesh nets, significant increase is unlikely to occur as a result of improved road links.

Total number of bancas for Aurora province are shown in Table 2-20.

Table 2-20
BANCA FLEET (AURORA)

Type	Motorized	Non-Motorized	Total
Aurora	405	641	1,046
of which:			
Baler	138	82	220
Dipaculao	52	158	210
Dingalan	76	72	148
TOTAL	266	312	578

Source: AIADP: Fisheries Study: Vol. I 1989.

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From the above figures it may be assumed that the total fishing population numbers about 1100 families. There are no ice-plants in Baler or Dingalan, and no facilities for smoking fish.

2.1.4.7 Forest Industry

The existing state of forest industry in Aurora, and the environmental degradation have been exhaustively studied by consultants under the EEC-financed Watershed Protection and Environmental/Land Use Planning Study, carried out within the Aurora Integrated Area Development Project (AIADP). This followed a detailed World Bank-financed Forestry, Fisheries, and Agricultural Resource Management Study (ffARM Study) 1989.

Forest exploitation, logging and saw-mills, provide the largest financial return in Aurora, and has provided the basis for population growth by immigration. Much cleared land has already been occupied by marginal hill-farmers.

Logging concessions at present (1991) cover about 89 percent of the remaining forest land, and about 69 percent of the province. All lowland forest areas are already gone; in the foothills only gallery formations remain in gullys. Most of the steep forest land has already been logged over, either by TLAs or illegal loggers. Aurora had only 24,610 ha. of primary forest at the end of 1989, and the annual decline in the old growth Dipterocarp forest is estimated at 8.5 percent. At this rate, the ffARM study considers that forest exploitable resources will be virtually extinct in Aurora Province as elsewhere in the Sierra Madre perhaps not later than the year 2010.

The total licensed logging area (TLA) in 1988 was 216,579 ha. Land use areas determined by the AIADP using aerial photos and satellite imagery show national production forest and forest plantations as 244,100 ha. and the total area of the province as 313,700 ha. The Bureau of Soils (1986) gives 253,006 ha. and the AIADP Main Report (1990) gives 219,951 ha. The ffARM Study (1989) based on SPOT (1988) gives 258,000 ha.

The total volume extracted in 1988-89 was 230,497 M3 from an area of 3,377 ha. logged over. At ₱1,738/M3 (1990) gross returns were ₱ 400.6 million or ₱ 118,627/ha. 61.4 percent was cut from areas within Aurora (AIADP, Economic Aspects Report 1990).

Net returns were estimated by the AIADP consultants as ₱ 85.94 million. In June 1990 there were six (6) logging companies operating in Aurora province. In addition, illegal logging continues virtually unchecked, while carabao logging provides a cash return for isolated groups of forest-dwellers.

At the present rate of forest resource extraction in the province, the remaining forest resources will be exhausted in about 10 years. The province as a whole will suffer a drastic loss of income with the closure of logging camps and saw-mills. Several thousand workers will become unemployed. Migration of surplus population to open up new hill farms will occur since there is no other available land for settlement. As a consequence, the lowland cultivated and irrigated areas will have lower production owing to the continued degradation of the watersheds and catchment basins.

Sustainable development of the remaining forest area as recommended by the consultants would begin by an immediate log ban on the remaining Dipterocarp forest, with logging limited to about 85,400 ha. of secondary forest. However, the implementation of a log ban on primary forest covering 24,610 ha. would result in a loss of income to Aurora Province of projected production over 7.5 years of 1.73 million M^3 valued at roughly ₱ 3.0 billion. About 50 percent of gross value of output represents production costs of which 12.4 percent is labour cost. The loss of income to local labour would be ₱ 185.97 million or ₱ 18.60 million annually for 10 years before the remaining Dipterocarp forest is exhausted by continued logging activities.

Sustained yields from the remaining secondary forest requires vigorous enforcement of DENR regulations, a sharp reduction in volumes of timber extracted, considerable investment in reforestation and in agro-forestry among hill farmers. This requires large capital investment, and the acceptance of conservation measures by the population most concerned, the hill-farmers. The average annual net income of hill-farmer households was estimated by the consultants as ₱ 6,550 per farm. This low income is increased by at least 50 percent by various non-farm activities, such as extraction of forest products and employment by the logging companies, so any reduction in these activities will mean a loss of income, and will be difficult to enforce.

With the growth in population, the number of hill-farmers could increase by 3.5 percent per year under medium population growth assumptions (AIADP 1989). If strict forest conservation measures are applied, large capital-investment will be necessary for environmental engineering and the introduction of sustainable agro-forestry technology such as Sloping Agricultural Land Technology (SALT) to enable these hill-farmers to survive.

The above considerations emphasize the precarious state of the economy of Aurora Province with regard to its future development. It is concluded that no increase in income, and little increased traffic will result from an improved road system, although these roads are essential for the long-term restoration of the environment and to sustain a productive agricultural base. This will only occur if conservation policies are vigorously applied, and capital made available for the necessary reconstruction.

Thus, in estimating development benefits over 20-year period, the possibility of increased income from the forestry sector may be discounted.

2.1.4.8 Linkage of the Aurora and Nueva Ecija Economies

While the eastern part of Nueva Ecija lies in the rugged western slopes of the Sierra Madre, most of the province is situated in the Central Luzon Plain. Fertile soils, an extensive irrigation network, good communications and considerable urbanization contribute to a productive provincial economy.

Agriculture is the main economic activity. The total cultivated area is 383,367 ha. of which about 120,000 ha. are irrigated.

Rice is the main crop, followed by onions of which Nueva Ecija and Zambales are the country's larger producers. Central Luzon accounts for 70% of the national onion production.

Forest land covers 233,519 ha. on the western slopes of the Sierra Madre. Recent surveys indicate that the remaining Dipterocarp reserves are heavily depleted.

Post-harvest facilities include six ice and cold storage plant with an aggregate capacity of 9,750 MT, 16 slaughterhouses, and 381 warehouses with a total capacity of 4,420,100 bags. There are 432 rice mills.

The economy of Nueva Ecija is considerably more developed than that of Aurora, and any benefits from improved inter-provincial links are likely to be marginal. The municipalities lying in the Dingalan - Palayan road sector are largely situated in the upper Coronel river valley, which has limited agricultural potential owing to extensive areas of gravel river-wash covering alluvial soils. The forest resources of the mountains bordering this valley are nearly exhausted. Some mineral prospection for manganese and chromite may lead to long-term developments, land the extent of ore-body's are unknown at present.

Transporters of forest products would be the major beneficiaries from improved interprovincial links, both on the Dingalan-Palayan, and to a lesser extent from links between the central zone and Pantabangan/Bongabon road. Future policy regarding the continued exploitation of the remaining Dipterocarp forest reserves, and possible restrictions, may reduce rather than increase the tonnages of logs and lumber exported from Aurora, via Nueva Ecija. Traffic resulting from forest exploitation is therefore likely to diminish.

Three municipalities - Gabaldon, Laur and Palayan - will benefit from the improved Dingalan - Palayan road sector in terms of shorter travel time and lower transport costs.

Three other municipalities - Pantabangan, Bongabon and less directly Rizal, will also benefit from improved interprovincial roads connecting Ma. Aurora with Pantabangan, or San Luis with Bongabon. The improvement of either one of them is essential if development benefits other than marginal gains are to occur as a result of upgrading the circumferential road linking Baler - San Luis - Ma. Aurora and Dipaculao.

Small benefits may occur in Gabaldon, Laur and Palayan from increased traffic from Dingalan/Paltic, and along the Coronel river valley with scattered cultivation and some irrigated paddy. These benefits will be considerably increased if the port construction, at present considered by NEDA, is realized at Dingalan/Paltic. Improvement of this road sector (80 km), while it may marginally reduce the cost of transport, is unlikely to bring any substantial benefits to the sparse agricultural population of the Coronel valley. The alluvial soils of this valley are extensively overlaid by layers of riverwash of rocks and coarse gravel brought down from numerous denuded watersheds flanking the river Coronel to the NE and SW.

As regards the long-term developments that might accrue to the municipalities through which improved interprovincial links would pass, these also are likely to be marginal. Increased benefits would be gained by the central geographic zone of Aurora province in the form of lower transport costs for coconuts being the main export, for passengers and freight, and the fuel and consumer goods which are all imported from Central Luzon.

2.1.5 Tribal Minorities

There are four recognized tribal minorities in Aurora - the Dumagats of Calabagan, the Agta of the Sierra Madre, the Ilongots and the Igorots. These groups show distinctive differences in physique, language and custom. Three cultural minority service centres operate in the province, and have registered a total of 1406 families out of an estimated about 14,000 total of populating persons as reflected by Table 2-21.

Table 2-21
ETHNIC MINORITY AND NUMBER OF FAMILIES
AURORA, 1989

SERVICE CENTRE	NUMBER OF FAMILIES IN MINORITY GROUPS				TOTAL NUMBER OF FAMILIES
Maria Aurora	0	64	455	359	878
Casiguran	170	0	0	176	346
San Luis (Dibut)	182	0	0	0	182
TOTAL	352	64	455	535	1,406

Source: Tuzon, G.A. Minority Groups in Aurora Province.

The traditional occupations of these ethnic groups are hunting and food gathering within the forest, shifting cultivation and fishing. In recent years, as the forests diminish, these people have settled as sedentary hill-farmers or taken employment with logging companies. Hunting and food gathering will cease in a few years, since the forest cover of the Sierra Madre is heading for extinction. Of these groups the Dumagats are traditionally semi-nomadic. They are the group concerned with the proposed San Luis-Dingalan road whose construction would accelerate the extinction of their habitat. They are primarily a coastal tribe, moving up valleys into the forested interior. The proposed San Luis-Dingalan road would encourage increased logging, both legal and illegal, with migration of hill-farmers into critical watershed areas which are also ancestral Ilongot and Agta territories. Agricultural benefits would be negligible.

2.1.6 Trade and Industry

Aurora province is reported by the Bureau of Mines to have deposits of still undetermined volume of manganese, chromite, copper and nickel. On the other hand, although small mining concessions are being worked in Gabaldon at an artisan level, the mineral deposits of Nueva Ecija have not been surveyed systematically and their volumes are also still undetermined.

Trade and industry consists of dealers in consumer goods, in agricultural commodities mainly palay and coconuts, rice-mills, cottage industries, insurance agencies, transport operators, and various manufacturing concerns. The different cottage industries in Aurora are presented in Table 2-22.

Data on the distribution of manufacturing firms and establishments by employment for Nueva Ecija and Aurora provinces are presented in the Appendix B-4.

Table 2-22
COTTAGE INDUSTRIES IN AURORA

COTTAGE INDUSTRIES	
Furniture	38
Food Processing	21
Handicrafts	5
Metal Working	4

Source: 1988 Socio-Economic Profile

Most of the products of the above are transported to Cabanatuan and other trading centers in Nueva Ecija province.

The Development Bank of the Philippines has a branch in Baler, and four Rural Banks operate in the municipalities of Baler, Casiguran, Dipaculao and Ma. Aurora.

2.1.7 Tourism

Although Aurora is endowed with natural tourist attractions including mountain scenery, beaches and a Wildlife Reservation at Villa Aurora, the lack of necessary infrastructure means that any tourism development is essentially a long-term possibility.

An all-weather inter-provincial road is the first priority, but hotel infrastructure in Baler is at present non-existent. However, the pristine environments of this area could well attract naturalists and back-packers. Benefits coming from this type of tourism are discussed further in Appendix B-3.

2.1.8 Administrative Structure

The province of Aurora has eight municipalities, which are subdivided into 150 barangays. The municipality of Ma. Aurora has the most barangays (40). Baler, the seat of the provincial government, has 13 barangays.

Nueva Ecija is politically subdivided into 29 municipalities and three cities. These cities and municipalities are further subdivided into 823 barangays. Cabanatuan City, the seat of the provincial government has the most number of barangays (83).

2.2 TRANSPORTATION SYSTEM

2.2.1 Aurora Project Roads

The existing roads in the project area are:

- a circumferential road linking Baler - San Luis - Ma. Aurora - Dipaculao in the central flood-plain (c. 40.5 km)
- Palayan - Dingalan (c. 48.7 km)
- Ma. Aurora - Rizal (c. 72.9 km)

Non-existing road in the project area:

- San Luis - Dingalan proposed for study c. 72.5 km. (from a preliminary vertical and horizontal alignment, based on a 1:25,000 scale topographic map).
- Km 170 - Km. 38 proposed road that will link the existing Palayan - Baler National Road and Rizal - Pantabangan - Ma. Aurora road (c. 17.0 km.)

The condition of the above roads resulting from field surveys is described in detail in Ch. 4.1.1 Road Inventory.

2.2.1.1 Road Network

As of 1988 the total road network in Aurora was 1,457 kms., 97 percent of which were gravel-surfaced. PCCP was 5.15 km., and Asphalt (DBST) 31.87 km. Table 2-23 below shows roads by type and classification.

Table 2-23
ROADS BY TYPE AND CLASSIFICATION
AURORA - 1988

	ROAD TYPE and LENGTH			
	CONCRETE	ASPHALT	GRAVEL	TOTAL
National	1.99	20.70	202.82	225.50
Provincial	-	-	118.81	118.81
Municipal	3.16	11.17	123.14	137.47
Barangay	-	-	975.72	975.72
TOTAL	5.15	31.87	1,420.49	1,457.51

Source: DPWH

Nueva Ecija had a larger road network, measuring 5,269 km. Of this length, only about 6% was concrete pavement while gravel road constituted 93% of the total road network. Table 2-24 presents the road network by types and classification for Nueva Ecija.

Table 2-24
ROADS BY TYPE AND CLASSIFICATION
NUEVA ECIJA - 1985

CLASSIFICATION	ROAD TYPE and LENGTH			
	CONCRETE	ASPHALT	GRAVEL	TOTAL
National	129.9	13.9	137.00	280.30
Provincial	56.8	-	640.60	697.40
Municipal	40.7	24.7	383.50	448.90
Barangay	29.0	9.6	2,442.10	2,480.70
Unclassified	60.1	0.8	1,300.40	1,361.30
TOTAL	316.00	49.00	4,904.00	5,269.00

Source: DPWH

2.2.2 Vehicle Registration

The total number of vehicles registered in Aurora province increased by 23 percent between 1987 and 1990, while for Nueva Ecija, total vehicle registrations increased by 15 percent over the same period from a much larger base. Nueva Ecija has about forty four times more vehicles than Aurora. In Aurora the largest increase was in the number of trucks (24%) with an almost similar increase in utility vehicles of 22 percent. It is not known whether the increase in trucks was related to logging operations. Table 2-25 provides a tabulation of vehicle registrations by province.

Table 2-25
VEHICLE REGISTRATION
AURORA - NUEVA ECIJA

CLASSIFICATION/YEAR	AURORA			NUEVA ECIJA		
	1987	1988	1990	1987	1988	1990
CARS	15	16	19	2872	3055	3516
UTILITY VEHICLES	232	246	284	10996	11695	13461
TRUCKS	95	101	117	2736	2642	3040
MOTORCYCLE	148	205	237	6454	7726	8892
TRICYCLE	45			810		
TOTAL	535	568	657	23868	25118	28909

Source: Land Transportation Office
Management Information Division

Note: Only one data for Tricycles and Motorcycles. Figures for 1987 and 1988 are extrapolated from 1990 data. 1987 and 1988 data were not classified by vehicle types. 1990 data were classified by types due to computerization of LTO data.

2.2.3 Sea Ports

There are three sea-ports in Aurora; one is at Cemento just south of Baler, another one at Dipacong near Casiguran, and the third at Barangay Paltic, Dingalan. These Ports are accessible by an all-weather road from Baler to Cemento, and by a dry-season road between Casiguran and Dipacong. An all-weather road links Paltic to Dingalan town proper and then to Palayan City. Banca traffic to and from Baler uses the river wharf in the center of the town. There is regular banca traffic for goods and passengers between Baler and Dipacong, with at least two bancas per day in each direction. There is no regular traffic between Baler and Paltic/Dingalan, and bancas only travel this route on special charter costing about ₱ 6,000 one-way.

2.2.4 Air Transport

Baler airfield (Bacong) is classified as a feeder airport, but is closed indefinitely for commercial traffic. It has a 875 x 30 metre runway of sodded sandy loam and a small concrete apron in front of the terminal building.

2.3 ZONE OF INFLUENCE (ZOI)

2.3.1 Introduction and Geographic Setting

The theoretical definition of the zone of influence is an area extending five kilometers from either side of the road. This area may be limited by bodies of water or other geographic charateristics that hinder travel. It is also affected by the zone of influence of another road that traverse it or is located in proximity to its own zone of influence. This definition is a necessary parameter for the calculation of theoretical development benefits resulting from road improvements.

The topography of the zone of influence of the project roads varies from flat (along the Coronel Valley and the Aurora Central Flood Plain) to hilly and mountainous (along the Sierra Madre Mountain ridges). A number of major rivers traverse the various project roads. Among these rivers are the Aguang, the Coronel and the Malupa Rivers.

The zone of influence of the Circumferential road sector is a flat terrain with a good seasonal water supply. The road is subject to flash-floods, and deposition of river wash gravel and boulders from the Aguang river system. The entire area of the Ma. Aurora flood plain is cultivated with irrigated and rain-fed paddy, coconut and bananas, with some small citrus plantations.

The Palayan-Dingalan road sector descends from degraded hilly land to follow the Coronel valley to the watershed between Gabaldon and a steep descent to Dingalan over rocky boulder-strewn land. The road is narrowly enclosed on both sides by steep degraded mountain slopes, with numerous small watersheds discharging substantial volumes of river-wash. This has greatly reduced the cultivated area in the valley. Small plots are cultivated for irrigated and rainfed paddy-rice, corn, onions and tomatoes.

The zone of influence of the Tablang - Ma. Aurora road sector consist of relatively flat lands to rolling and mountainous terrain. The relatively flat lands are located in the Tablang - Bongabon area and in the Ma. Aurora flood plain. Irrigated and rainfed paddy, vegetables and rootcrop are grown on these lands, particularly in the Bongabon area. Rolling and mountainous terrain starts at Barangay Calaanan in Bongabon where the road enters the Sierra Madre mountain range.

Part of this road sector is the Km 170 - Km 38 proposed road link. This is a non-existing road that will run parallel to the Cabatangan River as it traverse further the Sierra Madre Mountain. The western zone of this road section is a forest area which had partially been logged over. The eastern zone consist of part of Aurora National Park which is still thickly forested.

The zone of influence of the San Luis-Dingalan road sector is a mountainous forest area. Some parts of the zone had already been logged-over and had been intruded by shifting cultivators and hill-farmers. Cultivated areas consisting mostly to coconuts exist along coastal plains around Dikapinisan and Dibayaban. A logging road in very bad condition exists in the zone. This road intermittant and does not link Dingalan and San Luis. There are no public land transport vehicles servicing this route and the present direct transportation between Baler and Dingalan is by bancas on a chartered basis.

The Land Use opportunity map prepared by the Bureau of Soils and Water Management (1986) classifies large areas of Aurora as idle, less utilized lands with some potential for development. Any improvement in the productive capacity of these marginal lands would require considerable capital investment in soil and water conservation engineering. This concerns in particular the reorganization of anarchic settlement of hill-farmers identified in 19 watersheds by the AIADP. Some of these hill-farmers are occupying part of the Malupa and Ma. Aurora catchment basins which concern the Maria Aurora - Canili inter-provincial road built by the Department of Local Government.

The zone of influence of the project road is shown in Figure 2-2.

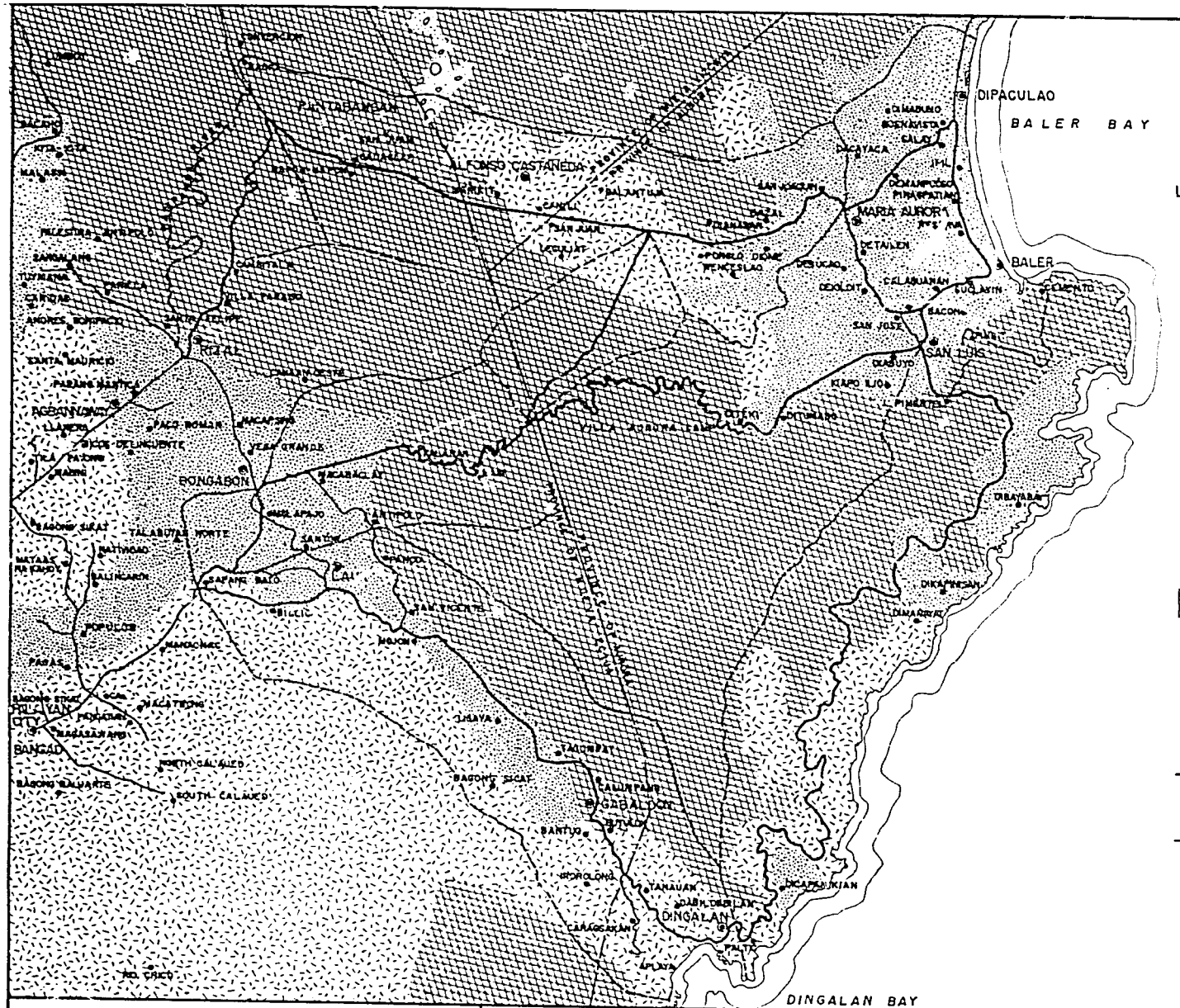
2.3.3 Population in the Zone of Influence

Population in the zone of influence represents the residents of the barangays located within the five kilometers theoretical limit of the zone. This is the population considered as directly and significantly affected by the road.

The majority of the population within the zone of influence consists of rural households dependent on agriculture-based activities. A considerable proportion of the zone population is engaged in forest-based activities such as logging, forest products gathering and hill-farming.

Residents of the barangays outside the zone of influence are expected to use the project road in areas where there are no alternative road connections. They are connected to the project roads by foot trails and by unmaintained barangay roads which are not served by public transportation. The impact of the road improvement would be less significant to these residents than those within the zone of influence due to distance and the apparent difficulty in transportation.

The ZOI and population concerned by the various project and alternative roads, have thus, been estimated as shown in Table 2-26.



5 0 5 1 1.5KMS.
SCALE 1: 250,000

LEGEND:

THESE ARE LANDS THAT ARE ACTIVELY UTILIZED FOR VARIOUS AGRICULTURAL ACTIVITIES. THESE ALSO INCLUDES VARIOUS DEVELOPMENT INFRASTRUCTURE SUCH AS ROADS, BRIDGES, IRRIGATION AND HUMAN SETTLEMENT AREAS.

THESE AREAS REPRESENT LANDS WITHIN THE CRITICAL WATERSHED SEEMINGLY SUBJECTED TO VARIOUS FORMS OF LAND USE ABUSES. VARIOUS FORMS OF ACTIVE AND INACTIVE EROSIONAL PROCESSES ARE VERY EVIDENT. FOR ECOLOGICAL REASONS, THESE AREAS ARE AT THE MOMENT BEST USE FOR TREES, EITHER FOREST OR ECONOMIC TREES (BUT THE FORMER IS PREFERRED). REVERTING THESE AREAS INTO ITS FORMER FOREST CONDITIONS IS RATHER EXPENSIVE BOTH IN TIME AND LABOR REQUIREMENTS.

THESE ARE AREAS PRIMARILY COVERED WITH TREES OR DOMINATED BY WOODY-TYPE OF VEGETATION. THESE REPRESENT AREAS THAT SHOULD BE PERMANENTLY RETAINED TO FOREST ENVIRONMENT. BY ALL MEANS, HUMAN ACTIVITIES SHOULD BE MINIMIZED TO PERPETUATE AND SUSTAIN THE GROWTH AND DESIRED DENSITY OF THE WOODY VEGETATION. THESE REFERS TO WATERSHED REGIONS AND THEREFORE SHOULD BE PROTECTED FROM ANY INTRUSION OF HUMAN AND AGRICULTURAL ELEMENTS.

THESE ARE IDLE, LESS UTILIZED LANDS THAT HAVE POTENTIAL FOR VARIOUS FORM OF AND WELL MANAGED AGRICULTURAL USES. THESE INCLUDE SLOPING LANDS THAT BASICALLY NEEDS LOW TO MODERATE LAND DEVELOPMENT COST. IN SOME CASES, ACCESSIBILITY IS A MAJOR PROBLEM. IN GENERAL, THE BEST USE OF THESE LANDS ARE FOR ECONOMIC TREES AND WITH MINIMUM OF USE FOR ANNUAL CROPS LIKE RICE AND CORN. HOWEVER, WHEN LAND TREATMENTS SUCH AS TERRACING, STONE WALLS, TREE LINES, CONTOURING ARE FEASIBLE. THE USE OF THESE LANDS FOR HIGH INCOME ANNUALS IS ECONOMICALLY VIABLE.

PROJECT ROADS

BARANGAYS

MUNICIPALITY

LIMIT OF THE ZONE INFLUENCE

LOUIS BERGER INTERNATIONAL, INC.
- LOCKWOOD GREENE INT'L
- ERNST & YOUNG INT'L.
- GLOBETROTTERS ENG'G. CORP.
- TRANS-ASIA(PHIL.), INC.
- CONSULTANT MANAGEMENT SERVICES, INC.

PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT 492-0452-C-00-0099-00

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY

SHEET TITLE	SCALE	DWG. NO.
LAND USE OPPORTUNITY MAP	NTS	FIG. 2-2
	DATE:	

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Table 2–26

ZONES OF INFLUENCE / POPULATION					
ROAD SECTOR	MUNICIPALITY	AREA KM²	ZOI AREA KM²	TOTAL POPULATION	ZOI POPULATION
A: Palayan–Dingalan	Palayan	359.0	15.0	20,393.0	1,209.0
	Laur	263.0	85.0	21,464.0	17,568.0
	Gabaldon	193.0	175.0	21,744.0	17,506.0
	Dingalan	318.0	80.0	14,475.0	9,614.0
Sub–total A		1,133.0	355.0	78,076.0	45,897.0
B: Palayan–Bongabon–Km. 170 – Km. 38	Palayan	359.0	10.0	20,393.0	3,271.0
	Bongabon	287.0	170.0	39,616.0	11,696.0
	Ma. Aurora	338.0	70.0	28,378.0	0.0
Sub–total B		984.0	250.0	88,387.0	14,967.0
C: Rizal–Pantabangan–Km. 38	Rizal	151.0	25.0	38,970.0	4,463.0
	Pantabangan	375.0	15[illegible].0	18,341.0	16,487.0
	Ma. Aurora	338.0	45.0	28,378.0	1,228.0
	A. Castañeda	375.0	70.0	3,751.0	1,721.0
Sub–total C		1,239.0	295.0	89,440.0	23,899.0
D: Km. 38 – Maria Aurora	Ma. Aurora	338.0	85.0	28,378.0	7,004.0
Sub–total D		338.0	85.0	28,378.0	7,004.0
E: Baler–Ma. Aurora–Dipaculao–San Luis–Baler	Baler	86.0	30.0	24,689.0	19,244.0
	Ma. Aurora	338.0	45.0	28,378.0	18,750.0
	Dipaculao	297.0	45.0	18,951.0	9,780.0
	San Luis	675.0	15.0	16,740.0	4,979.0
Sub–total E		1,396.0	135.0	88,758.0	52,753.0
F: Baler–Dingalan	San Luis	675.0	265.0	16,740.0	6,156.0
	Dingalan	318.0	40.0	14,475.0	227.0
Sub–total F		993.0	305.0	31,215.0	6,383.0

Source: NCSO (1990)

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2.3.4 Impact of the Roads

The effects of the project roads on the ZOI and on the economies of Aurora and Nueva Ecija provinces are examined in Chapter 6, Section 6.3.2 (Economic Evaluation), and in further detail in Appendix B-3 (Agricultural Development Benefits). Tables showing production and income data for municipalities traversed by the roads are presented in Appendix B-2.

The Consultants consider that while there will be Vehicle Operating Cost (VOC) benefits, the effect of improved roads on agricultural production is likely to be marginal. Benefits may even be offset by declining coconut production, increased hill farming at subsistence levels following the decline of the timber industry, and a possible decline in fisheries catches owing to over-fishing. Lowland agricultural production is likely to be at risk from the effects of soil erosion in the mountains, and increasing flash-floods.

Table 2-27 shows estimated production data for the ZOI for 1990.

Table 2-28 shows estimated household income in the ZOI for 1990. Urban income is taken from the NCSO Family Income and Expenditure Survey (1988). Rural income has been computed from the production data for 1990.

2.3.5 Additional Requests by Local Governments

The TOR identified a series of roadways which would be studied during this Feasibility Report. The Consultant was instructed to study additional roads which might serve as "alternative routes" to serve the transportation needs of Aurora Province. During the field data gathering stage and during the Environmental Scoping Sessions held in the province, several requests for alternative routes were brought to the Consultant's attention.

The League of Barangay Councilmen of the Philippines (LBCP) in a letter to the Consultant dated June 27, 1991 requested continued consideration of the San Luis-Dingalan road for the development of the barangays along the coastal area. See Figure 2-3.

The Barangay Council of Real, San Luis, Aurora on May 28, 1991 made a similar request for a link through Real to other coastal barangays. See Figure 2-4.

The Mayor of Palayan City in his letter to the Consultant dated July 1, 1991 requested that additional consideration be given to Palayan City since the main road connecting Cabanatuan City to Aurora Province locations is currently being paved. The Mayor's request was for an approximately 30 km long roadway from approximately Laur to Santa Rosa which would run parallel to the existing highway. See Figures 2-5 and 2-6.

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Table 2–27
ESTIMATED PRODUCTION IN THE ZONE OF INFLUENCE (1990)

ROAD SECTOR	MUNICIPALITY	PRODUCTION IN METRIC TONS													
		CROPS							LIVESTOCK AND POULTRY						
		PADDY	CORN	COCONUT	COFFEE	BANANA	OTHER	SUB–TOTAL	CARABAO	CATTLE	HOGS	GOAT	CHICKEN	OTHERS	SUB–TOTAL
A. Palayan – Dingalan	Palayan	268	7	0	0.00	30	122	426	0.00	0.58	4.38	0.03	1.00	4.39	10.37
	Laur	19,783	63	4	0.00	138	4,951	15,938	0.00	3.13	62.92	0.29	3.30	0.11	69.75
	Gabaldon	8,240	18	11	0.00	271	3,082	11,623	0.00	9.37	71.75	0.05	4.07	0.18	85.42
	Dingalan	851	100	60	40.25	217	465	1,733	0.67	13.65	12.47	0.00	1.31	0.02	28.12
	Sub–total	20,141	187	75	40	656	8,619	29,720	0.67	26.73	151.51	0.37	9.67	4.70	193.65
B. Palayan – Bongabon – Km. 170 – Km. Post 38	Palayan	178	4	0	0.00	20	81	28[illegible]	0.00	0.39	2.92	0.02	0.66	2.92	6.91
	Bongabon	11,563	46	3	0.00	101	3,629	15,343	0.00	2.30	46.13	0.21	2.42	0.08	51.14
	Ma. Aurora	195	0	133	0.04	15	14	357	0.00	1.28	0.71	0.06	0.01	0.00	2.06
	Sub–total	11,936	51	136	0	136	3,724	15,983	0	4	50	0	3	3	60
C. Rizal – Pantabangan – Km. Post 38	Rizal	9,131	928	1	0.00	5	900	10,965	0.00	0.59	63.08	0.43	2.32	0.00	66.42
	Pantabangan	2,322	49	0	0.00	0	1,013	3,384	0.00	3.31	42.16	0.00	2.03	0.00	47.49
	Ma. Aurora	938	0	643	0.20	71	109	1,761	0.00	6.16	3.43	0.27	0.07	0.01	9.94
	A. Castaneda	119	13	1	0.00	6	63	201	0.42	0.78	2.31	0.00	0.51	0.00	4.02
	Sub–total	12,510	990	645	0	82	2,085	16,312	0.42	10.84	110.98	0.70	4.92	0.01	127.87
D. Km. Post 38 – Maria Aurora	Ma. Aurora	2,954	0	2,025	0.63	224	206	5,410	0.00	19.40	10.80	0.85	0.21	0.03	31.29
	Sub–total														
E. Baler – San Luis – Ma. Aurora – Dipaculao – Baler	Baler	1,206	0	3,349	0.70	21	283	4,869	0.78	11.83	20.72	0.54	1.53	0.03	35.43
	San Luis	286	0	1,089	0.44	137	35	1,547	0.20	4.44	5.00	0.19	0.11	0.00	9.95
	Ma. Aurora	3,753	0	2,573	0.80	284	262	6,873	0.00	24.64	13.72	1.07	0.27	0.04	39.75
	Dipaculao	3,984	17	5,204	65.15	2,883	27	12,180	2.35	41.91	87.88	3.64	1.88	0.04	137.71
	Sub–total	9,229	17	12,215	67	3,325	606	25,459	3	83	127	5	4	0	223
F. San Luis – Dingalan	San Luis	757	0	2,886	1.18	362	93	4,099	0.52	11.78	13.25	0.51	0.29	0	26.35
	Dingalan	12	2	2	1.01	5	12	34	0.03	0.68	0.62	0	0.07	0	1.40
	Sub–total	769	2	2888	2.19	367	105	4133.19	0.55	12.46	13.87	0.51	0.36	0	27.75

Source: Municipal Profiles, Bureau of Agricultural Statistics and updated estimates from 1980 Census of Agriculture.

Table 2–28
AVERAGE HOUSEHOLD INCOME IN THE ZONE OF INFLUENCE

ZONE OF INFLUENCE		TOTAL INCOME IN THE ZOI	NO. OF HOUSEHOLDS		AVERAGE HOUSEHOLD INCOME
ROAD SECTOR	MUNICIPALITY		URBAN	RURAL	
A. Palayan–Dingalan					
	Palayan	3,406,786	–	262	13,003
	Laur	100,880,678	1,281	2,167	29,258
	Gabaldon	73,694,095	1,053	2,360	21,592
	Dingalan	29,396,429	861	1,028	15,562
	Sub total	207,377,988	3,195	5,817	79,415
B. Palayan – Bongabon – Km. Post 38	Palayan	7,671,770	–	590	13,003
	Bongabon	89,166,728	714	1,526	39,807
	Ma. Aurora	3,123,946	–	251	12,446
	Sub total	99,962,444	714	2,367	32,445
C. Rizal–Pantabangan–Km. Post 38	Rizal	27,463,380	784	70	32,159
	Pantabangan	44,048,970	–	3,045	14,466
	Ma. Aurora	19,540,220	–	1,570	12,446
	A. Castaneda	14,229,795	335	–	42,477
	Sub total	105,282,365	1,119	4,685	18,140
D. Km. 38 – Ma. Aurora	Ma. Aurora	16,590,518	–	1,333	12,446
	Sub total	16,590,518	–	1,333	12,446
E. Baler–Ma. Aurora–Dipaculao–San Luis–Baler	Baler	38,971,220	809	609	27,483
	Ma. Aurora	65,372,237	987	2,545	18,509
	Dipaculao	48,346,023	713	1,190	25,405
	San Luis	11,920,620	–	915	13,028
	Sub total	164,610,100	2,509	5,259	21,191
F. San Luis – Dingalan	San Luis	19,860,488	352	733	18,305
	Dingalan	342,980	–	44	7,795
	Sub total	20,203,468	352	777	26,100
GRAND TOTAL		**614,626,883**	**7,889**	**20,238**	**189,736**

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On July 12, 1991, The LBCP reaffirmed its position on development of the San Luis-Dingalan road through a letter to the editor of the newspaper DAWN. See Figure 2-7.

Lastly, through a resolution dated August 4, 1991 the Diteki Barangay Council requested the consideration of a road from their barangay to Maria Aurora. See Figure 2-8.

The Consultant reviewed these specific requests in light of the TOR and in light of the concept of "alternate routes". The requests of the LBCP and of the Barangay Council of Real, San Luis, Aurora have been incorporated into the study of Segment 3, Dingalan-San Luis. This Segment 3 is discussed in detail in Chapter 4.

The request by the Diteki Barangay Council was also considered in the alternatives evaluated for Segment 1C. The specific segments, $1C_2$ and 2A addressed each of the barangays mentioned. A full discussion of this alternative can be found in Chapter 4.

The request by the mayor of Palayan City for a parallel road to open up development through his community was briefly considered but was then dropped for obvious economic reasons. Traffic volumes on the existing paved road are not high enough to consider a parallel route only a few kilometers distant from it. Potential growth as outlined in this chapter does not appear sufficient to warrant the construction of an alternate road at this time.

LEAGUE OF BARANGAY COUNCILMEN OF THE PHILIPPINES
(LBCP)
San Luis, Aurora Chapter
Diteki, San Luis, Aurora

June 27, 1991

Mr. Kent O. Lande
Team Leader
Aurora Roads Infrastructure Project
LOUIS BERGER INTERNATIONAL, INC.
TM-8910, Mile Long Center
Amorsolo St., Legaspi Village
Makati, Metro Manila, Philippines

Dear Mr. Lande:

The League of Barangay Councilmen of the Philippines (LBCP), San Luis, Aurora Chapter, would like to express its gratitude to the USAID and the Louis Berger International, Inc. for having considered in its study the repair/construction of a 191-km roads and bridges network that will include the San Luis-Dingalan road which we have long yearned for realization.

Last December 27, 1990, we have read from the newspaper that the Rural Infrastructure Fund (RIF) has a ₱ 4.4 B fund for rural infrastructure projects nationwide. This forms part of a USAID grant worth $ 90 M. In January 13, 1991, the LBCP, San Luis, Aurora Chapter passed Resolution No. 1 requesting for assistance from RIF II and RIF III of the USAID for the construction of the San Luis-Dingalan road.

This Resolution earned a response from Secretary Jose Ping de Jesus of the DPWH, thru Undersecretary Teodoro T. Encarnacion. He expressed that this should be included as a priority project of the Region IV and that a feasibility study thereof should be submitted to the Regional Development Council of Region IV.

Last April 22, 1991, Director Florante Soriquez of the RIF sent us a letter, copy furnished the Hon. Senator Edgardo J. Angara; Mr. Leroy Purifoy, Office of Capital Projects, USAID; and Asst. Secretary for Planning Manuel Bonoan of the DPWH informing us that the San Luis-Dingalan road was included in the list of additional projects that is being studied and evaluated for possible funding by the USAID under Rural Infrastructure Project.

The LBCP, San Luis, Aurora is imploring your kindest consideration by highly recommending the construction of the said San Luis-Dingalan Road knowing fully well its importance and the developmental impact it could give to our barangays here in Aurora. It is worth considering the development of a historical place, the Dibut Bay, where the intense friendship between the Philippines and the United States was exhibited during the last World War.

Respectfully,

BENIGNO T. LAURETA
President

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	LETTER FROM LBCP SAN LUIS, AURORA	FIGURE 2-3

COPY OF THE MINUTES OF SESSION OF THE BARANGAY COUNCIL OF REAL, SAN LUIS, AURORA HELD LAST 28 MAY 1991 AT THE BARANGAY HALL

PRESENT:

Mr. Arnaldo C. Ruidera	Barangay Chairman
Mr. Hermilino Abonita	Council Member
Mr. Edilberto Llanillo	Council Member
Mr. Leonardo Gatita	Council Member
Mr. Jose Marzan	Council Member
Mr. Efren Tena	Council Member
Mr. Claro Serrano	Council Member

ABSENT:

None

RESOLUTION NO. 08-91

WHEREAS, it is the main concern of the Barangay Council of Real, San Luis, Aurora to have order and prosperity for the residents of the barangay, to include those that are travelling through Real;

WHEREAS, the Barangay of Real, San Luis, Aurora is the center of the adjoining Barangays of Dibut, Dibayabay, Dicapinisan, Dimanayat and Dibalo, residents of which are making use of its barangay roads whenever there is an inclement weather in the area;

WHEREFORE, on motion of Council Member Edilberto Llanillo, duly seconded by Council Member Claro Serrano.

RESOLVED, as it is hereby RESOLVED, that it is kindly requested of the Provincial Governor, Hon. Edgardo L. Ong through the Provincial Board, that assistance be extended to the Barangay Real, San Luis, Aurora, in making possible the construction of a road that traverses through the barangay that will serve as a link to the other coastal barangays.

RESOLVED further, that a copy of this Resolution be furnished the Provincial Governor of Baler, Aurora, Hon. Edgardo L. Ong, for his information and possible support.

Unanimously approved.

I CERTIFY to the correctness of the Resolution as above mentioned.

(SGD.) RANDY RAMOS
Secretary

ATTESTED:

ARNALDO C. RUIDERA
Barangay Chairman

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	MINUTES OF BARANGAY COUNCIL SESSION SAN LUIS, AURORA	FIGURE 2-4

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Republika ng Pilipinas
LUNGSOD NG PALAYAN
Tanggapan ng Punong Lungsod

01 July 1991

MR.KENT O. LANDE
Team Leader
Aurora Roads Infrastructure Project
Louis Berger International, Inc.

Dear Sir:

This is in connection with the feasibility studies that your good firm is presently conducting in connection with the proposed 191 Km. Nueva Ecija-Aurora Roads Infrastructure Development Project funded under the Philippine Assistance Program Support (PAPS) the assistance of the USAID.

Considering that Palayan City road portion has already been programmed for construction and as a matter of fact certain portion of which is now being concreted, may we suggest that another complementary road network going to Dingalan which has been earlier designed by DPWH for possible funding and implementation be considered by your good firm.

This road network will traverse from the existing NE-Aurora National Road to Aulo-Maligaya Road and within the military reservation and will pass thru the marine road earlier constructed by US-RP Military forces regularly conducting military exercises in Dingalan.

If considered, the new road network will boast and accelerate development of Palayan City and its neighboring towns and most important will provide access to forest management and environmental protection program of the government.

Hoping that you will give preferential consideration on this matter.

Congratulations and more power.

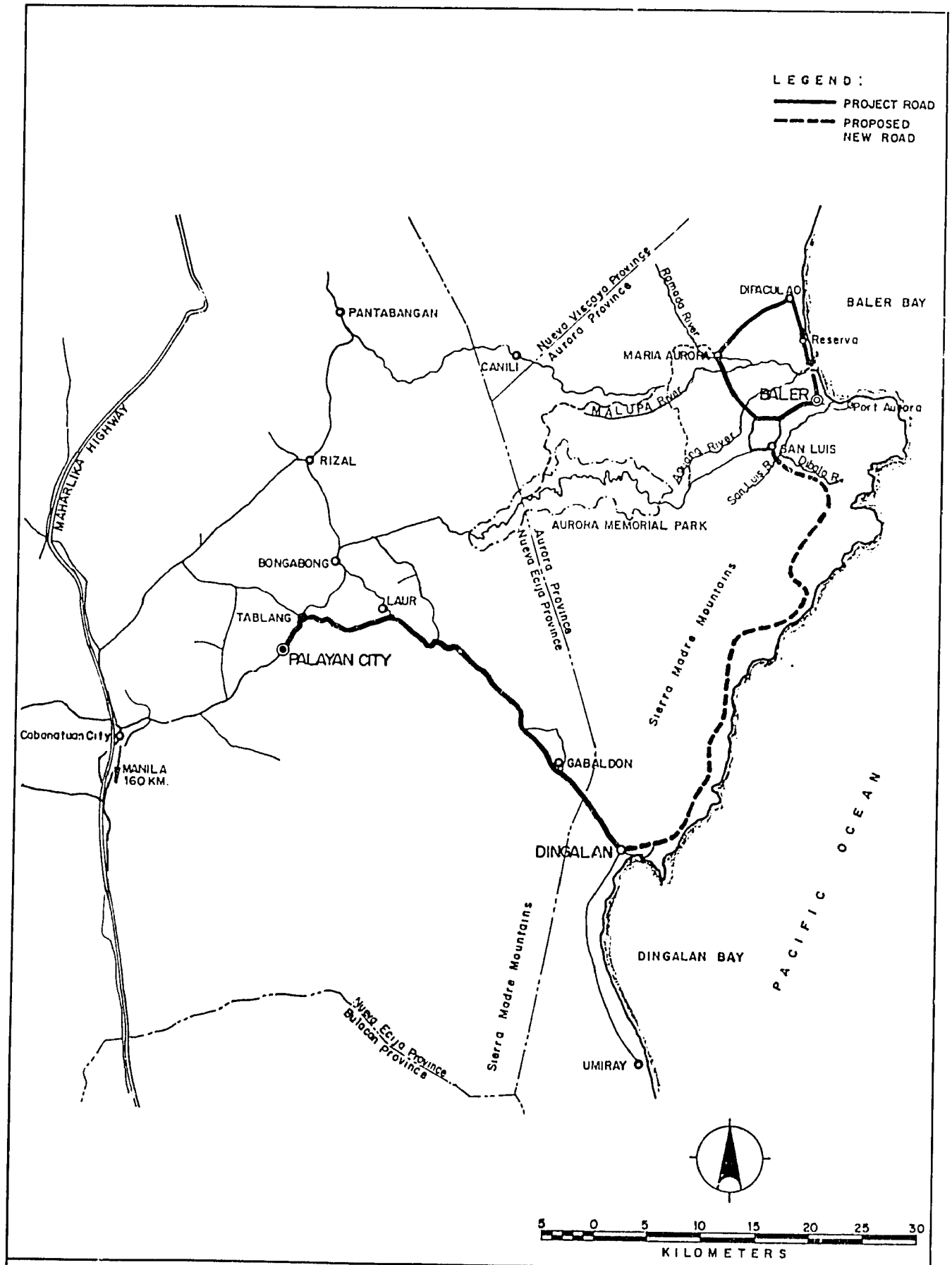
Very truly yours,

PACIFICO "RICO" M. FAJARDO
City Mayor

RCB/dns

KABISERA NG LALAWIGAN NG NUWEBA ESIHA

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	LETTER FROM CITY MAYOR PALAYAN CITY	FIGURE 2-5



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	ATTACHMENT TO THE PALAYAN CITY MAYOR'S LETTER	FIGURE 2-6

Letter to the Editor

CRUSADE

LEAGUE OF
BARANGAY
COUNCILMEN OF THE
PHILIPPINES

(LBCP)
San Luis, Aurora Chapter
Diteki, San Luis, Aurora

July 12, 1991

Mr. Editor
DAWN
Dela Torre St.
Baler, Aurora

Dear Editor:

This is a reaction to an article published in a Manila-based newspaper last July 3, 1991 which was protesting to the construction of the San Luis-Dingalan Road (Real, Dibalo, Dibut, Dibayabay, Dicapinisan, Dimanayat, Dikapanikian and Paltic). They allegedly were environmentalists. One of the reasons why they were protesting was that the project will destroy and might traverse through the virgin forest of the Sierra Madre Ranges.

During a recent public consultation meeting, the representatives of Haribon Foundation, Green Forum and the European-backed Aurora Integrated Area Development Project (AIADP) said that the aforementioned road project will cause the massive dislocation of tribal groups, soils erosion, loss of wildlife and will serve as a doorway that will lead to a rush of illegal logging activities.

Beautiful. The words they have said and their intentions were very beautiful. But then, they should see and study first several things if at present, their step is right and proper.

If ever that the project will traverse through the ancestral land of the tribal groups, this will not mean that they will be dislocated. They will not be deprived of their land and property. Even more, they will not be driven to the heart of the forested hills. There is a private group and a government agency that presently attend to their needs. Instead, they shall be living with their fellow Filipinos, socializing, getting married and bearing children. They should also benefit from the living comfort brought about by development. And this will only be realized by the Construction of the San Luis-Dingalan Road.

BEST AVAILABLE DOCUMENT

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	LETTER TO THE DAWN EDITOR LBCP, SAN LUIS, AURORA	FIGURE 2-7

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Yes, if you will look at the maps, this area is still a virgin forest. But the truth is, most of the area has been logged over. There are logging roads already. From Barangay Real up to Sitio Dibuan, Dibalo, San Luis, Aurora there is an existing road already. This is true also from Paltic to Dikapanikian, Dingalan, Aurora. And this is where Dingalan Forest Product Co. (DFPC), the Federated Timber Development Corporation (FTDC) and the Aurora Timber Corp. (ATICOR) conducted their logging activities and up to this time, the Inter-Pacific Forest Resource Corp. (IFRC) is still operating. Very recently, there was a report that several illegal loggers were apprehended by the authorities.

The alleged 26 bird species, the rare Philippine Eagle included, were long driven away by the noise of chain saws, bulldozers and logging trucks. Therefore, without the San Luis-Dingalan Road construction having started yet, we already have soil erosions and landslides during heavy rains and typhoons. The 14 watersheds, as alleged by the AIADP people, will be destroyed. I doubt the number though. They must have been referring to the entire Aurora Province.

I just could not fathom it and wonder why it is only now that these great environmentalists are taking actions to preserve the environment. And they have singled out the San Luis-Dingalan Road construction as a mean that will bring about the destruction of the virgin forests in the aforesaid areas.

According to Engr. Kent O. Lande, Team Leader, Aurora Road Infrastructure Development Project (ARIDP) Feasibility Study and the Louis Berger International, Inc., the San Luis-Dingalan road will serve as a link between the depressed areas of Aurora Province to other neighboring provinces that will give birth to development in the said areas.

Lande added that the project will be funded with ₱ 2M to ₱5M per kilometer or a total funding of ₱ 900 million, and that this might be finished within five (5) to ten (10) years.

If the San Luis-Dingalan road will be a reality, the income of Aurora Province will increase. Land owners will now gladly pay their taxes as they will feel the real care of the government. They will be visited frequently and with ease by the employees of the various government agencies that will attend to their needs.

The League of Barangay Councilmen of the Philippines (LBCP), San Luis, Aurora Chapter, last January 13, 1991 passed a Resolution requesting the United States Agency for International Development (USAID) for the construction of the San Luis-Dingalan road. And from that time on, the LBCP has been striving hard for the realization of said project.

Therefore, we are requesting everybody, specially those from Aurora, to act concertedly in working for the construction of the San Luis-Dingalan road in order to improve further the social and economic condition of the communities in the coastal areas. WE CAN CALL THIS AS A CRUSADE!

Can we count on your unified support?

Thank you very much

Respectfully,

BENIGNO T. LAURETA
President

BEST AVAILABLE DOCUMENT

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	LETTER TO THE DAWN EDITOR LBCP, SAN LUIS, AURORA	FIGURE 2-7

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MINUTES OF REGULAR MEETING OF DITEKI BARANGAY COUNCIL
San Luis, Aurora, Quezon Province
Held at the Barangay Hall, on Aug. 4, 1991

Present:

Mr. Pacito F. Licay	Barangay Captain, Chairman
Mr. Benigno T. Laureta	Council Member,
Mr. Florentino M. Fernandez	Council Member,
Mr. Tirso Z. Pascua	Council Member,
Mr. Avelino N. delos Santos	Council Member,
Mr. Luia O. Miemban, and	Council Member,
Mr. Bonifacio O. Olivar	Council Member.

Absent:

None.

RESOLUTION NO. 44-'91

WHEREAS, Barangay Diteki of San Luis, Aurora finds it necessary a shortest road leading to Maria Aurora;

WHEREAS, the mentioned road is highly necessary for the community of Barangay Diteki to facilitate travel to Maria Aurora;

WHEREFORE, on mention of Council Member Benigno T. Laureta, duly seconded by Council Member Bonofacio O. Olivar;

RESOLVED, as it is hereby resolved, that it is respectfully requested of Louis Berger International, Inc., thus Engineer Kent O. Lande, Team Leader, ARIDP Feasibility Study, to include the road from Barangay Diteki, San Luis, Aurora, Dialatnan, Maria Aurora, Suguit, Diaman, Wenceslao, Maria Aurora, be funded by USAID;

RESOLVED FURTHER, that a copy of this resolution be furnished to Engr. Kent O. Lande, Team Leader, ARIDP Feasibility Study, Louis Berger International, Inc., TM-8910, Mile Long Center, Amorsolo St., Legaspi Village, Makati, Metro Manila, for his information and valuable decision.

UNANIMOUSLY APPROVED.

I CERTIFY to the correctness of the Resolution as above mentioned.

SGD. AMOR B. OLIVAR
Secretary

ATTESTED:

SGD. PACIFICO F. LICAY
Barangay Chairman

AURORA ROADS INF STRUCTURE DEVELOPMENT OJECT FEASIBILITY STUDY	MINUTES OF BARANGAY COUNCIL SESSION, BARANGAY DITEKI SAN LUIS, AURORA	FIGURE 2-8

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CHAPTER 3

TRAFFIC

CHAPTER 3

TRAFFIC

This chapter describes the procedures used to forecast traffic volumes for the proposed road sections proposed for improvement in Aurora and Nueva Ecija Provinces. The chapter reviews sources for existing data, traffic surveys performed for this report, data analysis methods and the basis for future traffic projections. Additional details can be found in Appendix A.

3.1 BASELINE CONDITIONS

The Consultant obtained traffic counts and station data (1990 AADT) from the Project Monitoring Office (PMO), Infrastructure Research and Statistics Division, DPWH for the following locations:

- Region IV, Aurora (6 stations)
- Region III, Palayan City (5 stations)
- Region III, Nueva Ecija (15 stations)
- Region III, Cabanatuan City (12 stations)

The traffic station data is from the National Traffic Counting Program (NTCP) and includes data from coverage, control and seasonal stations. Additional data was gathered from the Regional, District and City Engineering Offices in the project area.

The traffic and other data directly relevant to the current study is found in the following reports:

- Philippine National Road Improvement Project (NRIP), 1989, by Louis Berger International, Inc.
- Madela-Casiguran Feasibility Report, 1990, by Louis Berger International, Inc.
- Rural Road Development Program II (RRDP II), Aurora, 1982, by Norconsult S.A., et. al.
- ADB assisted Third Road Improvement Project/T.A., 1985, by Norconsult S.A., et. al.

The latter two reports provide some traffic counts that will be helpful in establishing historical growth rates on three of the nine existing homogeneous traffic sections. In general, however, traffic count data was unavailable for many of the project roads. Thus, it became necessary to conduct the traffic surveys discussed below.

3.1.1 Traffic Surveys - Background

Traffic surveys were undertaken at key locations along the project roads to develop the existing traffic data used in forecasting future traffic growth. The forecast were then used in highway and pavement design, and in the economic evaluation of the project roads.

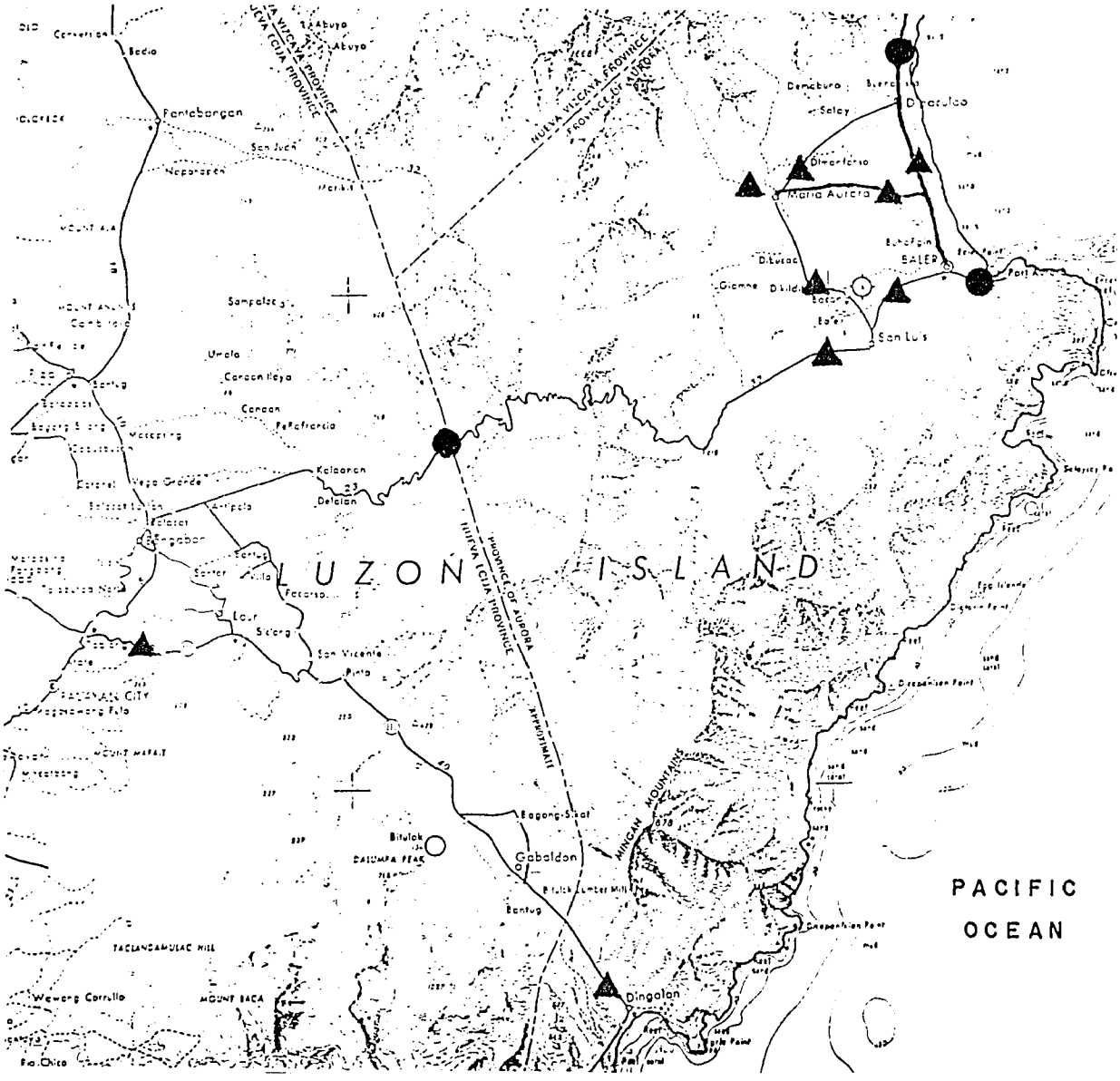
Four types of traffic surveys are usually required for the engineering and economic analysis. These are: 1) Traffic Count Surveys, 2) Origin-Destination (O-D) Surveys, 3) Axle Load Surveys, and 4) Travel Time and Delay Surveys.

All of the above surveys were conducted for the ARIDP roads project, except for the Axle Load Survey. Information on axle loads were obtained from the 1985 IBRD-DPWH study of axle loadings. The three remaining types of surveys were performed over a two-week period, in generally good weather, in early July. Figure 3-1 displays the locations where the traffic counts were conducted. Local personnel were hired in the vicinity of the project roads and trained to do the traffic counts and related tasks.

3.1.2 Traffic Survey - Results

The traffic count survey consisted of a manual classified count. The counts were undertaken for a three-day period and required tabulating the number of vehicles by type in each direction for a period of 12 hours (6:00 a.m. to 6:00 p.m.) over three consecutive days.

The 1991 base year AADTs are shown in Table 3-1 and Table 3-2. Tables 3-1 and 3-2 represent the base-case scenario, but the former excludes the effects of an improved interprovincial link between Km Post 170 on the Bongabon-Baler route and Km Post 38 on the Canili-Maria Aurora route. Much of the traffic on the circumferential road would shift if a new inter-provincial link were constructed. Table 3-2 shows what 1991 traffic levels would be like if the proposed new road link were in place right now. The arithmetic differences between the entries on the two tables shows (net) diverted traffic. The AADTs range from 50 to 260 on the circumferential road, from 130 to 230 on the interprovincial roads into Baler, and between 100 and 300 on the Palayan-Dingalan road. The number of movements of other vehicles (tricycle and motorcycles), not counted in AADT, is significant in the Baler area. A better measure of vehicular movements is the PCU or passenger car unit (equivalent). Table 3-3 shows PCUs for the study area. PCUs range from 200 to 650 on the circumferential road, 200 to 300 on the interprovincial links into Baler, and from 150 to 460 on the Palayan-Dingalan road.



LEGEND:

▲ - TRAFFIC COUNT LOCATION

● - DPWH TRAFFIC COUNT STATIONS

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	TRAFFIC SURVEY STATIONS	FIGURE 3-1

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Table 3-1
1991 AADTs

	CARS	JEEP/VAN	JEEPNEY	SMALL BUS	LARGE BUS	2-AXLE TRUCK	3-AXLE TRUCK	ARTICULATED TRUCK	SUB-TOTAL (AADTs)	OTHERS	TOTAL VEHICLES
Baler - Dipaculao	0	20	11	0	0	7	9	0	47	282	329
Dipaculao - Ma. Aurora	2	44	50	1	0	9	7	0	113	397	510
Ma. Aurora - San Luis	0	108	77	0	2	33	2	0	222	335	557
San Luis - Baler	2	122	94	0	6	32	7	1	264	582	846
Tablang - Gabaldon	7	66	166	2	18	30	10	3	302	33	335
Gabaldon - Dingalan	0	35	28	1	15	9	6	0	94	13	107
Rizal - Canili	0	82	140	0	7	8	8	6	251	30	268
Canili - Ma. Aurora	0	122	59	0	3	22	20	8	226	682	908
Bongabon - San Luis	0	55	41	0	5	26	3	0	130	517	646

Source: Consultant's Survey

Table 3-2
ESTIMATED 1991 AADTs WITH FULL ROAD

	CARS	JEEP/VAN	JEEPNEY	SMALL BUS	LARGE BUS	2-AXLE TRUCK	3-AXLE TRUCK	ARTICULATED TRUCK	SUB-TOTAL (AADTs)	OTHERS	TOTAL VEHICLES
Baler - Dipaculao	0	20	11	0	0	7	6	0	44	282	326
Dipaculao - Ma. Aurora	2	44	50	1	0	9	10	0	116	397	513
Ma. Aurora - San Luis	0	108	77	0	2	33	0	0	220	335	555
San Luis - Baler	2	99	84	0	3	29	7	1	225	582	807
Tablang - Gabaldon	7	66	166	2	18	30	10	3	302	33	335
Gabaldon - Dingalan	0	35	28	1	15	9	6	0	94	13	107
Rizal - Canili	0	29	103	0	2	0	0	6	140	15	155
Canili - Ma. Aurora	0	69	23	0	1	8	15	0	116	682	798
Bongabon - San Luis	0	55	41	0	5	26	3	0	129	517	646

Source: Consultant's Survey

The AADTs on the Rizal-Canili section are rough estimates only due to the reason that this section was added to the study after the traffic surveys had already been completed.

Table 3-3
1991 DAILY PCUs

Baler - Dipaculao	210
Dipaculao - Ma. Aurora	353
Ma. Aurora - San Luis	465
San Luis - Baler	649
Tablang - Gabaldon	467
Gabaldon - Dingalan	145
Rizal - Canili	371
Canili - Ma. Aurora	308
Bongabon - San Luis	192

Source: Consultant's Survey

Figures 3-2 through 3-6 display the hourly variation in traffic volumes at the traffic count locations. For the Baler-Dipaculao section, peak hours were from 7 a.m. to 10 a.m. with over 30 vehicles per hour observed moving in both directions. For the Dipaculao-Maria Aurora section, the peak hour was from 8 a.m. to 9 a.m. with over 57 vehicles per hour moving in both directions. The traffic on the Maria Aurora-San Luis section does not show a pronounced peak level; however, the heaviest level of movement occurred between 7 a.m. and 8 a.m. with 50 vehicles moving in both directions. For the San Luis-Baler section, the peak hour was from 7 a.m. to 8 a.m. with over 90 vehicles moving in both directions. Traffic on the narrow short-cut road between Baler and Maria Aurora via Reserva was very light with a peak hour between 8 a.m. and 9 a.m. with 13 vehicles moving in both directions. The highest level of peak hour traffic occurred on the Canili-Maria Aurora section where 99 vehicles were observed moving in both directions between 6 a.m. and 7 a.m.

The Tablang-Gabaldon section had a peak hour volume of 39 occurring between 3 p.m. and 4 p.m. This was only slightly more than the volume observed during the morning peak hour between 9 a.m. and 10 a.m. The Gabaldon-Dingalan section had pronounced morning and

afternoon peak hour volumes of 15 and 13, respectively. The morning peak hour occurred between 9 a.m. and 10 a.m. The afternoon peak hour occurred between 3 p.m. and 4 p.m. The Tablang-Bongabon-San Luis interprovincial link had a symmetrical peak hour volume between mornings and afternoons of 58 vehicles per hour moving in both directions. The peak hours were 7 a.m. to 8 a.m. and 5 p.m. to 6 p.m.

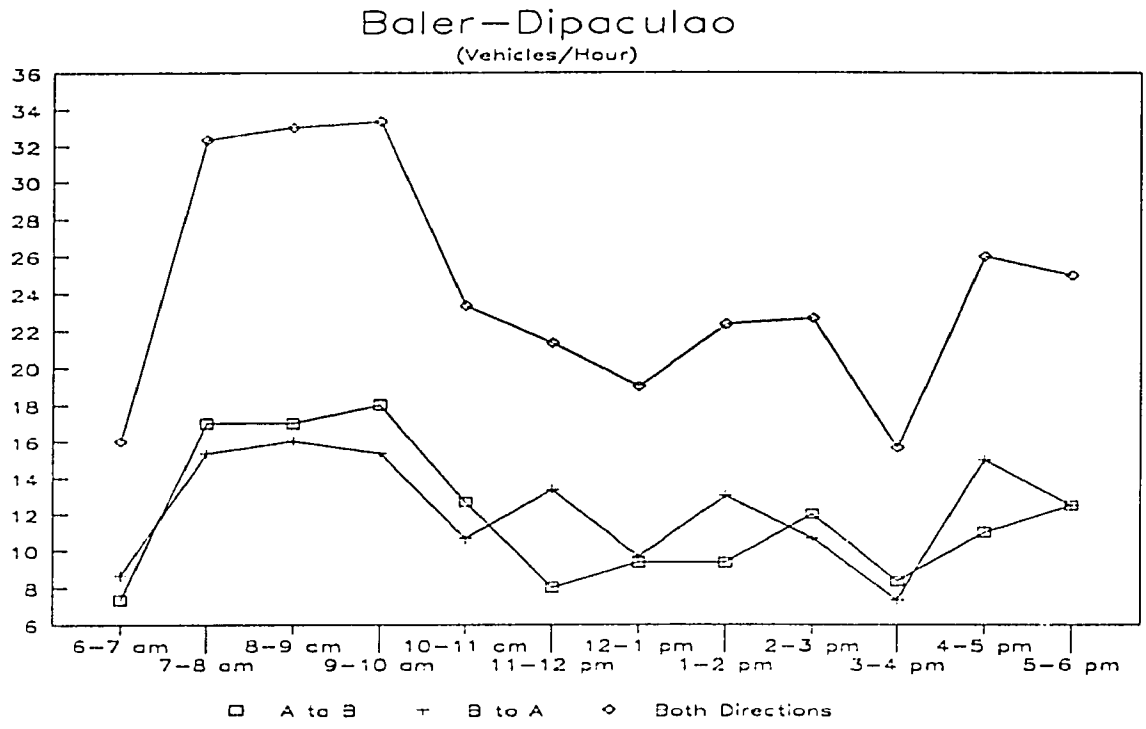
Table 3-4 summarizes the distance savings that could be achieved if a new link were built between the two interprovincial links into Baler. The left column shows distances to the municipalities on the existing road and the right column shows distances with the new link. The greatest distance savings accrue to travelers whose origin or destination is Maria Aurora or Dipaculao (nearly 30 kilometers). Travelers going to or coming from Baler or San Luis also save nearly eight kilometers in driving distance.

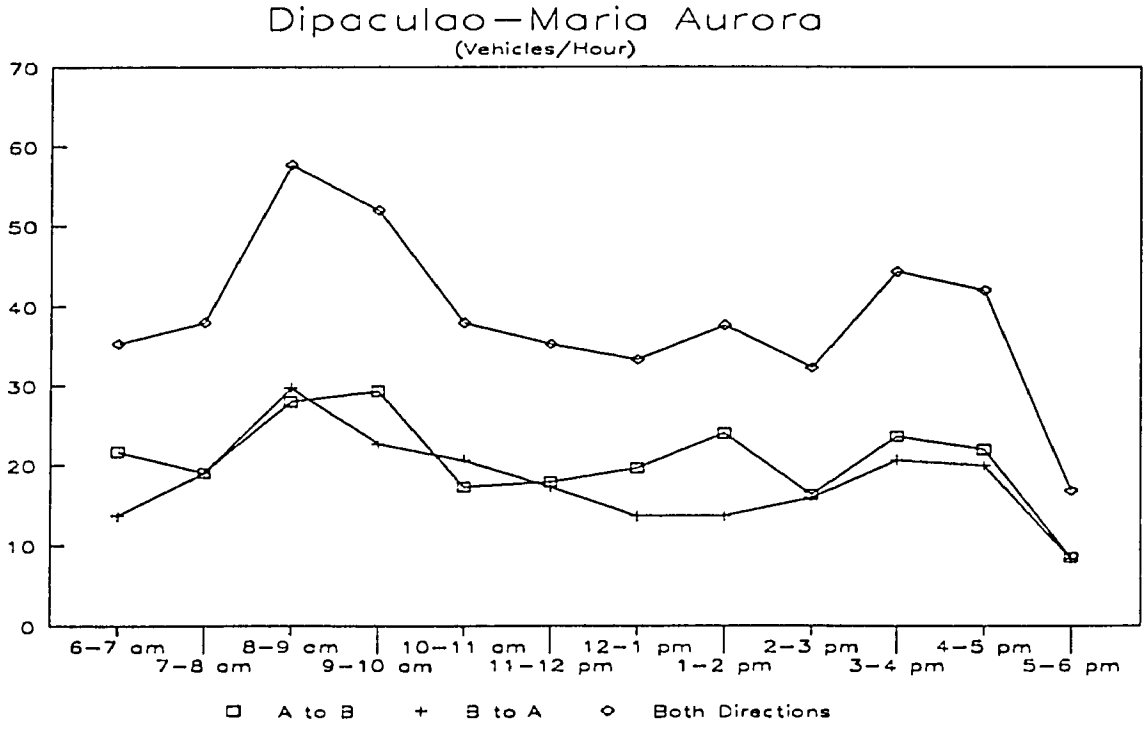
Table 3-4
DISTANCES MEASURED FROM KM POST 170 ON
BONGABON - BALER ROAD TO CITIES IN THE BALER AREA

EXISTING ROAD		PROPOSED NEW LINK	
San Luis	53.0 km	San Luis	45.9 km
Baler	60.2 km	Baler (via Reserva)	52.4 km
Dipaculao	71.8 km	Dipaculao	43.8 km
Ma. Aurora	63.7 km	Ma. Aurora	35.2 km

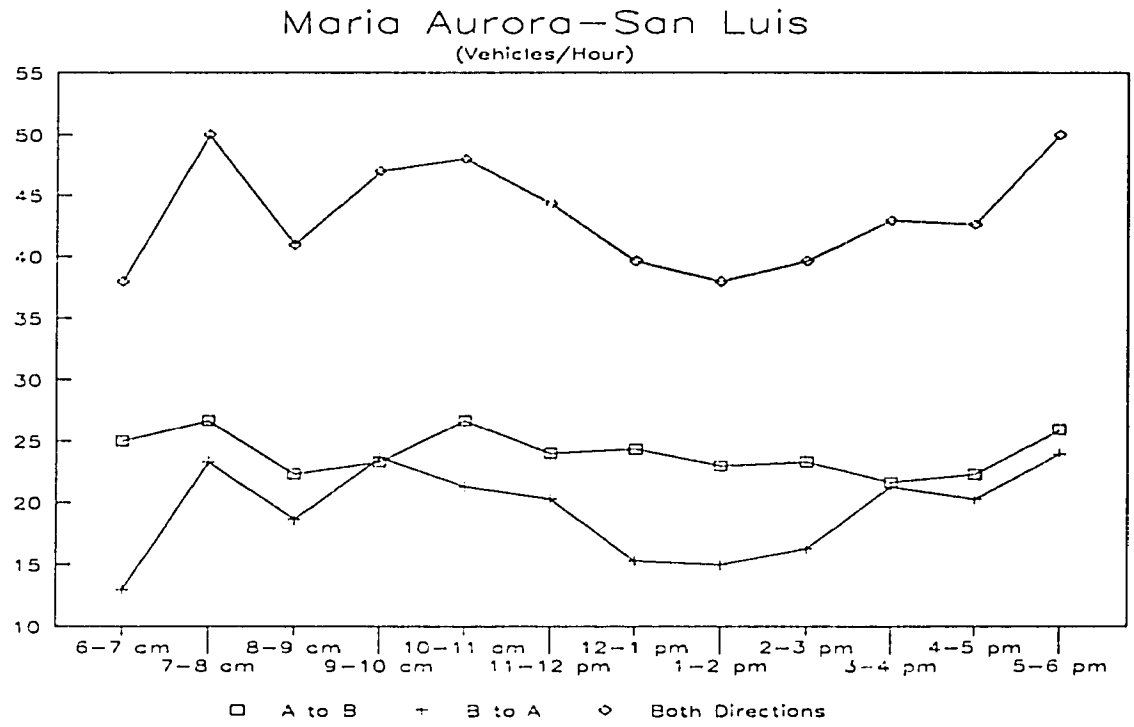
DISTANCE SAVINGS WITH NEW LINK	
Ma. Aurora	28.5 km
Dipaculao	28.0 km
Baler	7.8 km
San Luis	7.1 km

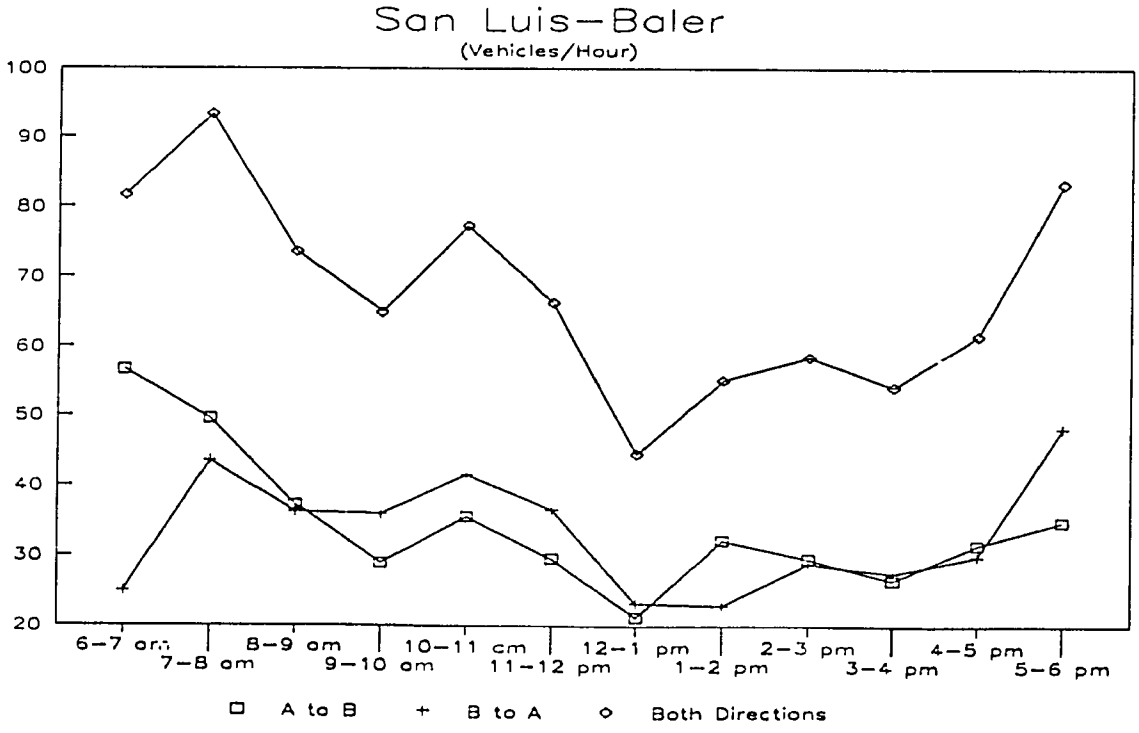
Source: Consultant's Estimates



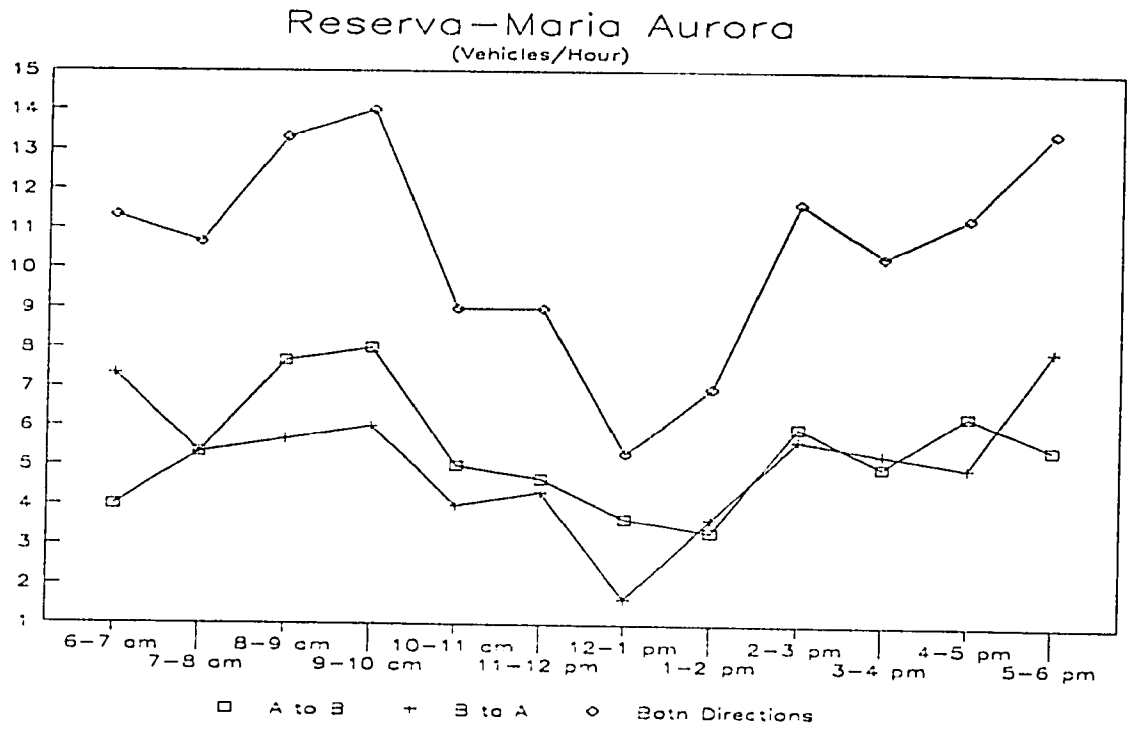


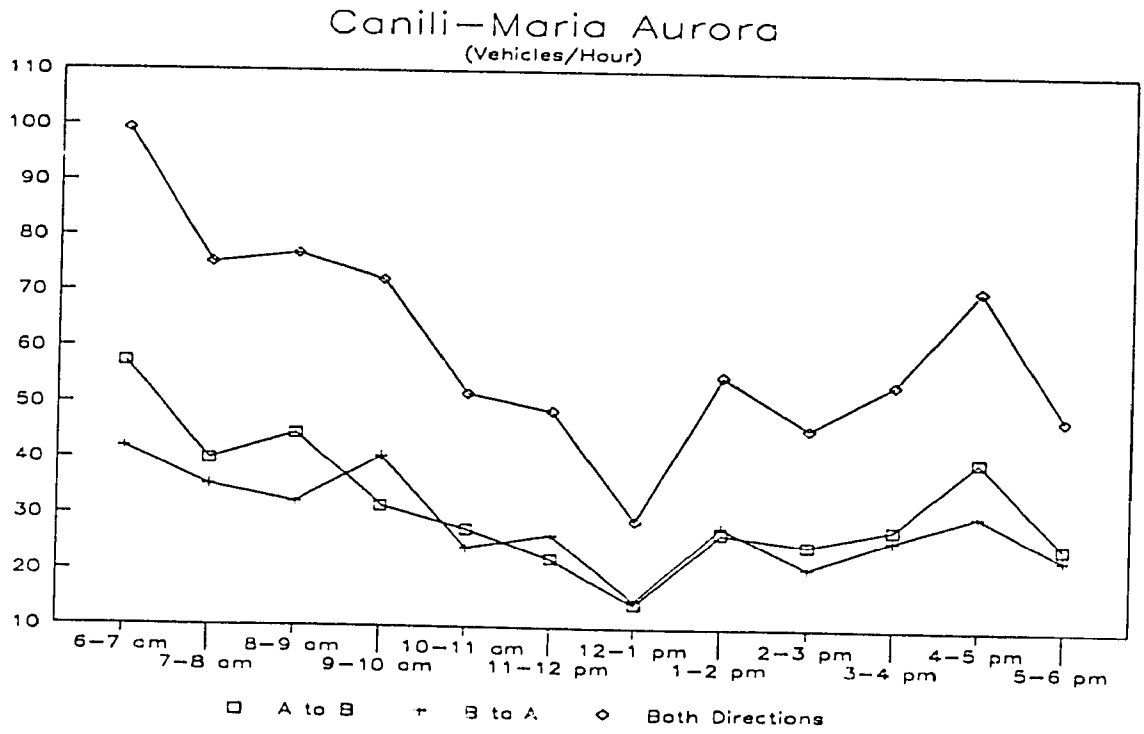
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	HOURLY TRAFFIC VARIATION	FIGURE 3-2





AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	HOURLY TRAFFIC VARIATION	FIGURE 3-3





AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	HOURLY TRAFFIC VARIATION	FIGURE 3-4

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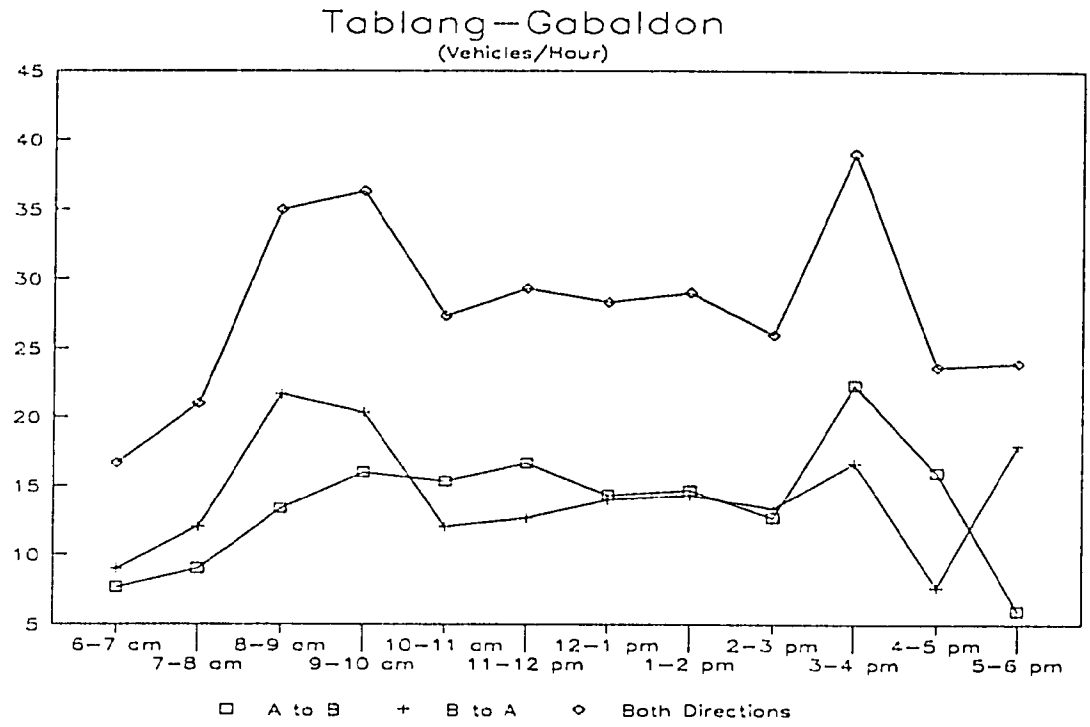
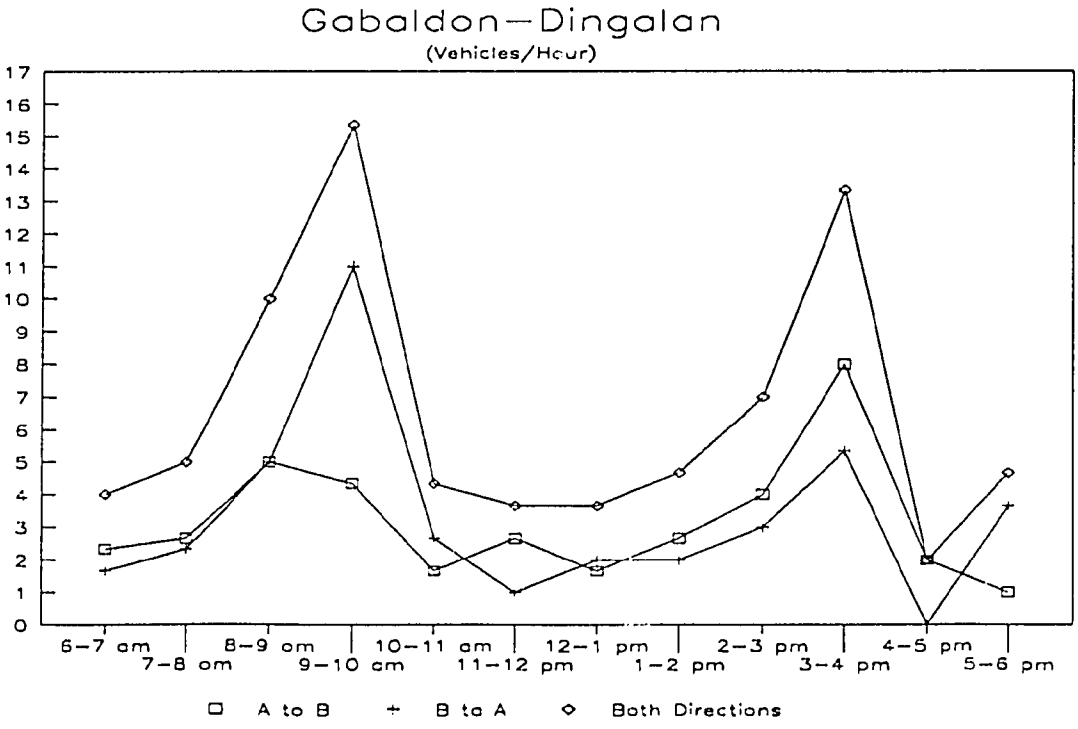
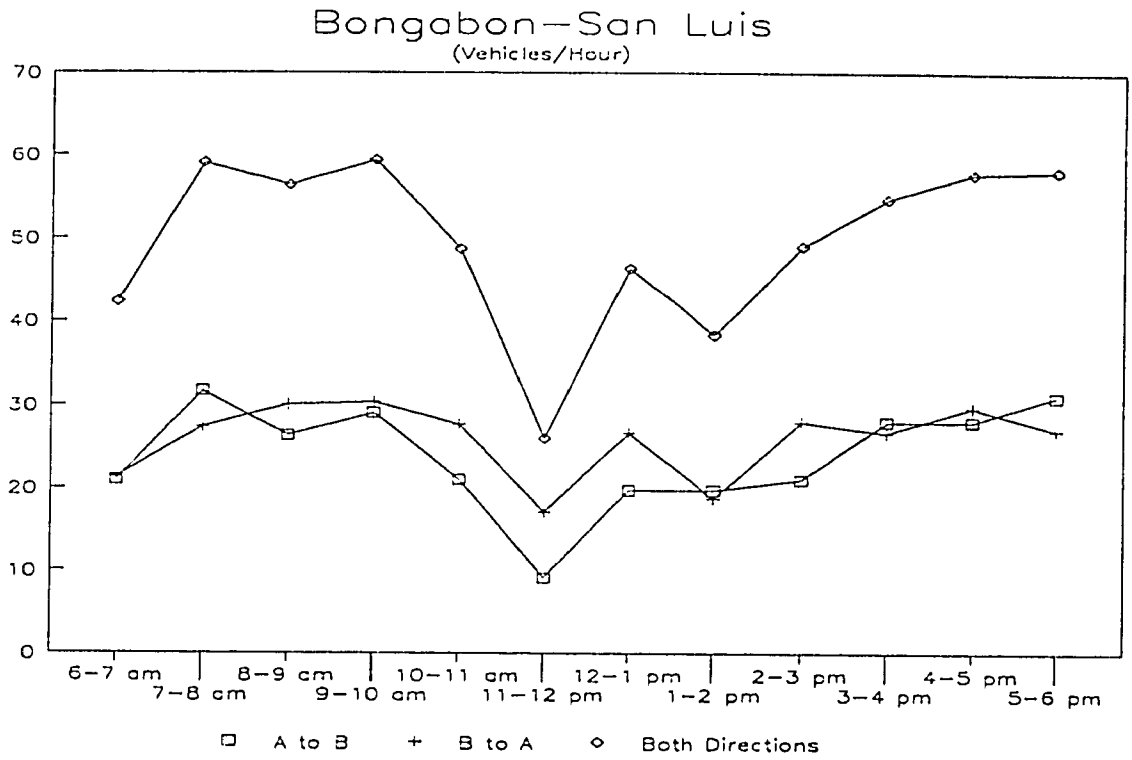




AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	HOURLY TRAFFIC VARIATION	FIGURE 3-5



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	HOURLY TRAFFIC VARIATION	FIGURE 3-6

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In addition to traffic volume counts, O-D Surveys were taken at the following locations:

- near Palayan City (going to Dingalan near the Tablang junction),
- near Maria Aurora (going to Canili),
- near Dingalan,
- near San Luis (going to Bongabon).

From the O-D Surveys, occupancy rates in the study area were determined. (See Table 3-5.) The Baler area has significantly higher occupancy rates compared to the Palayan/Dingalan area. This may be due to a shortage of vehicles in the Baler area or the poor condition of roads that causes vehicle owners to minimize the number of trips they make.

The O-D Matrices are shown in Appendix A. These matrices were used to estimate diverted traffic for the proposed road improvements.

Table 3-5
1991 OCCUPANCY RATES

VEHICLE	PALAYAN/ DINGALAN	SAN LUIS/ MA.AURORA
Car	3.50	na
Jeep	4.62	6.21
Pick-up	2.89	3.31
Van	3.20	3.00
Jeepney	11.73	14.68
Small Bus	4.50	na
Large Bus	52.05	52.05
2-Axle Truck	4.41	5.06
3-Axle Truck	4.09	5.57
Tricycle/Motorcycle	1.97	3.84

Source: Consultant's Survey

3.2 TRAFFIC PROJECTIONS

The tariff counts conducted by Renardet, et al, for the Third Road Improvement Project (TRIP) in 1984 can be compared with the Consultant's 1991 traffic survey to obtain an estimate of traffic growth rates in the Baler area. There are three traffic sections that can be compared: Baler-Dipaculao, Reserva-Maria Aurora, and Dipaculao-Maria Aurora. This information is presented in Table 3-6.

The 1991 counts show positive growth for all three sections, but with consistently higher tricycle/motorcycle traffic. AADTs (excluding tricycles/motorcycles) were similar for Baler-Dipaculao and Reserva-Maria Aurora, but were much higher for Dipaculao-Maria Aurora, probably because of the new interprovincial link via Canili. Both the 1984 and 1991 counts were taken with no bridge open to traffic between Dipaculao and Baler.

Table 3-6
COMPARISON OF TRAFFIC SURVEYS

VEHICLE TYPE	BALER-DIPACULAO		RESERVA-MARIA AURORA		DIPACULAO-MARIA AURORA	
	1984	1991	1984	1991	1984	1991
Car/Jeep	5	20	1	11	17	46
Jeepney	16	11	13	1	22	50
Small Bus	0	0	0	0	2	1
Large Bus	0	0	0	0	0	0
2-Axle Truck	0	7	2	7	15	9
3-Axle Truck	18	9	4	1	13	7
Sub-total	148	47	20	20	69	113
Tricycle/Motorcycle	187	329	80	122	260	510
Total Vehicles		376	100	142	329	623

Source: TRIP, Consultant's Survey

The growth in AADTs between 1984 and 1991 ranges between 2.5 percent and 7.3 percent per year. The apparently high growth in tricycle/motorcycle traffic, though, is harder to explain. The higher 1991 counts for these vehicles could be a matter of where the count station was placed between the two municipalities. The Rural Accessibility Planning in Aurora Province report by the Rural Transport Unit, Department of Interior and Local Government, states tricycles are the most common means of transport in Aurora province. Jeepneys, on the other hand, are not as popular because of long waiting times until the jeepney is sufficiently loaded.

The historical growth rates in traffic volumes should continue for the next 10 to 15 years before slowing as lumber and other resources are drawn down. In general, the traffic forecasts extrapolate historical growth over the medium term and show a slowing in growth after 2003. The forecasts were made for each homogeneous section using individual growth rates for different vehicle types. The forecasts were also prepared separately for normal, diverted and generated traffic.

Once the base year traffic levels were established for normal, diverted and generated traffic, the same forecasting methodology was applied to each traffic type to forecast volumes over the projected life of the facility.

The formula used was:

$$T_i = P + (I * \epsilon_i)$$

where,

T_i = Annual growth rate for passenger travel in vehicle type i,

P = Annual growth rate of population in the study area,

I = Annual growth rate in real per capita income in the study area; and

ϵ_i = Income elasticity of passenger travel demand for vehicle type i.

Population was forecast to increase at 2.0 percent p.a. through 2003 and 1.5 percent p.a. thereafter. Real per capita income was forecast to grow 2.0 percent p.a. through 2003, and 1.5 percent p.a. thereafter. The income elasticity travel of demand by cars was estimated to be 1.4, that is, for every 1 percent increase in real income, the demand for travel by car increases by 1.4 percent. (The same elasticity applies to travel by tricycle, jeep, van or pickup). The income elasticity for travel by jeepneys and buses was taken as 0.5 percent and 0.8 percent, respectively. The lower elasticities for jeepneys and buses reflects an expected shift in passenger demand from crowded jeepneys and buses to more comfortable cars, pickups and vans. Tricycle traffic is expected to continue to be very important in the movement of passenger in urban areas.

The growth rate in real Gross Provincial Domestic Product for Aurora Province was used to forecast the growth rate of truck traffic. The growth rate used for real gross output through 2003 was 2.0 percent p.a. and 1.5 percent p.a. thereafter.

3.2.1 Normal Traffic

Increases in traffic volumes along road sections due to natural population growth and increase in the level of economic activity is called normal traffic. Normal traffic is defined as the total

future traffic along a road section without the proposed project, but it is only a portion of future traffic if the improvement occurs.

3.2.2 Diverted Traffic

Diverted traffic is expected to be significant only on Bongabon-Km Post 170-Km Post 38-Maria Aurora sections. The section between Km Post 170 and Km Post 38 is currently nonexistent, but will shorten travel distances a great deal if it is built. If this section is not built, i.e., in the "With Gap" analysis, there will only be some small diverted traffic along the circumferential road. The latter will occur principally because of better access between San Luis and Maria Aurora.

The distances savings with the new link were shown previously to be between 7.1 km and 28.5 km (See Table 3-4). Based on the O-D surveys in the Baler area, this corresponds to an average distance savings of 17.0 km, as measured from Km Post 170 km on the Bongabon-Baler road. There are additional distance savings for travelers coming or going to Cabanatuan. This is the kilometer difference in travelling to Bongabon compared to travelling to Rizal as measured from Cabanatuan. This distance is approximately 20.0 km, thus the total distance savings for Cabanatuan-Baler area travelers is 37.0 km.

3.2.3 Generated Traffic

The proposed road improvements will reduce vehicle operating costs and travel times in the study area. This will cause several beneficial effects on consumers and producers within the zone of influence of the upgraded roads. For example, the transport costs of goods produced in the area will be reduced, increasing the quantity demanded, and likely increasing profit margins. Spoilage rates will be reduced and higher prices will spur increases in production. Consumer goods from outside the study area will be cheaper to import. Passenger travel times will be reduced, freeing time for more productive activities. The greater the reduction in transport costs, the larger the resulting level of generated traffic.

This study used a travel demand elasticity factor of 1.0 to forecast generated traffic. Thus, for example, a 20 percent reduction in operating costs resulted in a forecast of an additional 20 percent (of normal) increase in traffic levels. Benefits from the increased in generated traffic were considered a measure of producer surplus and were valued at 50 percent of roadway user savings "with" and "without" the project. The levels of generated traffic with respect to normal traffic are shown in Table 3-7.

Included in generated traffic are seed volumes for some sections. Seed volumes represent small positive values assigned to certain vehicle types that are not currently using the road, but will should the improvement be made. (For example, cars and small buses.) Conversely, negative

values are possible for vehicle types that would be phased out of use or used elsewhere should a road improvement be made. An example of the latter is the high-axle weapon carriers used to cross deep water areas on the Casiguran-Baler road north of Dipaculao. (Only a few weapons carriers were found to be in use in the current study area.)

Table 3-7
INCREASE IN GENERATED TRAFFIC
DUE TO LOWER VOCs
(as percent of Normal Traffic)

SECTION	PCT INCREASE
Baler - Dipaculao	20.5
Dipaculao - Maria Aurora	31.3
Maria Aurora - San Luis	35.2
San Luis - Baler	2.6
Tablang - Gabaldon	27.2
Gabaldon - Dingalan	45.8
Rizal - Canili	56.0
Canili - Km Post 38	33.9
Bongabon - Km Post 170	39.4
Km Post 170 - Km Post 38	58.7*
Km Post 38 - Maria Aurora	39.4

* Percent increase as a percent of diverted traffic

Source: Consultant's Estimates

Appendix A presents the parameters and traffic forecasts by homogeneous traffic section. If the new link between Km Post 170 and Km Post 38 west of Maria Aurora is built, the traffic projection is called the "Full Road" projection. If this new road is not built, the traffic projection is called the "With Gap" projection.

CHAPTER 4

ENGINEERING DESIGN

CHAPTER 4

ENGINEERING DESIGN

4.1 DATA COLLECTION AND ANALYSIS PERFORMED

4.1.1 Road Inventory

Inventories of two existing road sectors included in the project and an alternative route were made along their entire lengths. Data collected from the inventories included:

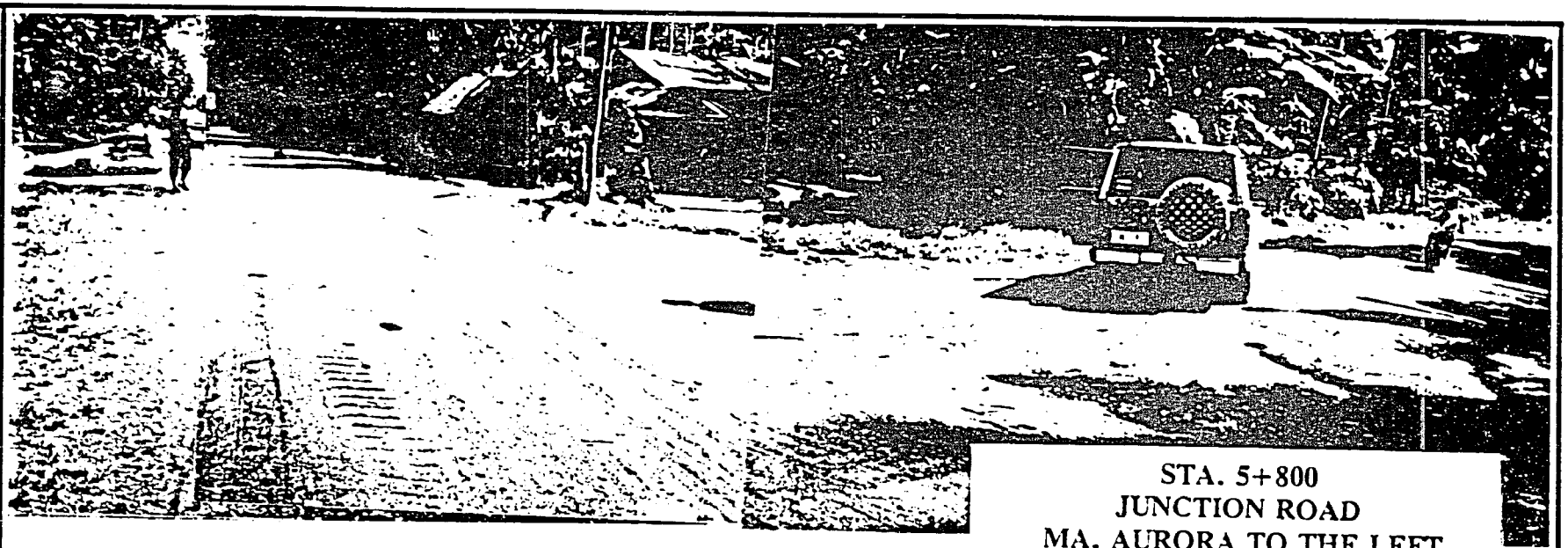
- Terrain Classification
- Surface Type, Condition and Width
- Land Use Classification
- Identification of Flood Plains
- Location and Inventory of Structures

The road inventory data collection sheets are provided in Appendix F-1.

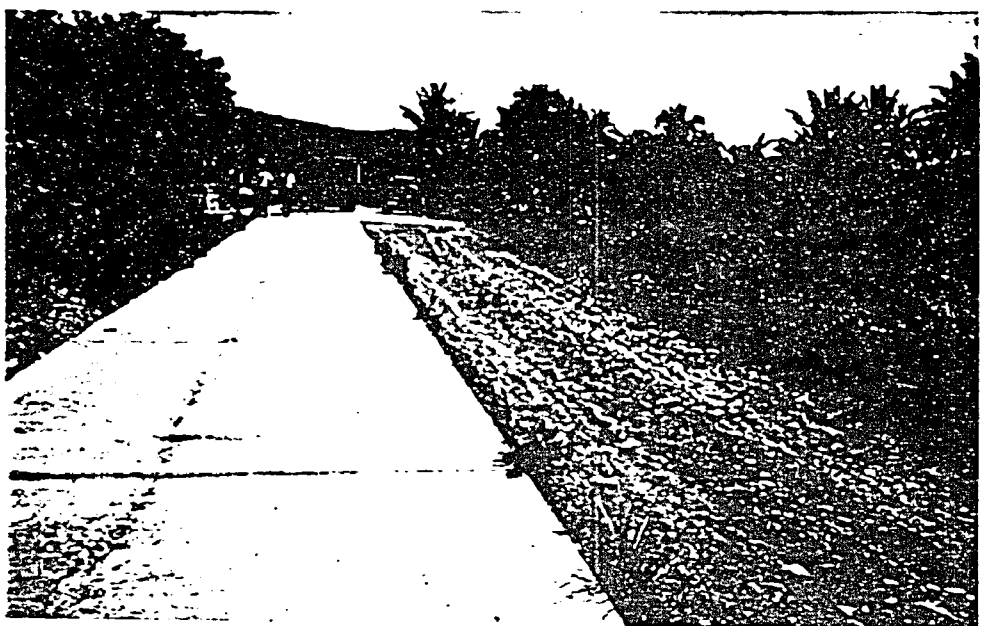
Data acquired reveals that except for a few short stretches of PCCP, most of the roads are in poor to possibly fair condition. Drainage must be improved, shoulder and roadways need better maintenance and many structures require stream stabilization upstream or downstream from the structure. Revegetation of slopes and erosion control measures must be considered to mitigate massive loss of soil in cuts and on embankments. Figures 4.1 through 4.7 show a sampling of field findings.

4.1.2 Hydrology

Methodology



STA. 5+800
JUNCTION ROAD
MA. AURORA TO THE LEFT
DIPACULAO TO THE RIGHT



STA. 13+850
EXISTING HALF LANE PAVEMENT
@ FIRST APPROACH OF LIPIT
BRIDGE; LEFT SIDE OF ROAD;
LANE WIDTH = 3.05 m

AURORA ROADS INFRASTRUCTURE
DEVELOPMENT PROJECT
FEASIBILITY STUDY

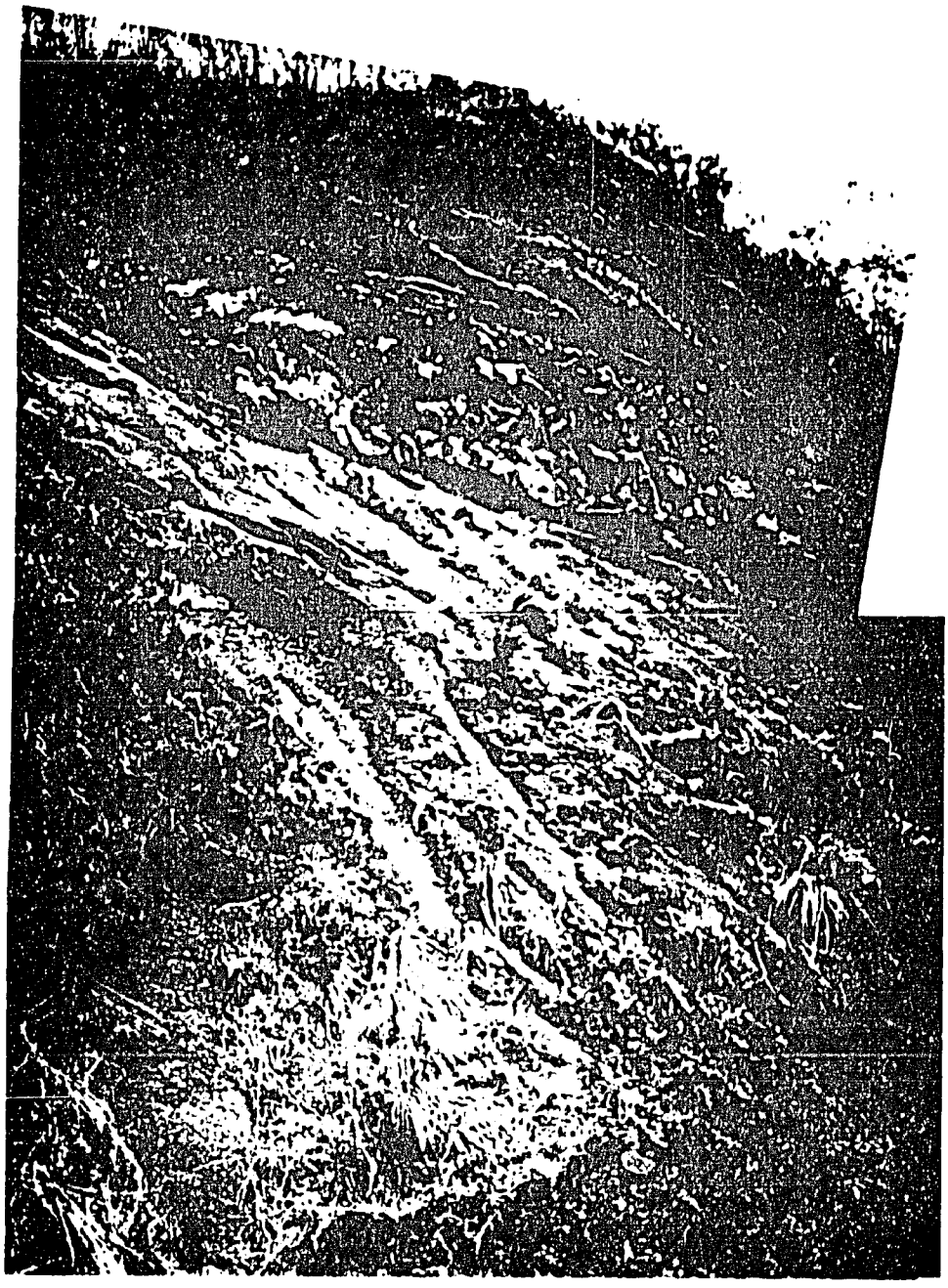
CIRCUMFERENTIAL ROAD
SEGMENT 1A & 1B

FIGURE
4-1

STA 14+050
JUNCTION ROAD TO MA. AURORA
ROADWAY WIDTH = 4.5 m

STA 15+600
EXISTING GRAVEL ROAD GOING TO MA. AURORA
ROADWAY WIDTH = 10.00 m

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	CIRCUMFERENTIAL ROAD SEGMENT 1B	FIGURE 4-2

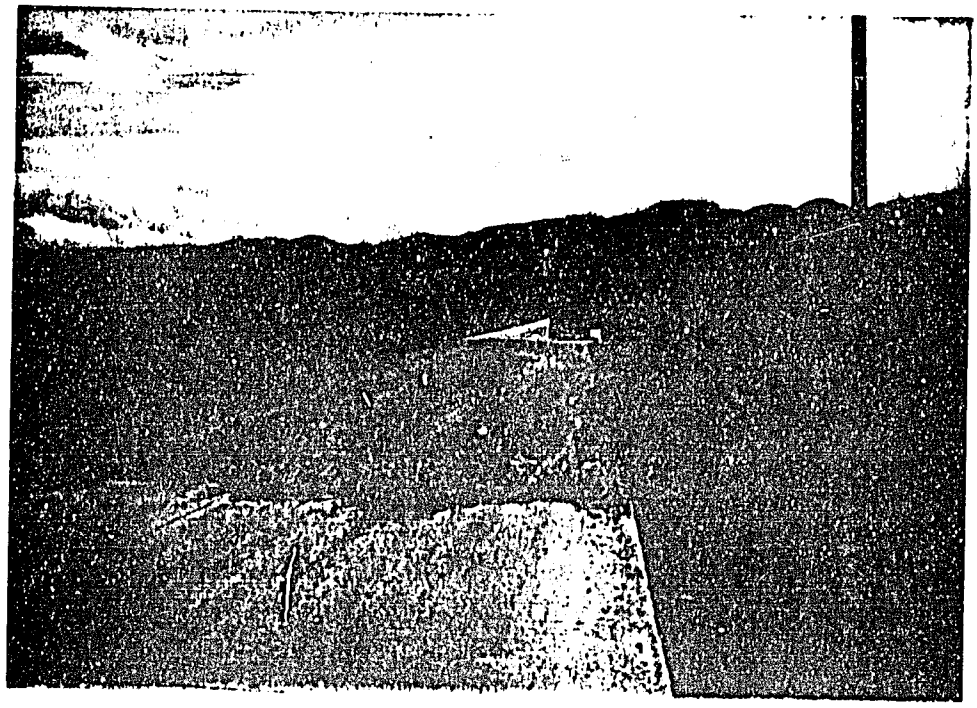


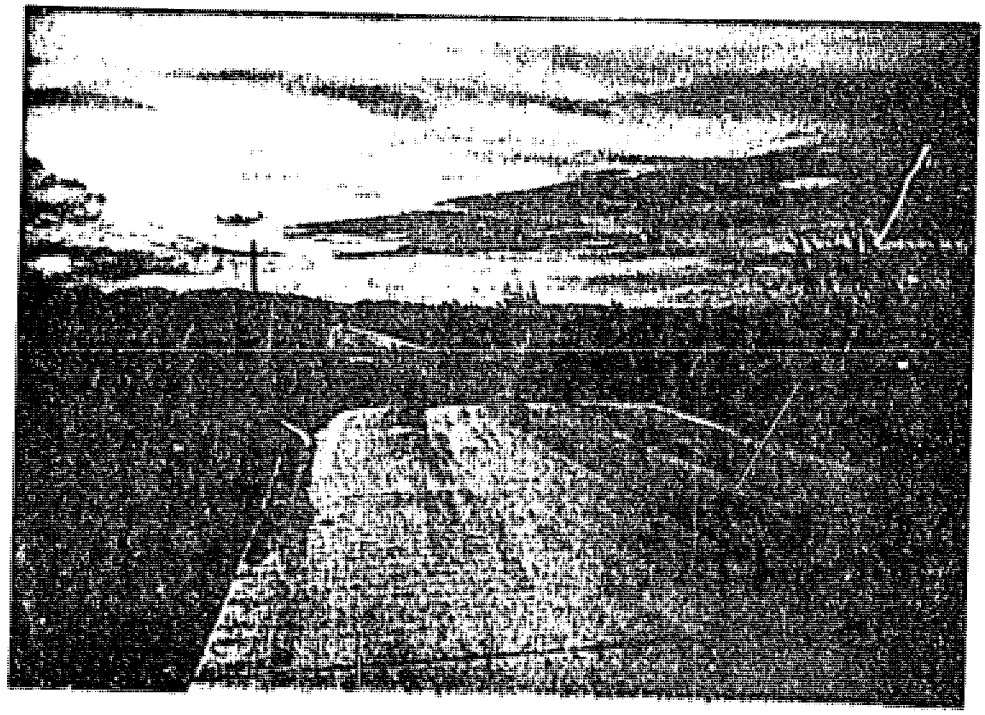
EXISTING BACKSLOPE CONDITION ALONG THE NEWLY CONSTRUCTED CANILI-BAZAL ROAD

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	CANILI-BAZAL ROAD SEGMENT 2	FIGURE 4-3

SHOULDER EROSION ON BOTH SIDES OF THE CANILI-BAZAL ROAD DUE TO THE ABSENCE OF APPROPRIATE SHOULDER PROTECTION

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	CANILI BAZAL ROAD SEGMENT 2	FIGURE 4-4





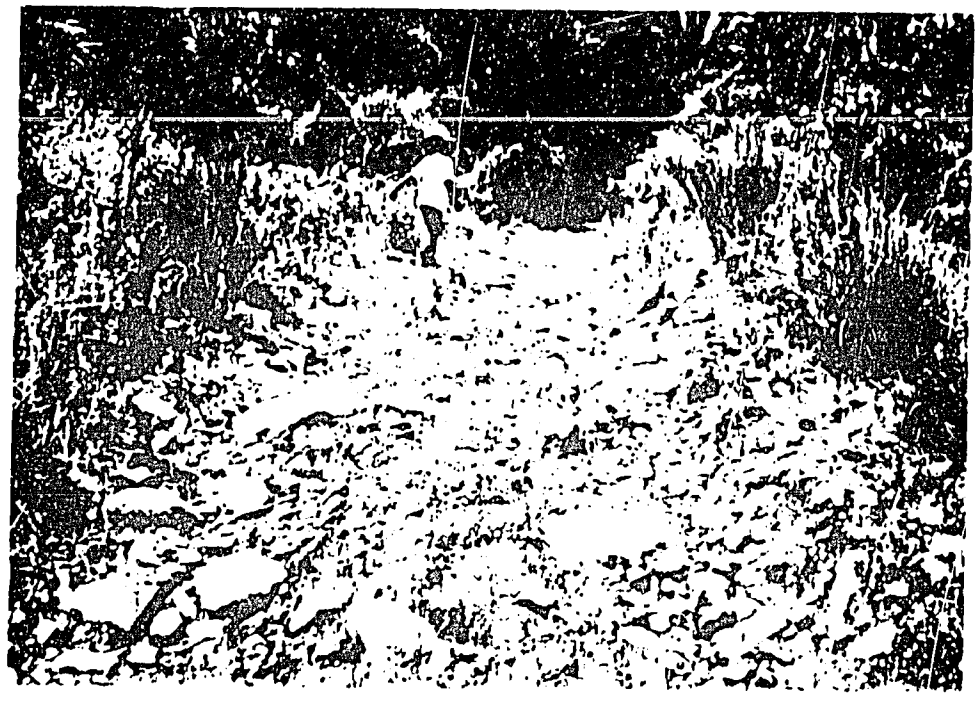
UNPAVED LOCATIONS ALONG TABLANG-DINGALAN ROAD WHERE CROSS DRAINAGE NEEDS TO BE INSTALLED

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	TABLANG DINGALAN ROAD SEGMENT 4	FIGURE 4-5

LONGITUDINAL CRACKING OF PCCP
ALONG TABLANG-DINGALAN ROAD

DAMAGED GRAVEL ROAD CAUSED BY
EARTHQUAKE OF JULY 16, 1990

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	TABLANG-DINGALAN ROAD SEGMENT 4	FIGURE 4-6



LOGGING ROAD TO BARANGAY DIKAPANIKIAN
JUST BEYOND PALTIC RIVER

LOGGING ROAD TO BARANGAY DIKAPANIKIAN
BEYOND BARANGAY PALTIC

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	DINGALAN-SAN LUIS LOGGING ROAD SEGMENT 3	FIGURE 4-7

4.1.2.1 Area of Catchment

The first step undertaken in conducting the hydrologic and drainage studies was the collection and compilation of all available topographic maps covered by the project. Maps collected were of the 1:50,000 scale.

From these maps the catchment area of the stream or waterways for each bridge, culvert and cross drains were determined.

4.1.2.2 Rainfall Data

Rainfall data were collected from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) specifically from its publication on the Rainfall Intensity Duration - Frequency Data of the Philippine. From these data the rainfall records at the Baler station are used in the Aurora project roads and the rainfall records collected from the gaging station in Gabaldon Nueva Ecija are used for the Nueva Ecija road project. Refer to Table 4-1 and 4-2.

4.1.2.3 Streamflow Data

Streamflow data were collected from the National Water Resources Council (NWRC) specifically from its publication on the Philippine Water Resources Summary Data. No stream flow recordings were made on the different rivers included in the project area. The base flow calculations were made using the stream flow data of nearby rivers within the region and similar to the project river/water way.

4.1.2.4 Rational Formula Method

The rational formula as described below was used in the determination of design discharge for box culverts, and pipe culverts which catchment areas are 10 sq. km. or less. $Q = .278\,CIA$

where:	Q	-	discharge, CMS
	C	-	coefficient of run-off
	I	-	rainfall intensity mm/hr
	A	-	drainage area, km^2
	.278	-	metric conversion factor

4.1.2.5 Run-off Coefficient

Values of the coefficient of run-off C, were chosen based on field observations as to the general type of watershed cover. Watershed cover were classified based on the procedure described on the Design Guidelines of the Department of Public Works and Highways. Table 4-3.

Table 4-1
RAINFALL RECORDS
GABALDON, NUEVA ECIJA
BASED ON 13 YEARS OF RECORDS

COMPUTED EXTREME VALUES (IN MILLIMETERS) OF PRECIPITATION

RETURN PERIOD (YEARS)	5 MINS.	10 MINS.	15 MINS.	30 MINS.	60 MINS.	2 HRS.	3 HRS.	6 HRS.	12 HRS.	24 HRS.
2	9.9	15.1	19.9	31.8	45.9	66.1	81.1	114.5	153.8	175.6
5	12.6	20.0	25.8	42.4	61.4	84.5	109.6	168.3	231.9	273.8
10	14.4	23.2	29.7	49.4	71.7	96.8	128.5	204.0	283.6	338.8
15	15.4	25.0	31.9	53.4	77.5	103.6	139.2	224.1	312.7	375.4
20	16.2	26.2	33.4	56.2	81.5	108.5	146.6	238.1	333.2	401.1
25	16.7	27.2	34.6	58.3	84.6	112.2	152.4	249.0	348.9	420.9
50	18.4	30.2	38.3	64.9	94.3	123.6	170.1	282.4	397.3	481.8
100	20.1	33.2	41.9	71.4	103.8	135.0	187.7	315.5	445.4	542.2

INTENSITY (IN MILLIMETERS/HOUR) OF COMPUTED EXTREME VALUES

RETURN PERIOD (YEARS)	5 MINS.	10 MINS.	15 MINS.	30 MINS.	60 MINS.	2 HRS.	3 HRS.	6 HRS.	12 HRS.	24 HRS.
2	118.8	90.6	79.6	63.6	45.9	33.0	27.0	19.1	12.8	7.3
5	151.2	120.0	103.2	84.8	61.4	42.3	36.5	28.0	19.3	11.4
10	172.8	139.2	118.8	98.8	71.7	48.4	42.8	34.0	23.6	14.1
15	184.8	150.0	127.6	106.8	77.5	51.8	46.4	37.3	26.1	15.6
20	194.4	157.2	133.6	112.4	81.5	54.3	48.9	39.7	27.8	16.7
25	200.4	163.2	138.4	116.6	84.6	56.1	50.8	41.5	29.1	17.5
50	220.8	181.2	153.2	129.8	94.3	61.8	56.7	47.1	33.1	20.1
100	241.2	199.2	167.6	142.8	103.8	67.5	62.6	52.6	37.1	22.6

Source: PAGASA

Table 4-2
RAINFALL RECORDS
BALER, AURORA
BASED ON 13 YEARS OF RECORDS

COMPUTED EXTREME VALUES (IN MILLIMETERS) OF PRECIPITATION

RETURN PERIOD (YEARS)	5 MINS.	10 MINS.	15 MINS.	30 MINS.	60 MINS.	2 HRS.	3 HRS.	6 HRS.	12 HRS.	24 HRS.
2	14.2	20.3	25.7	36.3	51.4	75.0	86.6	117.1	144.9	171.7
5	16.9	24.5	31.3	45.2	66.3	95.6	115.0	153.8	187.6	230.8
10	18.7	27.3	35.0	51.1	76.2	709.3	133.8	178.1	215.8	270.0
15	19.7	28.9	37.1	54.4	81.8	117.0	144.4	191.8	231.7	292.0
20	20.4	30.0	38.6	56.7	85.7	122.4	151.9	201.4	242.9	307.5
25	20.9	30.8	39.8	58.5	88.7	126.5	157.6	208.8	251.5	319.4
50	22.6	33.4	34.3	64.0	97.9	139.3	175.2	231.5	277.9	356.1
100	24.2	36.0	46.7	69.5	107.1	152.0	192.7	254.1	304.2	392.5

INTENSITY (IN MILLIMETERS/HOUR) OF COMPUTED EXTREME VALUES

RETURN PERIOD (YEARS)	5 MINS.	10 MINS.	15 MINS.	30 MINS.	60 MINS.	2 HRS.	3 HRS.	6 HRS.	12 HRS.	24 HRS.
2	170.4	121.8	102.8	72.6	51.4	37.5	28.9	19.5	12.1	7.2
5	202.8	147.0	125.2	90.4	66.3	47.8	38.3	25.6	15.6	9.6
10	224.4	163.8	140.0	102.2	76.2	54.6	44.6	29.7	18.0	11.3
15	236.4	173.4	148.4	108.8	81.8	58.5	48.1	32.0	19.3	12.2
20	244.8	180.0	154.4	113.4	85.7	61.2	50.6	33.6	20.2	12.8
25	250.8	184.8	159.2	117.0	88.7	63.3	52.5	34.8	21.0	13.3
50	271.2	200.4	173.2	128.0	97.9	69.6	58.4	38.6	23.2	14.8
100	290.4	216.0	186.8	139.0	107.1	76.0	64.2	42.3	25.3	16.4

Source: PAGASA

Table 4-3
RUN-OFF COEFFICIENT

PHYSICAL CHARACTERISTICS:	COEFFICIENT "c"
* Topography	
Flat land, with average slope of 1 m to 3 m per km	0.30
Rolling land with average slope of 5 m to 20 m per km	0.20
Hilly with average slope of 50 m to 75 m per km	0.10
* Soil	
Tight impervious soil	0.10
Medium combination of clay and loam	0.20
Open sandy loam	0.40
* Cover	
Cultivated lands	.10
Woodland	.20

Computed Run-off coefficient, C = 1 (Σ of all Run-off coefficient chosen depending on physical characteristics)

Source: DPWH Design Guidelines.

4.1.2.6 Time of Concentration

The time of concentration Tc, was computed using the formula:

$$Tc = \frac{L^{1.15}}{51H^{0.38}}$$

where:

- Tc - time of concentration, min.
- L - stream length, m
- H - difference in elevation from divide to site of waterway crossing, m

The calculated Tc for each structure is provided in Appendix D-1.

4.1.2.7 Rainfall Intensity

The rainfall data gathered from PAGASA was used to determine the rainfall intensity corresponding to the computed time of concentration. Rainfall Intensity - Duration - Frequency Curves were plotted for the following return periods: 2-yr, 5-yr, 10-yr, 25-yr, 50-yr. Refer to Figure 4-8 and Figure 4-9.

For pipe Culverts, rainfall intensity for 10-yr return period was used. Side ditches were designed using rainfall intensity for 2-year return period.

4.1.2.8 Synthetic Unit Hydrograph Method

This method was used to determine the design discharge for bridges and box culverts and for catchment areas greater the 10 sq. km. This method takes into consideration several physiographic characteristics of the catchment areas such as the stream length centroidal length and channel slope. Specific Methodology is provided in Appendix D-2.

4.1.3 Hydraulics

4.1.3.1 Design Flood Depth

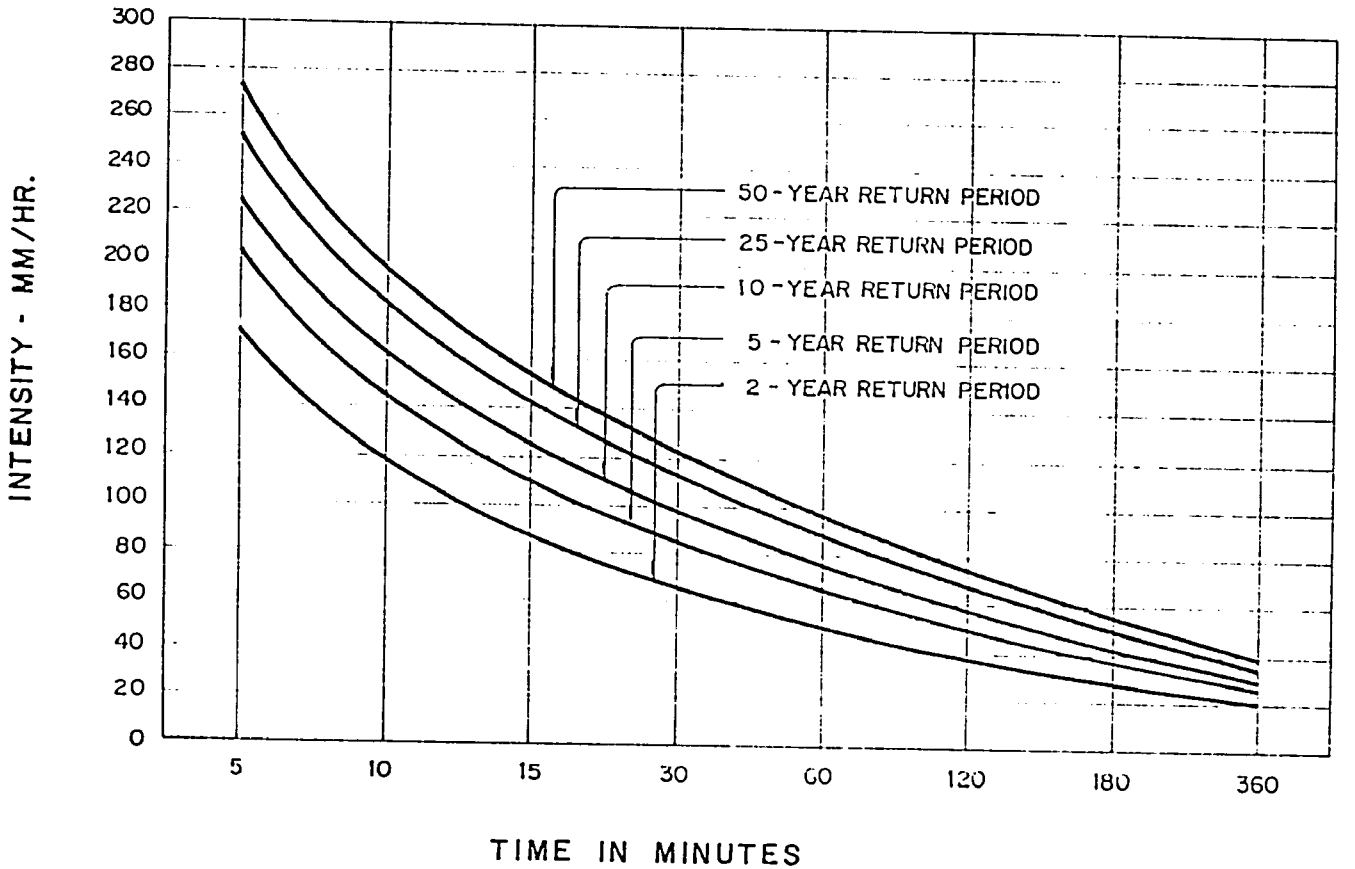
Using the design discharges values obtained from the hydrologic analysis, and the computed base flow, the flood depth corresponding to the design discharge is determined.

The flood depth corresponding to the computed 25 yr, 50-yr and 100 yr discharges for bridges was determined using Manning's formula:

$$Q = \frac{1}{n} AR^{2/3}S^{1/2}$$

where:

n	-	Manning's roughness constant
A	-	cross section area of river at bridge site, sq. m.
P	-	wetted perimeter at bridge site, m.
R	=	$\frac{A}{P}$ hydraulic radius, m
S	=	average slope of water course at the immediate upstream of the bridge site.



AURORA ROADS INFRASTRUCTURE
DEVELOPMENT PROJECT
FEASIBILITY STUDY

RAINFALL INTENSITY-FREQUENCY
DURATION CURVE
BALER, AURORA

FIGURE
4-8

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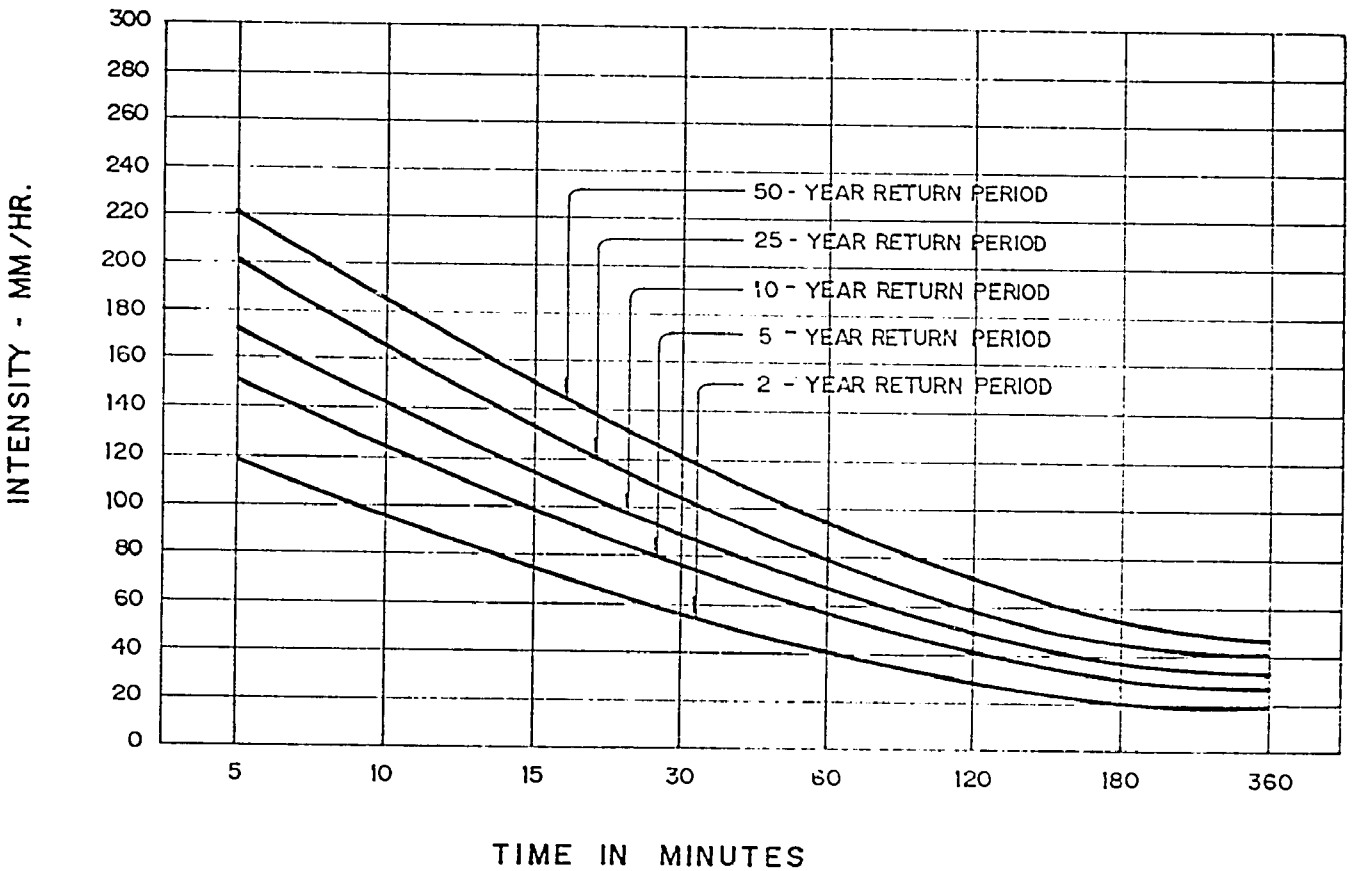

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY

RAINFALL INTENSITY-FREQUENCY DURATION CURVE GABALDON, NUEVA ECIJA

FIGURE 4-9

4.1.3.2 Required Opening for Bridges

From the calculations, tail water rating curves were developed to assess the different levels of flood of different frequencies.

Through a series of iterations the discharge corresponding to a given depth was computed until the design discharge value was reached. The corresponding depth became the flood depth. The width at this flood level became the required opening for the bridge sites. Discharge computations are provided in Appendix D-3.

Trapezoidal sections with embankment side slopes of 1:1 were fitted to the bridge site section in the determination of the flood depth. In isolated cases side slopes of 1 horizontal to 2 vertical (1:2) were used where grouted riprapping could be provided to adequately protect the embankment from erosion.

4.1.3.3 Culvert Opening

A culvert opening was determined using the procedures of Hydraulic Design Series No. 5 of the U.S. Federal Highway Administration. (FHWA) Through a series of iterations, the final culvert opening was arrived at. The following condition were considered:

- Headwater Depth for Concrete Pipe Culvert with Outlet Control
- Head for Concrete Pipe Culverts Flowing Full
- Headwater Depth for Concrete Box Culverts with Outlet Control
- Head for Concrete Box Culverts Flowing Full

To determine optimum size, outlet control for culvert analysis were made. In the final design phase, a culverts relative location must be taken into consideration and a detailed analysis must be performed. Discharge Computations are provided in Appendix D-3.

4.1.3.4 Drainage Ditches and Sizing

Rain falling on the roadways will be drained to the drainage ditches placed alongside the road at the shoulders. Roadway drainage water will be channeled to the nearest waterway or stream and disposed there.

The side ditches were designed using the Manning's formula for open channel flow as described earlier taking the natural ground slope as the design slope.

4.1.3.5 Drainage Culverts

All existing drainage culverts that are still serviceable were retained. Those that were either heavily clogged with silt and debris, damaged, exposed or had earth cover less than the minimum requirement were replaced if they could not be reset or were inadequate in size. Culverts with adequate size to carry the design discharge but shorter than the design width of the road or having an invert elevation which varied considerably from the finished grade elevation were lengthened accordingly. However, there were cases where multiple rows of culverts were resorted to when the existing one was inadequate in size but still in good working condition. Culverts that were rehabilitated or lengthened were provided with transition works. The culvert transitions were also provided with scour protection works.

4.1.3.6 Scour Protection Works

Scour Analyses were done using the method presented in the FHWA Hydraulic Design Series No. 5 for Culverts.

The scour protection recommended for the bridge sites consists of grouted rock slope protection blanketing the embankments. The toe will be laid on a continuous boulder apron extending up to the slope drain (at the upstream and downstream side of the embankment) and beyond where necessary. The width and depth of the apron will vary according to the computed expected depth of scour for each bridge site. Local scour due to the presence of piers will also be similarly protected on the river bed around the piers.

The box culverts together with the bridges will have the road shoulders protected from local scouring and erosion by sodding and stone riprapping at the immediate vicinity of the structure. A special case of erosion and scour protection work will be used for sections prone to flooding or erosion and must be determined during the detailed engineering phase.

4.1.3.7 Slope Stability

Slope protection works in an areas where there are severe erosions and scouring were also recommended. Benching or installation of berms are proposed to be provided where slope height is more than 3 meters. Grouted or dry stone rip-rap are the general form of protection recommended, although in the detailed engineering phase other form of protection must be taken into consideration. Soils's natural angle of repose were considered in the selection of the design side slope. Weep holes were also provided at strategic locations and intervals to relieve pressure that may be induced by the presence of ground water particularly during rainy period. Lined ditches were likewise proposed at the toe of the slope to facilitate the immediate draining of surface run-off that will be generated from the protected slope.

Similarly, road-side lined ditches on steep grades where excessive velocities are expected will be provided with energy dissipators. Baffled blocks or vertical drops with stilling pools were the recommended form of energy dissipators. Specially designed culvert inlets were also proposed for culverts that will act as the outfall structure for the steep lined ditches. A protective structure in the form of inclined chutes with baffled blocks and stilling basin were recommended to be the form of outfall structure for ditches that are expected be disposing of run-offs into rivers or creeks. Location of this structure must be carefully selected during the detailed engineering phase to avoid bank erosion especially were permanent structures are near.

4.1.4 Topographic Survey

Topographic surveys were performed for the Circumferential Road and for the Palayan-Dingalan Road over a two (2) month period following criteria set by the Consultant. The criteria is sufficient enough to gather adequate data to be used in quantity estimates and at the same time fully describe the existing road conditions. The comprehensive criteria adopted are enumerated in the following subsections:

4.1.4.1 Traversing and Horizontal Alignment Surveys

- All tangent lines were defined by a distance and an azimuth from point to point of intersection.
- All point of intersection (PI) and point of tangency (POT) were referenced by two semi-permanent points with distances and angles.
- Points used for references were painted nails with bottle caps on semi-permanent features such as tree trunks, fence posts, house corners, etc.
- Traverses were closed to insure accuracy of survey to the modified third order accuracy.

4.1.4.2 Leveling

- Bench marks were established within the project road at 500.00 meter intervals for the Baler Circumferential and at an average of 850.00 meter intervals for Palayan-Dingalan Road.
- Level runs between BM were double run (once each direction) and closed within the limits of modified third order accuracy.

- An elevation was taken on centerline at 50.0 meter interval and at usual breaks or changes in elevation between stations.

- Normal cross-sections were taken at 500.00 meter intervals on flat to rolling terrain and at 100.00 meter intervals on rugged terrain.

- Cross-sections were taken to at least 30.0 meters on each side of the centerline taking into considerations important features such as edge of pavement or road, shoulders, toes or top of slopes and drainage ditches.

- Physical characteristics of pipes and box culverts such as skew angle, length, size, number of cells and invert elevations were recorded.

- Centerline profile of waterway crossings were taken at 500.0 meter upstream and downstream sections of the river.

4.1.4.3 Alignment via Topographic Maps

For non existing road locations which are in rugged mountain terrain, the Consultant utilized 1:50,000 scale topographic maps as prepared by the Department of Environment and National Resources, National Mapping and Resource Information Authority. Contour interval on these maps are at 20 meter thus detailed design is impractical. The Consultant enlarged these maps to 1:20,000 scale and developed preliminary alignments and grades. Any more detailed design through these mountainous locations will require establishment of ground control stations, aerial and/or satellite photography and plotting of contours to at least 3 meter intervals. For feasibility study level of work, the available information is adequate in these areas.

4.1.5 Geotechnical Studies

4.1.5.1 Geology and Topography

The geology of Aurora is determined by the formations of the Sierra Madre range running NNE-SSW with flanks consisting of thick metamorphosed sequences of upper Cretaceous to upper Eocene volcanic lava flows and pyroclastic rocks. Progressively towards the inner core of the Sierra Madre mountains, Oligocene andesites and basalt lavas with tuff breccia's exist, and these conglomerate layers overlay the older volcanic sequences.

The stratigraphy of the Sierra Madre slopes shows relative degrees of alteration of the older strata with associated clastic sedimentary rocks. Younger rocks of Middle to Upper Miocene age dominate the core of the mountain range and are associated with patches of limestone and conformable clastic sediments. Multi-stage intrusions of variable composition including quartz and diorite occur on the eastern flanks of the mountain.

The rocks on both sides of the Laur - Dingalan valley are composed of ophiolitic lavas with associated chert rocks and fine greywackes of late Eocene to early Oligocene age.

The volcanic rocks weather to brown and red clay soils, and the metamophics of sedimentary and igneous origin weather to fine to coarse loamy soils.

Eroded and transported sediments have formed river terraces surrounding the central Aurora flood plain, and the numerous river fans, with clay, silt and sand overlaying an assemblage of sub-angular to rounded gravels, pebbles and boulders.

Figure 4-10 shows the geology of the project area in the zones of Aurora and Nueva Ecija provinces in which the project road sections are situated.

The topography of the project area has been described in Section 2.1.1.2, Provincial Profile. The road topography varies from flat to mountainous.

4.1.5.2 Seismic Data

Significant tectonic activity shocks can be expected in Aurora province and earthquakes in excess of 7.0 (Richer scale) have been recorded in North-East, Luzon. Aurora is traversed NE-SW by the Casiguran fault which at its southern end joins the Philippine Fault Zone, a major structural zone of the Philippines, termed the "mobile or Pacific earthquake belt" (Gervacio: 1964). The Aurora coast line faces the East Luzon Trench.

Earthquakes are frequent factors affecting slope stability by triggering slope failure. They reduce stability of structures by imparting shearing stress and a reduction in material strength. Following the 1990 earthquake considerable damage was caused to road sections and bridges on the Dingalan - Palayan road sector. The recently completed Aguang bridge (803 meter) may also be at risk.

The Seismicity Map of the Philippines for 1990 (Figure 4-11) shows a significant concentration of earthquake epicenters offshore of Aurora province, which is bounded to the east by a subduction zone, and lies on an active fault zone.

The Earthquake Catalogue prepared annually by the Philippine Institute of Volcanology and Seismicity, has shown frequent earthquakes in the Baler project area registering up to and over 5.0 in the Richter scale. A map showing the epicenters of destructive earthquakes (Figures 4-12) illustrates the concentration of these events in the project area.

AURORA ROADS INFRASTRUCTURE
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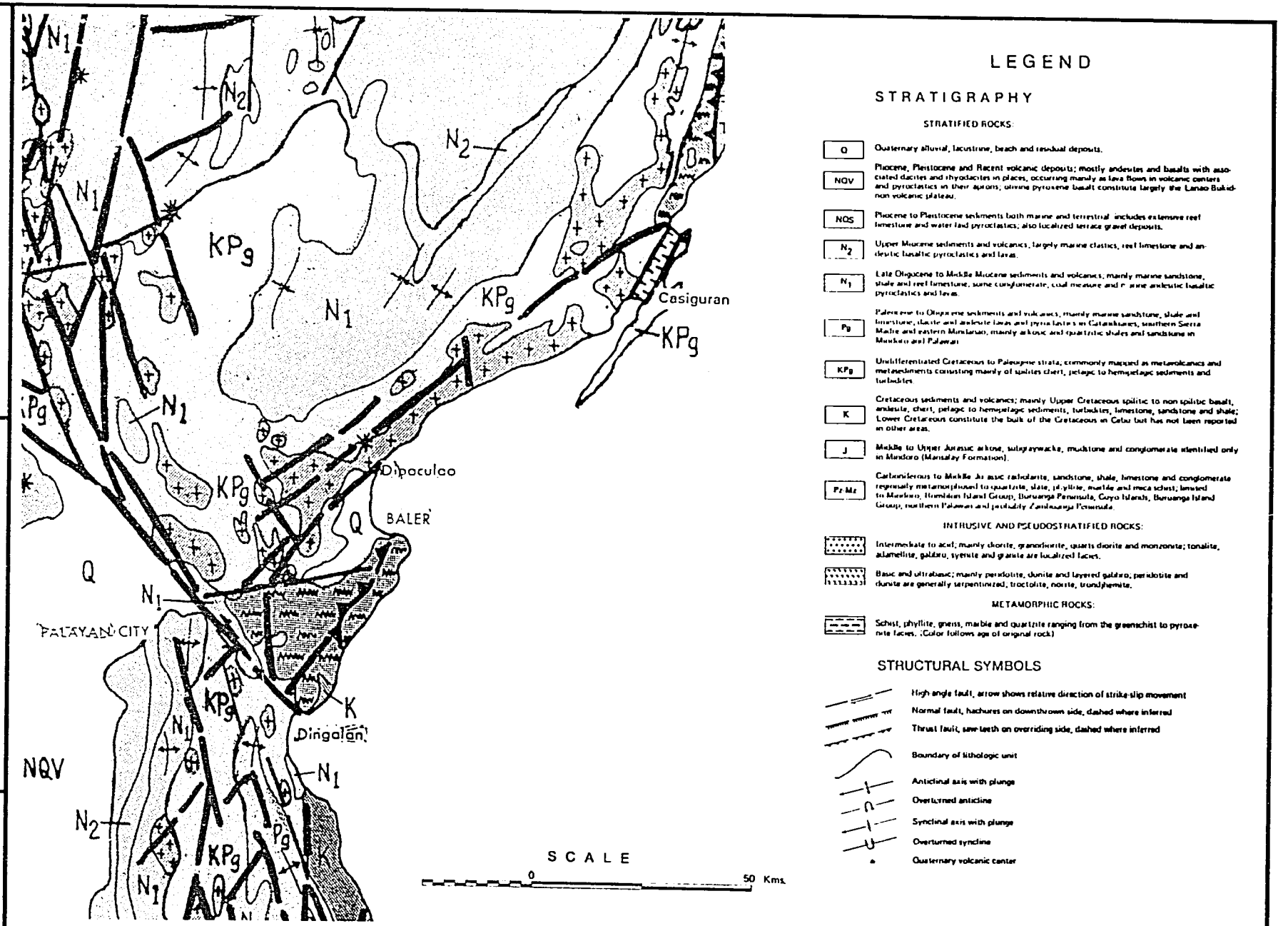
GEOLOGY OF PROJECT AREA

FIGURE
4-10



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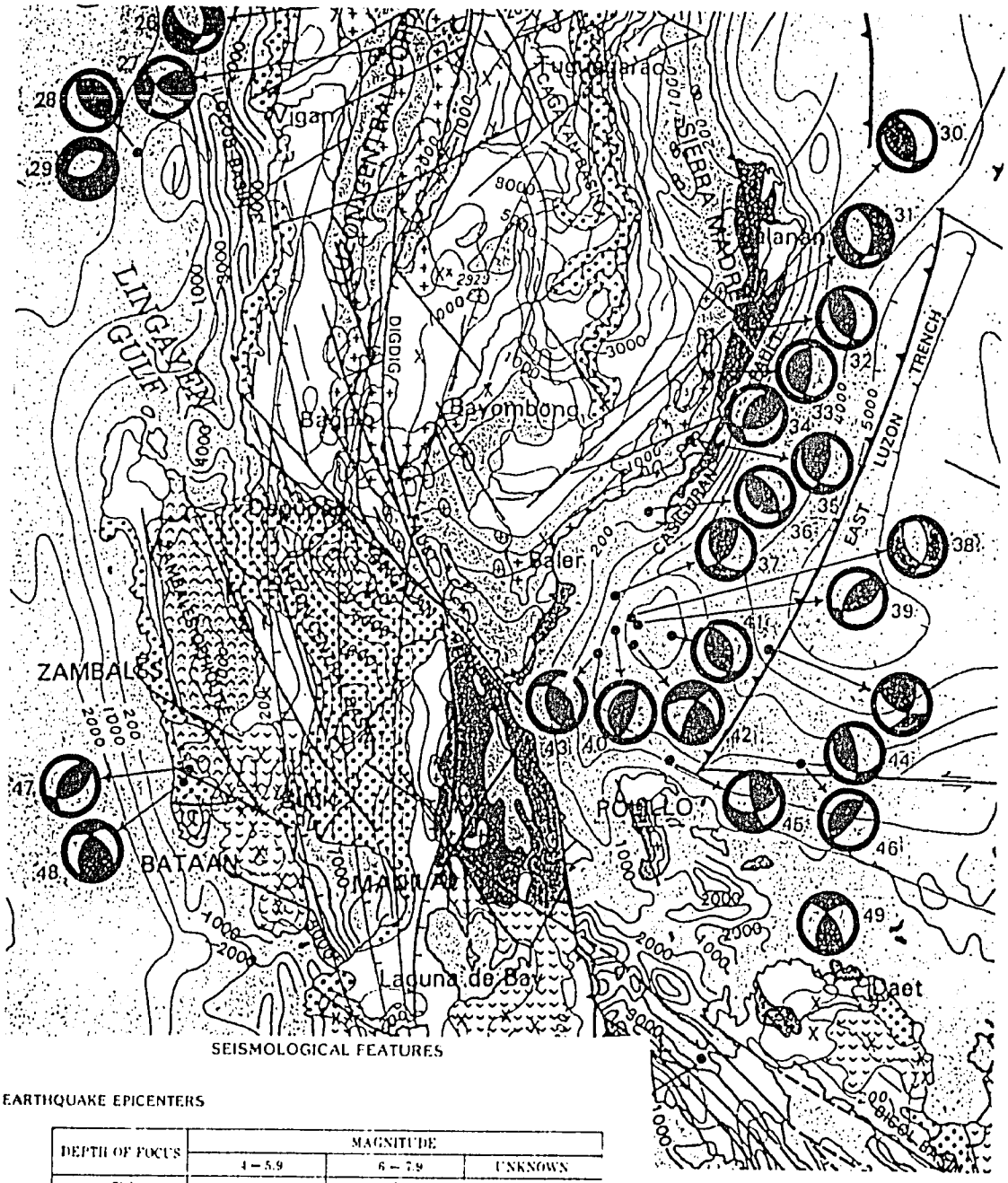


SEISMOLOGICAL FEATURES

EARTHQUAKE EPICENTERS

DEPTH OF FOCUS	MAGNITUDE		
	4 – 5.9	6 – 7.9	UNKNOWN
0-70 km	●	◐	△
70-300 km	○	○	△
> 300 km	●	◐	▲
UNKNOWN	○	◐	△

FOCAL MECHANISM SOLUTION

0-70 km 70-300 km > 300 km

MAXIMUM OBSERVED INTENSITY CONTOUR

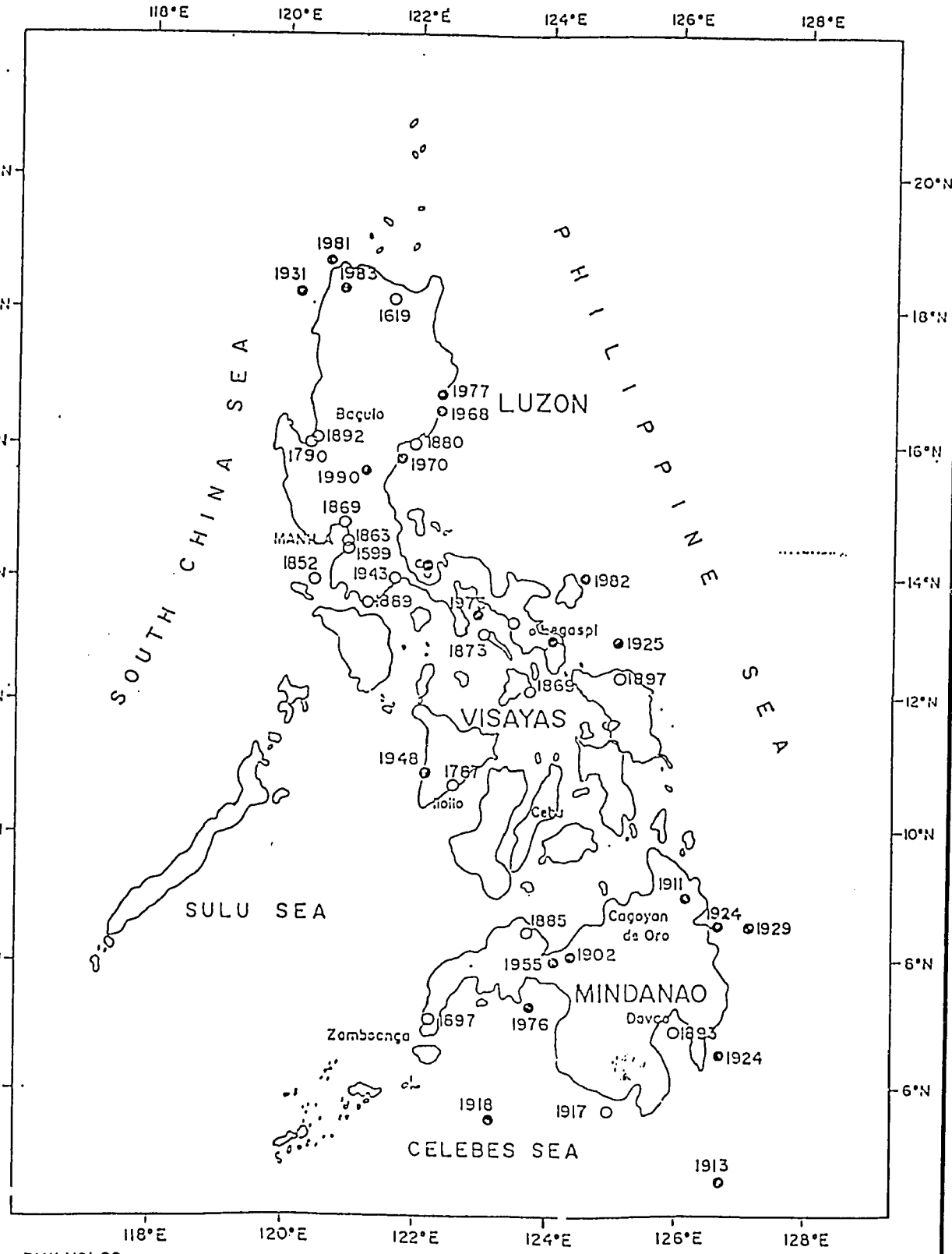
Roman number indicates intensity

SEISMIC FLUX CONTOUR

3

In units of 10^{14} ergs Km^2 yr^{-1}

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	SEISMICITY MAP OF THE PHILIPPINES 1990	FIGURE 4-11



Source - PHILVOLCS

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	EPICENTERS OF DESTRUCTIVE PHILIPPINE EARTHQUAKES	FIGURE 4-12

4.1.5.3 Tsunamis

Tsunamis are high-energy sea waves generated by earthquakes. When they reach the coast under certain condition they may get as high as 10 m. The time interval between successive waves is from 20 to 30 mintues. Tsunamis travel at approximately 700 to 800 kph, depending on the water depth.

A report published by the Philippine Institute of Volcanology and Seismology (PHILVOLCS) mentions that the coastal areas of Luzon facing the Philippine Sea are prone to tsunamis because tsunamigenic earthquakes often originate under the bottom of the Philippine Sea. The areas with recorded tsunamis hits are shown in Figure 4-13.

On December 27, 1735, Baler was utterly destroyed by a tidal wave or "Tromba Marina" from the Pacific Ocean.

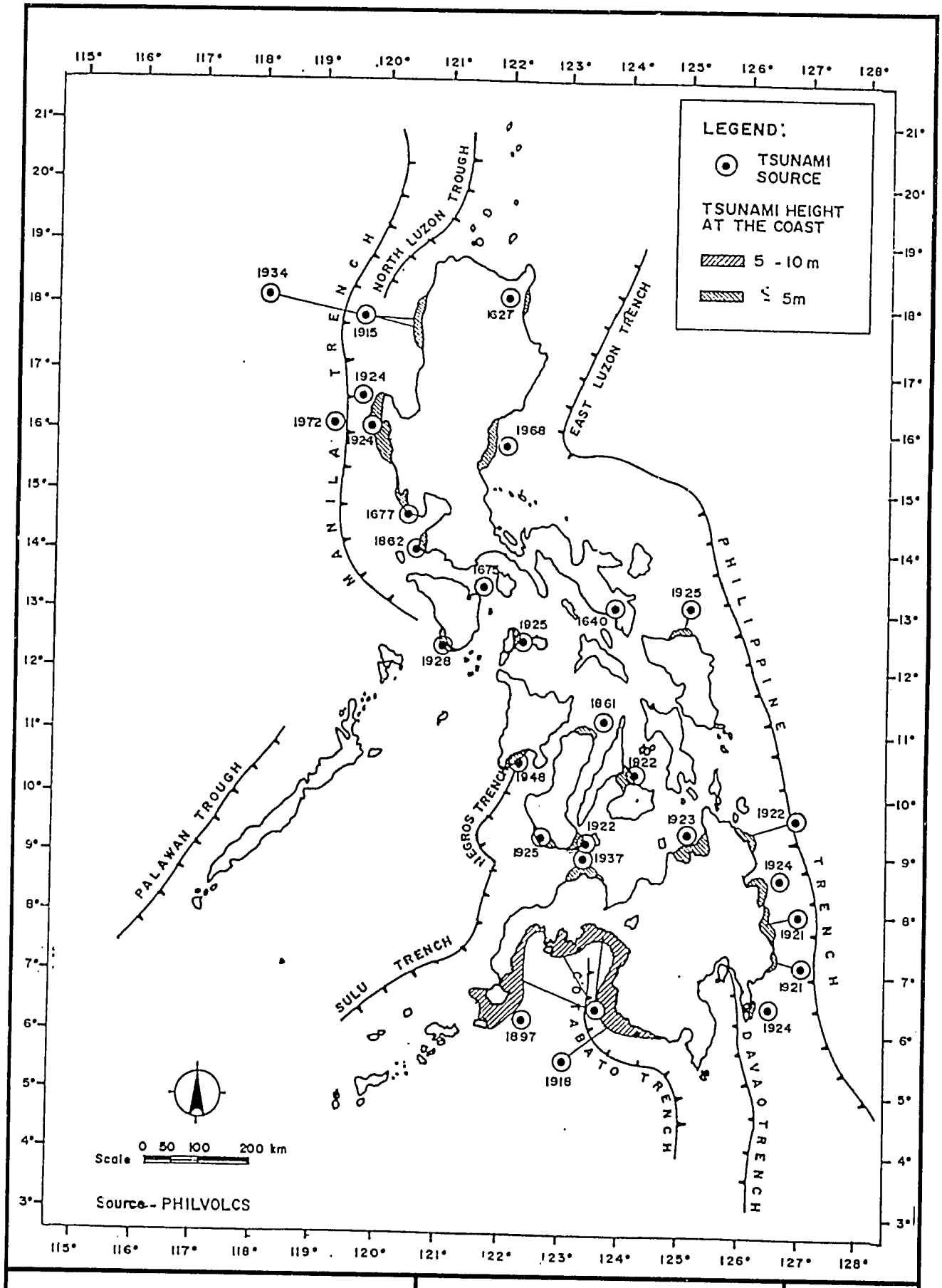
Figure 4-13 indicates that a tsunamis of < 5 m height occured along the Baler coastal region.

4.1.5.4 Previous Geotechnical Explorations

Initial data searches revealed that no subsurface investigations had been performed along the overall road alignment. Of the six existing Reinforced Concrete Deck Girder bridges (RCDG), within the study area, only the Aguang bridge got the Standard subsurface investigation. This study was performed by Geotechnics Philippines Incorporated, dated January 7, 1983, under a commission from the Department of Public Works and Highways. Two (RCDG) bridges, the Villa Aurora bridge from Bongabon to Baler and the Dupinga bridge going to Gabaldon from Palayan City are presently limited only to light vehicles due to foundation failure. In view of the lack of previous soil explorations, the detailed design stage of any future project must pay particular attention to subsurface investigation on proposed bridges crossing open waterways.

4.1.5.5 Soil Investigation Along Road Alignment

For feasibility study level, the actual Soil Investigation conducted involved field locations, sampling and laboratory testings. The methods used were Test pit excavating and Auger hole drilling to a depth not more than 1.50 meters. They were space at optimum distance (approximately two kilometers between Test Pits) and were alternately located along the alignment. Auger Borings by hand @1.00 meter depth were interspaced midway between Test Pits. Offsets on locations of some Test Pits and Auger holes due to obstructions and physical changes of soil formations were also recorded in field boring logs. (See Drawings 4-1 and 4-2 in Appendix F for Test Pits and Auger Boring location Plan.)



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	DISTRIBUTION OF TSUNAMI HIT AREAS IN THE PHILIPPINE	FIGURE 4-13

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A full time Sub-Consultants' field Engineer/Geologist monitored all the field work. An Engineering representative of the consultant with the assistance of the Engineering team were also present during most of the sampling operation. The field Engineer/Geologist maintained field logs indicating the depth, thickness and the nature of soil layers encountered in the test pits. Natural ground water levels were also monitored and recorded. Representative samples from each type of soil encountered were immediately sealed, taking all the necessary precautions to prevent contamination on other materials and sent to the Sub-Consultant's laboratory for further testing and evaluation. Collecting, handling and storing samples obtained in the test pits follow the recommendations in AASHTO T-203 respectively.

Laboratory testing program involves two main scopes of work which are: The Evaluation of Existing road condition and the Material Source evaluation.

The program of tests in existing road condition consists of the following: CBR determination on existing subgrade, Grain Size Analysis, Atterberg Limits, Natural moisture content determination, Specific gravity test, General Soil Classification and Determination of core strengths and thickness of existing paved sections. Refer to Table 4-4 for the Summary of Subgrade Test Results and to Table 4-5 for the summary of Concrete Core Testing.

Material Source Evaluation involves the following tests. Grain Size Analysis, Atterberg limits, Specific gravity, Unit weight, Abrasion, Soundness Test and Classification. Table 4-6 provides a summary of test results for Aggregate and Borrow Material Sources also.

Refer to the Terms Related to the Classification of soils and soil-aggregate mixture for Highway Construction, preceding the Summary of Subgrade, Test Results in Appendix F-7.

4.1.5.6 Material Sources

Material source maps obtained from the Department of Public Works and Highways (DPWH) show more than adequate quantities of materials available for use in any future project within these regions. More than thirty (30) sources were reflected in the maps, however, only the major ones with greater quantities and nearest the proposed road alignment were reflected in the modified material source map shown in Appendix F, Drawing F-6.1.

Peat gravel and sand is abundant in these sources and size requirements per engineering criteria maybe controlled by sieving or installation of plant crushers.

Data obtained from the design plans for construction of the Ma. Aurora-Canili-Pantabangan route reveal additional material sources for that route. Locations are as shown in Figure 4-7.

Table 4-4
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
1+350	TP-1	1.50	Sandy Clay	A-7-6	--	--	--	--	100	97	64	41	13	28	24	20.00	1.75	18.00	--
2+025	AH-1	1.00	Silty Clay	A-7-6	--	--	--	100	90	85	80	32	13	19	19	--	--	--	--
2+700	TP-2	1.50	Gravelly Sand	A-1-b	--	100	81	67	57	22	1	NIL	NIL	NP *	4	9.60	2.02	18.00	--
3+655	AH-2	1.00	Silty Sand	A-2-4	--	--	100	96	95	92	39	32	23	9	9	--	--	--	--
2+765	TP-3	1.50	Lean Clay	A-7-6	--	--	--	--	100	99	95	38	24	14	30	23.50	1.61	3.20	--
5+095	AH-3	1.00	Lean Clay	A-7-5	--	--	--	--	100	99	95	47	32	15	33	--	--	--	--
4+545	TP-4	1.50	Silty Sand	A-4	--	--	--	--	--	100	58	NIL	NIL	NP	24	18.10	1.66	6.95	--
6+620	AH-4	1.00	Silty Sand	A-2-4	--	--	--	100	98	77	18	NIL	NIL	NP	15	--	--	--	--
5+645	TP-5	1.50	Clayey Sand	A-2-7	--	100	80	80	79	60	20	53	27	26	2	16.70	1.92	15.00	--
8+600	AH-5	1.00	Lean Clay	A-7-6	--	--	--	100	99	97	78	47	29	18	40	--	--	--	--
7+600	TP-6	1.50	Sandy Clay	A-4	--	--	--	--	--	100	88	63	27	22	5	18.70	1.61	7.31	--
10+605	AH-6	1.00	Silty Sand	A-2-4	--	100	31	31	30	29	18	NIL	NIL	NP	5	--	--	--	--
9+600	TP-7	1.50	Silty Sand	A-2-4	--	--	--	--	100	79	32	34	26	8	12	14.20	1.84	26.50	--
11+945	AH-7	1.00	Silty Sand	A-2-7	--	100	46	43	40	38	34	70	38	32	19	--	--	--	--
11+610	TP-8	1.50	Silty Fine Sand	A-3	--	--	--	--	100	82	5	NIL	NIL	NP	8	10.30	1.92	22.50	--
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT					SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT													CIRCUMFERENTIAL ROAD	

* NP – Non Plastic

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Table 4–4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/4"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
12+955	AH–8	1.00	Fat Clay	A–7–6	--	--	--	--	100	99	90	53	29	24	32	--	--	--	--
12+280	TP–9	1.50	Clayey Clay	A–7–6	--	100	68	66	64	56	56	45	28	17	21	10.30	1.92	22.50	--
14+370	AH–9	1.00	Silty Clay	A–4	--	--	--	100	99	98	94	35	10	25	15	--	--	--	--
12+350	TP–10	1.50	Clayey Gravel	A–2–6	--	100	26	23	23	23	23	40	22	18	13	--	--	--	--
16+120	AH–10	1.00	Clayey Silt	A–2–4	--	--	100	85	70	62	32	12	4	8	8	--	--	--	--
13+560	TP–11	1.50	Silty GRavel	A–2–7	--	100	40	38	37	36	35	NIL	NIL	NP	15	--	--	--	--
18+170	AH–11	1.00	Sandy Clay	A–6	--	--	100	94	90	84	62	32	18	14	25	--	--	--	--
13+620	TP–12	1.50	Lean Brown Clay	A–7–6	--	--	--	100	99	98	96	47	26	21	35	25	1.5	4.60	--
20+380	AH–12	1.00	Sandy Clay	A–6	--	--	--	100	99	97	67	36	20	16	25	--	--	--	--
15+120	TP–13	1.50	Fat Clay	A–7–6	--	100	94	94	94	93	90	53	23	30	35	25	1.5	5.15	--
22+470	AH–13	1.00	Sandy Clay	A–6	--	100	71	65	64	56	43	33	22	11	15	--	--	--	--
17+120	TP–14	1.50	Lean Clay	A–7–6	--	--	--	--	100	99	92	47	23	24	21	26	1.5	4.00	--
24+480	AH–14	1.00	Sandy Silt	A–4	--	--	--	--	100	99	60	40	30	10	28	--	--	--	--
19+220	TP–15	1.50	Clayey Sand	A–2–6	--	100	85	75	65	56	35	32	21	11	14	10	2.1	35.00	--
26+500	AH–15	1.00	Sandy Gravel	A–1–a	--	100	52	36	25	4	2	NIL	NIL	NP	--	--	--	--	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | CIRCUMFERENTIAL ROAD

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Table 4–4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/4"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)	(%)	OMC (%)	MDD		
19+280	TP–16	1.50	Lean Clay	A–6	--	--	--	--	100	98	90	39	19	20	31	22	1.56	4.70	--
28+475	AH–16	1.00	Lean Clay	A–7–6	--	--	100	93	87	81	74	45	26	19	25	--	--	--	--
21+480	TP–17	1.50	Silty Sand	A–2–4	--	100	75	67	57	43	13	NIL	NIL	NP	12	10	1.98	13.00	--
30+425	AH–17	1.00	Lean Clay	A–7–6	--	--	--	--	100	100	91	48	19	29	35	--	--	--	--
23+460	TP–18	1.50	Lean Clay	A–6	--	--	--	--	--	100	61	31	21	10	20	15	1.82	12.00	--
32+270	AH–18	1.00	Clayey Silt	A–7–5	--	--	--	100	93	84	72	72	47	25	32	--	--	--	--
25+500	TP–19	1.50	Lean Clay	A–7–6	--	--	--	100	99	98	86	45	27	18	29	26	1.56	12.51	--
33+960	AH–19	1.00	Sandy Gravel	A–1–b	--	100	64	52	41	21	3	NIL	NIL	NP	--	--	--	--	--
27+500	TP–20	1.50	Sandy Clay	A–7–6	--	--	--	100	99	98	73	48	30	18	21	17	1.58	4.90	--
35+480	AH–20	1.00	Lean Clay	A–7–6	--	--	--	100	93	83	73	48	28	20	31	--	--	--	--
29+450	TP–21	1.50	Sandy Gravel	A–1–b	--	100	68	54	38	15	3	NIL	NIL	NP	5	6.5	2.20	47.00	--
37+000	AH–21	1.00	Sandy GRavel	A–6	--	--	100	95	90	82	54	30	18	12	19	--	--	--	--
31+400	TP–22	1.50	Fat Clay	A–7–5	--	--	--	--	100	99	95	52	31	21	35	28	1.47	5.00	--
0+050	AH–22	1.00	Silty Clay	A–2–4	--	100	90	74	49	33	15	NIL	NIL	NP	7	--	--	--	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

SOILS AND MATERIALS SURVEY
SUBGRADE TEST RESULT

CIRCUMFERENTIAL ROAD

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Table 4–4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)	(%)	OMC (%)	MDD		
33+145	TP–23	1.50	Sandy Clay	A–7–6	--	100	90	90	86	75	47	61	45	16	25	18	1.7	10.00	--
33+160	TP–24	1.50	Sandy Silt	A–4	--	--	100	97	96	88	47	34	26	8	--	12	1.84	18.00	--
34+760	TP–25	1.50	Lean Clay	A–7–6	--	--	--	100	93	76	49	42	14	28	37	14	1.9	11.00	--
36+200	TP–26	1.50	Lean Clay	A–7–6	--	--	--	100	98	94	87	43	12	31	29	24	1.61	3.40	--
37+800	TP–27	1.50	Lean Clay	A–6	--	--	--	100	99	98	92	39	25	14	34	28	1.5	2.55	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | CIRCUMFERENTIAL ROAD

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Table 4-4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
0+00	TP-1	1.50	Sandy Fat Clay	A-7-5	--	--	100	96	80	60	50	52	33	19	22	28.80	1.48	5.00	--
7+000	TP-2	1.50	Clayey Silt	A-5	--	--	100	95	94	87	68	46	36	10	29	27.90	1.505	5.70	--
16+800	TP-3	1.50	Fat Clay	A-7-5	--	--	--	100	100	94	79	58	40	18	45	30.20	1.45	2.00	--
22+160	TP-4	1.50	Clayey Sand	A-2-6	--	100	94	84	69	46	28	27	16	11	10	21.10	1.58	5.00	--
27+000	TP-5	1.50	Sandy Silt	A-5	--	--	--	--	100	100	75	59	53	6	21	20.00	1.535	2.30	--
33+400	TP-6	1.50	Silty Clay	A-7-5	--	--	100	98	96	94	84	56	32	24	25	26.70	1.47	3.20	--
37+700	TP-7	1.50	Clayey Sand	A-2-6	--	100	82	72	57	39	30	39	23	16	14	21.70	1.605	5.20	--
44+000	TP-8	1.50	Clayey Sand	A-7-6	--	--	--	100	96	96	85	49	22	27	18	26.00	1.46	4.00	--
60+000	TP-9	1.50	Clayey Sand	A-2-6	--	100	98	99	84	72	48	26	22	18	18	21.10	1.63	8.00	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT	SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT	MARIA AURORA-PANTABANGAN ROAD

Reference Point: Station 00+000. Infront of Maria Aurora Municipal Hall

Table 4–4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)	(%)	OMC (%)	MDD		
6+480	TP–1	1.50	Sandy Clay	A–7–6	--	--	100	98	92	77	55	42	26	16	17	26.50	1.54	10.00	--
13+200	TP–2	1.50	Sandy Clay	A–6	--	100	99	93	85	69	51	38	24	14	13	19.80	1.60	5.80	--
21+375	TP–3	1.50	Sandy Silt	A–7–6	--	100	97	93	89	80	52	41	28	13	27	22.00	1.51	9.00	--
28+000	TP–4	1.50	Silty Clay	A–7–6	--	100	94	93	91	87	77	66	50	16	51	34.00	1.37	7.80	--
36+930	TP–5	1.50	Sandy Silt	A–6	--	--	100	99	98	96	57	36	24	12	22	21.00	1.64	4.50	--
42+000	TP–6	1.50	Silty Clay	A–5	--	--	100	88	85	84	72	NIL	NIL	NP	--	26.00	1.475	16.50	--
50+350	TP–7	1.50	Clayey Sand	A–2–6	--	--	100	97	95	89	30	41	29	12	24	20.00	1.85	13.20	--
59+600	TP–8	1.50	Sandy Clay	A–6	--	100	87	74	67	55	36	37	25	12	21	19.00	1.68	7.80	--
65+110	TP–9	1.50	Clayey Silt	A–7–6	--	--	--	100	99	97	91	45	28	17	33	25.50	1.52	4.10	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT	SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT	BONGABON–SAN LUIS NATIONAL ROAD

Reference Point: Kalaanan Primary School, DPWH km. Post 153+900 referred to as Station 00+000

Table 4-4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
14+800	AH-8	1.00	Fat Clay	A-7-6	--	--	100	98	93	84	74	59	28	32	27	--	--	--	--
15+800	TP-9	1.50	Sandy Gravel	A-1-a	100	78	58	51	44	14	4	NIL	NIL	NP *	1.9	12.40	1.87	17.20	--
17+050	AH-9	1.00	Sandy Silt	A-4	--	--	--	--	100	99	75	--	--	--	--	--	--	--	--
18+300	TP-10	1.50	Silty Sand	A-2-4	--	100	76	53	31	20	13	29	21	8	5	10.00	2.04	41.00	--
19+150	AH-10	1.00	Silty Sand	A-2-4	--	100	70	58	45	36	23	22	15	7	4	--	--	--	--
20+000	TP-11	1.50	Sandy Silt	A-4	--	100	80	66	58	51	37	28	18	10	7	11.25	1.98	41.00	--
20+950	AH-11	1.00	Silty Sand	A-2-4	--	100	76	65	53	45	33	28	19	9	6	--	--	--	--
21+900	TP-12	1.50	Lean Clay	A-6	--	100	91	72	60	54	44	35	21	14	16	24.60	1.48	4.60	--
22+450	AH-12	1.00	Silty Sand	A-2-4	--	100	91	58	41	27	14	NIL	NIL	NP	4	--	--	--	--
23+100	TP-13	1.50	Fine Sand	A-3	--	--	100	98	98	93	11	NIL	NIL	NP	3	10.00	2.06	58.00	--
24+000	AH-13	1.00	Gravelly Sand	A-1-b	--	100	67	49	32	16	7	NIL	NIL	NP	2	--	--	--	--
25+000	TP-14	1.50	Sandy Silt	A-4	--	--	--	--	100	97	58	22	17	5	14	20.00	1.60	3.00	--
26+000	AH-14	1.00	Silty Sand	A-2-4	--	100	81	73	62	50	33	27	18	9	12	--	--	--	--
27+000	TP-15	1.50	Sandy Gravel	A-1-b	--	100	64	42	26	12	1	20	15	15	5	8.70	2.03	43.00	--
28+000	AH-15	1.00	Silty Sand	A-2-4	--	100	93	74	55	39	23	21	15	6	7	--	--	--	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | TABLANG-DINGALAN ROAD

Table 4-4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
0+00	TP-1	1.50	Lean Clay	A-7-6	--	--	100	97	87	75	59	40	18	22	19	20.30	1.68	7.80	--
1+00	AH-1	1.00	Gravelly Sand	A-1-b	--	100	92	67	51	24	9	NIL	NIL	NP*	3	--	--	--	--
2+00	TP-2	1.50	Sandy Clay	A-6	--	--	100	91	74	54	35	38	22	16	13	19.88	1.70	8.00	--
3+00	AH-2	1.00	Sandy Clay	A-6	--	--	100	93	82	66	50	38	24	14	12	--	--	--	--
4+00	TP-3	1.50	Fat Clay	A-7-6	--	--	--	100	95	94	86	59	26	33	31	30.00	1.46	3.70	--
5+00	AH-3	1.00	Sandy Clay	A-6	--	--	100	97	91	82	57	30	18	12	16	--	--	--	--
6+00	TP-4	1.50	Sandy Clay	A-2-4	--	100	84	78	64	52	42	42	21	21	8	18.60	1.72	4.80	--
7+00	AH-4	1.00	Silty Sand	A-2-4	--	100	91	81	62	39	17	NIL	NIL	NP	6	--	--	--	--
8+00	TP-5	1.50	Clayey Sand	A-2-6	--	100	81	65	51	40	32	36	20	16	12	14.70	1.94	9.60	--
9+00	AH-5	1.00	Silty Sand	A-2-4	--	100	87	70	52	30	13	19	15	4	6	--	--	--	--
10+00	TP-6	1.50	Silty Sand	A-2-4	--	100	83	74	58	40	19	NIL	NIL	NP*	8	8.10	2.20	42.50	--
11+00	AH-6	1.00	Clayey Sand	A-2-6	--	100	97	79	63	41	29	32	18	14	12	--	--	--	--
12+00	TP-7	1.50	Sandy Silt	A-7-6	--	100	93	83	69	60	49	56	28	28	20	24.90	1.51	5.70	--
13+00	AH-7	1.00	Clayey Sand	A-5	--	--	--	100	99	97	87	42	33	9	23	--	--	--	--
13+800	TP-8	1.50	Clayey Sand	A-4	--	--	100	99	95	87	81	37	29	8	28	27.80	1.47	4.80	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | TABLANG-DINGALAN ROAD

* NP = Non Plastic

Table 4-4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
29+400	TP-16	1.50	Sandy Gravel	A-1-b	--	100	69	58	43	21	7	NIL	NIL	3	3	8	2.17	56.50	--
30+950	AH-16	1.00	Silty Silt	A-4	--	--	--	100	95	81	64	29	9	20	20	--	--	--	--
31+500	TP-17	1.50	Lean Clay	A-6	--	--	--	100	99	95	83	35	23	12	24	31	1.30	2.00	--
22+750	AH-17	1.00	Silty Sand	A-2-4	--	100	96	83	65	44	23	23	17	6	6	--	--	--	--
33+000	TP-18	1.50	Clayey Gravels	A-2-6	--	100	30	18	15	13	8	28	17	11	6	11	1.88	22.00	--
34+000	AH-18	1.00	Silty Sand	A-2-4	--	100	78	53	33	20	13	22	14	8	6	--	--	--	--
35+000	TP-19	1.50	Sandy Silt	A-4	--	100	97	95	90	80	58	24	17	7	16	20	1.61	4.00	--
36+000	AH-19	1.00	Silty Sand	A-2-4	--	100	60	56	49	40	19	NIL	NIL	NP	7	--	--	--	--
37+000	TP-20	1.50	Sandy Clay	A-6	--	100	96	93	89	89	59	40	22	18	28	26	1.53	4.20	--
38+000	AH-20	1.00	Fat Clay	A-7-5	--	100	84	83	79	77	75	77	39	38	35	--	--	--	--
39+000	TP-21	1.50	Fat Clay	A-7-6	--	--	--	100	96	89	74	55	27	28	49	26	1.50	3.20	--
40+000	AH-21	1.00	Lean Clay	A-7-5	--	100	96	96	93	90	83	49	35	14	25	--	--	--	--
41+000	TP-22	1.50	Fat Clay	A-7-5	--	--	--	100	89	63	59	76	33	43	32	23	1.51	3.40	--
42+000	AH-22	1.00	Sandy Clay	A-7-6	--	100	95	88	80	72	61	52	28	24	24	--	--	--	--
43+000	TP-23	1.50	Fat Clay	A-7-5	--	--	--	100	97	96	89	60	36	24	40	28	1.45	3.00	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | TABLANG-DINGALAN ROAD

Table 4-4 (continued)
SUMMARY OF SUBGRADE TEST RESULTS

STATION (km)	SAMPLE NO.	DEPTH (M)	SOIL DESCRIPTION	SOIL CLASSIFICATION AASHTO	GRAIN ANALYSIS (% PASS SIEVE NO.)							ATTERBERG LIM			NMC (%)	COMPACTION		CBR @ 95% MDD	OTHERS
					2"	1"	3/8"	#4	#10	#40	#200	LL (%)	PL (%)	PI (%)		OMC (%)	MDD		
44+000	AH-23	1.00	Fat Clay	A-7-5	--	--	100	98	94	90	84	72	33	39	29	--	--	--	--
45+000	TP-24	1.50	Clayey Sand	A-2-7	--	--	100	84	75	42	21	41	25	16	24	27	1.45	14.20	--
45+500	AH-24	1.00	Lean Clay	A-7-5	--	100	82	13	60	52	41	49	32	17	12	--	--	--	--
46+000	TP-25	1.50	Clayey Sand	A-2-7	--	100	62	49	34	23	17	45	28	17	13	18	1.81	6.50	--
46+650	AH-25	1.00	Clayey Sand	A-2-6	--	100	65	57	47	32	18	35	17	18	13	--	--	--	--
47+300	TP-26	1.50	Sandy Silt	A-4	--	100	71	68	59	41	36	29	28	1	10	16	1.91	31.00	--
48+030	AH-26	1.00	Sandy Gravel	A-1-9	--	100	65	49	28	12	5	NIL	NIL	NP	5	--	--	--	--

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT | SOILS AND MATERIALS SURVEY SUBGRADE TEST RESULT | TABLANG-DINGALAN ROAD

Table 4–5
SUMMARY OF CONCRETE CORING TEST (ASTMC–42)

IDENTIFICATION	ACTUAL DIAMETER ☐ in. ☐ cm.	STRENGTH CORRECTION FACTOR	CROSS SECTIONAL, AREA ☐ in. ☐ cm.	COMPRESSIVE STRENGTH ☐ MPa ☐ PSI	CORRECTED COMPREHENSIVE STRENGTH ☐ MPa ☐ PSI	REMARKS
CIRCUMFERENTIAL ROAD						
C–1 (Sta. 0+970)	3.95	0.982	12.25	5,633	5,520	
C–2 (Sta. 0+470)	3.95	0.966	12.25	1,551	1,498	AVERAGE
C–3 (Sta. 0+000)	3.96	0.963	12.32	1,867	1,798	
C–10 (Sta. 33+920)	3.95	0.976	12.25	1,796	1,753	3,763 PSI
C–11 (Sta. 33+420)	3.96	0.931	12.32	5,925	5,516	
C–15 (Sta. 21+340)	3.95	0.967	12.25	4,735	4,579	
C–16 (Sta. 20+300)	3.9	0.892	11.95	3,515	3,135	
C–18 (Sta. 3+210)	3.95	0.988	12.25	4,082	4,033	
C–19 (Sta. 2+715)	3.94	0.986	12.19	4,184	4,121	
C–20 (Sta. 2+375)	3.94	0.937	12.19	5,660	5,303	
C–21 (Sta. 1+685)	3.97	0.986	12.38	4,200	4,141	

Table 4–5 (continued)
SUMMARY OF CONCRETE CORING TEST (ASTMC–42)

IDENTIFICATION	ACTUAL DIAMETER ☐ in. ☐ cm.	STRENGTH CORRECTION FACTOR	CROSS SECTIONAL, AREA ☐ in. ☐ cm.	COMPRESSIVE STRENGTH ☐ MPa ☐ PSI	CORRECTED COMPREHENSIVE STRENGTH ☐ MPa ☐ PSI	REMARKS
TABLANG – DINGALAN ROAD						
C–1 (Sta. 0+500)	3.94	0.954	12.19	3,035	2,895	
C–2 (Sta. 5+000)	3.96	1.000	12.32	5,276	5,276	AVERAGE
C–3 (Sta. 5+500)	3.95	0.967	12.25	3,265	3,157	
C–4 (Sta. 6+000)	3.95	0.961	12.25	4,163	4,001	3,846 PSI
C–5 (Sta. 6+500)	3.94	0.990	12.19	5,332	5,279	
C–6 (Sta. 7+000)	3.95	0.994	12.25	4,082	4,058	
C–7 (Sta. 8+000)	3.94	0.994	12.19	4,512	4,485	
C–8 (Sta. 8+500)	3.95	0.940	12.25	4,082	3,837	
C–9 (Sta. 9+500)	3.95	0.934	12.25	2,939	2,745	
C–10 (Sta. 10+000)	3.95	0.993	12.25	4,245	4,215	
C–12 (Sta. 36+500)	3.95	0.982	12.25	1,959	1,924	
C–13 (Sta. 37+000)	3.95	0.990	12.25	3,837	3,799	
C–14 (Sta. 37+500)	3.94	0.977	12.19	4,430	4,328	

Table 4-6
SUMMARY OF TEST RESULTS FOR AGGREGATE AND BORROW MATERIAL SOURCES

AGGREGATE SOURCES	SIEVE ANALYSIS														ATTERBERG LIMIT			SPECIFIC GRAVITY				UNIT WEIGHT		ABRASION LOSS (%)	SOUNDNESS (Na_2SO_4) (%)	ORGANIC CONTENT
	2 1/2	2	1 1/2	1	3/4	1/2	3/8	4	8	16	30	50	100	200	LL	PL	PI	DRY	SSD	APP	ABS (%)	LOOSE	RODDED			
BALER-AURORA (RIVER)																										
TP-1A (AGUANG)	-	100	83	75	64	57	57	46	40	33	26	9	3	1	NIL	NIL	N.P.	2.73	2.76	2.82	1.19	1.76	1.92	17.66	0.19	SATISFACTORY
TP-2A (MALUPA)	-	-	100	88	72	59	53	41	34	27	21	13	6	5	NIL	NIL	N.P.	2.71	2.75	2.83	1.54	1.76	1.94	21.72	0.57	SATISFACTORY
TP-3A (DIAMAN)	-	100	99	99	89	77	68	55	46	36	28	16	10	10	NIL	NIL	N.P.	2.74	2.77	2.81	87.00	1.76	1.97	18.97	0.62	SATISFACTORY
TP-4A (DIKILDIT)	-	-	100	88	75	56	46	32	24	17	13	7	3	2	NIL	NIL	N.P.	2.77	2.79	2.83	0.67	1.81	1.94	21.66	0.90	SATISFACTORY
TP-5A (BALITWAK)	-	100	94	85	74	71	62	44	34	27	23	19	17	16	NIL	NIL	N.P.	2.75	2.77	2.81	0.77	1.80	1.94	20.95	1.17	SATISFACTORY
TP-6A (DITEKI)	-	100	99	86	75	59	48	25	13	7	4	2	1	1	NIL	NIL	N.P.	2.80	2.82	2.84	0.48	1.80	1.93	23.16	1.15	SATISFACTORY
TP-7A1 (VILLA AURORA)	-	-	100	97	86	67	56	32	18	10	7	4	3	3	NIL	NIL	N.P.	2.75	2.78	2.81	0.77	1.64	1.81	18.54	1.75	SATISFACTORY
TP-7A2 (VILLA AURORA)	100	95	76	76	64	53	48	36	29	25	24	23	22	22	NIL	NIL	N.P.	2.76	2.77	2.79	0.43	1.70	1.81	19.26	0.62	SATISFACTORY
PALAYAN-DINGALAN (RIVER)																										
TP-1A (BATO FERRY)	-	-	100	90	82	61	49	31	22	16	11	5	2	2	NIL	NIL	N.P.	2.81	2.82	2.84	0.40	1.69	1.90	22.85	0.61	SATISFACTORY
TP-2A (SEGUM)	100	92	76	69	62	83	46	32	20	13	10	6	4	2	NIL	NIL	N.P.	2.77	2.80	2.87	1.26	1.71	1.84	24.54	0.93	SATISFACTORY
TP-3A (LIGAYA)	-	100	95	80	68	83	44	30	20	12	9	4	2	1	NIL	NIL	N.P.	2.86	2.88	2.91	0.66	1.79	1.94	20.72	0.38	SATISFACTORY
TP-4A (DUPINGA)	-	100	87	73	59	77	35	22	14	9	6	4	3	3	NIL	NIL	N.P.	2.78	2.81	2.86	1.07	1.69	1.87	21.35	1.13	SATISFACTORY
TP-5A (DANGLAN)	-	100	96	80	69	54	44	27	15	7	4	2	1	1	NIL	NIL	N.P.	2.72	2.76	2.83	1.42	1.65	1.82	22.54	7.88	SATISFACTORY
TP-6A	100	96	93	75	67	55	48	34	24	15	9	5	3	2	NIL	NIL	N.P.	2.83	2.85	2.89	0.74	1.73	1.88	20.00	1.79	SATISFACTORY

4.2 PRELIMINARY DESIGN

4.2.1 Roadway Design

As a result of the traffic studies performed, this preliminary design focused on an AADT of less than 900 vehicles on all road segments with numerous segments having AADTs under 500 vehicles. Thus, from DPWH standards, a typical section of 6.0 meter wide roadway with 1.0 meter shoulder on both sides was considered for all road sectors. The type of surfacing for each segment was based on projected 20 year ADDT for that segment. Various pavement designs are shown in the Pavement Design Section (Section 4.3).

Minimal geometric improvements were introduced to meet the standards set by the DPWH as shown on Table 4-7. These improvements included the setting of minimum radius to 50.0 meter for the Baler Circumferential and 30.0 meter for the rugged terrain in Palayan-Dingalan. Incorporation of equations were done to tie in with the original survey data. For vertical curvature, the profile followed as much as possible existing ground line with raising of grades through areas subject to inundation.

Field survey data are shown in Appendix F-13.

4.2.1.1 Preparation of Drawings and Cross-Sections

Field survey data was computed and plotted on a millimeter paper. Drawings were developed on A-3 size mylar paper with the following scale:

Plan:	1:20,000	
Profile:	Horizontal	1:20,000
	Vertical	1:2,000
Cross-Sections:	Horizontal	1:100
	Vertical	1:100

These same scale drawings were utilized for plan and profile on segments for which only topographic maps were used for determining alignment.

Table 4-7

MINIMUM DESIGN STANDARD PHILIPPINE HIGHWAYS *

AVERAGE DAILY TRAFFIC ON OPENING	UNDER 200	200-400	400-1000		1000-2000		MORE THAN 2000	
			MINIMUM	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM	DESIRABLE
Design Speed (km/h)								
Flat Topography	60	70	70	90	80	95	90	100
Rolling Topography	40	50	60	80	60	80	70	90
Mountainous Topography	30	40	40	50	50	60	60	70
Radius (Meter)								
Flat Topography	120	160	160	280	220	320	260	350
Rolling Topography	55	85	120	220	120	220	160	280
Mountainous Topography	30	50	50	80	80	120	180	160
Grade (Percent)								
Flat Topography	6.0	6.0	5.0	3.0	4.0	3.0	4.0	3.0
Rolling Topography	8.0	7.0	6.0	5.0	5.0	5.0	5.0	4.0
Mountainous Topography	10.0	9.0	8.0	6.0	7.0	6.0	7.0	5.0
Pavement Width (m)	4.0	5.5; 6.0	6.10	6.10	6.70	6.70	6.70	7.30
Shoulder Width (m)	0.50	1.00	1.50	2.00	2.50	3.0	3.0	3.0
Right of Way Width (m)	20	30	30	30	30	30	60	60
Superelevation (m/m)	0.10 (max.)		0.10 (max.)		0.10 (max.)		0.10 (max.)	
Non-Passing Sight Distance (meter)								
Flat Topography	70	90	90	135	115	150	135	160
Rolling Topography	40	60	70	115	70	115	90	135
Mountainous Topography	40	40	40	60	60	70	70	90
Passing Sight Distance (meter)								
Flat Topography	420	490	490	615	560	645	615	675
Rolling Topography	270	350	420	560	420	560	490	615
Mountainous Topography	190	270	270	350	360	420	420	490
Type of Surfacing	Gravel, Crushed Gravel or Crushed Stone Bit. Preservative Treatment, Single or Double Bit. Surface Treatment, Bituminous Macadam Pavement.		Bituminous Macadam Pavement, Dense or Open Graded Plant Mix Surface Course, Bituminous Concrete Surface Course.		Bitumious Concrete Surface Course		Bituminous Concrete Surface Course, Portland Cement Concrete Pavement	

* Table 3.2 Page 736, DPWH Guidelines

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4.2.1.2 Plan and Profile Sheets

Plan and profile sheets incorporated important details such as design traffic volume, carriageway and shoulder widths, type of pavement and improvement to be made, direction of drainage flow on both sides of the road, existing and proposed structures like bridges, Reinforced Concrete Box Culverts (RCBC) and Reinforced Concrete Pipe Culverts (RCPC) and miscellaneous details like a maximum height of flood level. Each plan and profile sheet contained a maximum roadway length of 7.0 km. Preliminary plan and profile sheets are shown in Appendix F-10.

4.2.1.3 Preliminary Design by Segment

Each segment of roadway has been evaluated according to terrain type, CBR soil support value, AADT and physical location with respect to "typhoon resistant" design. The flat coastal plain of the Circumferential road because of its proximity to the Philippine Sea and probable frequent typhoon damage was evaluated for PCCP and AC. Other road segments were evaluated more closely according to AADT and expected ESAL values to ascertain a proposed pavement type. It should be noted that in nearly all segments, the ESAL values expected at year 20 are below 1,000,000. The DPWH Design Guide recommends that DBST roads can be constructed for ESALs up to 2,500,000 and that AC or DBST can be utilized for 1,000,000 < ESAL < 2,500,000. Because of the requirement for design of "typhoon resistant" roads, no gravel surfacing will be considered at this time. Final design may dictate that some low volume segments receive gravel surfacing during the first stage (10 years) and then receive DBST or AC surfacing in Stage 2 (after 10 years).

- CIRCUMFERENTIAL

(a) Baler to Dipaculao - Segment 1A

The projected traffic for this segment is:

YEAR	AADT
1994	106
2004	149
2014	195

The proposed improvements to this section will consist of the reconstruction of the existing roadway by raising the existing grade 0.0-1.0 meters, reestablishing ditches on both sides and widening shoulders to meet the 6-1-1 roadway requirement. Cross drainage culverts will be installed or rehabilitated as necessary. Surfacing will consist of PCCP.

(b) Dipaculao to Maria Aurora - Segment 1B

The projected traffic for this segment is :

YEAR	AADT
1995	228
2004	318
2014	414

The proposed improvements to this section will consist of the reconstruction of the existing roadway by raising the existing grade 0.0-1.5 meters, re-establishing ditches on both sides and widening shoulders to meet the 6-1-1 roadway requirement. Cross drainage culverts will be installed or rehabilitated as necessary and a new Salay bridge will be constructed. Surfacing will consist of PCCP.

(c) Maria Aurora to San Luis - Segment 1C

The projected traffic for this segment is :

YEAR	AADT
1994	418
2004	605
2014	775

The proposed improvements to this section will consist of the reconstruction of the existing roadway by raising the existing grade 0.0-1.0 meters, re-establishing ditches on both sides and widening shoulders to meet the 6-1-1 roadway requirement. Cross drainage culverts will be installed or rehabilitated as necessary and new overflow structures will be constructed at the Malupa River, the Diamin River and the Diteki River. Surfacing will consist of PCCP.

(d) San Luis to Baler - Segment 1D

The projected traffic for this segment is :

YEAR	AADT
1994	260
2004	374
2014	475

The proposed improvements to this section will consist of the reconstruction of the existing roadway by raising the existing grade 0.0-0.5 meters, re-establishing ditches on both sides and widening shoulders to meet the 6-1-1 roadway requirement. Cross drainage culverts will be installed or rehabilitated as necessary. Existing asphalt surfacing should be scarified, mixed with additional granular material to meet base thickness requirements and recompacted in place. Surfacing will consist of PCCP.

- TABLANG-BONGABON-KM170-CABATANGAN/MALUPA-KM38-MARIA AURORA

(a) Tablang to Bongabon - Segment 5C

The projected traffic for this segment is :

YEAR	AADT
1994	500
2004	750
2014	1000

The proposed improvements to this section will consist of the reconstruction of the existing roadway by excavation and embankment. The section will include raising the grade 0.0-1.0 m to keep the road above flood elevations of the surrounding farmlands. Side ditches will be rehabilitated and shoulders widened. Four existing reinforced concrete box culverts will be replaced. Several kilometers of PCCP exist which are in good condition. Some isolated slab panels of this pavement were damaged by the July 1990 earthquake and must be replaced. Approximately 2.0 km of existing asphalt surfacing should be scarified, mixed with additional granular material to meet base thickness requirements and recompacted in place. Surfacing will be AC except for the existing PCCP sections.

(b) Bongabon to KM 170 - Segment 5B

The projected traffic for this segment is :

YEAR	AADT
1994	539
2004	755
2014	986

The proposed improvements to this section will consist of the reconstruction of the existing roadway by excavation and embankment. The section from Bongabon to Calaanan will basically include raising the grade 0.0-1.0 m to keep the road above flood elevations of the surrounding farmlands. Side ditches will be rehabilitated and shoulders widened.

The section from Calanaan to km 170 is currently very mountainous and horizontal alignment is very tenuous. Heavy excavation and embankments as well as installation of numerous drainage structures will be necessary.

A new 2-lane, 5-span, 105 m long bridge should be constructed at Labi to replace an existing Bailey bridge. Reinforced concrete box culverts are proposed at fourteen locations between Bongabon and KM 170 to replace existing undersized structures or structures in poor condition. Several concrete pipe culverts will be extended in length by up to 5 m.

The proposed surfacing will be AC.

(c) KM 170 to KM 38 through Cabatangan/Malupa valley - Segment 5A

The projected traffic for this segment is :

YEAR	AADT
1996	403
2005	567
2015	743

The proposed improvements to this section will consist of the construction of a new roadway on new alignment by excavation and embankment. The proposed alignment begins near the Aurora-Nueva Ecija provincial border and proceeds easterly and northerly into the Cabatangan river valley and the Malupa river valley. It then ties into an existing local government developed road at km 17 (Segment 5A) = km 38 (Segment $2B_1$). A logging trail follows much of the river valley upstream from the confluence of the Cabatangan river with the Malupa

river. This routing skirts the existing boundary of the Aurora Memorial Park from km 0 to km 7 and construction of this alignment could enhance the ability of park officials to protect the current and future park development programs. This new alignment would then border the park rather than bisect the park as the existing National Highway does.

Construction will consist of 20 concrete pipe culverts, 3 reinforced concrete box culverts and 2 multi span bridges. Maximum vertical gradient will be 9 per cent from km 1 to km 5.

Surfacing will be PCCP from km 1 to km 5; DBST from km 5 to km 17.

(d) KM 38 to Bazal - Segment $2B_1$

The projected traffic for this segment is :

YEAR	AADT
1996	378
2005	536
2015	706

The proposed improvements to this section will consist of the reconstruction of the existing roadway recently built by local government. Rehabilitation will consist of excavation and embankment plus a significant amount of drainage mitigation. Little if any work was done in the current project to minimize soil erosion on steep embankments and cut sections. These areas will be improved by installation of concrete drainage channels, let-down structures, slope protection, geotextile erosion control blankets and revegetation. Based on plans and profiles provided by the Department of Local Government, there are several sections with substandard horizontal curves and several locations with vertical gradients in excess of the desired 9.0 per cent.

Those sections requiring horizontal alignment improvements consist of twenty-seven (27) locations with a total length of 1.56 km. At these locations, current curvature varies from 20.0 m to 50.0 m. Those sections requiring vertical alignment improvements include twenty-nine (29) locations with a total length of 1.95 km. Current vertical gradients as shown on the plans in excess of the desired 9.0 percent range from 10.17 per cent to 19.78 per cent. Discussions with field construction personnel representing local government revealed that numerous locations on the Canili-Maria Aurora road were redesigned in the field and vertical gradients were lowered up to 3 per cent less than design grades. No "as built" drawings were available to ascertain specific locations where alignments were modified. Thus, this design assumes that all construction within this segment will be modified from existing plans to meet design standards. The

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Department of Local Government office did provide a quantity calculation of earthwork quantities on the Canili-Maria Aurora section so the Consultant could develop preliminary quantity estimates.

Maximum vertical gradient will be 9 per cent from km 1 to km 5.

Construction will consist of concrete pipe culverts at 18 locations, and widening from 1 lane to 2 lanes the following three bridge locations - Binuangan, Dimanglat and Dianawan. Surfacing will be AC.

(e) Bazal to Maria Aurora - Segment 2A

The projected traffic for this segment is :

YEAR	AADT
1996	378
2005	536
2015	706

The proposed improvements to this section will consist of the reconstruction of the existing roadway according to the same techniques as Segment $2B_1$ above. Structural improvements include the rehabilitation of the San Joaquin bridge, and widening from 1 lane to 2 lanes the Estonillo bridge.

Surfacing will consist of AC.

♦ RIZAL-KM 38

Rizal to Pantabangan to Canili Km 38 - Segments 2D, 2C and $2B_2$

The projected traffic for this segment is:

YEAR	AADT
1995	450
2004	624
2014	805

The proposed improvements to this section will consist of the reconstruction of the existing roadway according to the same techniques as Segment $2B_1$ and 2A above. Structural improvements will include widening three existing one-lane bridges to two lanes, constructing one new bridge and providing riprap and abutment repairs to two bridges. Because of concern expressed by local officials over the ability of the Canili

dam to sustain continuous heavy loads, a bypass road and bridge is proposed to cross below the dam. Should the dam ever fail, the road and bridge bypass would be subject to inundation and potential destruction. This alternative is however much less costly than an 8-10 km route around the reservoir. Surfacing will be AC.

- TABLANG-DINGALAN

(a) Tablang to Laur - Segment 4A

The projected traffic for this segment is :

YEAR	AADT
1996	456
2005	619
2015	788

The proposed improvements to this section will consist of the reconstruction of the existing roadway by both excavation and embankment, installing concrete pipe culverts at 10 locations, installing 5 reinforced concrete box culverts and constructing the Culiat bridge. The 10 km segment currently has PCCP paving on approximately 3.7 km. which is in good condition. Only shoulder widening, ditch improvements and minor slab replacement will be required where PCCP currently exists. Surfacing will consist of DBST.

(b) Laur to Gabaldon - Segment 4B

The projected traffic for this segment is :

YEAR	AADT
1996	456
2005	619
2015	788

The proposed improvements to this section will consist of the reconstruction of the existing roadway by both excavation and embankment, installing concrete pipe culverts at 22 locations, installing 7 reinforced concrete box culverts, constructing a one lane bridge at the Bato Ferry crossing, rehabilitating the Dupinga bridge and constructing the Malinao bridge. The 14 km segment currently has less than 1 km of PCCP paving. Surfacing will consist of DBST.

(c) Gabaldon to Dingalan - Segment 4C

The projected traffic for this segment is :

YEAR	AADT
1996	167
2005	233
2015	303

The proposed improvements to this section will consist of the reconstruction of the existing roadway by both excavation and embankment, installing concrete pipe culverts at 9 locations and installing 5 reinforced concrete box culverts. The 13.4 km segment currently has less than 1 km of PCCP paving. Surfacing will consist of DBST.

♦ DINGALAN-SAN LUIS

(a) Dingalan to San Luis - Segment 3

In the Inception Report and in the Preliminary Report, the Consultant recommended against further consideration of a "typhoon resistant" road being constructed in this segment because of obvious high costs versus low perceived economic benefits. Questions were raised at these presentations of the possibility of constructing foot trail type facilities which would serve the local population and potentially serve a modified type of tourist traffic. Tourism would be in the form of natrualists and/or environmentalist who would be backpackers and hikers.

Construction of a trail facility used for pedestrians only could be constructed for a fraction of the cost of a standard roadway. Also, existing logging roads could be utilized for a significant portion of the route with only drainage mitigation measures necessary to transform the logging road into the trail facility. The logging road would then serve a dual purpose of moving forest products as well as moving local residents and potential tourists.

Any proposed improvements to this section would consist of the construction of a 2 m wide footpath by both excavation and embankment, installing stone and timber pipe culverts at 78 locations, and constructing eight multi-span wood timber pedestrian bridges.

Surfacing of the path would be gravel and structures would consist of an engineered design of timber bridges and culverts.

Currently, the proposed routing is approximately 72.5 km in length. Logging roads which currently exist account for approximately 57 km of the total length. Fifteen km of new trail would be constructed on the main alignment. In addition, approximately 5 km of spur trail from the main route to the barangays of Dibut and Dibayabay would have to be constructed.

This proposed trail system would provide a link for pedestrian traffic and light weight commercial products between Dingalan or San Luis and the several barangays along the route. Heavier commercial goods would continue to be transported via boat service along the coast.

4.2.2 Structure Design

4.2.2.1 Design Criteria

AASHTO design criteria have been adopted for the design of bridges in this project. In addition, the use of standard plans as developed by DPWH is recommended.

Bridge member sizes have been designed in accordance with AASHTO Standard Specifications for Highway Bridges; 1989 Edition, using MS18 live load.

Design stresses for bridge members are as follows:

- minimum compressive strength of concrete after 28 days of curing fc^1 = 20.7 MPa.
- reinforcing steel bars conforming to ASTM A615, grade 275, with a specified yield strength fy = 275 MPa
- structural steel conforming to ASTM A36 with a specified yield strength fy = 36,000 psi (248.2 MPa)

4.2.2.2 Geometrics

Typical bridge and box culvert sections and elevations proposed for this project are illustrated in Appendices F-11 and F-12.

The design section calls for a 6.70 meter carriageway with a 0.75 meter sidewalk on each side raised 0.25 meter from the deck, and a 0.90 meter high railing, also on both sides of the carriageway.

Freeboard is a minimum of 1.5 meters for waterways with heavy debris or heavy logs, and 1.0 meter, for rivers with light debris.

4.2.2.3 Earthquake Design

The recommendations set forth in the AASHTO 1989 edition have been adopted in this project.

Solid shaft piers are generally selected for use in the bridges, in order to provide greater shear force capacity in the transverse axis of the bridge and at the same time with greater resistance to the heavy logs or heavy debris expected to pass on waterways.

4.2.2.4 Engineering Alternatives

The following alternative strategies were considered for each bridge studied:

- Maintain (do nothing on existing bridge)
- Rehabilitate the existing bridge
  - (a) Strengthen
  - (b) Widen
- Replace the existing bridge with a new bridge
- Replace the existing bridge with a new reinforced concrete box culvert.

4.2.2.5 Baler Circumferential Road (Segments 1A, 1B, 1C, & 1D)

Tabulated descriptions and details of the existing condition and recommended improvements, if any, of the bridges and culverts on this road are presented in Tables 4-8 and 4-14 through 4-17.

The five bridges inventoried are made up of four permanent and one temporary structures.

The permanent structures consist of three reinforced concrete deck girder bridges (RCDG) which are in good condition and one bridge with a combination of precast concrete deck girder (PCDG) and steel girder.

Table 4-8

INVENTORY OF EXISTING AND PROPOSED BRIDGES

CIRCUMFERENTIAL ROAD (SEGMENTS 1A, 1B, 1C, & 1D)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION AND CONDITION	APPROACH A & B PROTECTION AND CONDITION	
1	PODOK BRIDGE STA 2 + 715.85	RCDG	3	45.00	GOOD BRIDGE 2-LANE 7.40 ROADWAY 2-1.00 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP FAIR	NATURAL VEGETATION FAIR	GENERALLY GOOD BRIDGE NIPA TREES ON RIVER BANKS MAINTAIN
2	AGUANG BRIDGE STA 3 + 545.74		18	800.00	2-LANE 7.4 m ROADWAY 2-1.00 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE, UNDER CONSTRUCTION
3	LIPIT BRIDGE STA 12 + 306.6	RCDG	2	40.00	GOOD BRIDGE 2-LANE 7.40 m ROADWAY 2-0.5 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE NO RIVER CHANNEL PROTECTION MAINTAIN
4	SALAY BRIDGE STA 13 + 579.75	TIMBER	4	25.40	POOR BRIDGE 1-LANE 3.50 m ROADWAY NO SIDEWALK	CONCRETE POOR	CONCRETE POOR	RIPRAP POOR	RIPRAP POOR	POOR BRIDGE, REPLACE WITH 2 LANE 2-SPAN AT 12.5 m, TO BE FUNDED BY JICA
5	DIMANPUDSO BRIDGE STA 19 + 229	RCDG	3	60.00	GOOD BRIDGE 2-LANE 6.50 m ROADWAY 2-0.45 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP FAIR	RIPRAP POOR	MAINTAIN
6	MALUPA BRIDGE STA 23 + 026	---	---	---	---	---	---	---	---	PROPOSED NEW BRIDGE
7	DIAMAN BRIDGE #1 STA 24+ 875	---	---	---	---	---	---	---	---	PROPOSED NEW BRIDGE
8	DIAMAN BRIDGE #2 STA 25 + 284	---	---	---	---	---	---	---	---	PROPOSED NEW BRIDGE
9	DITEKI BRIDGE STA 26 + 550	---	---	---	---	---	---	---	---	PROPOSED NEW BRIDGE

The Salay temporary timber bridge is expected to be replaced by a RCDG bridge which will be funded by Japan International Cooperation Agency (JICA).

Special design and calculation was provided in segment IC (Ma. Aurora - San Luis) of the Aurora Circumferential Road. Three (3) alternatives were developed across the three major river crossings in this route, the Malupa, Diaman and Diteki rivers. The different options are discussed below.

RIVER CROSSING	OPTION 1	OPTION 2	OPTION 3
MALUPA Q_{MFL} = 810.67 cms Q_{100} = 634.83 cms Q_{50} = 573.37 cms Q_{25} = 519.56 cms	No overtopping @ maximum flood level (MFL). Provision of 109 mts of bridge opening and 6 - 3.0 x 3.0 box culvert to accommodate Q_{MFL} and Q_{100}.	No overtopping @ Q_{MFL} and Q_{100}. Provision of 129 m bridge opening to accommodate both Q_{MFL} and Q_{100}. River re-channelling upstream will be required to concentrate flow under the bridge opening.	Overtopping allowed both on Q_{MFL}, Q_{100} and Q_{50}. Provision of total bridge opening of 135 mts to accommodate Q_{25} and protected roadway/ embankment within the river flood plain. Type of structure proposed under this option is shown as photo or plan and Section of this crossing.
DIAMAN Q_{MFL} = 6882.15 cms Q_{100} = 1135.82 cms Q_{50} = 1021.77 cms Q_{25} = 925.37 cms	Provision of 107 m and 149 m of bridge opening on both sides and 3 - 3.0 x 3.0 m box culvert at the middle. These openings are calculated to accommodate Q_{100} but Q_{MFL} is allowed to over flow on a 250 m paved section with downstream protection. Bridge openings are set to clear the Q_{MFL} level.	Provision of 245 mts and 159 mts of bridge openings at both sides of the river flood plain to accommodate Q_{MFL} and a protected embankment/ roadway at the middle.	Provision of 145 mts and 75 mts bridge opening @ both sides and 3 - 3 x 3 box culverts at the middle of the river flood plain. These openings are set to clear Q_{25} and allowed to be overtopped by Q_{50}, Q_{100} and Q_{MFL}. Rest of the river flood plain is provided with protected embankment to act as roadway. Type of structure is similar to the Bato Ferry Crossing between Laur and Gabaldon.
DITEKI Q_{MFL} = 1307.63 cms Q_{100} = 818.50 cms Q_{50} = 741.04 cms Q_{25} = 668.68 cms	Provision of 89 mts of bridge opening on one side and 6 - 2.4 x 3.0 box culvert at other side. These openings are made to clear Q_{100}, but allowed to overflow Q_{MFL} on a protected paved section across the river flood plain. The bridge opening is set to Clear Q_{MFL}.	Provision of bridge openings with 80 mts on both sides and protected embankment at the middle to act as road way. These openings are set to clear Q_{MFL}.	Provision of 90 m and 64 m of bridge openings on both side of the river flood plain. The openings are set to accommodate Q_{25} and allowed to overflow any discharge greater than Q_{25}. Protected embankment to act as roadway is also proposed in between these openings. Type of structure is similar to the Bato Ferry Crossing.

Sizing and location of bridge openings were calculated on the basis of the current position of the meandering river flows. This explains why the bridge openings are set on both sides of the river flood plains as the case of the three major rivers crossings discussed above. Q_{MFL} denotes the flood discharge calculated at maximum flood level. Q_{100}, Q_{50} and Q_{25} denote flood volume calculated at the recurrence of 100 year return period, 50 year return period and 25 year return period respectively. Calculated flood depths were set to minimums especially in cases where overflow sections are proposed to form part of the structure. This was done to avoid a very high protected embankment and to minimize excessive protection work at the downstream section of the embankment. These cases are usually true under option 3.

As a result of preliminary costing of structures, grading, base and paving of the three alternatives described above, and the fact that the Aguang Bridge between Baler and Dipaculao is now open, the Consultant concluded that Option 3 was the most cost effective.

Further, Option 3 with periodic roadway overtopping by flood waters was discussed with the provincial governor, the mayor of Maria Aurora and other area elected officials. By consensus, they felt that if significant cost savings would result, the infrequent detours via Baler - Dipaculao would be acceptable.

4.2.2.6 Rizal - Maria Aurora (Segments 2A, 2B, 2C, & 2D)

This alternative route provides an inter-provincial link. Tabulated descriptions and details of the existing condition and recommended improvements, if any, of the bridges and culverts on this road are presented in Tables 4-9 and 4-18 through 4-19.

The fourteen bridges inventoried in this section are all permanent. They consist of ten RCDG, one PCDG and three overflow bridges.

Three RCDG bridges are in good condition, two need rehabilitation and five need widening.

The only PCDG bridge in this section needs to be widened.

Two of the overflow bridges need to be widened while the other one needs to be rehabilitated.

4.2.2.7 Dingalan - San Luis (Segment 3)

This is a new proposed route connecting Dingalan and Baler. There are eight proposed RCDG bridges in this route, namely; Real bridge 85 m long, Dicapinisan bridge 46 m long, Dikapanikian bridge 46 m long and five other with a total length of 144 m. Table 4-10 identifies the proposed bridges while Table 4-20 identifies necessary culverts.

Table 4-9

INVENTORY OF EXISTING AND PROPOSED BRIDGES

RIZAL - MARIA AURORA SECTION (SEGMENTS NO. 2A, 2B, 2C, & 2D)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION & CONDITION	APPROACH A & B PROTECTION AND CONDITION	
1	OVERFLOW	-	-	200	GOOD OVERFLOW BRIDGE ONE-LANE	-	-	-	-	MAINTAIN AND ADD ANOTHER LANE
2	CAMBITALA BRIDGE	RCDG	1	12	GOOD BRIDGE 2-LANE 6.7 m ROADWAY 2-0.45 m SIDEWALK	-	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP FAIR	GOOD BRIDGE MAINTAIN
3	GANDOS BRIDGE	RCDG	1	15	GOOD BRIDGE 2-LANE 7.45 m ROADWAY 2-0.50 m SIDEWALK	-	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP BAD	GOOD BRIDGE, NEEDS SOME REHABILITATION ON ONE APPROACH
4	OVERFLOW	-	-	10	GOOD OVERFLOW BRIDGE ONE-LANE	-	-	-	-	MAINTAIN AND ADD ANOTHER LANE
5	MAGUITIL BRIDGE STA 12+976	RCDG	3	44	GOOD BRIDGE 2-LANE 6.8 m ROADWAY 2-0.50 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP FAIR	GOOD BRIDGE MAINTAIN
6	DILACAY BRIDGE STA 14+880	RCDG	2	30.1	GOOD BRIDGE 2-LANE 6.85 m ROADWAY 2-0.50 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP BAD	RIPRAP BAD	GOOD BRIDGE, NEEDS SOME REHABILITATION ON RIPRAP PROTECTION
7	ALFONSO CASTAÑEDA STA 23+748	RCDG	2	36	GOOD BRIDGE 2-LANE 6.7 m ROADWAY 2-0.45 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE, NEEDS SOME REHABILITATION ON RAILINGS.
8	DIMOTOL BRIDGE STA 33+32	RCDG	1	24	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	-	RC ABUTMENT POOR	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE

(continued)

Table 4-9 (continued)

INVENTORY OF EXISTING AND PROPOSED BRIDGES

RIZAL - MARIA AURORA SECTION (SEGMENTS NO. 2A, 2B, 2C, & 2D)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION & CONDITION	APPROACH A & B PROTECTION AND CONDITION	
9	DIMASALAN BRIDGE STA 34+120	RCDG	1	14.0	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	-	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE
10	DIANAWAN BRIDGE STA 41+250	RCDG	3	48.0	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE
11	DIMANGLAT BRIDGE STA 43+723	RCDG	1	12.5	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	-	RC ABUTMENT GOOD	RC WALL	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE
12	BINUANGAN BRIDGE STA 43+750	RCDG	1	20	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.80 m SIDEWALK	-	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE
13	ESTONILLO BAZAL BRIDGE STA 52+025	PCDG	9	145	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE. MAINTAIN AND ADD ONE LANE
14	SAN JOAQUIN BRIDGE STA 53+820	OVER-FLOW	-	17.20	6.0 m ROADWAY BAD OVERFLOW BRIDGE	-	-	-	-	APPROACH B SUBSIDES. NEEDS REHABILITATION

Table 4-10
INVENTORY OF PROPOSED BRIDGES
DINGALAN - BALER (SEGMENTS NO.3)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION AND CONDITION	APPROACH A & B PROTECTION AND CONDITION	
1	DIKAPANIKIAN BRIDGE STA 15 + 000	---	---	---	---	---	---	---	---	PROPOSED 50 m RCDG BRIDGE, 3 SPAN AT 16.67 m, TWO-LANE
2	W. W. # 17 STA 29 + 000	---	---	---	---	---	---	---	---	PROPOSED 60 m RCDG BRIDGE, 3 SPAN AT 20 m, TWO-LANE
3	W. W. # 16 STA 36 + 000	---	---	---	---	---	---	---	---	PROPOSED 25 m RCDG BRIDGE, 1 SPAN, TWO-LANE
4	W. W. # 12 STA 46 + 000	---	---	---	---	---	---	---	---	PROPOSED 40 m RCDG BRIDGE, 2 SPAN AT 20 m, TWO-LANE
5	DIKAPINISAN BRIDGE STA 51 + 300	---	---	---	---	---	---	---	---	PROPOSED 50 m RCDG BRIDGE, 3 SPAN AT 16.67 m, TWO-LANE
6	W. W. # 6 STA 66 + 500	---	---	---	---	---	---	---	---	PROPOSED 25 m RCDG BRIDGE, 1 SPAN, TWO-LANE
7	W. W. # 5 STA 73 + 000	---	---	---	---	---	---	---	---	PROPOSED 20 m RCDG BRIDGE, 1 SPAN, TWO-LANE
8	REAL BRIDGE STA 83 + 120	---	---	---	---	---	---	---	---	PROPOSED 85 m RCDG BRIDGE, 4 SPAN AT 21.25 m, TWO-LANE

4.2.2.8 Palayan City - Dingalan (Segments 4A, 4B & 4C)

Tabulated descriptions and details of the existing condition and recommended improvements, if any, of the bridges and culverts on this road are presented in Tables 4-11 and 4-21 through 4-23.

The twenty one bridges inventoried in this section are made up of ten permanent and eleven temporary structures.

The permanent structures consist of six RCDG, one PCDG and three steel girder bridges. Permanent bridges which are under construction are Asan and Langawan bridges near Gabaldon and Dingalan proper, respectively. The Asan bridge is being funded under the Regular Infrastructure projects, while the Langawan bridge is funded under the Jumbo - Bridge Reconstruction projects.

The Dupinga and Sawmill bridges are the permanent structures along this alignment requiring rehabilitation. Both suffered damages during the strong 16 July 1990 earthquake. Damages to the Dupinga bridge are the failure in abutment B of the back wall and embankment protection and the subsidence of the fourth pier. Failures in the Sawmill bridge are buckling both in the lateral brace and web member of the left most girder of abutment A. The rehabilitation is being funded under RA 6960.

The bridge that needs to be widened or to be replaced as an all-weather (typhoon resistant) structure is the 239.2 m Bato Ferry overflow bridge. This existing structure is a good single lane bridge but usually floods up to one meter during heavy rainfalls. The recommendation is to build a new single lane, elevated RCDG bridge that can be used during flood and to maintain the existing single lane overflow bridge which can be used during dry season. Dry weather traffic would be bi-directional on two structures while wet weather traffic would be on the one lane bridge. The piers and substructure should be built for ultimate two lane traffic but initial decking would allow one way traffic on the new bridge and one way traffic on the existing overflow bridge.

The eleven temporary structures consist of eight timber bridges and three Bailey bridges, all needing replacement.

4.2.2.9 Tablang - Bongabon - Provincial Boundary - Cabatangan/Malupa River Valley - Maria Aurora (Segments 5C, 5B, 5A, $2B_1$, 2A)

This is another alternative inter-provincial route. Tabulated descriptions and details of the existing condition and recommended improvements, if any, of the bridges and culverts on this road are presented in Tables 4-12 and 4-24 through 4-26 and 4-18 and 4-19.

The eleven bridges inventoried in this section are made up of ten permanent and one temporary structures.

Table 4-11

INVENTORY OF EXISTING AND PROPOSED BRIDGES

PALAYAN CITY - DINGALAN SECTION (SEGMENTS NO. 4A, 4B, & 4C)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION & CONDITION	APPROACH A & B PROTECTION AND CONDITION	
1	SAGANA BRIDGE STA 5 + 354.3	RCDG	3	45.00	GOOD BRIDGE 2-LANE 7.50 m ROADWAY 2-1.00 SIDEWALK	RC PILE GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE MAINTAIN
2	BILIK BRIDGE STA 6 + 129.8	TIMBER	1	6.00	FAIR 1-LANE 3.60 m ROADWAY NO SIDEWALK	-	TIMBER POOR	TIMBER POOR	NATURAL VEGETATION POOR	TEMPORARY BRIDGE REPLACE WITH 1-3 x 3 RCBC
3	CULIAT BRIDGE STA 7 + 436.4	TIMBER	1	6.20	FAIR 1-LANE 3.60 m ROADWAY NO SIDEWALK	-	RC ABUTMENT POOR	-	NATURAL VEGETATION POOR	TEMPORARY, REPLACE WITH 2 LANE 1-SPAN AT 20m RCDG
4	SAN JUAN BRIDGE #1 STA 11 + 980.3	RCDG	1	7.00	GOOD BRIDGE 2-LANE 7.80 m ROADWAY 2-1.00 m SIDEWALK	-	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP POOR	GOOD BRIDGE MAINTAIN
5	SAN JUAN BRIDGE #2 STA 12 + 365.30	RCDG	3	27.00	GOOD BRIDGE 2-LANE 7.70 m ROADWAY 2-1.10 m SIDEWALK	RC PILE GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP FAIR	GOOD BRIDGE MAINTAIN
6	SAN JUAN BRIDGE #3 STA 12 + 708.75	RCDG	3	24.20	GOOD BRIDGE 2-LANE 7.40 m ROADWAY 2-0.75 m SIDEWALK	RC PILE GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE MAINTAIN
7	BATO FERRY OVERFLOW BRIDGE STA 14 + 462.7	RCDG	-	239.3	GOOD BRIDGE 1-LANE 3.80 m ROADWAY NO SIDEWALK	RC SHAFT GOOD	RC ABUTMENT GOOD	-	NONE -	GOOD BRIDGE, MAINTAIN, BUT ADD ADDITIONAL SINGLE LANE, ELEVATED RCDG BRIDGE, 14 SPAN AT 20 m
8	BATERIA BRIDGE (AMALUNGAN) STA 18 + 272.6	TIMBER	3	16.50	NO CARRIAGEWAY	RC PILE POOR	RC ABUTMENT POOR	-	-	IMPASSABLE, REPLACE 3-3 x 3 RCBC

(continued)

Table 4-11 (continued)

INVENTORY OF EXISTING AND PROPOSED BRIDGES

PALAYAN CITY - DINGALAN SECTION (SEGMENTS NO. 4A, 4B, & 4C)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION & CONDITION	APPROACH A & B PROTECTION AND CONDITION	
9	INASAN BRIDGE STA 21 + 865.5	BAILEY BR.	1	12.20	FAIR BRIDGE 1-LANE 3.90 m ROADWAY NO SIDEWALK	-	RC ABUTMENT FAIR	-	NATURAL VEGETATION POOR	OBSTRUCTION TO RIVER CHANNEL SHALL BE REMOVED REPLACE WITH 2 LANE 1-SPAN AT 20m RCDG
10	DUPINGA BRIDGE 27 + 839.55	PCDG	7	157.75	SPANS 4 & 5 ARE BAD 2-LANE 7.30 m ROADWAY 2-1.00 m SIDEWALK	SOLID SHAFT 4TH PIER SUBSIDE	RC ABUTMENT A - GOOD B - BAD	RIPRAP GOOD	RIPRAP GOOD	CRACKS WERE OBSERVED ON THE BACKWALL OF ABUT. B. AND PIER NO.4 SUBSIDES. TO BE REHABILITATED.
11	MALINAO BRIDGE STA 31 + 312	TIMBER	2	10 10	FAIR BRIDGE 1-LANE 3.30 m ROADWAY NO SIDEWALK	RC PILE FAIR	RC FILES (TEMPORARY) POOR	RIPRAP FAIR	RIPRAP FAIR	FUNDED UNDER RA6960 TEMPORARY BRIDGE REPLACE WITH 2 LANE 1-SPAN AT 15m
12	PANTOC BRIDGE STA 32 + 556	TIMBER	1	5	FAIR BRIDGE 1-LANE 3.45 m ROADWAY NO SIDEWALK	-	RC FILES (TEMPORARY) POOR	RIPRAP FAIR	RIPRAP FAIR	TEMPORARY BRIDGE REPLACE WITH 1-2.40 x 2.75 RCBC
13	ASAN BRIDGE STA 33 + 641.14	UNDER CONSTRUCTION								FUNDED UNDER THE REGULAR INFRASTRUCTURE PROJ
14	SAWMILL BRIDGE STA 34 + 837.78		1	40.60	BAD BRIDGE 2-LANE 7.30 m ROAD WAY 2-1.00 m SIDEWALK	-	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	WEB OF LEFTMOST BEAM FAILED (BUCKLES) TO BE REHABILITATED, FUNDED UNDER RA 6960
15	CUYAPA BRIDGE #1 STA 35 + 524.45	BAILEY	3	21.35	COLLAPSED SUPERSTRUCTURE	RC PILES TEMPORARY POOR	RC PILES TEMPORARY POOR	NO SLOPE PROTECTION POOR	NO PROTECTION POOR	IMPASSABLE, REPLACE WITH 3-2.4 x 2.4 RCBC
16	CUYAPA BRIDGE #2 STA 37 + 094.30	TIMBER ON STEEL GIRDER	2	9.40	FAIR 1-LANE 4.20 m ROAD WAY NO SIDEWALK	RC PILES TEMPORARY POOR	RC PILES TEMPORARY POOR	RIPRAP POOR	NO PROTECTION POOR	TEMPORARY BRIDGE REPLACE WITH 2-3.0 x 3.0 RCBC

Table 4-11 (continued)

INVENTORY OF EXISTING AND PROPOSED BRIDGES

PALAYAN CITY - DINGALAN SECTION (SEGMENTS NO. 4A, 4B, & 4C)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION & CONDITION	APPROACH A & B PROTECTION AND CONDITION	
17	CUYAPA BRIDGE #3 STA 39 + 077.3	TIMBER ON STEEL GIRDER	1	3.7	FAIR 1-LANE 3.60 m ROAD WAY NO SIDEWALK	-	RC PILES TEMPORARY POOR	NO PROTECTION	NO PROTECTION	TEMPORARY BRIDGE REPLACE WITH 2-2.4 x 2.4 RCBC
18	TANAUN BRIDGE STA 40 + 022.69	RC ON STEEL GIRDER	1	25.50	GOOD BRIDGE 2-LANE 7.30 m ROAD WAY 2-1.00 m SIDEWALK	-	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE MAINTAIN
19	LANGAWAN BRIDGE STA 44 + 296.49	RC ON STEEL GIRDER	3	75.55	UNDER CONSTRUCTION					FUNDED UNDER THE JUMBO BRIDGE RECONSTRUCTION PROJECTS
20	SUBSUB BRIDGE STA 45 + 144.15	BAILEY	2	30.76	FAIR 1-LANE 4.00 m ROAD WAY NO SIDEWALK	RC PILES TEMPORARY FAIR	RC ABUTMENT FAIR	RIPRAP POOR	NO PROTECTION POOR	TO BE REPLACED BY 2 - 3.0 x 3.0 RCBC
21	VILLAPANDO BRIDG STA 46 + 533.73	TIMBER	1	10.27	FAIR 1-LANE 3.75 m ROAD WAY NO SIDEWALK	TIMBER	TIMBER POOR	NO PROTECTION POOR	NO PROTECTION POOR	REPLACE WITH 1-2.40 x 2.40 RCBC

Table 4-12

INVENTORY OF EXISTING AND PROPOSED BRIDGES

MA. AURORA - BONGABON - CABATANGAN/MALUPA VALLEY - PALAYAN CITY SECTIONS (SEGMENTS NO. 2A, 2B$_1$, 5A TO 5C)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION AND CONDITION	APPROACH A & B PROTECTION AND AND CONDITION	
1	SAN JOAQUIN BRIDGE STA. 53+820	OVER-FLOW	-	17.20	6.0 m ROADWAY BAD OVERFLOW BRIDGE	-	-	-	-	APPROACH A SUBSIDES NEEDS REAHBILITATION
2	ESTONILLO (BAZAL) BRIDGE STA. 52+025	RCDG	9	145	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	SOLID SHAFT GOOD	RC ABUTMENT GOOD	RIPRAP GOOD	RIPRAP GOOD	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE, MAINTAIN AND ADD ONE LANE
3	BINUANGAN BRIDGE STA. 47+750	RCDG	1	20	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.80 m SIDEWALK	-	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE, MAINTAIN AND ADD ONE LANE
4	DIMANGLAT BRIDGE STA. 43+723	RCDG	1	12.5	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	-	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE, MAINTAIN AND ADD ONE LANE
5	DIANAWAN BRIDGE STA. 41+250	RCDG	3	48	GOOD BRIDGE 1-LANE 4.0 m ROADWAY 2-0.75 m SIDEWALK	SOLID SHAFT	RC ABUTMENT GOOD	RC WALL GOOD	-	GOOD BRIDGE, WITH PROVISION FOR ANOTHER LANE, MAINTAIN AND ADD ONE LANE
6	CABATANGAN BRIDGE #2									PROPOSED 85 m RCDG BRIDGE, 4 SPAN AT 21.25 m, TWO-LANE
7	CABATANGAN BRIDGE #1									PROPOSED 45 m RCDG BRIDGE, 3 SPAN AT 15 m, TWO-LANE
8	LABI BRIDGE STA. 162+060	BAILEY BRIDGE	7	105	3.6 m ROADWAY	-	-	-	-	TEMPORARY BRIDGE REPLACE WITH 2-LANE 5 SPAN AT 21.0 m RCDG

(continued)

Table 4-12 (continued)

INVENTORY OF EXISTING AND PROPOSED BRIDGES

MA. AURORA - BONGABON - CABATANGAN/MALUPA VALLEY - PALAYAN CITY SECTIONS (SEGMENTS NO. 2A, $2B_1$, 5A TO 5C)

NO.	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION AND CONDITION	APPROACH A & B PROTECTION AND AND CONDITION	
9	CALAANAN BRIDGE	RCSL	1	12	2-LANE 6.7 m ROADWAY 2-0.76 m SIDEWALK	-	-	-	-	MAINTAIN
10	CORONEL RIVER BRIDGE STA. 138+600	RCDG	9	196.794	2-LANE 6.7 m ROADWAY 2-0.76 m SIDEWALK	-	-	-	-	MAINTAIN

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The permanent structures consist of eight RCDG, one RCSL and one overflow. Six of the RCDG and the overflow bridge need widening.

The lone temporary bridge needs to be replaced. Two additional new bridges with a total length of 130 m are required in this route.

4.2.2.10 Tablang - Bongabon - through the Aurora Memorial Park - San Luis (Segments 5C, 5B and 6)

This is another alternative inter-provincial route following the existing national highway alignment. Tabulated descriptions and details of existing condition and recommended improvements, if any, of the bridges on Segment 6 are presented in Table 4-13.

4.2.2.11 Culvert Sizing

Based on the hydrology and hydraulic data developed in Sections 4.1.2 and 4.1.3 concrete pipe culverts were sized and located within each proposed road segment. Tables 4-14 through 4-26 identify the pipe culverts by diameter, type, number of pipes of each site and station location. The tables are identified by road segment.

4.2.3 Engineering and Construction Standards

4.2.3.1 Preliminary Scope of Work for Final Design

A Draft Scope of Work for Detailed Design Services and Construction Supervision was developed and is provided in Appendix E-1. This outline document provides for a basic scope of services for the design phase and for construction management. It is the strong recommendation of the Consultant that construction management services be funded and provided by the donor agency for the construction.

4.2.3.2 Suggested Outline Specifications

The DPWH has standard specifications dated 1988 and published in two volumes for contract conditions and for construction requirements. These standard specifications could be incorporated into the contract packages for any construction. The TOR however, indicated that the Consultant ...should provide outline specifications defining the proposed standards of quality of construction ...

Table 4-13
INVENTORY OF EXISTING AND PROPOSED BRIDGES
PROVINCIAL BOUNDARY - SAN LUIS
SEGMENT 6

NO	NAME OF BRIDGE AND STATION	EXISTING CONDITION								REMARKS & RECOMMENDATION
		TYPE	NUMBER OF SPAN	TOTAL LENGTH (m)	SUPERSTRUCTURE CONDITION	PIERS TYPE AND CONDITION	ABUTMENT A & B CONDITION	ABUTMENT A & B PROTECTION AND CONDITION	APPROACH A & B PROTECTION AND CONDITION	
1	VILLA AURORA BRIDGE	RCDG	4	75						POOR BRIDGE REPLACE WITH 2 LANE 4 SPAN AT 18.75 m RCDG
2	DIMANI BRIDGE	RCDG	2	28						MAINTAIN
3	DIPAWAN BRIDGE	RCDG	1	10						MAINTAIN
4	DICONG BRIDGE	RCDG	1	18						MAINTAIN
5	DITAOLAG BRIDGE	RCDG	3	21						MAINTAIN
6	DITEKI BRIDGE A	STEEL	4	164						POOR BRIDGE REPLACE WITH 2 LANE 8 SPAN AT 20.5 m BRIDGE
7	DITEKI BRIDGE B	RCDG	1	10						MAINTAIN
8	DIABUYO BRIDGE	RCDG	2	20						MAINTAIN
9	DITUMABO BRIDGE	RCDG	2	28						MAINTAIN
10	DISALET BRIDGE	RCDG	1	10						MAINTAIN
11	DUONGAN BRIDGE	RCDG	4	54						MAINTAIN

Table 4-14
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: AURORA CIRCUMFERENTIAL ROAD
SEGMENT I-A (BALER - DIPACULAO)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
0+600	760		1	13.0	Proposed
1+000	760		1	13.0	Proposed
1+650	760		1	13.0	Proposed
3+000	760		1	13.0	Proposed
3+300	760		1	13.0	Proposed
4+700	760		1	13.0	Proposed
5+050	760		1	13.0	Proposed
5+400	760		1	13.0	Proposed
5+765	910		1		Existing to be retained
6+100	760		1	13.0	Proposed
6+526	600		1		Existing to be retained
6+950	760		1	13.0	Proposed
7+448	600		1		Existing to be retained
7+900	760		1	13.0	Proposed
8+450	760		1		Proposed
8+749	900		2	15.0	Existing to be retained
9+269		2.70 x 1.80	2		Existing to be retained
9+608	600		1		Existing to be retained
9+850	760		1	13.0	Proposed
10+150	760		1	13.0	Proposed
10+450	760		1	13.0	Proposed
11+000	760		1	13.0	Proposed
11+450	760		1	13.0	Proposed
11+900	760		1	13.0	Proposed

Table 4-15
LIST OF EXISTING OF PROPSOED AND EXISTING CULVERTS
AURORA CIRCUMFERENTIAL ROAD
SEGMENT IB - (DIPACULAO - MA. AURORA)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
12+360	760		1	13.0	Proposed
12+900	760		1	13.0	Proposed
13+250	760		1	13.0	Proposed
13+850	760		1	13.0	Proposed
14+300	760		1	13.0	Proposed
14+600	760		1	13.0	Proposed
14+976	600		1		Existing to be retained
15+300	760		1	13.0	Proposed
15+700	760		1	13.0	Proposed
16+000	760		1	13.0	Proposed
16+450	760		1	13.0	Proposed
16+791.60	600		1		Existing to be retained
17+042	600		1		Existing to be retained
17+350	760		1	13.0	Proposed
17+701	600		1		Existing to be retained
18+700	760		2	13.0	Proposed
18+710	600		2		Existing to be retained
19+000	760		1	13.0	Proposed
19+550	760		1	13.0	Proposed
19+950	760		1	13.0	Proposed
20+300	760		1	13.0	Proposed
20+750	760		1	13.0	Proposed
21+507	600		1	13.0	Existing to be retained

Table 4-16
LIST OF EXISTING OF PROPSOED AND EXISTING CULVERTS
AURORA CIRCUMFERENTIAL ROAD
SEGMENT IC - (MA. AURORA - SAN LUIS)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
22+288	600		1		Existing to be retained
22+320		3.0 x 3.0	2	15.0	Proposed
22+600	760		1	13.0	Proposed
23+573	900		1		Existing to be retained
23+760.75	1220		3		Existing to be retained
23+986	600		1		Existing to be retained
24+002	600		1		Existing to be retained
24+500	760		1	13.0	Proposed
26+000	760		1	13.0	Proposed
27+221	900		2		Existing to be retained
27+600	760		1	13.0	Proposed
28+450	760		1	13.0	Proposed
29+100	760		1	13.0	Proposed
29+428	600		1		Existing to be retained
29+532.90	600		1		Proposed

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Table 4-17
LIST OF PROPOSED AND EXISTING CULVERTS
AURORA CIRCUMFERENTIAL ROAD
SEGMENT I-D (SAN LUIS - BALER)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
30+650	760		1	13.0	Proposed
30+926	600		1		Existing to be retained
31+155	600		1		Irrigation Str.
31+650	760		1	13.0	Proposed
32+438.30	900		2		Existing to be retained
32+941	600		2		Existing to be retained
33+012	600		1		Existing to be retained
33+152	900		1		Existing to be retained
33+876	900		1		Proposed
34+300	760		1	13.0	Proposed
34+700	760		1	13.0	Proposed
35+200	760		1	13.0	Proposed
33+570	900		1	13.0	Proposed
35+683.1	900		1	13.0	Proposed
35+700	900		1		Existing to be retained
35+724	600		1		Existing to be retained
36+000	760		1	13.0	Proposed
36+350	760		1	13.0	Proposed
36+700	760		1	13.0	Proposed
37+513	600		1		Existing to be retained
37+657	600		1		Existing to be retained
37+400	900		1		Existing to be retained

Table 4-18
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: MA. AURORA - RIZAL
SEGMENT: 2A (MA. AURORA - BAZAL)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
0+200	610		1	8.0	Existing to be retained
0+400	610		1	8.0	Existing to be retained
0+600	610		1	8.0	Existing to be retained
0+800	610		1	8.0	Existing to be retained
1+000	610		1	8.0	Existing to be retained
1+200	610		1	8.0	Existing to be retained
1+400	610		1	8.0	Existing to be retained
1+600	610		1	8.0	Existing to be retained
1+800	610		1	8.0	Existing to be retained
2+000	610		1	8.0	Existing to be retained
2+200	610		1	8.0	Existing to be retained
2+315		1.5 x 1.0	4	8.0	Existing to be retained
2+580		1.5 x 1.0	12	8.0	Existing to be retained
2+750	610		1	8.0	Existing to be retained
3+000	610		1	8.0	Existing to be retained
3+200	610	3.0 x 3.0	1	8.0	Existing to be retained
3+400	610		1	8.0	Existing to be retained
3+600	1220		2	11.0	Existing to be retained
3+800	610		1	8.0	Existing to be retained
4+000	610		1	8.0	Existing to be retained
4+533	600		1	8.0	Existing to be retained

Table 4-19
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: MA. AURORA - RIZAL
SEGMENT: 2B (BAZAL - KM 38)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
4+760	610		1	8.0	Existing to be retained
5+000	610		1	8.0	Existing to be retained
5+242.50	1.52		4	14.0	Existing to be retained
5+690	600		1	20.0	Existing to be retained
6+100	600		1	20.0	Existing to be retained
6+360	610		1	12.0	Existing to be retained
6+480	610		1	11.0	Existing to be retained
6+740	760		1	13.0	Proposed
7+020	760		1	13.0	Proposed
7+320	610		1	11.0	Existing to be retained
7+725		2.0 x 2.50	2	16.0	Existing to be retained
7+979	610		1	8.0	Existing to be retained
8+100	760		1	13.0	Proposed
9+000	610		1	10.0	Existing to be retained
9+460	760		1	13.0	Proposed
9+660	610		1	13.0	Existing to be retained
10+020	610		1	11.0	Existing to be retained
10+455	760		1	13.0	Proposed
10+860	610		1	12.0	Existing to be retained
11+060	760		1	13.0	Proposed
11+300	610		1	13.0	Existing to be retained
11+420	610		1	13.0	Existing to be retained
11+950	760		1	13.0	Proposed
12+200	610		1	18.0	Existing to be retained
12+480	760		1	18.0	Proposed
12+900	760		1	18.0	Proposed
13+200	760		1	18.0	Proposed
13+350	760		1	18.0	Proposed
13+620	760		1	18.0	Proposed
13+850	760		1	18.0	Proposed
14+080	610		1	8.0	Existing to be retained
14+880	760		1	20.0	Proposed
15+680	760		1	18.0	Proposed
16+000	760		1	18.0	Proposed
16+480	760		1	18.0	Proposed
17+000	610		1	16.0	Existing to be retained
17+360	610		1	11.0	Existing to be retained
17+720	610		1	11.0	Existing to be retained
17+900	760		1	13.0	Proposed

Table 4-20
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: SAN LUIS - DINGALAN
SEGMENT 3

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
2+000		3 x 3	3	15.0	Proposed
4+400	1200		3	13.0	Proposed
5+400	1200		2	13.0	Proposed
5+700	1200		2	13.0	Proposed
6+350	1200		2	13.0	Proposed
6+720		2.4 x 2.75	1	15.0	Proposed
7+250	1200		3	13.0	Proposed
7+600		2.4 x 2.75	1	15.0	Proposed
8+600	760		1	13.0	Proposed
9+000		2.10 x 2.40	1	15.0	Proposed
9+500		3.0 x 3.0	2	15.0	Proposed
11+600	760		1	13.0	Proposed
12+800	760		1	13.0	Proposed
13+600	760		1	13.0	Proposed
16+000	760		1	13.0	Proposed
19+000	760		1	13.0	Proposed
19+600		3.0 x 3.0	4	15.0	Proposed
20+150	760		1	13.0	Proposed
22+350	760		1	13.0	Proposed
22+750		2.75 x 3.0	2	15.0	Proposed
23+000	760		1	13.0	Proposed
23+300	760		1	13.0	Proposed
23+700	760		1	13.0	Proposed
24+700	760		1	13.0	Proposed
25+000	760		1	13.0	Proposed
25+500	760		1	13.0	Proposed
27+000	760		1	13.0	Proposed
30+800	760		1	13.0	Proposed
31+800	760		1	13.0	Proposed
33+500	760		1	13.0	Proposed
34+000	760		1	13.0	Proposed
34+500	760		1	13.0	Proposed

(continued)

Table 4-20 (continued)
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: SAN LUIS - DINGALAN
SEGMENT 3

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
39+500	760		1	13.0	Proposed
41+600		2.75 x 3.0	2	15.0	Proposed
43+000		2.75 x 3.0	5	15.0	Proposed
43+720		3.0 x 3.0	3	15.0	Proposed
45+250	760		1	13.0	Proposed
47+250		2.75 x 3.0	3	15.0	Proposed
		2.75 x 3.0	3	15.0	Proposed
50+000	760		1	13.0	Proposed
52+000	760		1	13.0	Proposed
52+500	760		1	13.0	Proposed
53+000	760		1	13.0	Proposed
54+400	760		1	13.0	Proposed
54+900	760		1	13.0	Proposed
55+800	760		1	13.0	Proposed
56+750	760		1	13.0	Proposed
57+500	760		1	13.0	Proposed
60+200		3.0 x 3.0	5	15.0	Proposed
61+000		3.0 x 3.0	1	15.0	Proposed
62+000	760		1	13.0	Proposed
64+500	760		1	13.0	Proposed
65+500		3.0 x 3.0	2	15.0	Proposed
67+000	760		1	13.0	Proposed
68+500	760		1	13.0	Proposed
68+800	760		1	13.0	Proposed
69+000	760		1	13.0	Proposed
69+500	760		1	13.0	Proposed
70+000	760		1	13.0	Proposed
70+500	760		1	13.0	Proposed
72+500	760		1	13.0	Proposed
74+000		2.75 x 3.0	1	15.0	Proposed
74+500	760		1	13.0	Proposed
75+000	760		1	13.0	Proposed

Table 4-20 (continued)
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: SAN LUIS - DINGALAN
SEGMENT 3

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
75+600	760		1	13	Proposed
76+100	760		1	13	Proposed
77+450	760		1	13	Proposed
77+320		2.75 x 3.0	3	15	Proposed
78+250	760		1	13	Proposed
78+600	760		1	13	Proposed
79+120		2.4 x 2.75	1	15	Proposed
79+600	760		1	13	Proposed
80+400	760		1	13	Proposed
81+000	760		1	13	Proposed
81+620		3.0 x 3.0	3	15	Proposed
82+000	760		1	13	Proposed
82+500	760		1	13	Proposed
82+850	760		1	13	Proposed

Table 4-21
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: PALAYAN - DINGALAN
SEGMENT 4A (TABLANG - LAUR)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
0+200	760		1	13.0	Proposed
0+350	760		1	13.0	Proposed
0+800	760		1	13.0	Proposed
1+350	760		1	13.0	Proposed
2+400	910		2		Proposed
2+800	760		1	13.0	Proposed
3+416.50	900		1		Existing to be retained
3+643	900		1		Existing to be retained
3+910.50	900		1		Existing to be retained
4+050	900		1		Existing to be retained
4+093	900		1		Existing to be retained
4+630.50	600		2		Existing to be retained
4+940		0.50 x 1.0	1	17.2	Existing to be retained
5+244	600		1		Existing to be retained
5+915.50	600				Existing to be retained
6+132.75		3 x 3	1	15.0	Proposed
6+782.2	1220		3	13.0	Proposed
6+953		2.4 x 2.4	2	15.0	Proposed
8+033	760		1	13.0	Proposed
8+221.0		3.0 x 3.0	2	15.0	Proposed
8+400	600		1		Existing to be retained
8+900		2.75 x 3.0	2	15.0	Proposed
9+690		2.40 x 2.40	2	15.0	Proposed

Table 4-22
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: PALAYAN - DINGALAN
SEGMENT 4B (LAUR - GABALDON)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
10+700	760		1	13.0	Proposed
11+350	760		1	13.0	Proposed
11+650	760		1	13.0	Proposed
13+358	900		1		Existing to be retained
13+800	760		1	13.0	Proposed
14+300	760		1	13.0	Proposed
15+075	1220		3	13.0	Proposed
15+450	1220		3	13.0	Proposed
15+950	1220		2		Existing to be retained
16+450		3 x 3	3	15.0	Proposed
17+600		3 x 3	2	15.0	Proposed
18+287		3 x 3	3	15.0	Proposed
19+626		2.40 x 2.40	2	15.0	Replace existing pipe
19+780.70	900		1		Existing to be retained
20+300	760		1	13.0	Proposed
20+393	600		1		Existing to be retained
20+950		2.75 x 3.0	2	15.0	Proposed
21+356		2.40 x 2.75	3	15.0	Replace existing pipe
21+770	900		1	9.5	Existing to be retained
22+400	760		1	13.0	Proposed
22+800	760		1	13.0	Proposed
23+500	760		1	13.0	Proposed
24+300	760		1	13.0	Proposed
24+650	760		1	13.0	Proposed
25+300	600		1	10.0	Existing to be retained
25+875	600		1	9.0	Existing to be retained
26+250	760		1	13.0	Proposed
26+750	760		1	13.0	Proposed
27+300	760		1	13.0	Proposed
28+500	760		1	13.0	Proposed
28+750	600		2	15.0	Existing to be retained
29+100	760		1	13.0	Proposed
29+550	760		1	13.0	Proposed
30+250	760		1	13.0	Proposed
30+876.30	600		2	11.0	Existing to be retained
31+580	760		1	13.0	Proposed
32+350	760		1	13.0	Proposed
32+560		2.40 x 2.75	1	15.0	Proposed

Table 4-23
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: PALAYAN - DINGALAN
SEGMENT 4C (GABALDON - DINGALAN)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
33+060	600		2	7.0	Existing to be retained
33+720	600		1	9.0	Proposed
33+950	760		1	13.0	Proposed
34+400	760		1	13.0	Proposed
35+250	760		3	13.0	Proposed
35+535		2.40 x 2.40	1	15.0	Proposed
36+050	760		1	13.0	Proposed
36+485	900		2	13.0	Existing to be retained
37+098.50		3.0 x 3.0	1	15	Proposed
37+656	900		1	10.7	Existing to be retained
37+900	760		1	13.0	Proposed
38+270.70	1200		1		Existing to be retained
38+600	760		2	13.0	Proposed
39+080		2.40 x 2.40	1	15.0	Proposed
39+300	760		1	13.0	Proposed
39+641	900		1	9.0	Existing to be retained
40+232.5	900		1		Existing to be retained
40+303.85	900		1		Existing to be retained
40+515	600		1		Existing to be retained
40+768.70	600		1		Existing to be retained
40+950	760		1		Existing to be retained
41+969.50	600		1		Proposed
42+240	600		1		Existing to be retained
43+504	600		1		Existing to be retained
44+009	600		1		Existing to be retained
44+598	600		1	15.0	Existing to be retained
45+170		3.0 x 3.0	2	15.0	Proposed
45+606	600		1	6.0	Existing to be retained
+856.5	600		1	8.5	Existing to be retained
46+407.08	1200		2	15.0	Replace existing pipe
46+530		2.40 x 2.40	1	15.0	Proposed
46+785.60	600		1	8.5	Existing to be retained
46+900	600		1	9.3	Existing to be retained

Table 4-24

LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: PROVINCIAL BOUNDARY TO KM 38 (SEGMENT $2B_1$)
SEGMENT 5A

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
0+600	760		1	13.0	Proposed
0+950	760		1	13.0	Proposed
1+400	760		1	13.0	Proposed
3+300	760		1	13.0	Proposed
3+800	760		1	13.0	Proposed
4+100		3.0 x 3.0	2	15.0	Proposed
4+450	760		1	13.0	Proposed
4+950	760		1	13.0	Proposed
5+200	760		1	13.0	Proposed
5+450	760		1	13.0	Proposed
5+800	760		1	13.0	Proposed
6+250	760		1	13.0	Proposed
6+600		2.40 x 3.0	2	15.0	Proposed
6+950	760		1	13.0	Proposed
7+200	760		1	13.0	Proposed
7+700	760		1	13.0	Proposed
8+100	760		1	13.0	Proposed
8+550	760		1	13.0	Proposed
9+000	760		1	13.0	Proposed
9+750		3.0 x 3.0	1	15.0	Proposed
10+200	760		1	13.0	Proposed
10+600	760		1	13.0	Proposed
11+100	760		1	13.0	Proposed
11+600	760		1	13.0	Proposed
12+500	760		1	13.0	Proposed
13+600	760		1	13.0	Proposed
14+500	760		1	13.0	Proposed
15+150	760		1	13.0	Proposed
15+800	760		1	13.0	Proposed
16+150	760		1	13.0	Proposed
16+800	760		1	13.0	Proposed

Table 4-25
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: TABLANG-PROVINCIAL BOUNDARY
SEGMENT 5B (BONGABON - PROVINCIAL BOUNDARY)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
9+263	1000		1	10.0	Existing to be retained
9+370	600		1	10.0	Existing to be retained
9+532	1000		1	12.0	Existing to be retained
9+792	600		1	10.0	Existing to be retained
9+885	600		1	12.0	Existing to be retained
10+144	1000		1	8.0	Existing to be extended by 5m
10+193	600		1	8.0	Existing to be extended by 5m
10+360	1000		1	10.0	Existing to be retained
10+940	600		1	12.0	Existing to be retained
10+985	600		1	10.0	Existing to be retained
11+035	1000		1	7.0	Existing to be extended by 6m
11+686	600		1	9.0	Existing to be extended by 4m
12+224	600		1	11.0	Existing to be retained
12+409	600		1	9.0	Existing to be extended by 4m
13+716	600		1	8.0	Existing to be extended by 5m
14+844	600		1	9.0	Existing to be extended by 4m
15+564	1000		1	10.0	Existing to be retained
15+961	600		1	10.0	Existing to be retained
17+313	600		1	10.0	Existing to be retained
19+399	600		1	12.0	Existing to be retained
20+346	600		1	9.0	Existing RCBC to be extended by 6m
20+369	600		1	12.0	Existing to be retained
20+394	1500		1	12.0	Existing to be retained
20+504	600		1	11.0	Existing to be retained
22+875		3.0 x 3.0	4	15.0	Proposed to replace existing
23+796	600		1	7	Existing to be extended by 6m
24+419	600		1	8.0	Existing to be extended by 5m
24+539	600		1	10.0	Existing to be retained
24+886		3.0 x 3.0	2	15.0	Proposed to replace existing
25+070	1000		1	10.0	Existing to be retained
25+093		2.10 X 2.40	1	15.0	Proposed to replace existing
26+068	600		1	8.0	Existing to be extended by 5m
26+098	600		1	8.0	Existing to be extended by 5m

(continued)

Table 4-25 (continued)
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: TABLANG-PROVINCIAL BOUNDARY
SEGMENT 5B (BONGABON - PROVINCIAL BOUNDARY)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
26+215	600		1	8.0	Existing to be extended by 5m
26+333		3.0 x 3.0	2	15.0	Proposed to replace existing
27+333	600		1	7.0	Existing to be extended by 6m
27+408		3.0 x 3.0	4	15.0	Proposed to replace existing
27+663	600		1	9.0	Existing to be extended by 4m
28+191	600		1	10.0	Existing to be retained
28+946	600		1	12.0	Existing to be retained
29+035	600		1	8.0	Existing to be extended by 5m
30+600		2.75 x 3.0	1	15.0	Proposed to replace existing
30+714	1000		1	11.0	Existing to be retained
30+781	1000		1	10.0	Existing to be retained
30+829		2.10 x 2.40	2	15.0	Proposed to replace existing
31+142	1000		1	10.0	Existing to be retained
31+344	1000		1	9.0	Existing to be extended by 4m
31+759	600		1	10.0	Existing to be retained
31+830		2.40 x 2.75	2	15.0	Proposed to replace existing
32+434	600		1	10.0	Existing to be retained
32+572		2.40 x 2.75	2	15.0	Proposed to replace existing
32+896	600		1	10.0	Existing to be retained
33+340		2.40 x 2.75	2	15.0	Proposed to replace existing
33+757	600		1	10.0	Existing to be retained
33+801	600		1	10.0	Existing to be retained
33+854	600		1	10.0	Existing to be retained
35+981	600		1	9.0	Existing to be extended by 4m
36+100		2.40 x 2.75	1	15.0	Proposed to replace existing
36+168	600		1	9.0	Existing to be extended by 4m
36+522		3.0 x 3.0	1	15.0	Proposed to replace existing
36+715	600		1	10.0	Existing to be retained
36+975	600		1	9.0	Existing to be extended by 4m
37+049		2.10 X 2.40	2	15.0	Proposed to replace existing
37+109		2.10 X 2.40	1	15.0	Proposed to replace existing

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Table 4-26
LIST OF PROPOSED AND EXISTING CULVERTS
SECTION: TABLANG-PROVINCIAL BOUNDARY
SEGMENT 5C (TABLANG - BONGABON)

STATION	TYPE OF CULVERT		NO. OF ROWS	LENGTH (m)	REMARKS
	RCPC (mm)	RCBC (m)			
0+900					Existing to be retained
2+200					Existing to be retained
2+450					Existing to be retained
4+200	1500		2	10.0	Existing to be retained
4+850		2.40 x 2.75	1	15.0	Proposed to replace existing
5+900		2.40 x 2.75	1	15.0	Proposed to replace existing
7+500		1.80 x 2.10	1	15.0	Proposed to replace existing
7+650	600		1	9.0	Existing to be extended by 4m
8+450		2.40 x 2.40	1	15.0	Proposed to replace existing

A suggested set of STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION has been included in Appendix E-2. This document provides suggested contract documents, provides all general provisions, provides a section (Section 205) of recommendations for the development of Project Special Conditions and lastly provides several sections of technical specifications for actual construction activities. These Standard Specifications were developed based on similar specifications used by a number of county and local government units in the USA. It should be the responsibility of the design engineer to adapt these Standard Specifications to actual site conditions and if appropriate to modify them to equal or exceed the requirements of the DPWH Standard Specifications.

In addition to preparing the draft Standard Specifications for Public Works Construction, the Consultant developed a SUGGESTED PREQUALIFICATION SCHEME FOR CONTRACT ROADWORKS AND BRIDGEWORKS (See Appendix E-3). This draft document provides an outline for soliciting potential contractors to perform the various phases of construction. Since many small contractors have difficulty in acquiring performance bonds and do not have financial resources to set up an escrow to ensure compliance with the specifications, it is reasonable to consider prequalifying these contractors before awarding them a contract. Although the prequalification methodology does not guarantee that a contractor will complete a project, the mere fact that he has adequate equipment and manpower and has completed projects of similar magnitude provides a level of assurance to the Owner that work can be done.

4.2.3.3 Alternative Construction Methods

Modern roadbuilding tends to favor equipment intensive construction practices as opposed to labor intensive practices. Section 4.4.2.3 indicates that several thousand male unskilled laborers are available in Aurora Province and a significant number are also available in Nueva Ejica Province. Although a number of these laborers could be put to work in grading and paving activities, modern heavy equipment is necessary to move the large volumes of dirt necessary to build vertical grades and horizontal alignments necessary to meet DPWH standards.

One potential project which could be considered for a labor intensive project is that of Segment 3, the construction of a trail system to augment the existing logging road network between Dingalan and San Luis. The Consultant recommended against further analysis of a normal road in this segment because of high costs compared to perceived benefits. The concept of building a trail network for local access to the coastal barangays as well as for the possible development of a tourism base (backpackers and naturalists) was raised during the presentation of the preliminary report. It is possible to develop a trail system with rock and timber structures by utilizing labor intensive methods. Rough grading of the trail could be done with a small bulldozer. Fine grading and installation of granular base could be accomplished by hand labor or small mechanized buggies. Timber is readily available in this segment that could be incorporated into bridge construction. Little heavy equipment would be necessary. Culverts could be constructed using local stone and portland cement brought in for mortar. The total trail network could be developed following a pattern similar to that developed by the Works Progress

Administration (WPA) in the United States in the 1930's. Little outside materials would be necessary and the nature of the construction lends itself to use of a large amount of unskilled labor.

4.3 PAVEMENT DESIGN

The TOR in Section III A indicates that the Consultant "...shall analyze the feasibility of constructing new or upgrading the existing components into an all-weather (typhoon resistant) highway network to complement and link with other roads servicing the project areas..." By definition in Chapter 2 of the Inception Report presented to USAID in June 1991, the Consultant then referred to PCCP as the desired pavement unless, in the professional opinion of the Consultant, a section or subsection of the road would be sufficiently sheltered that a suitable AC or DBST design would be practicable.

Four pavement surface options were then be considered for the Aurora Project Roads in the following order of preference:

(a) Portland Cement Concrete Pavement (PCCP)

(b) Asphaltic Concrete (AC)

(c) Double Bituminous Surface Treatment (DBST)

(d) Gravel surfaces were considered as an alternative for those Road Sectors with extremely light traffic (where 10-year Equivalent Standard Axle Loads - ESAL is less than 100,000); however, such road surfaces would probably not meet the "Typhoon Resistant" criteria.

The pavement design principles in the DPWH Guide utilize methods and recommendations from the original AASHTO Design Guide, modified to conform to factors specific to the Philippines. Another widely utilized design guide, Road Note 31, "a guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries" was also utilized as a reference in the pavement design. Reference was also made to the latest edition of the AASHTO Revised Design Guide when appropriate for clarification of recommendations to be made. All three sets of design criteria are similar to each other and common use of the same references between AASHTO and Road Note 31 is quite evident.

All three design guides utilize the principle that a pavement structure is a layered system designed to distribute concentrated traffic loads to the subgrade. Current DPWH design procedures, found in Chapter 4 (Design Procedures) of the DPWH design manual utilize the

same procedures and many of the same tables and charts as Road Note 31. Since Road Note 31 was specifically written for application in tropical and sub-tropical climates, the design procedures utilized within it will be compared with DPWH criteria. Use of DPWH versus Road Note 31 criteria will be noted.

Recommended surface types will be designed in accordance with DPWH Design guide, Chart 4.10 with the following as general guidelines:

- DBST surface for ESALs up to 2,500,000
- DBST or Asphaltic Concrete for ESALs 1,000,000 to 2,500,000
- Asphaltic Concrete or PCCP for ESALs 2,500,000 to 5,000,000
- PCCP for ESAL's over 5,000,000.

Further, Road Note 31, the DPWH Design Guide and the AASHTO Revised Design Guide require certain minimum thicknesses for any asphaltic concrete placed on aggregate base and assume that regular and periodic maintenance programs are in place - such maintenance includes additional seal coats, overlays, crack sealing programs, etc. When these maintenance and rehabilitation considerations are taken into account, any of the three proposed surfaces can be expected to serve 40 to 50 years or more.

There are three main steps which the designer must consider when designing a new road pavement. These are:

(a) preparing an estimate of the amount of traffic - and its approximate axle load distribution - that will use the road over its expected design life,

(b) determining the strength of the subgrade soils upon which the road will be built, and

(c) evaluating a) and b) to select the most economical combination of pavement materials and layer thicknesses that will provide satisfactory service over the design life of the pavement considering normal routine maintenance.

Road Note 31 indicates that special emphasis should be given to two aspects of pavement design that are of major significance in design of roads under tropical conditions. Those aspects are:

(a) detailed consideration must be given to the influence of tropical climates on moisture conditions in road subgrades, and

(b) attention must be drawn to the desirability of adopting a stage construction approach to road building where traffic growth rates are high or long-term predictions are uncertain.

4.3.1 Traffic Loading

The loads imposed by private cars and other light vehicles do not contribute significantly to the structural damage caused to road pavements by traffic. As a result, it is widely accepted that for the purposes of structural design, cars can be ignored and only the total number and the axle loading of the commercial vehicles that will use the road during its design life need to be considered. For this Feasibility Study the commercial vehicle then will be defined as any goods or public service vehicle of 1500 kg (1.5 tons) or more.

In order to estimate the number of commercial vehicles on a pavement segment during its design life, the designer must develop a current average annual daily traffic (AADT) along with an AADT of commercial traffic. An annual growth rate for traffic must then be determined. Road Note 31 indicates that in developing countries the annual growth rate is often very difficult to determine. Based upon data generated in Chapter 2 (Economic Overview) and Chapter 3 (Traffic) of this report, an annual rate of 4 per cent will be used for traffic growth.

Traffic counts taken in July 1991 at 9 locations within the study area reveal AADT's ranging from a high of 302 vehicles on the Tablang-Gabaldon segment to a low of approximately 47 vehicles between Baler-Dipaculao and 94 vehicles between Gabaldon-Dingalan. Counts identified vehicles by class and these classes will be used as follows:

(a) car/taxi, jeep/pickup/van, jeepney and other (motorcycles & tricycles) = non-commercial vehicles

(b) small bus, large bus, 2-axle truck, 3-axle truck, & articulated truck = commercial vehicles

The AADT's shown do not include the total for "other" vehicles which are comprised of tricycles and motorcycles. The traffic counts indicate that commercial traffic, that which causes significant structural damage to the road, currently averages less than 60 vehicles per day in one direction. The high commercial vehicle traffic count occurred on the Bongabon-San Luis segment with a lesser count on the Palayan City-Dingalan segment. Using Table 4-27 (summarized from several tables in chapter 3) the one way number of ESALs will vary from approximately 150,000 in 10 years to 1,500,000 in 20 years.

Another factor which must be considered when determining pavement deterioration over time is the number of repetitions of loaded axles. For design purposes then, it is necessary to consider not only the total number of commercial vehicles that will use the road, but also the wheel loads (or, for convenience, the axle loads) of these vehicles. Current practice is to assign

as a "standard" the 8,200 kg (18,000 lb) axle road and to design on the loads) of these vehicles. Current practice is to assign as a "standard" the 8,200 kg (18,000 lb) axle load and to design on the basis of an equivalent number of standard axles. Different pavement design criteria utilize varying terminology such as equivalent daily load applications (EDLA), equivalent standard axle load (ESAL), or design traffic number (DTN). Use of these three terms relative to total "standard" axles yields basically the same number. This design will utilize the term ESAL when considering "standard" axle.

Table 4-27
SUMMARY OF PAVEMENT DESIGN CRITERIA
BASIS: ONE WAY ESAL VALUES

SEGMENT	DESCRIPTION	1995 $ESAL_1$	2004 $ESAL_{10}$	2014 $ESAL_{20}$
Circumferential Road				
1A	Baler-Dipaculao	13,100	148,000	330,000
1B	Dipaculao-Maria Aurora	24,000	267,000	560,000
1C	Maria Aurora-San Luis	24,000	302,000	600,000
1D	San Luis-Baler	41,000	257,000	500,000
Tablang-Bongabon-Km 170-Cabatangan/Malupa-Km 38-Maria Aurora				
5C	Tablang-Bongabon	24,000	527,000	1,175,000
5B	Bongabon-Km 170	24,000	527,000	1,175,000
5A	Km 170-Cabanatangan/Malupa-Km 38	33,000	372,000	830,000
$2B_1$	Km 38-Bazal	60,000	682,000	1,516,000
2A	Bazal-Maria Aurora	60,000	682,000	1,516,000
Palayan City - Dingalan				
4A	Tablang-Laur	39,000	448,000	1,002,000
4B	Laur-Gabaldon	39,000	448,000	1,002,000
4C	Gabaldon-Dingalan	22,000	298,000	558,000

Because of the nature of the industry in Aurora province, the loaded vehicles generally are departing the province and the heaviest loads consist primarily of logs and similar forest products. Not all commercial vehicles are carrying logs but the breakdown of commercial vehicles by axle reveals that only a small percentage are 3-axle or articulated type trucks. The one-way ESAL values derived from the traffic analysis indicate a range of approximately 140,000 ESALs to 680,000 ESALs for 10 years and 330,000 to 1,520,000 for 20 years. Both the 10 year cumulative total and the 20 year total will be used in developing the pavement design thickness for flexible pavements. Only the 20 year ESAL value will be used for the rigid

(PCCP) pavement design. The 10 year term will be used to develop a staged construction scenario for the flexible pavement alternative.

Serviceability Index (SI) is a term relating to the ability of a pavement to serve high speed, high volume automobile and truck traffic. The DPWH design manual (Section 4.113) defines SI in terms of a Present Serviceability Rating (P_t). This SI varies from a high of 5 to a low of 0. DPWH suggests that lower traffic volume roads be assigned an SI of 2.0.

The solution of the thickness of flexible pavements then becomes a matter of solving an equation involving a term called the Structural Number. The SN is a term which expresses the structural strength of a pavement required, as a combination of the soil support value which is determined from geotechnical analyses, the total Equivalent Standard Axle Loadings (ESAL), the Serviceability Index (SI), and the Regional Factor (R). The soil support value is a number associated with a laboratory test called the California Bearing Ratio (CBR).

Standard design practice also dictates that a Regional Factor (R) be utilized to adjust the Structural Number (SN) for local environment and other considerations. This factor, for flexible pavement roads, is used to control variation in rate or reduction of serviceability, as strength loss of roadbed materials. DPWH suggests (R) = 1.5-2.0 for general conditions with sufficient drainage. This design will use (R) = 2.0. When the Regional Factor (R) is a number other then 1.0, then a Weighted Structural Number ($\bar{S}\bar{N}$) must be developed. The DPWH manual (page 748), Figure 4-14 herein, provides for determination of the ($\bar{S}\bar{N}$) by means of a nomograph as (R) varies.

4.3.1.1 Flexible Pavement Design

The design formula utilized for flexible pavement surfaces then becomes :

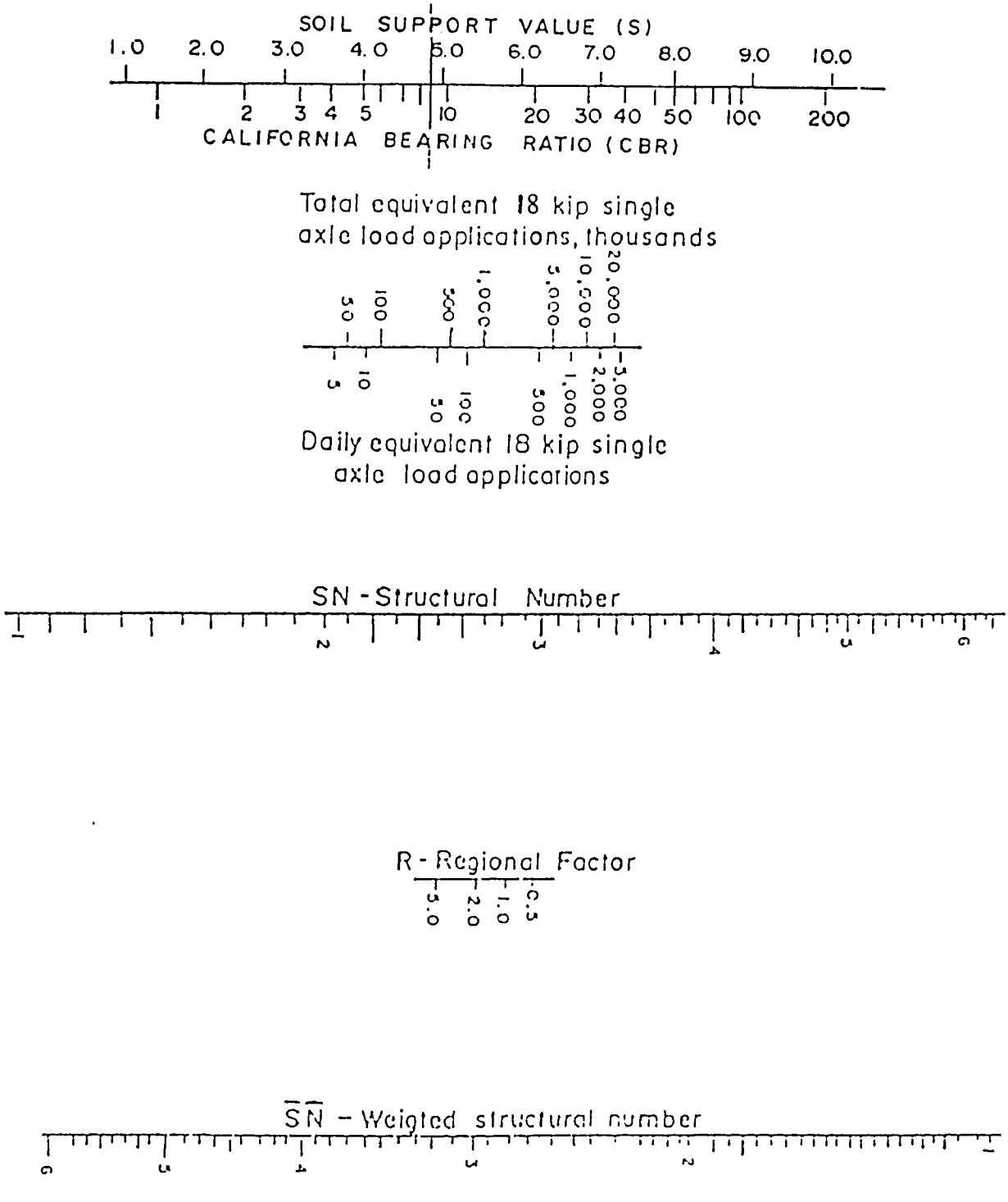
$$SN = a_1D_1 + a_2D_2 + a_3D_3 + \ldots$$

where:

$a_1, a_2, a_3, \ldots$ = the layer coefficient for surface, base and subbase.

$D_1, D_2, D_3, \ldots$ = the thickness of surface, base and subbase courses, respectively.

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	DESIGN CHART FOR FLEXIBLE PAVEMENTS	FIGURE 4-14



Design chart for flexible payments, P_t -20

The layer coefficient is used to convert the required SN to actual thickness of surfacing, base and subbase, so pavement design depends largely on the structural coefficients that are selected for the various layers of the pavement. The DPWH design manual suggests using the following structural layer coefficients. See Table 4-28.

Table 4-28
STRENGTH COEFFICIENTS

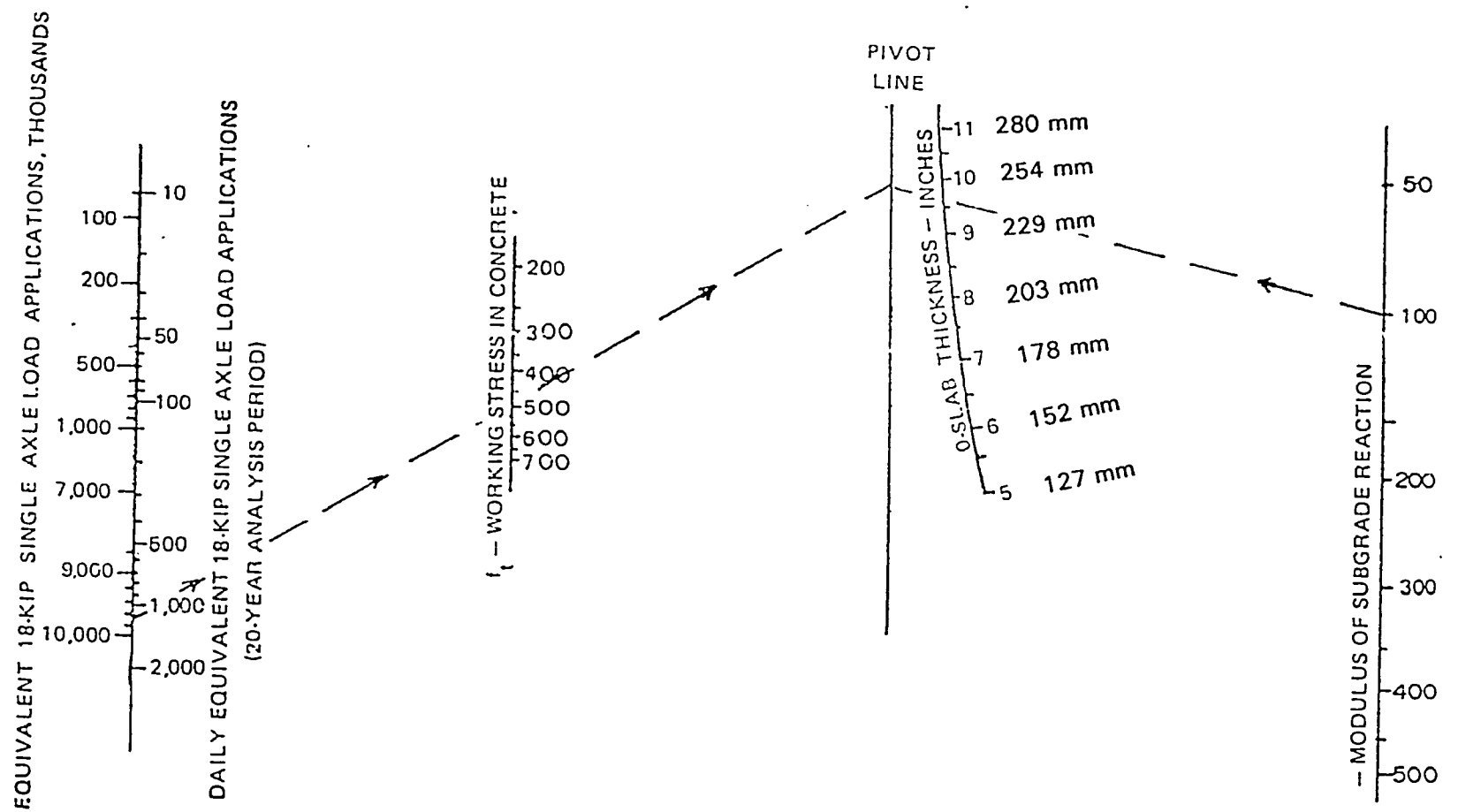
PAVEMENT COMPONENT	LAYER COEFFICIENT
Asphalt Concrete, good condition	0.38
Asphalt Concrete, fair condition	0.20-0.30
Asphalt Concrete, bad condition	0.15
Bituminous Surface Treatment	0.20
Cement Concrete, good condition	0.44
Cement Concrete, fair condition	0.35
Cement Concrete, bad condition	0.20
Cement Concrete, very bad condition	0.15
Cement Treated Base	0.17-0.23
Crushed Gravel Base	0.15
Broken Stone Macadam Base	0.14
Granular Subbase (meeting specifications)	0.11
Subbase (poorly graded or containing clay)	0.07

4.3.1.2 Rigid Pavement Design

A rigid pavement, Portland Cement Concrete Pavement, (PCCP), is normally designed based on a structure consisting of two layers, the pavement slab and the subbase course. When the roadbed soils are of subbase quality, ie. when the soil support value is high, the subbase course is often omitted. The design procedure deter-mines the thickness of portland cement concrete pavement and any base/subbase thickness. The pavement slab thickness is determined by the use of design charts developed in conjunction with the Portland Cement Association (PCA) and the American Association of State Highway and Transportation Officials (AASHTO). The design chart to be used on this project is shown in Figure 4-30 and reflects the same SI = 2.0 as for flexible pavements. Rigid pavement design incorporates a term entitled modulus of subgrade reaction (K) in the determination of slab thickness.

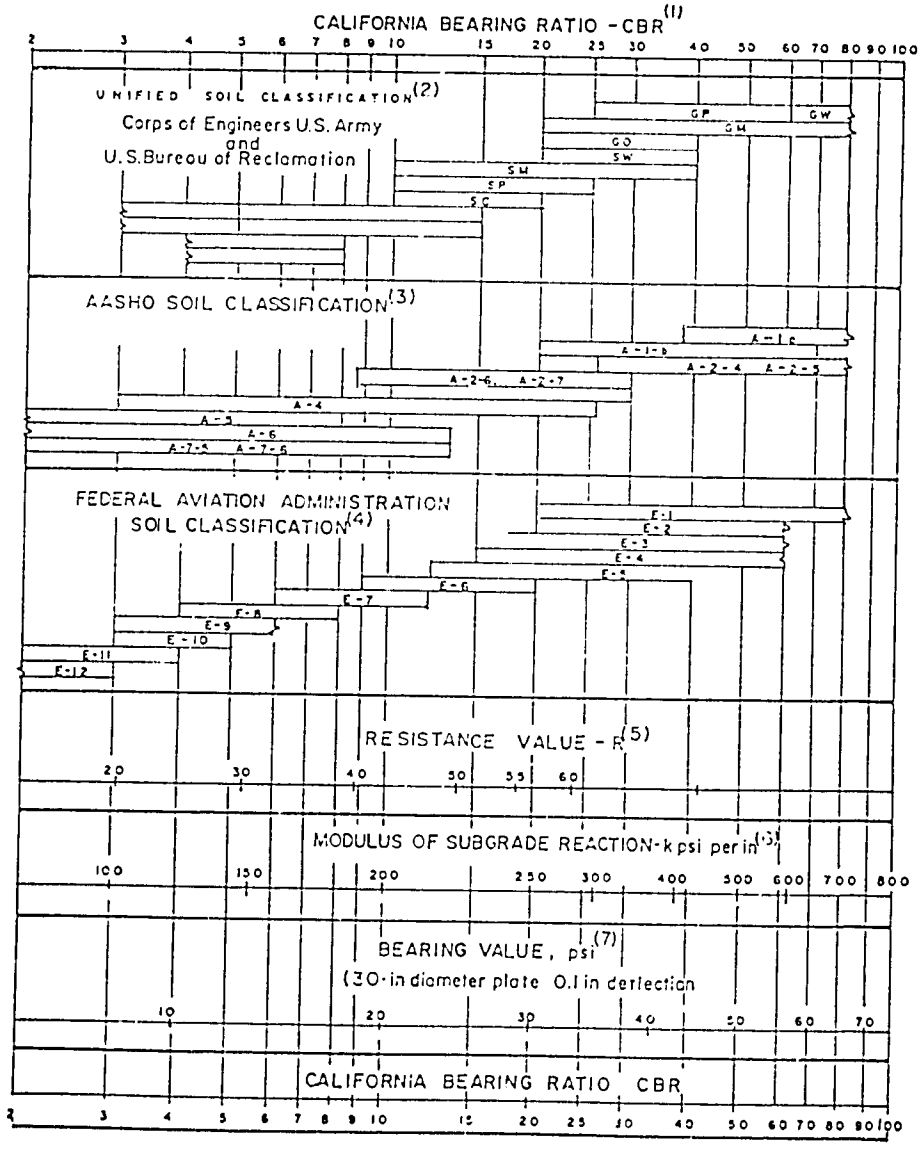
This K represents the load in pounds per square inch on a loaded area, divided by the deflection in inches of that loaded area. The K value can be determined from the data in Figure 4-16.

The DPWH design guide also refers to the Road Note 29 Method of PCCP design. From that method, the minimum concrete slab thickness equals 180 millimeters (unreinforced). Subgrade and subbase thicknesses are as shown on Table 4-31.



DESIGN CHART "B" FOR RIGID PAVEMENTS, P_t = 2.0

CORRELATION CHART
FOR ESTIMATING k - VALUES
(Ref : Portland Cement Association
"Thickness Design for Concrete Pavements"



Approximate interrelationships of soil classifications and bearing values.

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	CORRELATION CHART FOR ESTIMATING K VALUES	FIGURE 4-16

Table 4-31 *
CLASSIFICATION OF SUBGRADE FOR CONCRETE
ROADS AND MINIMUM THICKNESS OF SUBBASE REQUIRED

TYPE OF SUBGRADE	DEFINITION	MINIMUM THICKNESS OF SUBBASE REQUIRED
Very Weak	All subgrade of CBR value 2 percent or less	280 mm
Weak	All subgrade of CBR value 2-4 percent	180 mm
Normal	Subgrades with CBR > 4 percent but less than 15 percent and with subgrade CBR > 15 percent but not free draining subgrade	100 mm
Very Stable	All subgrades with CBR value over 15 percent	0 mm

*Source: DPWH Design Guide

In order to properly utilize the various design formulae and nomographs, the structural support (CBR) available from the roadbed soils must be known and factored into the equations. Geotechnical data obtained for this project reveal that the roadbed soil support values (CBR) vary considerably over the segments of the project. As a result, a given segment of road may have to have several different design elements and thickness conditions considered for optimum design. Section 4.1.4, Geotechnical Studies, of this report provides a detailed analysis of the soil conditions within the study area and the type of materials available for subbase.

4.3.1.3 Evaluation of Subgrade Soil

There is a significant variation in the soils found in the road subgrade. Soil types range from (A-7-6) to (A-7-5) to gravelly sand (A-2-4) and poorly graded gravel (A-1-b) at random intervals throughout the overall alignment. Refer to Appendix F.7.1 for a definition of terms and classification of soils and soil-aggregate mixtures. The A-7-5 and A-7-6 soils have a CBR of not less than 2 but not greater than 7. The A-4 and the A-5 soils have a CBR range from 3 to 18. At one location, the CBR of A-2-4 is less than 10. This significant variation suggests that some sections along the alignment may be improved to obtain higher and more uniform representative CBR values. Table 4-32 shows sections where soil conditions can be improved and how the modified CBR values change the overall pavement structure.

4.3.1.4 Evaluation of Existing Gravel Surfaces

To meet the design requirements, the existing aggregate, soil-aggregate mixtures represented by the base and subbase materials should not be less than 480 mm with sizes no greater than 50 mm. However, the thickness of gravel noted during the soil survey completed in mid-July of 1991 ranges from 150 mm to 250 mm. this actual gravel thickness does not satisfy the minimum requirement and most of its material classification is not suitable for aggregate base and subbase. The following locations represented at random where gravel layers were noted are shown in Table 4-32.

Table 4-32
EXISTING GRAVEL SURFACE CONDITIONS

STATION	GRAVEL THICKNESS (+)	GRAVEL TYPE
Circumferential Road		
1+350	250 mm	A-1-a on A-7-6
3+655	250 mm	A-2-4 on A-7-6
2+765	300 mm	A-1-4 on A-7-6
5+095	150 mm	A-1-4 on A-7-5
9+600	400 mm	A-1-4 on A-3
11+350	150 mm	A-1-a on A-7-6
18+350	200 mm	A-2-4 on A-2-6
20+380	200 mm	A-2-4 on A-2-4
24+480	200 mm	A-2-4 on A-7-6
30+350	250 mm	A-1-b on A-7-6
37+000	300 mm	A-3 on A-1-b
37+800	100 mm	A-2-4 on A-2-4
Palayan-Dingalan Road		
0+000	200 mm	A-2-6 on A-7-6
2+000	250 mm	A-6 on A-6
4+000	250 mm	A-1-a on A-7-6
6+000	150 mm	A-2-4 on A-7-6
11+000	250 mm	A-2-7 on A-2-4
15+800	150 mm	A-2-4 on A-2-4
18+300	100 mm	A-2-6 on A-2-4
22+000	200 mm	A-2-4 on A-6
26+000	100 mm	A-2-4 on A-4
31+500	250 mm	A-2-4 on A-6
37+000	150 mm	A-2-4 on A-7-6
41+000	250 mm	A-6 on A-2-5
46+000	250 mm	A-2-4 on A-2-7

This information shows that existing gravel layer construction is unusually variable and it is likely that other locations with different gravel thicknesses exist. A more thorough investigation on this thickness variation should be initiated during the detailed design stage of any project.

4.3.2 New Pavements

A series of pavement design sections were developed for each of the four potential surface conditions. For PCCP, three design sections were developed; slab on subbase of 100 mm, slab on subbase of 130 mm and slab on subbase of 178 mm. For hot mix Asphalt Concrete pavement, an asphalt concrete (AC) surface course of 51 mm was used on top of granular base and subbase. For DBST, an initial surface was applied over base and base and subbase. Then at year 5, an additional DBST was programmed and at year 10 a single application seal coat was programmed. At year 20, the entire seal coat pavement structure was overlaid with a 51 mm to 63 mm AC overlay. For gravel surface a 200 mm or a 250 mm surface was considered for low volume roads with low ESAL's. For gravel surfaces, a complete re-evaluation will be necessary by year 10 depending on the traffic growth and the development of ESAL values. A total of 16 surface thickness alternatives were developed.

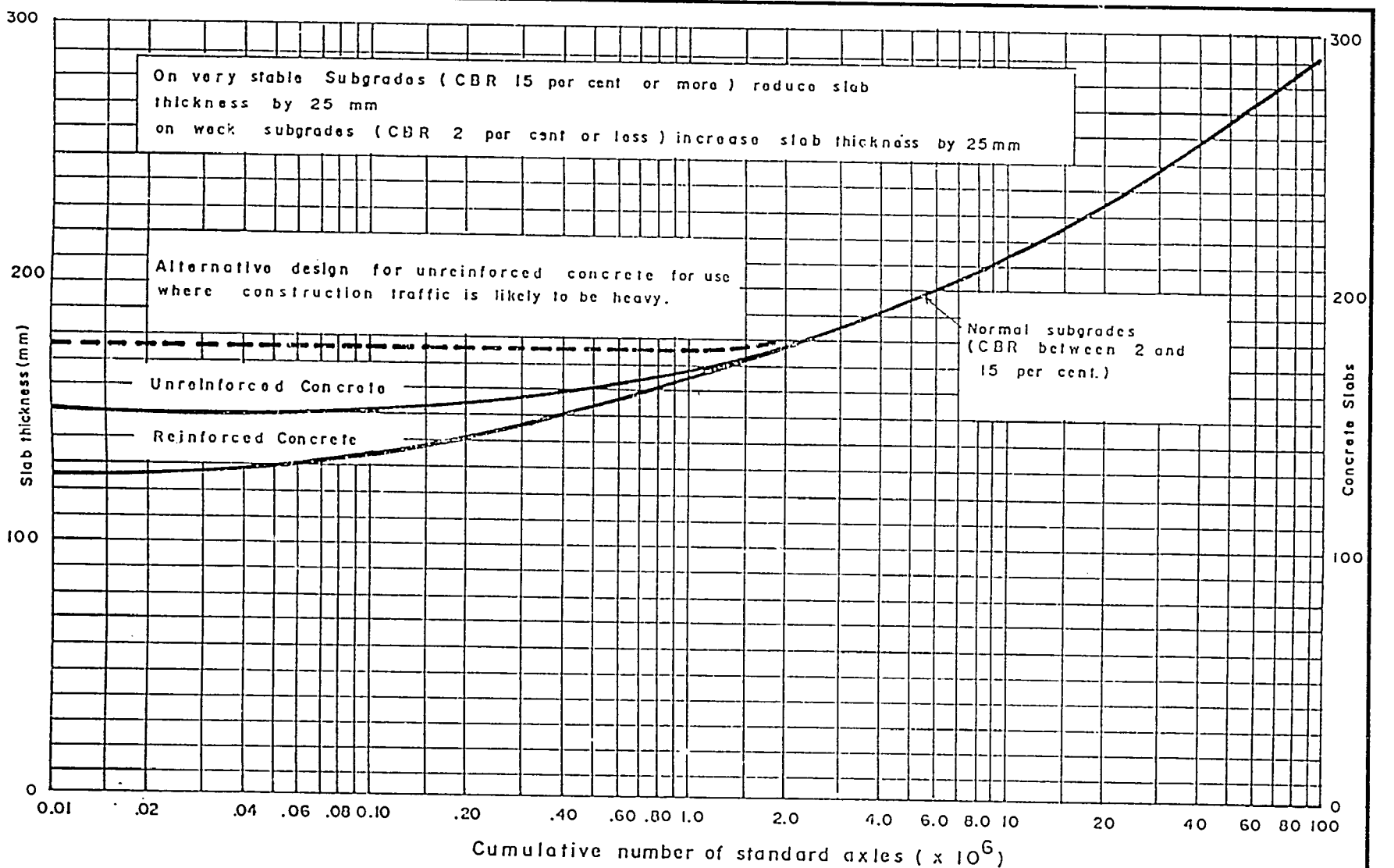
4.3.2.1 Portland Cement Concrete Pavement (PCCP)

The rigid pavement designs were developed based on the $ESAL_{20}$ and the CBR for each specific segment of roadway. The Design Chart for rigid pavements, Figure 4-15, the Correlation Chart for Estimating k-Values, Figure 4-16 and the Minimum Thickness of Subbase Required for Concrete, Table 4-17 were used to determine the slab and subbase thickness for each roadway segment. A summary of these slab and subbase configurations is shown in Table 4-33. In all cases use f_t = 400 psi since it is probable that field construction conditions will not provide as high quality PCCP as in urban areas. The design slab thickness configurations developed in Table 4-33 check closely with those which would be developed from Figure 4-17.

NOTE: Quality control must be provided in the field during construction. If existing field practices are used for PCCP, then a much lower f_t must be used and the pavement slab thickness will increase accordingly.

4.3.2.2 Flexible Pavement (AC) and (DBST)

In similar fashion to that of rigid pavement, the design charts and nomographs were used to develop the pavement components for AC and DBST. Table 4-33 summarizes the various pavement components which were developed in accordance with the formula in Section 4.3.1.1.



Cement concrete pavements: minimum thickness of slabs.

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY

DPWH MINIMUM SLAB THICKNESS FOR PCCP

FIGURE 4-17

Table 4-33
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: BALER-DIPACULAO
SEGMENT 1A$_1$

Sta. 0 + 00 to Sta. 2 + 763

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 250,000		$ESAL_{20}$ = 500,000	
	EXISTING CBR 3	IMPROVE CBR 10	EXISTING CBR 3	IMPROVED CBR 10
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm (6")	152 mm (6")	152 mm	152 mm
2.b Sub-base	180 mm	180 mm	180 mm	182 mm
2. Asphalt Concrete (AC)			63 mm AC (overlay)	63 mm AC (overlay)
2.a Asphalt Concrete	51 mm	51 mm	51 mm	51 mm
2.b Gravel Base	178 mm	150 mm	178 mm	100 mm
2.c Sub-Base	300 mm	200 mm	250 mm	200 mm
3. Double Bituminous Surface Treatment (DBST)			Add 51 mm (overlay @ yr. 10)	Add 51 mm (overlay @ yr. 10)
3.1 DBST	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5
3.2 Gravel Base	200 mm	150 mm	200 mm	150 mm G.B.
3.3 Sub-base	400 mm	300 mm	400 mm	300 mm S.B.
4. Gravel Surface				
4.1 Gravel Surface	250 mm	200 mm	Re-evaluate the total $ESAL_s$ to determine whether higher level may be required	200 mm
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: BALER-DIPACULAO
SEGMENT $1A_2$

Sta. 2 + 763 to Sta. 7 + 800

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 150,000		$ESAL_{20}$ = 330,000	
	EXISTING CBR 4	IMPROVE CBR no improvement	EXISTING CBR 4	IMPROVED CBR no improvement
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm		152 mm	
2.b Sub-base	130 mm		180 mm	
2. Asphalt Concrete (AC)			63 mm (overlay)	
2.a Asphalt Concrete	51 mm AC		51 mm	
2.b Gravel Base	150 mm		100 mm	
2.c Sub-Base	300 mm		230 mm	
3. Double Bituminous Surface Treatment (DBST)			Add 51 mm overlay yr. 10	
3.1 DBST	20 mm yr. 1 20 mm yr. 5		20 mm yr. 1 20 mm yr. 5	
3.2 Gravel Base	200 mm		200 mm	
3.3 Sub-base	300 mm		300 mm	
4. Gravel Surface			Re-evaluate the total $ESAL_t$ to determine whether higher level may be required	
4.1 Gravel Surface	250 mm			
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: DIPACULAO-MARIA AURORA
SEGMENT 1B

Sta. 7 + 800 to Sta. 13 + 600

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 270,000		$ESAL_{20}$ = 600,000	
	EXISTING CBR 14	IMPROVE CBR none	EXISTING CBR 14	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm		152 mm	
2.b Sub-base	100 mm		100 mm	
2. Asphalt Concrete (AC)			63 mm (overlay)	
2.a Asphalt Concrete	51 mm		51 mm	
2.b Gravel Base	100 mm		100 mm	
2.c Sub-Base	300 mm		300 mm	
3. Double Bituminous Surface Treatment (DBST)				
3.1 DBST	20 mm yr. 1 20 mm yr. 2		20 mm yr. 1 20 mm yr. 5	
3.2 Gravel Base	150 mm		200 mm	
3.3 Sub-base	380 mm		380 mm	
4. Gravel Surface			Re-evaluate the total ESALs to determine whether higher level may be required	
4.1 Gravel Surface	200 mm			
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: MARIA-AURORA-SAN LUIS
SEGMENT 1C

Sta. 13 + 600 to Sta. 31 + 400

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 150,000		$ESAL_{20}$ = 330,000	
	EXISTING CBR 14	IMPROVE CBR none	EXISTING CBR 14	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm		152 mm	
2.b Sub-base	100 mm		100 mm	
2. Asphalt Concrete (AC)			63 mm (overlay)	
2.a Asphalt Concrete	51 mm		51 mm	
2.b Gravel Base	100 mm		100 mm	
2.c Sub-Base	300 mm		300 mm	
3. Double Bituminous Surface Treatment (DBST)				
3.1 DBST	20 mm yr. 1 20 mm yr. 5		20 mm yr. 1 20 mm yr. 5	
3.2 Gravel Base	150 mm		200 mm	
3.3 Sub-base	380 mm		380 mm	
4. Gravel Surface			Re-evaluate the total $ESAL_t$ to determine whether higher level may be required	
4.1 Gravel Surface	250 mm			
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: SAN-LUIS BALER
SEGMENT 1D

Sta. 31 + 400 to Sta. 0 + 00

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 250,000		$ESAL_{20}$ = 500,000	
	EXISTING CBR 3	IMPROVE CBR 10	EXISTING CBR 3	IMPROVED CBR 10
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm (6")	152 mm (6")	152 mm	152 mm
2.b Sub-base	180 mm	180 mm	180 mm	182 mm
2. Asphalt Concrete (AC)			63 mm (overlay)	63 mm AC (overlay)
2.a Asphalt Concrete	51 mm	51 mm	51 mm	51 mm
2.b Gravel Base	178 mm	15 mm	178 mm	100 mm
2.c Sub-Base	250 mm	200 mm	250 mm	200 mm
3. Double Bituminous Surface Treatment (DBST)			add 51 mm (overlay @ year 10)	add 51 mm (overlay @ year 10)
3.1 DBST	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5	20 mm yr. 1 20 mm yr. 5
3.2 Gravel Base	200 mm	150 mm	200 mm	150 mm G.B.
3.3 Sub-base	380 mm	300 mm	400 mm	300 mm S.B.
4. Gravel Surface			Re-evaluate the total ESALs to determine whether higher level may be required	
4.1 Gravel Surface	250 mm	200 mm		200 mm
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: PANTABANGAN-CANILE
SEGMENT 2C

Sta. _____ to Sta. _____

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 200,000		$ESAL_{20}$ = 500,000	
	EXISTING CBR 4	IMPROVE CBR none	EXISTING CBR 4	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP) 1.a PCCP SLAB 2.b Sub-base	 152 mm 130 mm		 152 mm 130 mm	
2. Asphalt Concrete (AC) 2.a Asphalt Concrete 2.b Gravel Base 2.c Sub-Base	 51 mm 200 mm 250 mm		51 mm AC (overlay) 51 mm 200 mm 380 mm	
3. Double Bituminous Surface Treatment (DBST) 3.1 DBST 3.2 Gravel Base 3.3 Sub-base	 20 mm yr. 1 20 mm yr. 2 200 mm 380 mm		Add 51 mm (overlay @ YR. 10) 20 mm yr. 1 20 mm yr. 2 200 mm 380 mm	
4. Gravel Surface 4.1 Gravel Surface 4.2 Base	 350 mm		Re-evaluate the total ESALs to determine whether higher level may be required	

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: CANILI-BAZAL
SEGMENT 2B2

Sta. _____ to Sta. _____

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 200,000		$ESAL_{20}$ = 500,000	
	EXISTING CBR 4	IMPROVE CBR none	EXISTING CBR 4	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP) 1.a PCCP SLAB 2.b Sub-base	 152 mm 130 mm		 152 mm 130 mm	
2. Asphalt Concrete (AC) 2.a Asphalt Concrete 2.b Gravel Base 2.c Sub-Base	 51 mm AC 200 mm 250 mm		51 mm AC (overlay) 51 mm 200 mm 380 mm	
3. Double Bituminous Surface Treatment (DBST) 3.1 DBST 3.2 Gravel Base 3.3 Sub-base	 20 mm 20 mm 200 mm 380 mm		Add 51 mm overlay yr. 10 20 mm yr. 1 20 mm yr.5 200 mm 380 mm	
4. Gravel Surface 4.1 Gravel Surface 4.2 Base	 250 mm		Re-evaluate the total ESALs to determine whether higher level may be required	

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: TABLANG- LAUR
SEGMENT 4A

Sta. 0 + 00 to Sta. 14 + 800

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 450,000		$ESAL_{20}$ = 1 X 10^6	
	EXISTING CBR 4	IMPROVE CBR none	EXISTING CBR 4	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP)				
1.a PCCP SLAB	152 mm		152 mm	
2.b Sub-base	130 mm		180 mm	
2. Asphalt Concrete (AC)			63 mm (overlay)	
2.a Asphalt Concrete	51 mm		51 mm	
2.b Gravel Base	200 mm		200 mm	
2.c Sub-Base	380 mm		380 mm	
3. Double Bituminous Surface Treatment (DBST)			Add 63 mm overlay	
3.1 DBST	20 mm yr. 1 20 mm yr. 5		20 mm yr. 1 20 mm yr. 5	
3.2 Gravel Base	200 mm		255 mm	
3.3 Sub-base	400 mm		420 mm	
4. Gravel Surface			Re-evaluate the total ESALs to determine whether higher level may be required	
4.1 Gravel Surface	250 mm			
4.2 Base				

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: LAUR-GABALDON
SEGMENT 4B

Sta. 14 + 800 to Sta. 34 + 500

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 450,000		$ESAL_{20}$ = 1 X 10^6	
	EXISTING CBR 5	IMPROVE CBR 20	EXISTING CBR 5	IMPROVED CBR 20
1. Portland Cement concrete Pavement (PCCP) 1.a PCCP SLAB 2.b Sub-base	152 mm 130 mm	152 mm 130 mm	152 mm 180 mm	152 mm 130 mm
2. Asphalt Concrete (AC) 2.a Asphalt Concrete 2.b Gravel Base 2.c Sub-Base	51 mm 200 mm 380 mm	51 mm 100 mm 255 mm	63 mm (overlay) 51 mm 200 mm 380 mm	51 mm 150 mm 255 mm
3. Double Bituminous Surface Treatment (DBST) 3.1 DBST 3.2 Gravel Base 3.3 Sub-base	20 mm yr. 1 20 mm yr. 5 200 mm 400 mm	20 mm yr.1 20 mm yr. 5 150 mm 400 mm	Add 63 mm overlay yr. 10 20 mm yr. 1 20 mm yr.5 255 mm 420 mm	20 mm yr. 1 20 mm yr. 5 150 mm 380 mm
4. Gravel Surface 4.1 Gravel Surface 4.2 Base	250 mm	150 mm	Re-evaluate the total ESALs to determine whether higher level may be required	

Table 4-33 (continued)
SUMMARY OF ACTUAL PAVEMENT STRUCTURES
LOCATION: GABALDON-DINGALAN
SEGMENT 4C

Sta. 34 + 500 to Sta. 47 + 300

STRUCTURAL COMPONENT	COMPONENT THICKNESS			
	$ESAL_{10}$ = 250,000		$ESAL_{20}$ = 575,000	
	EXISTING CBR 7	IMPROVE CBR none	EXISTING CBR 7	IMPROVED CBR none
1. Portland Cement concrete Pavement (PCCP) 1.a PCCP SLAB 2.b Sub-base	152 mm 100 mm		152 mm 100 mm	
2. Asphalt Concrete (AC) 2.a Asphalt Concrete 2.b Gravel Base 2.c Sub-Base	51 mm 152 mm 255 mm		51 AC (overlay) 51 mm AC 152 mm 255 mm	
3. Double Bituminous Surface Treatment (DBST) 3.1 DBST 3.2 Gravel Base 3.3 Sub-base	20 mm yr. 1 20 mm yr. 5 200 mm 380 mm		Add 51 mm (overlay @ yr. 10) 20 mm yr. 1 20 mm yr. 5 200 mm 380 mm	
4. Gravel Surface 4.1 Gravel Surface 4.2 Base	200 mm		Re-evaluate the total ESALs to determine whether higher level may be required	

An example of the design procedure is shown below:

Circumferential Road: Baler to Dipaculao

Sta. 0 + 000 to Sta. 2 + 763 and
Sta. 31 + 400 to Sta. 0 + 000
Segment 1A & 1D
CBR = 3 existing
CBR = 10 improved

Consider stage construction with Stage 1 = $ESAL_{10}$ = 250,000 and
Stage 2 = $ESAL_{20}$ = 500,000

Pt = 2.0
R = 2.0

From Figure 4-14, with $ESAL_{10}$, CBR = 3, $\bar{S}\bar{N}$ = 3.1

Thus, $3.1 = a_1D_1 + a_2D_2 + a_3D_3 + \ldots$

Use D_1 = 51 mm (2"), then a_1 = 0.38 (new bituminous surface);

Try D_2 = 178 mm (7") using crushed gravel base, then a_2 = 0.15

Try D_3 = 300 mm (12") using granular subbase meeting specifications, then a_3=0.11

$3.1 = (0.38)(2) + (0.15)(7) + (0.11)(12)$

$3.1 = 0.76 + 1.05 + 1.32$

$3.1 = 3.13$ <u>OK</u>

Stage 1 construction = 51 mm AC
+ 178 mm of crushed gravel base
+ 300 mm of granular subbase

Try Stage 2 construction:

From Figure 4-14, with $ESAL_{20}$, CBR = 3, $\bar{S}\bar{N}$ = 3.8

Thus, $3.8 = a_1D_1 + a_2D_2 + a_3D_3 + \ldots$

Use D_1 = 63 mm (2.5"), then a_1 = 0.38 (new asphalt overlay)

Use D_2 = 51 mm (2"), then a_2 = 0.25 (old asphalt, fair condition) - year 10 seal coat is incorporated in this layer with no structural component

D_3 = 178 mm (7") crushed gravel base, then a_3 = 0.15

D_4 = 300 mm (12") granular subbase meeting specifications, then a_4 = 0.11

$$3.85 = (0.38)(2.5) + (0.25)(2) + (0.15)(7) + (0.11)(12)$$

$$3.85 = 0.95 + 0.50 + 1.05 + 1.32$$

$$3.85 = 3.82 \quad \underline{\text{OK}}$$

Stage 2 construction = 63 mm hot mix asphalt overlay on top of existing surface

4.3.2.3 Double Bituminous Surface Treatment (DBST)

A DBST road is a modified flexible pavement with the surface consisting of a double layer of fine, crushed chips or pea-sized gravel applied immediately following the application of a light coating of hot liquid bituminous oil. This treatment is applied in two layers and becomes the wearing course. A DBST surface is a low cost alternative for paving of low volume roads. The rationale for a DBST surface design is identical to that of an AC design. The various surface components are summarized in Table 4-33.

4.3.2.4 Gravel Surfacing

A gravel road is a viable option in areas of low traffic volumes. A good guideline for design purposes is to consider gravel surfaces for roads with under 400 AADT. On those gravel roads with AADTs over 200 the periodic cost of maintenance and regravelling increases dramatically. The DPWH Design Manual, Table 4-34 herein, provides a guide for the design of a gravel road base and surface.

4.4 CONSTRUCTIBILITY ANALYSIS

Any proposed infrastructure development program should be subjected to an analysis of its constructibility. Such a plan should address the major factors associated with the construction of the project such as availability of resources, special construction concerns like climate, specialty equipment and source of funding, and should address maintenance factors such as the availability of equipment and manpower to take care of the completed project.

Table 4-34
RECOMMENDED THICKNESS OF GRAVEL LAYERS TO BE PLACED ON THE SUBGRADE OF A GRAVEL ROAD

TRAFFIC A.D.T. (in both directions)	SUBGRADE SOIL	RECOMMENDED TOTAL MINIMUM THICKNESS OF GRAVEL+
< 200	A1, A2, A3 Soils of if CBR > 7	150 mm
	A4, A5, A6, A7 Soils or if CBR is between 3 and 7	200 mm
> 200	A1, A2, A3, Soils or if CBR > 7	200 mm
	A4,A5, A6, A7 Soils or if CBR is between 3 and 7	250 mm

+ if drainage is bad (water-table less than 600 mm below subgrade formation) use additional 50 mm gravel.

- if CBR of soil is less than 3%, add 50 mm of gravel to the recommended minimum thickness.

4.4.1 Plan for Execution-Contract Packages

In order to minimize the amount of detours necessary for the construction of the various segments of this project, to allow for construction to take place during the low rainfall months and to allow the use of an optimum number of local laborers in construction, a bar chart of reflecting proposed design, tender and construction phases was developed. This bar chart is shown on Table 4-35. Figures 4-18 through 4-20 identify construction type by year of construction. Three to four months have been allowed for the design of most segments. Likewise three months have been allotted for tendering of contract documents. Some design segments can probably be designed in less than three months. Governmental and sponsor reviews are included in the tendering stage of the time line and could cause an extension of that time line. Construction of structures can be done in many cases during the rainy seasons although piling and pier work may be delayed unless cofferdams are utilized to protect the construction zone. Grading and paving have been scheduled for construction during the normal dry season of December through July of each year. Some of the construction phases allow for

Table 4-35 (continued)
PROPOSED DESIGN AND CONSTRUCTION SCHEDULE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

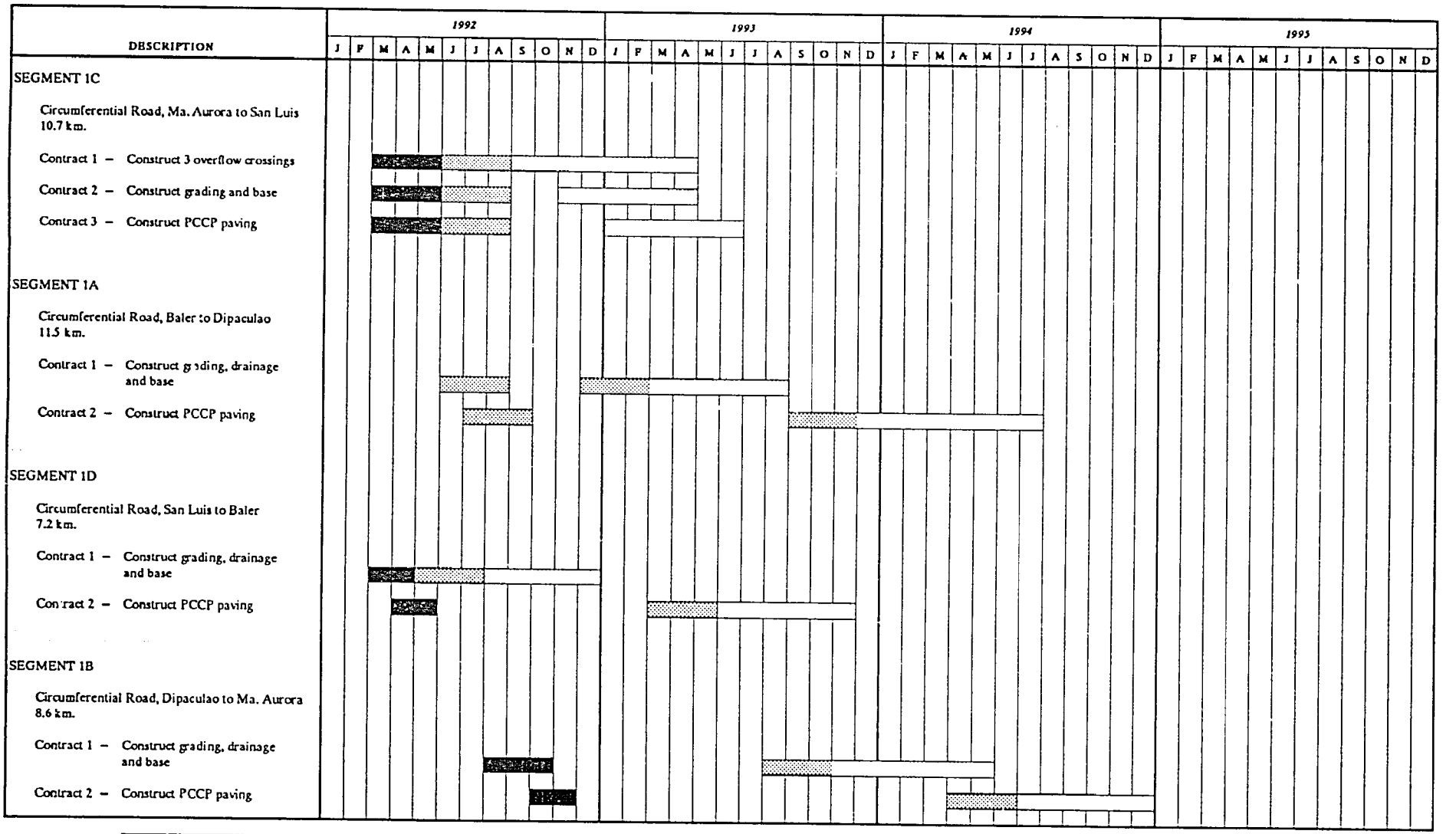


Table 4-35 (continued)
PROPOSED DESIGN AND CONSTRUCTION SCHEDULE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

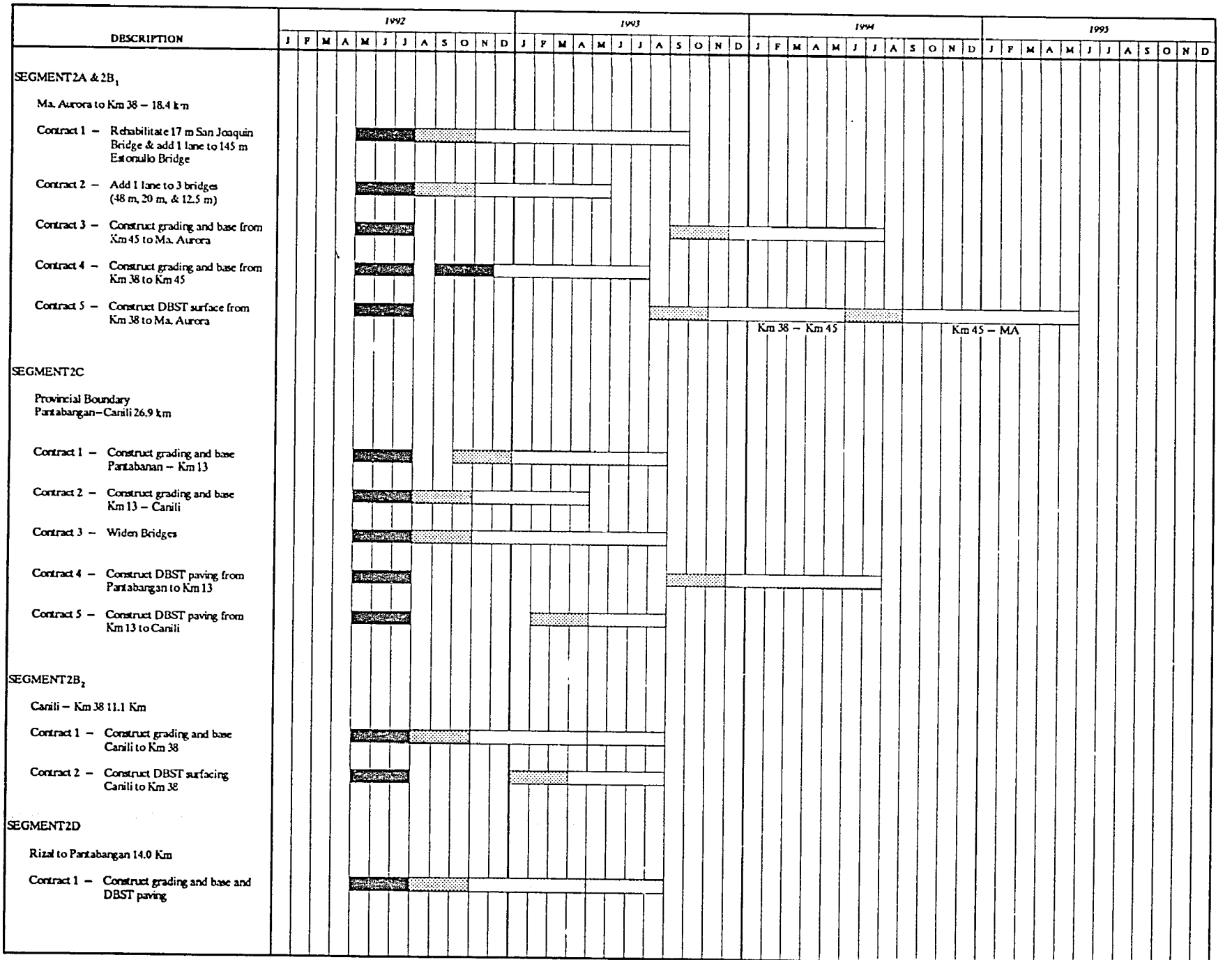


Table 4-35 (continued)
PROPOSED DESIGN AND CONSTRUCTION SCHEDULE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

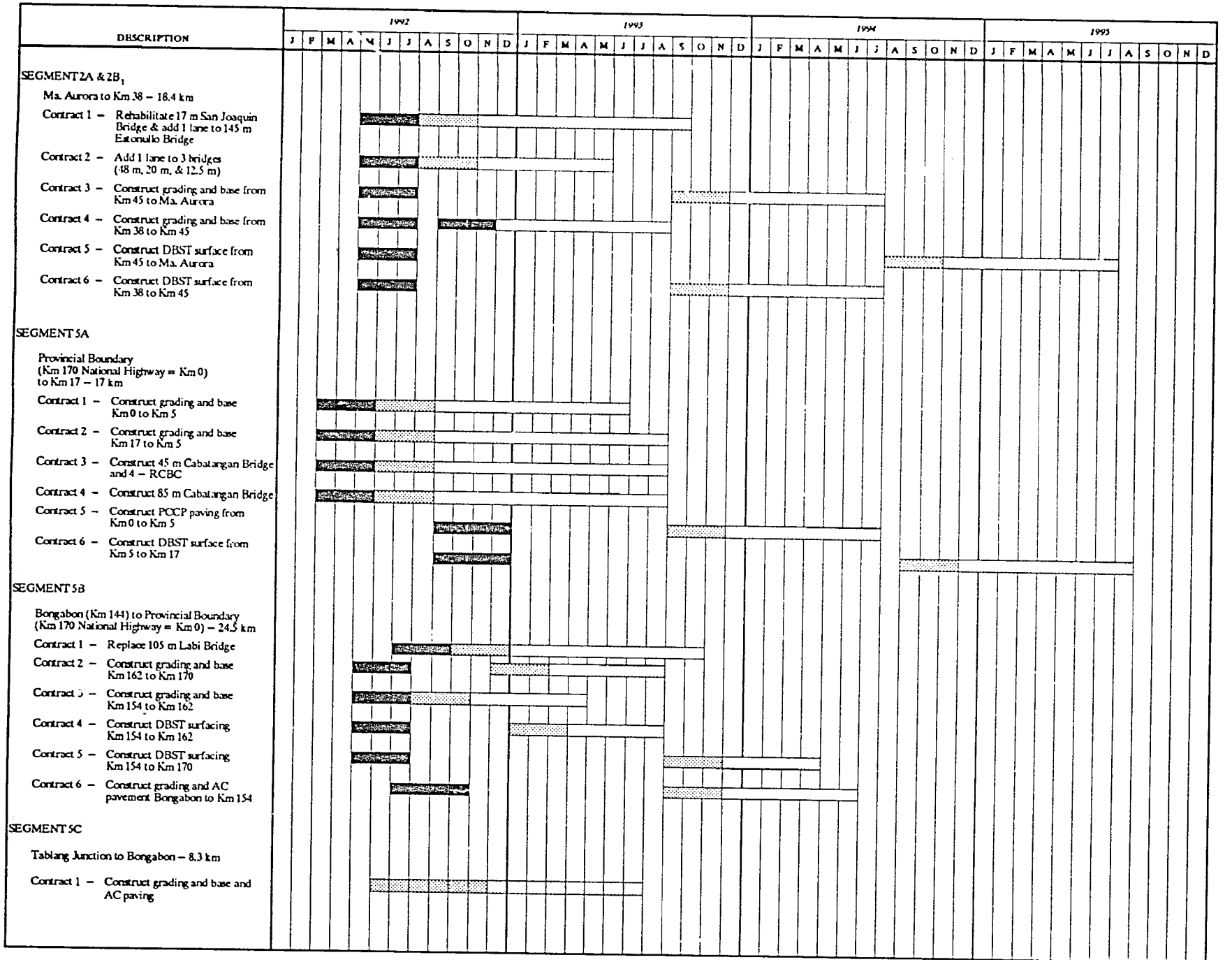
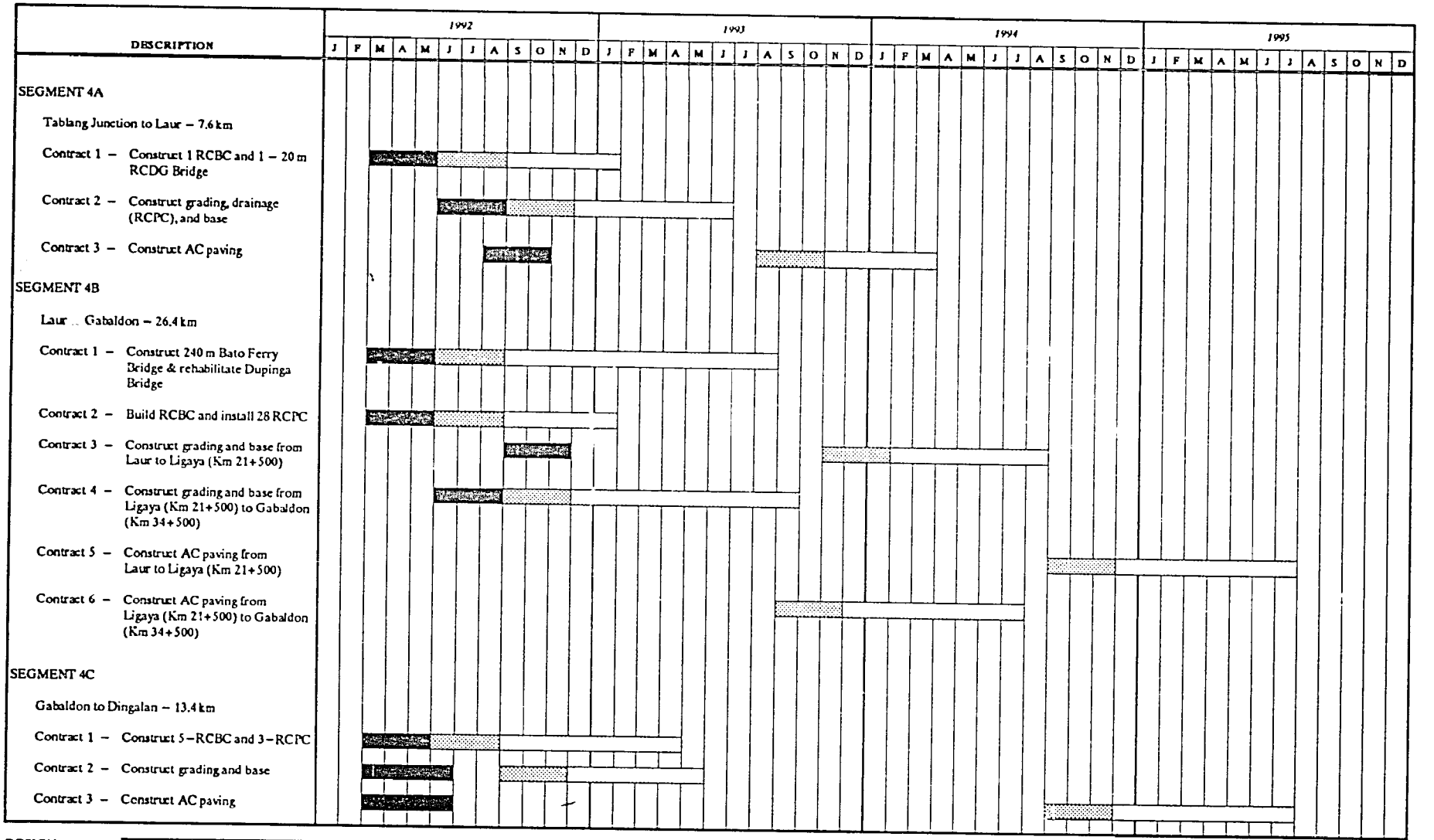
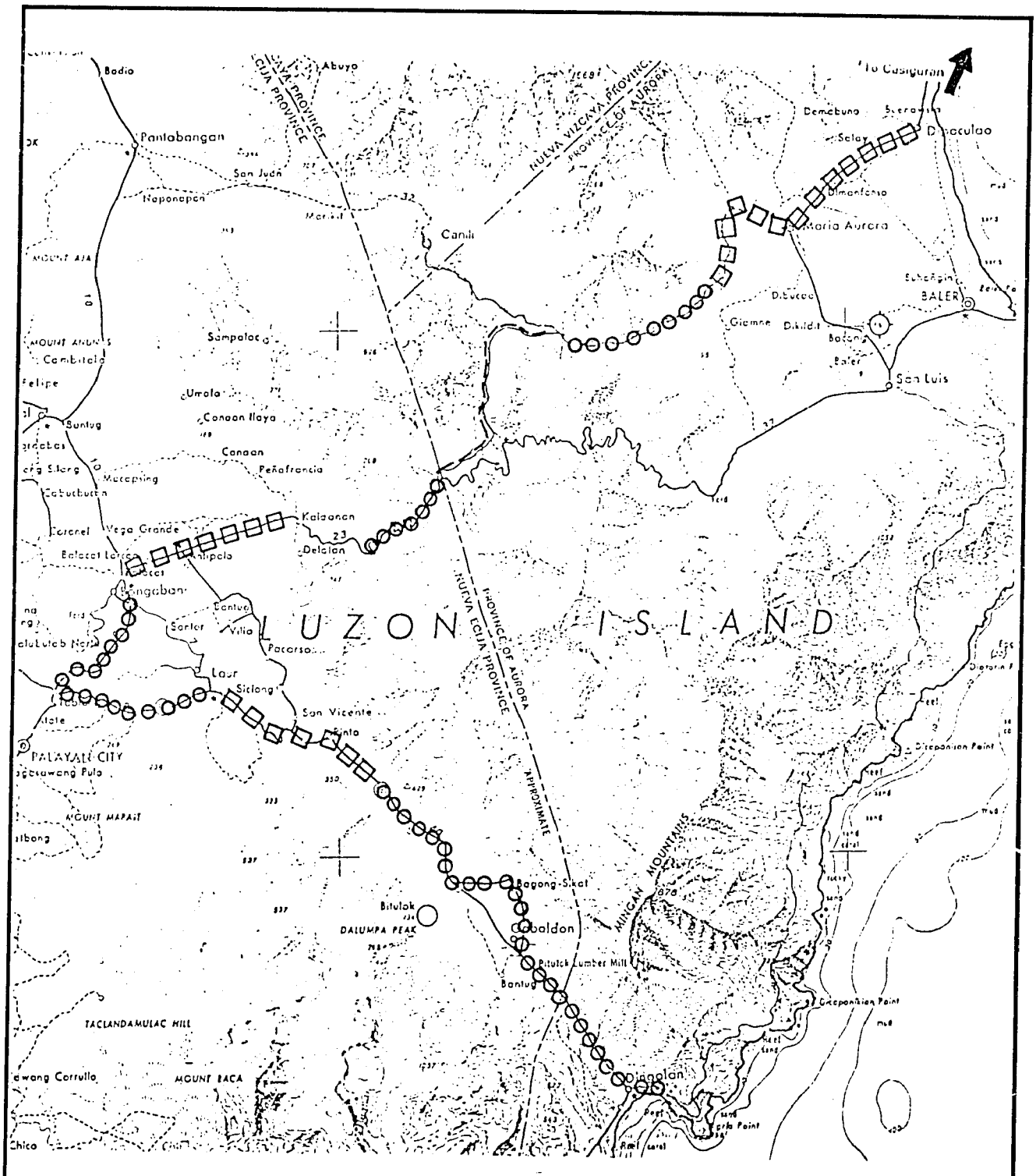


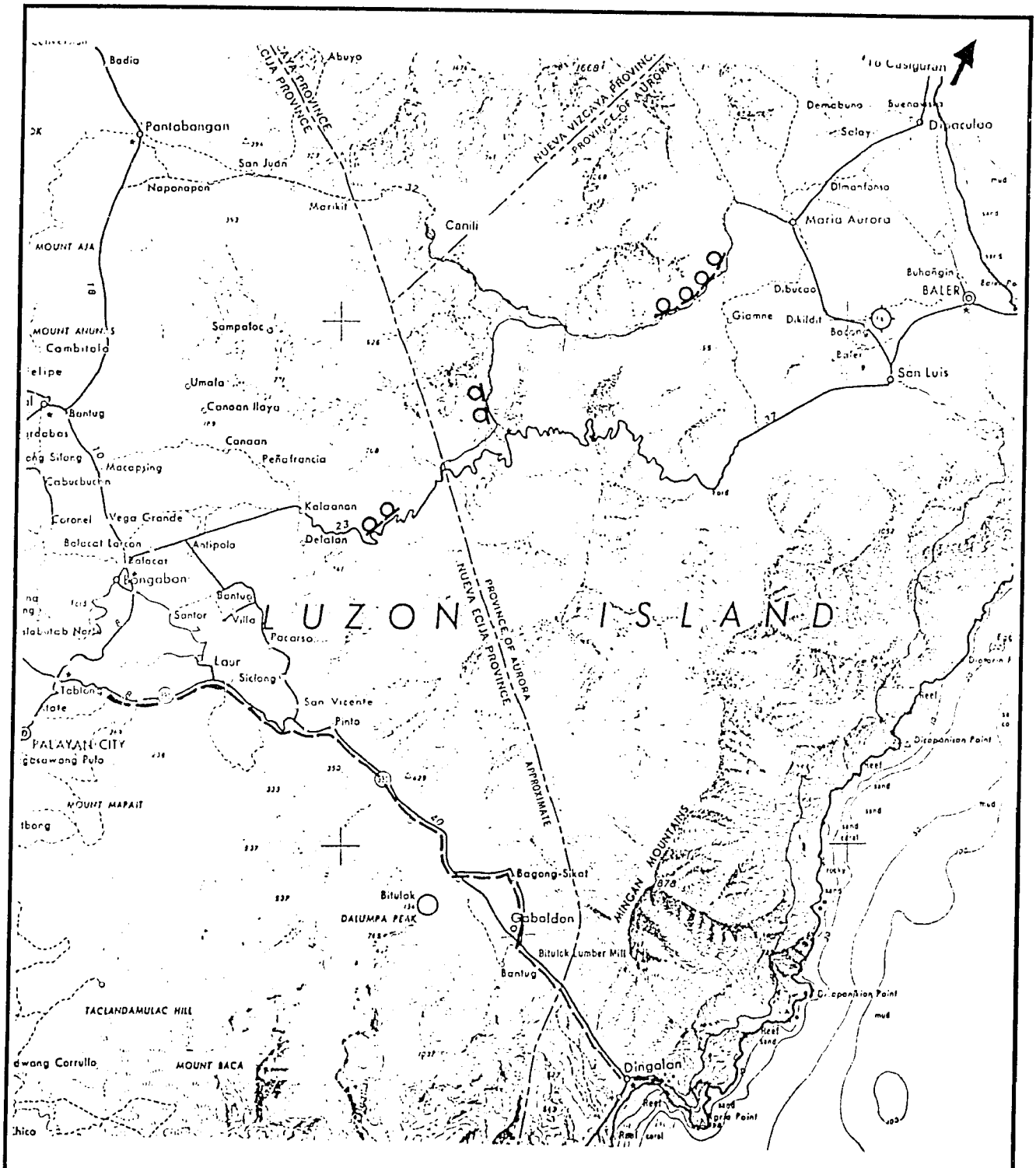
Table 4-35 (continued)
PROPOSED DESIGN AND CONSTRUCTION SCHEDULE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT



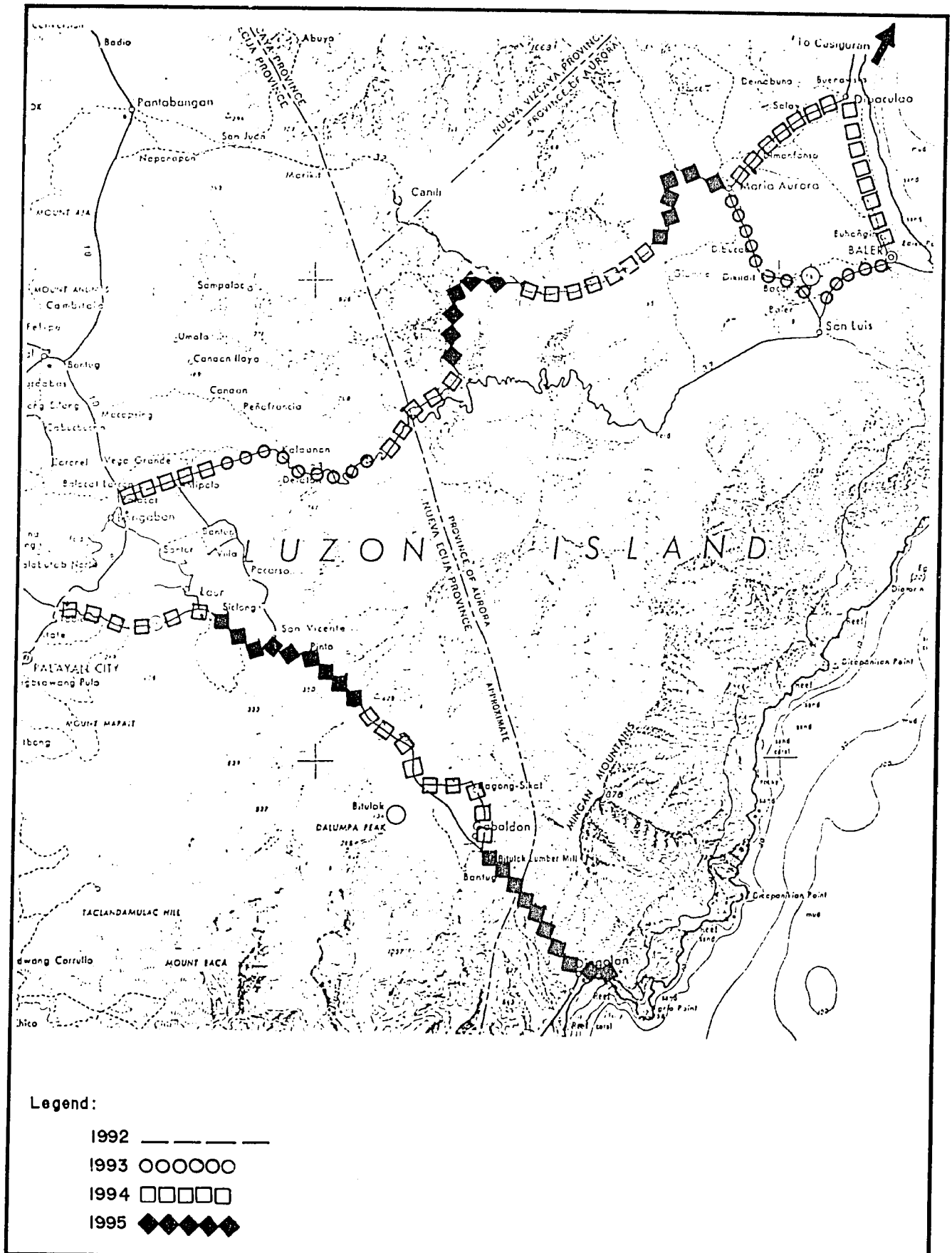
DESIGN –
TENDER –
CONSTRUCTION –



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	GRADING AND BASE	FIGURE 4-18



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	BRIDGES AND CULVERTS	FIGURE 4-19



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	PAVING	FIGURE 4-20

some segments to have grading and base plus paving to occur during the same construction year while other segments have these phases spread out over two construction years.

4.4.2 Availability of Resources

Aurora Province is rather remote and underdeveloped with respect to many other areas of the Philippines and of Luzon. Lack of major construction programs in the past has left the area without very many highway and heavy construction oriented contractors. Within Nueva Ecija Province, more construction has taken place in recent years and both the number of available contractors and their capabilities is greater.

4.4.2.1 Materials

The geotechnical report for this project reveals the nature of road building materials in the proximity of each of the road segments. Soil bearing capacity (CBR) varies from a low of 2 to above 20. Aggregate sources are readily available in most of the rivers and streams of the area and these aggregates when mixed and incorporated with on-site materials will provide very good subbase and base.

Material Source Maps from the Department of Public Works and Highways (DPWH) were obtained. More than thirty (30) sources were reflected in these maps showing more than adequate quantities available for use in any future project within these regions. Sources with greater quantities and within the nearer locations for use in this project were further inspected on site for quantity. Samples were taken from most of these sources for quality tests and evaluation.

Peat gravel, Boulders, Sand and Ideal borrow materials are abundant in these sources. Production operations will include one or more of the following operations: Selection, loading, hauling, screening, crushing size, blending and stock piling. Crushing plants will be necessary to meet size requirements and other engineering design consideration required in pavements and other structures.

Data obtained from the design plans for construction of the Maria-Aurora-Canili-Pantabangan road and the proposed alternative routes reveal additional material sources. A materials source map in Appendix F-6.1 shows the locations of all these material sources. Refer to Table 4-36 for the estimated quantities, types, acquisition costs, accessibility and haul distances for these sources.

Table 36
MATERIAL SOURCES

SOURCE NAME	APPROXIMATE LOCATION (Km.)	ACCESSIBILITY	MATERIAL TYPE	ESTIMATED QUANTITY (m^3)	REMARKS
1. Detcki River Quary	18.90 km. from Sta. 00+00 (near Baler) going to Villa Aurora	Accessible to National Road	Boulders, Gravel and Sand	276,000	no acquisition cost
2. Balitwak River Quarry	14.40 km. from Sta. 0+00 (near Baler) going to Villa Aurora	Accessible to National Road	Boulders, Gravel and Sand	155,000	no acquisition cost
3. Suklayin River Quarry	3.00 km. from Sta. 0+00 (near Baler) going to Port Aurora	Accessible to Municipal Road going southeast	Gravel and Sand	50,000	no acquisition cost
4. Aguang River Quarry	4.20 km. from Sta. 0+00 (near Baler) going to Dipaculao	Accessible to Municipal Road going northwest	Sand, Gravel and Borrow Materials	480,000	no acquisition cost
5. Didilkit River Quarry	Located @ 4.50 kms. from Ma. Aurora	Accessible to National Road going south	Sand, Gravel and Borrow Materials	250,000	no acquisition cost
6. Ma. Aurora Creek Quarry	Located @ 3.80 km from Ma. Aurora	Accessible to national Road going south	Sand, Gravel and Borrow Materials	200,000	no acquisition cost
7. Malupa River Quarry	Located @ 2.0 km. from Ma. Aurora	Accessible to National Road going south	Sand, Gravel and Borrow Materials	390,000	no acquisition cost
8. Dibutunan River Quarry	35.00 km. from Dipaculao heading north	Accessible to National Road	Boulders	15,400	no acquisition cost
9. Diatt River Quarry	3.00 km. from Sta. 0+00 (Ma. Aurora Reference) to Canili	Accessible to National Road	Gravel, Sand and Boulders	unlimited	no acquisition cost
10. Bazal River Quarry	5.00 km. from Sta. 0+00 (Maria Aurora)	Accessible to National Road	Gravel, Sand and Boulders	10,000	no acquisition cost
11. Castañeda Quarry	1.50 km. from Canili	Accessible to National Road	Gravel and Sand	50,000	no acquisition cost
12. Pantabangan River Quarry	1.00 km. from Pantabangan	Accessible to National Road	Gravel and Sand	---	no acquisition cost
13. Villa Aurora River Quarry	35 km. from San Luis	Accessible to National Road heading southwest to Bongabon	Boulders, Gravel and Sand	50,000	no acquisition cost
14. Atate River Quarry	3.00 km. from Sta. 0+00 (Tablang) going to Dingalan	Accessible to National Road	Gravel and Sand	---	no acquisition cost
15. Bato Perry River Quarry	15.00 km. from Sta. 0+00 (Tablang) to Dingalan	Accessible to National Road	Gravel and Sand	50,000	no acquisition cost
16. Ligaya River Quarry	22.50 km. from Sta. 0+00	Accessible to National Road	Gravel and Sand	20,000	no acquisition cost
17. Dupinga River Quarry	22.50 km. from Sta. 0+00 or 1.00 km. or 3.50 km. from Gabaldon	Accessible to National Road	Gravel, Sand and Borrow Materials	20,000 unlimited	no acquisition cost

18. Cuyapa River Quarry	37.40 km. from Sta. 0+00 or 1.40 km. from Gabaldon going to Dingalan	Accessible to National Road	Boulders, Gravel and Sand	20,000	no acquisition cost
19. Coronell River Quarry	Along Palayan-Dingalan Road	Accessible to National Road at an average distance of 1.00 km. passing private properties	Boulders, Gravel, Sand and Borrow Materials	unlimited	no acquisition cost

Portland cement must be imported to the site from cement plants located on Luzon or on Mindanao. However, experience in the last 2 years in the Philippines reveals that portland cement had to be imported from outside sources such as China or Indonesia. The magnitude of construction in the Metro Manila area and other urban centers has stretched the ability of the Philippine cement plants to produce an adequate annual amount of materials. The 1990 central Luzon earthquake and the 1991 Mt. Pinatubo disaster has further exacerbated the problem of availability of construction materials. Numerous major roads and bridges within Pampangas, Tarlac and Zambales Provinces will most likely take a high priority for materials and construction in the next 1-3 years. Thus the availability of portland cement for pavements, box culverts, pipe culverts and bridges may be limited unless another outside source is forthcoming.

Asphalt cement for use in the manufacture of asphalt concrete pavement is a petroleum product and is available in adequate supplies. At least three asphalt pavement contractors work out of Manila and others have facilities within Nueva Ecija. During the development of this feasibility report, the Consultant noted the installation of a modern portable asphalt paving plant in the vicinity of Bongabon.

Steel reinforcing bars for use in bridges and culverts are manufactured locally on Luzon in abundant supply and should be readily available for construction.

It is proposed that geotextile fabrics be utilized for erosion control on steep slopes. Such materials may have to be imported from outside the Philippines. An alternate to the use of these fabrics might be the concept of hydroseeding these slopes. The equipment to perform this operation might also have to be imported.

4.4.2.2 Contractors

A discussion with DPWH engineers within Aurora Province reveals that only three small portland cement paving contractors currently work within the province. The production capacity of each of these contractors is less than 100 sq. meters per day. Such a production rate would require at least four construction years to complete the circumferential road. The current practices of these small contractors is to use wood forms, manual labor for fine grading and a small portable mixer for making the plastic concrete. If productivity could be increased through

the use of portable batch plants and transit mixers plus the use of more modern fine grading and compaction techniques, then paving in the circumferential road area could potentially be reduced to two years without bringing in outside paving contractors.

DPWH also indicated that no bridge contractors or skilled personnel competent to construct bridges were available in Aurora Province. All structures currently under construction are being built by outside contractors. In Nueva Ejica Province numerous contractors are available to do bridge construction. Many bridge and culvert contractors are available in the Metro Manila area.

4.4.2.3 Local Work Forces

An analysis was made of the labor force within Aurora Province for the year 1991. This data came from an NCSO, April 1991 survey. The report revealed the following:

AURORA PROVINCE
MALE WORKERS

	URBAN	RURAL
Employed	14,000	23,000
Unemployed	2,000	7,000
Not in Labor Force	-	-
TOTAL	16,000	30,000

This high rate of unemployment (underemployment) is founded in the fact that most work is in the agricultural sector and most of these males are unskilled. They could perform as unskilled labor within a construction project but without substantial training most probably could not serve as equipment operators, mechanics or in a supervisory capacity. Thus, skilled labor and supervisory help must probably be brought in from outside sources.

4.4.2.4 Construction Camps

Because of the long distances between various portions of the proposed projects, it is reasonable to develop several construction camp sites one of which would become a base camp. The Consultant feels that the base camp should be located near Maria Aurora. This camp should be developed as a complete construction management compound with family housing for expatriate and filipino professional and technical staff, lodging facilities for contractor personnel, mess

facilities, a materials storage yard and equipment maintenance facilities for donor furnished equipment as identified in Section 4.4.3.2. Adequate land is available in the immediate proximity of Maria Aurora for the establishment of this base camp. This facility would then serve as headquarters for all construction activities for the duration of the project and would also function as the project management office for the construction of the Circumferential roads, Segments 2A, $2B_1$ and 5A. The westerly limit of construction activities from this location would be 35 km (provincial boundary) and the easterly limit would be 18 km (Baler).

A second construction camp with a management office, maintenance facility and materials storage yard should be set up near Laur-Bongabon. This camp would monitor construction activities from Tablang easterly for 50 km to the provincial boundary at km 170 and from Tablang southeasterly for 48 km to Dingalan.

4.4.3 Special Construction Concerns

4.4.3.1 Climate

Aurora province is located along the Philippine Sea and the coastal area is subject to a number of typhoons annually. The rainy season normally is from July through November but as shown in Table 4-37, at the Baler Station, August appears to be the month in which the lowest long term average rainfall occurs. This PAGASA chart reflects a 40 year average of rainfall at the Baler Station. The typhoon season normally occurs during these late summer and fall months. Some forms of construction can occur in any month but maintaining a dry subgrade or subbase on which to place a pavement surface will be very dependent on weather conditions.

Table 4-37
AVERAGE MONTHLY RAINFALL, AURORA
(Recorded in Baler Station)

MONTH	RAINFALL MM
	BALER
January	349.9
February	449.4
March	132.7
April	256.5
May	216.0
June	175.8

July	111.2
August	64.3
September	181.6
October	815.0
November	305.8
December	76.7
TOTAL	**3,134.9**

Source: PAGASA, Aurora, 1988

4.4.3.2 Specialty Equipment

As noted above when describing the availability of contractors in the area, there are few contractors and their supply of heavy equipment is also severely limited. Dump trucks when operating consist of single axle dumps or military surplus tandem axle (6x6) trucks. The Consultant was able to identify only 3 private sector front end loaders 3 D-6 bulldozers and 2 motor graders in Aurora Province. Each of these pieces of equipment was in marginal operating condition. Discussions with DPWH officials in Nueva Ejica Province reflect that a substantial supply of contractors
equipment is available and in use in that province. This was evidenced by the Consultant during field trips through the province on the way to Aurora. Numerous highway related projects were under construction or rehabilitation and heavy equipment was available.

From the Work Program and Budget program developed by the Consultant for maintenance management of the infrastructure within each of the two provinces, it is evident that equipment available now within the DPWH maintenance offices responsible is inadequate to maintain the existing roads. Thus, to add nearly 100 km of surfaced road in Aurora Province and a similar amount of road in Nueva Ejica Province would mean that crews could not perform the necessary maintenance on the roads.

The Consultant thus recommends that a pool of heavy equipment be provided for use during construction of the various road segments and that it then be turned over for use by DPWH for long term maintenance of the roads within respective maintenance districts.
Such equipment should include:

DESCRIPTION	NUMBER
D-7 bulldozers w/ripper	2
135 hp motor graders w/scarifier	3
150 hp motor grader w/ripper	2
vibratory steel face compactors	2
vibratory sheep foot compactor	2
rubber tire compactors	4
front end loaders - 2 cu m	2
front end loaders - 3 cu m	2
single axle dump trucks - 5 cu m	6
tractor back hoe 35 hp	2
maintenance (lube) truck	2
hydro seeding machine w/truck	1

4.4.3.3 Delivery Lead Times

As mentioned above in Section 4.4.2.1, the availability of portland cement concrete may be a problem given current construction programs and the recent 1990-91 natural disasters in the Philippines. Perhaps by 1993 additional portland cement manufacturing capacity may be operational and the problem of delivery will be solved. Final design construction scheduling should take this factor into account.

Also, if the specialty equipment mentioned above is made a part of the construction package, lead times for procurement and delivery must be considered. Specification preparation, tendering, and contracting for USA manufactured equipment would normally take 90-120 days. Delivery of such equipment to a US shipping port from the factory may take 120-150 days depending on the manufacturers production schedule and any delivery quotas which he may have. Shipment to the Philippines, customs and shipment to the site could also take 120-180 days. In total, the procurement of heavy construction equipment for use on the projects could take a total of 9-12 months.

4.4.3.4 Detours

As with any construction project, there will be inconveniences to the travelling motorist. However, the low traffic volumes on these roads and the current delays and inconveniences experienced at the present time will overshadow any perceived delays caused by detours. The

project phasing has attempted to keep construction segments to 12 km or under. Construction on the circumferential segment has been staged to allow for detours around the construction zone. Example: when segment 1C is under construction between Maria Aurora and San Luis, all traffic can be rerouted via Baler and Dipaculao; when the Baler-Dipaculao segment 1A is under construction, traffic will reroute to a completed segment 1C. Likewise, other construction segments have been scheduled to minimize detours.

Traffic volumes are low enough on all roads that short delays of 30 minutes or less can be allowed through a specific construction site and then with flagpersons and/or pilot cars the traffic can be routed through the construction zone. When paving occurs, PCCP paving practice in the Philippines is to construct one lane and drive on the other lane. Asphalt paving can also be done one lane at a time and if DBST surfacing is done, traffic can drive on the completed pavement in a very short time.

The mountainous areas of segments $2B_1$, 5B (between Calanaan and KM 170) and 4C because of the large amounts of cut and fill required, may necessitate additional consideration for traffic control. The low volumes of existing traffic will not cause major problems however. The location of the new Labi Bridge on Segment 5B should be at a site which will allow the existing structure to be used until the new bridge is completed. Temporary structures or low water crossings at other bridge sites can be developed for specific locations.

4.4.3.5 Local Funding Share

There are no known sources of local funding for this project. DPWH has identified several bridges in their long range plan for funding via their own funds or by means of foreign government grants or loans. These bridges have been identified in this Feasibility Report and their costs have not been included in the costing of the projects. The grading, structures and gravel surfacing on the Pantabagan-Canili-Maria Aurora road, Segment 2, has been accomplished in 1987-91 by the Department of Local Government at a cost in excess of 61 million pesos. Other than through the provision of the unskilled labor force and perhaps through their ability to provide assistance in acquisition of rights-of-way, it is doubtful that local government could provide any funding for the construction of any segment of the proposed improvements.

The Consultant feels that the administrative, professional and technical staff assigned to each district is adequate to handle the expected work functions now and after road construction. Line maintenance staff in the form of supervisors, foremen, equipment operators and labor personnel should be added commensurate to the level of maintenance effort expected within each district and based on the crew compositions shown on the Activity Plan.

The Consultant recommends that the existing DPWH maintenance management program be updated and incorporated into the maintenance program for each of the three districts. If the existing program is not set up to identify the level of detail identified in Chapter 5, then such a program which can be operated on a personal computer at the district level should be developed.

Given the current maintenance funding capabilities of DPWH, and the fact that most governmental agencies defer maintenance far beyond optimum dates, the Consultant feels that an inadequate annual maintenance budget will be forthcoming. Special emphasis needs to be placed on granting of capital funding so that the Philippine governmental agency responsible for recurring maintenance sets aside adequate maintenance funds annually.

4.4.4 Operation and Maintenance

The Consultant feels that the administrative, professional and technical staff assigned to each district is adequate to handle the expected work functions now and after road construction. Line maintenance staff in the form of supervisors, foremen, equipment operators and labor personnel should be added to commensurate to the level of maintenance effort expected within each district and based on the crew compositions shown on the Activity Plan.

The Consultant recommends that the existing DPWH maintenance management program be updated and incorporated into the maintenance program for each of the three disticts. If the existing program is not set up to identify the level of detail identified in Chapter 5, then such a program which can be operated on a personal computer at the district level should be developed.

Given the current maintenance funding capabilities of DPWH, and the fact that most governmental agencies defer maintenance far beyond optimum dates, the Consultant feels that an inadequate annual maintenance budget will be forthcoming. Special emphasis needs to be placed on granting of capital funding so that the Philippine governmental agency responsible for recurring maintenance sets aside adequate maintenance funds annually.

CHAPTER 5

COSTING

CHAPTER 5

COSTING

5.1 PROPOSED IMPROVEMENTS

The proposed improvements consist of constructing new roads or upgrading the existing components with an all-weather (typhoon resistant) highway network to complement and link with other roads. Specific road segments which have been costed are identified in Section 4.2.1.3.

5.2 UNIT PRICES

Cost development of unit rates was made for major work items required for construction. Unit price of a particular work item involves two main factors: the direct cost which includes expenses accrued directly from its production (i.e., material, labor, equipment) and the indirect cost which is expressed in terms of percentages of direct cost. Breakdown of the local and foreign components were made during the derivation of unit prices. A summary of unit rates for various items used in costing are shown in Table 5-1. The detailed development of these unit costs for each pay item is shown in Table 5-2.

5.2.1 Direct Cost

- Material

  The nature and quantity of material established per activity corresponds to the output expected from construction in actual working condition. Below are the two types of construction materials:

  1) Commercial Materials - These are materials available commercially and are cheaper when bought and delivered to site than when produced and hauled to the site. These include petroleum products, portland cement, lumber, steel and steel products.

  2) Basic Materials - These include materials which are locally available and are either bought or produced by the contractor at site. These include aggregates from identified quarry areas.

Table 5-1
SUMMARY OF UNIT RATES
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

PAY ITEM NO.	DESCRIPTION	UNIT	FOREIGN COMPONENT DIRECT		FOREIGN COMPONENT INDIRECT		FOREIGN COMPONENT TOTAL		LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
			%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)
	I. EARTHWORK															
100 (1)	Clearing and Grubbing	SQ.M.	63.99	1.99	—	—	63.99	1.99	3.86	0.12	32.15	1.00	67.85	2.11	100.00	3.11
(3)	Tree Removal, Large	EA	29.98	56.27	—	—	29.98	56.27	55.00	103.21	15.02	28.19	84.98	159.48	100.00	187.67
101 (1)	Removal of Structures and Obstructions	L.S.			—	—	0.00	0.00					0.00	0.00	0.00	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	57.20	77.95	—	—	57.20	77.95	14.19	19.33	28.61	38.99	71.39	97.28	100.00	136.27
102 (1)	Unsuitable excavation	CU.M.	63.72	63.71	—	—	63.72	63.71	4.41	4.41	31.87	31.86	68.13	68.12	100.00	99.98
(2)	Surplus common excavation	CU.M.	64.04	61.15	—	—	64.04	61.15	3.95	3.77	32.01	30.57	67.99	64.92	100.00	95.49
(3)	Surplus rock excavation	CU.M.	61.09	230.99	—	—	61.09	230.99	9.40	35.55	29.51	111.54	70.49	266.54	100.00	378.08
103 (1)	Structure excavation	CU.M.	58.61	60.12	—	—	58.61	60.12	12.07	12.38	29.32	30.07	70.68	72.50	100.00	102.57
(2)	Bridge excavation	CU.M.	58.61	60.12	—	—	58.61	60.12	12.07	12.38	29.32	30.07	70.68	72.50	100.00	102.57
(3)	Foundation fill	CU.M.	42.00	105.33	—	—	42.00	105.33	35.00	87.38	23.00	59.37	77.00	192.71	100.00	252.08
(4)	Excavation below plan elevation	CU.M.	48.51	306.22	—	—	48.51	306.22	27.70	174.86	23.79	150.17	76.21	481.08	100.00	631.25
(5)	Shoring, cribbing, etc.	L.S.			—	—	0.00	0.00					0.00	0.00	0.00	0.00
(6)	Pipe culvert excavation	CU.M.	58.61	60.12	—	—	58.61	60.12	12.07	12.38	29.32	30.07	70.68	72.50	100.00	102.57
104 (1)	Embankment	CU.M.	51.00	62.06	—	—	51.00	62.06	21.00	24.81	28.00	33.80	72.00	86.87	100.00	120.67
(2)	Embankment, selected material	CU.M.	44.41	62.07	—	—	44.41	62.07	28.87	40.35	26.72	37.35	73.28	102.42	100.00	139.77
105 (1)	Subgrade preparation, common	SQ.M.	63.48	2.19	—	—	63.48	2.19	5.22	0.18	31.30	1.08	68.70	2.37	100.00	3.45
(2)	Subgrade preparation, extg. pavement	SQ.M.	62.58	4.38	—	—	62.58	4.38	6.57	0.46	30.85	2.16	69.15	4.84	100.00	7.00
	II. PAVEMENT															
200	Aggregate subbase course	CU.M.	49.47	132.59	—	—	49.47	132.59	24.72	66.24	25.81	69.17	74.19	198.83	100.00	268.00
201	Aggregate base course	CU.M.	49.47	132.59	—	—	49.47	132.59	24.72	66.24	25.81	69.17	74.19	198.83	100.00	268.00
202	Crushed aggregate base course	CU.M.	29.87	129.67	—	—	29.87	129.67	53.86	233.84	16.27	70.64	83.73	363.51	100.00	434.15
208	Soil aggregate shoulder	CU.M.	49.47	132.59	—	—	49.47	132.59	24.72	66.24	25.81	69.17	74.19	198.83	100.00	268.00
300 (1)	Gravel surface course	CU.M.	29.87	129.67	—	—	29.87	129.67	53.86	233.84	16.27	70.64	83.73	363.51	100.00	434.15
301	Bituminous prime coat, MC-70	M.T.	12.76	1,270.57	45.36	4,516.30	58.12	5,786.87	20.06	1,996.68	21.82	2,172.74	78.18	7,783.55	100.00	9,956.29
302 (3)	Bituminous tack coat, CRS-2	M.T.	12.76	939.69	45.36	3,340.18	58.12	4,279.87	20.06	1,476.72	21.82	1,606.92	78.18	5,756.59	100.00	7,363.51
304 (1)	Single bituminous surface treatment	M.T.	42.30	694.47	17.64	289.68	59.94	984.15	12.97	212.89	27.09	444.75	72.91	1,197.04	100.00	1,641.79
304 (2)	Double bituminous surface treatment	M.T.	42.30	1,368.11	17.64	570.67	59.94	1,938.78	12.97	419.39	27.09	876.16	72.91	2,358.17	100.00	3,234.33

(continued)

Table 5-1 (continued)
SUMMARY OF UNIT RATES
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

PAY ITEM NO.	DESCRIPTION	UNIT	FOREIGN COMPONENT DIRECT		FOREIGN COMPONENT INDIRECT		FOREIGN COMPONENT TOTAL		LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
			%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)
304 (2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.	57.32	457.11	—	—	57.32	457.11	13.99	111.60	28.69	228.55	71.31	568.71	100.00	797.26
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	17.88	80.28	32.02	143.74	49.90	224.02	31.81	142.83	18.29	82.10	81.71	366.85	100.00	448.95
(2)	Patching extg. PCC pavement	SQ.M.	32.97	39.76	20.30	24.47	53.27	64.23	23.36	28.17	23.37	28.18	76.63	92.40	100.00	120.58
(2)	Sealing cracks, existing PCC pavement	L.M.	11.14	2.64	26.62	6.31	37.76	8.95	47.77	11.32	14.47	3.43	85.53	20.27	100.00	23.70
	III. STRUCTURES															
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.	24.94	386.68	20.17	312.66	45.11	699.34	35.44	549.54	19.45	301.55	80.55	1,248.88	100.00	1,550.43
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	16.00	157.44	21.00	206.64	37.00	364.08	48.00	472.32	15.00	147.60	85.00	836.40	100.00	984.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	63.42	487.77	—	—	63.42	487.77	20.08	154.46	16.50	126.81	83.50	642.23	100.00	769.04
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.	63.42	487.77	—	—	63.42	487.77	20.08	154.46	16.50	126.81	83.50	642.23	100.00	769.04
(15)	Test piles, driven	L.M.	63.42	487.77	—	—	63.42	487.77	20.08	154.46	16.50	126.81	83.50	642.23	100.00	769.04
(22)	Load test	EA	23.00	12,095.70	22.00	11,569.80	45.00	23,665.50	40.00	21,036.00	15.00	7,888.50	85.00	44,701.50	100.00	52,590.00
401	Concrete bridge railing	L.M.	16.71	203.85	30.09	367.35	46.80	571.20	37.05	452.25	16.15	197.17	83.85	1,023.45	100.00	1,220.62
404	Reinforcing steel for birdges	KG	6.23	1.61	—	—	6.23	1.61	81.77	21.04	12.00	3.09	88.00	22.65	100.00	25.74
405 (1)	Structural concrete, Class A	CU.M.	15.96	523.47	28.77	943.32	44.73	1,466.79	39.83	1,305.90	15.44	506.33	84.56	2,772.69	100.00	3,279.02
(2)	Structural concrete, Class P	CU.M.	15.21	545.94	29.78	1,069.36	44.99	1,615.30	39.64	1,423.33	15.37	551.77	84.63	3,038.63	100.00	3,590.40
406 (1)	P/S concrete girder, Type 4	EA	23.00	49,588.00	22.00	47,432.00	45.00	97,020.00	40.00	86,240.00	15.00	32,340.00	85.00	183,260.00	100.00	215,600.00
407 (1)	Rehabilitation of existing bridges	L.S.														
	IV. DRAINAGE EROSION WORKS															
500 (1)	Backfill material, pipe culvert	CU.M.	42.00	105.33	—	—	42.00	105.33	35.00	87.38	23.00	59.37	77.00	192.71	100.00	252.08
(76)	RCPC, 76 cm diameter	L.M.	32.42	443.02	17.05	233.04	49.47	676.06	30.09	411.17	20.44	279.37	79.56	1,087.23	100.00	1,366.60
(91)	RCPC, 91 cm diameter	L.M.	30.87	600.95	19.55	380.49	50.42	981.44	29.30	570.35	20.28	394.73	79.72	1,551.79	100.00	1,946.52

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Table 5-1 (continued)
SUMMARY OF UNIT RATES
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

PAY ITEM NO.	DESCRIPTION	UNIT	FOREIGN COMPONENT DIRECT		FOREIGN COMPONENT INDIRECT		FOREIGN COMPONENT TOTAL		LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
			%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)	%	UNIT COST (PESOS)
(107)	RCPC, 107 cm diameter	L.M.	30.54	755.34	20.92	517.33	51.46	1,272.67	28.10	694 97	20.44	505.63	79.56	1,967.64	100.00	2,473.27
(120)	RCPC, 120 cm diameter	L.M.	30.32	975.92	21.51	692.55	51.83	1,668.47	27.70	891.77	20.47	659.04	79.53	2,560.24	100.00	3,219.28
(10)	Structural concrete for box pipe headwalls	CU.M.	15.53	504.88	29.01	943.32	44.54	1,448.20	40.17	1,305.89	15.29	497.05	84.71	2,754.09	100.00	3,251.14
(11)	Reinforcing steel for RCBC/RCPC	KG	6.23	1.61	—	—	6.23	1.61	81.77	21.04	12.00	3.09	88.00	22.65	100.00	25.74
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.	59.79	327.57	—	—	59.79	327.57	10.32	56.51	29.89	163.79	70.11	384.08	100.00	547.87
(5)	Grouted riprap	CU.M.	24.82	359.46	25.82	373.96	50.64	733.42	29.53	427.63	19.83	287.15	80.17	1,161.05	100.00	1,448.20
509	Gabions	CU.M.	34.00	696.45	—	—	34.00	696.45	49.00	1,003.72	17.00	348.23	83.00	1,700.17	100.00	2,048.40
600	Lined Ditch	L.M.	27.07	154.76	22.97	131.29	50.04	286.05	29.82	170.46	20.14	115.11	79.86	456.51	100.00	571.62
	V. INCIDENTAL WORKS															
603 (3)	Metal beam guardrail	L.M.	40.00	396.00	—	—	40.00	396.00	25.00	247.56	35.00	346.56	65.00	643.56	100.00	990.12
605 (1)	Working sign	EA	42.00	1,435.00	—	—	42.00	1,435.00	23.00	785.57	35.00	1,195.43	65.00	2,220.57	100.00	3,416.00
(2)	Regulatory signs	EA	42.00	1,435.00	—	—	42.00	1,435.00	23.00	785.57	35.00	1,195.43	65.00	2,220.57	100.00	3,416.00
(3)	Informatory Signs	EA	43.00	5,559.04	—	—	43.00	5,559.04	24.00	3,102.72	33.00	4,206.24	67.00	8,661.76	100.00	12,868.00
610	Sodding	SQ.M.	21.00	1.72	—	—	21.00	1.72	49.00	4.02	30.00	2.46	70.00	5.74	100.00	8.20
	VI. LAND ACQUISITION	SQ.M.														

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 01
Pay Item No. 100(1) Clearing and Grubbing **Output: 800 m²/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1015	1.00 Dozer D-6C @ P 783.02/hr	P/hr	783.02			391.51	1,174.53
1011	0.50 Wheel Loader 1 3.4 m³ @ 372.00		186.00			93.00	279.00
1047	2.00 Dump Truck 9-10 m³ @ 956.95		1,435.42			717.71	2,153.13
	TOTAL A		2,404.44	0.00	0.00	1,202.22	3,606.66
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	1.50 Heavy Equip. Optr. @ 23.39				35.08		35.08
2005	1.50 DT Driver @ 17.71				26.57		26.57
2006	2.00 Skilled Laborer @ 15.20				30.40		30.40
2007	2.00 Unskilled Laborer @ 12.68				25.36		25.36
	TOTAL B			0.00	142.80	0.00	142.80
	TOTAL A & B		2,404.44	0.00	142.80	1,202.22	3,749.46
	Output in m²/hr. = 800						
	C. Unit Cost (Equipment and Labor)	P/m²	3.01		0.18	1.50	4.69
	Estimated Direct Cost (EDC)		3.01		0.18	1.50	4.69
	Indirect Cost 10% of EDC		0.30	0.00	0.02	0.15	0.47
	Profit 10% of (EDC + IDC)		0.33	0.00	0.02	0.17	0.52
	Value Added Tax 10% of Labor & Eqpt.		0.30	0.00	0.02	0.15	0.47
	Bond Insurance 1% of Total UC		0.04	0.00	0.002	0.02	0.06
	TOTAL UNIT COST/m²		3.98		0.24	1.99	6.21
	PERCENT (%)		64.09		3.86	32.05	100.00

* Since 50% is already cleared on existing road,
Unit Price = 50% (6.21)
= 3.11 /m²

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Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 02
Pay Item No. 101(3) Removal of Existing Concrete Pavement — Output: 128 m²/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1028	16.00 Air Compressor (160 CFM) @ P 225.00	P/Hr	3,600.00	–	–	1,800.00	5,400.00
1021	48.00 Jack Hammer @ 42.00		2,016.00			1,008.00	3,024.00
1015	1.00 Dozer, D-6 @ 783.02		783.02			391.51	1,174.53
1011	0.50 Wheel Loader 1 3/4 m3 @ 372.00		186.00			93	279.00
1047	1.00 Dump Truck 9-10 m3 @ 956.95		956.95			478.47	1,435.42
	TOTAL A		7,541.97	–	–	3,770.98	11,312.95
	B. Labor						
2001	16.00 Foreman @ P 25.39				406.24		406.24
2003	1.50 Heavy Equip. Optr. @ 23.39				35.09		35.09
2004	16.00 Light Equip. Optr. @ 17.21				275.36		275.36
2005	1.00 DT Driver @ 17.21				17.21		17.21
2006	48.00 Skilled Laborer @ 15.20				729.60		729.60
2007	32.00 Unskilled Laborer @ 12.68				405.76		405.76
	TOTAL B		–	–	1,869.26	–	1,869.26
	TOTAL A & B		7,541.97	–	1,869.26	3,770.98	13,182.21
	Output m²/hr. = 128.00						
	C. Unit Cost (Equipment & Labor)		58.92	–	14.61	29.46	102.99
	Estimated Direct Cost (EDC)		58.92	–	14.61	29.46	102.99
	Indirect Cost 10% of EDC		5.89	–	1.46	2.95	10.30
	Profit 10% of (EDC + IDC)		6.48	–	1.61	3.24	11.33
	Value Added Tax 10% of Labor & Eqpt.		5.89	–	1.46	2.95	10.30
	Bond/Insurance 1% of Total UC		0.77	–	0.19	0.39	1.35
	TOTAL UNIT COST/m²		77.95	–	19.33	38.99	136.27
	PERCENT (%)		57.20	–	14.19	28.61	100

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 03
Pay Item No. 102(1) Unsuitable Excavation **Output: 80 m³/hr**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1015	2.00 Dozer, D6 DD @ P 783.02		1,566.04	–	–	783.02	2,349.06
1011	1.00 Whell Loader 1 3/4 m³ @ 372.00		372.00			186.00	558.00
1047	2.00 Dump Truck 9-10 m³ @ 956.95		1,913.90			956.95	2,870.85
	TOTAL A		3,851.94	–	–	1,925.97	5,777.91
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2003	3.00 Heavy Equip. Optr. @ 23.39				70.17		70.17
2005	2.00 DT Driver @ 17.21				34.42		34.42
2006	4.00 Skilled Laborer @ 15.20				60.80		60.80
2007	4.00 Unskilled Laborer @ 12.68				50.72		50.72
	TOTAL B		–	–	266.89	–	266.89
	TOTAL A & B		3,851.94	–	266.89	1,925.97	6,044.80
	Output m3/hr. = 80.00						
	C. Unit Cost (Equipment & Labor)		48.15	–	3.34	24.07	75.56
	Estimated Direct Cost (EDC)		48.15	–	3.34	24.07	75.56
	Indirect Cost 10% of EDC		4.82	–	0.33	2.41	7.56
	Profit 10% of (EDC + IDC)		5.29	–	0.37	2.65	8.31
	Value Added Tax 10% of Labor & Eqpt.		4.82	–	0.33	2.41	7.56
	Bond/Insurance 1% of Total UC		0.63	–	0.04	0.32	0.99
	TOTAL UNIT COST/m3		63.71	--	4.41	31.86	99.98
	PERCENT (%)		63.72	–	4.41	31.87	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 04
Pay Item No. 102(2) Surplus Common Excavation — Output: 125 m³/hr

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1014	3.00 Dozer, D6 DD @ P 783.02		2,349.06	–	–	1,174.53	3,523.59
1011	1.50 Wheel Loader 1 3/4 m³ @ 372.00		558.00			279.00	837.00
1047	3.00 Dump Truck 9-10 m³ @ 956.95		2,870.85			1,435.43	4,306.28
	TOTAL A		5,777.91	–	–	2,888.96	8,666.87
	B. Labor						
2001	3.00 Foreman @ P 25.39				76.17		76.17
2003	4.50 Heavy Equip. Optr. @ 23.39				105.26		105.26
2005	3.00 DT Driver @ 17.21				51.63		51.63
2006	3.00 Skilled Laborer @ 15.20				45.60		45.60
2007	6.00 Unskilled Laborer @ 12.68				76.08		76.08
	TOTAL B		–	–	354.74	–	354.74
	TOTAL A & B		5,777.91	–	354.74	2,888.96	9,021.61
	Output m³/hr. = 125.00						
	C. Unit Cost (Equipment & Labor)		46.22	–	2.84	23.11	72.17
	Estimated Direct Cost (EDC)		46.22	–	2.84	23.11	72.17
	Indirect Cost 10% of EDC		4.62	–	0.29	2.31	7.22
	Profit 10% of (EDC + IDC)		5.08	–	0.31	2.54	7.93
	Value Added Tax 10% of Labor & Eqpt.		4.62	–	0.28	2.31	7.22
	Bond/Insurance 1% of Total UC		0.61	–	0.04	0.30	0.95
	TOTAL UNIT COST/m³		61.15	–	3.77	30.57	95.49
	PERCENT (%)		64.04	–	3.95	32.01	

Table 5–2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 05
Pay Item No. 102(3) Surplus Rock Excavation (Solid Rock by Blasting) Output: 25 m³/hr

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1028	1.00 Air Compressor 160 CFM @ P 225.00	P/hr	225.00	–	–	112.50	337.50
1021	2.00 Jack Hammer @ 42.00		84.00	–	–	42.00	126.00
1011	1.50 Wheel Loader 1.75 m³ @ 372.00		558.00	–	–	279.00	837.00
1047	2.00 Dump Truck 9–10 m³ @ 956.95		1,913.90	–	–	956.95	2,870.85
	TOTAL A		2,780.90	–	–	1,390.45	4,171.35
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2003	2.50 Heavy Equip. Optr. @ 23.39				50.48		50.48
2004	4.00 Light Equip. Optr. @ 17.21				68.84		68.84
2005	2.00 DT Driver @ 17.21				34.42		34.42
2006	6.00 Skilled Laborer @ 15.20				91.20		91.20
2007	16.00 Unskilled Laborer @ 12.68				202.88		202.88
	TOTAL B		–	–	498.60	–	498.60
	TOTAL A & B		2,780.90	–	498.60	1,390.45	4,669.95
	Output m³/hr. = 25.00						
	C. Unit Cost (Equipment & Labor)	P/m³	111.24	–	19.94	55.62	186.80
	D. Material/Basic Item QTY UC						
3059	Dynamite 0.50 63.00		20.17	–	2.20	9.13	31.50
3060	Busting Cap 4.00 5.405		13.83	–	1.52	6.27	21.62
3061	Safety Fuse 6.00 9.00		34.56	–	3.78	15.66	54.00
	TOTAL D		68.56	–	7.50	31.06	107.12
	Estimated Direct Cost (EDC)		179.80	–	27.44	86.68	293.92
	Indirect Cost 10% of EDC		17.98	–	2.74	8.67	29.39
	Profit 10% of (EDC + IDC)		19.78	–	3.02	9.53	32.33
	Value Added Tax 10% of Labor & Eqpt.		11.12	–	2.00	5.56	18.68
	Bond/Insurance 1% of Total UC		2.29	–	0.35	1.10	3.74
	TOTAL UNIT COST/m3	P/m³	230.97	–	35.55	111.54	378.06
	PERCENT (%)		61.09	–	9.40	29.51	

Table 5–2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 06
Pay Item No. 104(1) Embankment

Output: 90 m³/hr

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1012	1.50 Wheel Loader 1.75 m³ @ 372.00	P/hr.	186.00			93.00	279.00
1015	2.00 Dozer, DGDD @ 783.02		1,566.04			783.02	2,349.06
1047	2.00 Dump Truck 9–10 m³ @ 956.95		1,913.90			956.95	2,870.85
1011	0.50 Motor Grader 125 HP @ 384.99		192.50			96.25	288.75
1020	1.00 Vibratory Drum Roller @ 363.87 (7 tons cap.)		363.87			181.94	545.81
	TOTAL A		4,222.31			2,111.16	6,333.47
	B. Labor						
2001	2.00 Foreman @ P 25.39	P/hr.			50.79		50.79
2003	4.00 Heavy Equip. Optr. @ 23.39				93.24		93.24
2004	2.00 DT Driver @ 17.71				35.42		35.42
2006	4.00 Skilled Laborer @ 15.20				60.80		60.80
2007	16.00 Unskilled Laborer @ 12.68				76.08		76.08
	TOTAL B				316.33	2,111.16	316.33
	TOTAL A & B		4,222.31	–	316.33	2,111.16	6,649.80
	Output m³/hr. = 90						
	C. Unit Cost (Equipment & Labor)	P/m³	46.92		3.51	23.46	73.89
	D. Material/Basic Item QTY UC						
301	Common Borrow 1.25 15.00				16.50	2.25	18.75
	TOTAL D				16.50	2.25	18.75
	Estimated Direct Cost (EDC)		46.92		20.01	25.71	92.64
	Indirect Cost 10% of EDC		4.69		2.00	2.57	9.26
	Profit 10% of (EDC + IDC)		5.16		2.20	2.83	10.19
	Value Added Tax 10% of Labor & Eqpt.		4.69		0.35	2.35	7.39
	Bond/Insurance 1% of Total UC		0.60		0.25	0.34	1.19
	TOTAL UNIT COST/m3	P/m³	62.06		24.81	33.80	120.67
	PERCENT (%)		51.00		21.00	28.00	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 08
Pay Item No. 103(1) Structure Excavation

Output: 25 m³/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1014	1.00 Backhoe HD-750, 3/4 CY @ P 657.85	P/hr	657.85			328.93	986.78
1047	2.00 Dump Truck 9-10 m³ @ 956.95		478.48			239.24	717.72
	TOTAL A		1,136.33		0.00	568.17	1,704.50
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	1.00 Heavy Equip. Optr. @ 23.39				23.31		23.31
2004	3.00 DT Driver @ 17.71				53.13		53.13
2005	2.00 Spotter @ 15.20				30.42		30.42
2007	2.00 Unskilled Laborer @ 12.68				101.44		101.44
	TOTAL B				233.69		233.69
	TOTAL A & B		1,136.33		233.69	568.17	1,938.19
	Output in m³/hr. = 25						
	C. Unit Cost (Equipment and Labor)		45.45		9.35	22.73	77.53
	Estimated Direct Cost (EDC)		45.45		9.35	22.73	77.53
	Indirect Cost 10% of EDC		4.54		0.94	2.27	7.75
	Profit 10% of (EDC + IDC)		5.00		1.03	2.50	8.53
	Value Added Tax 10% of Labor & Eqpt.		4.54		0.94	2.27	7.75
	Bond Insurance 1% of Total UC		0.59		0.12	0.30	1.01
	TOTAL UNIT COST/m³	P/m³	60.12		12.38	30.07	102.57
	PERCENT (%)		58.61		12.07	29.32	

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Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 09
Pay Item No. 103(3) Foundation Fill (Mixed Gravel) Output: 2.50 m³/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1042	1.00 Vibro Plate Compactor @ P 99.70	P/Hr	99.70			49.85	149.55
1094	Miscellaneous Hand Tools L.S. 30.00				30.00		30.00
	TOTAL A		99.70		30.00	49.85	179.55
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2006	1.00 Skilled Laborer @ 15.20				15.20		15.20
2007	2.00 Unskilled Laborer @ 12.68				25.36		25.36
	TOTAL B		–	–	65.95	–	65.95
	TOTAL A & B		99.70	–	95.95	49.85	245.50
	Output m³/hr. = 2.50						
	C. Unit Cost (Equipment & Labor)		39.88	–	38.38	19.94	98.20
	D. Material/Basis Item Qty. U.C.						
	Mixed Gravel 1.25 79.97		43.01		29.96	26.99	99.96
	Estimated Direct Cost (EDC)		82.89	–	68.38	46.93	198.16
	Indirect Cost 10% of EDC		8.29	–	6.83	4.69	19.81
	Profit 10% of (EDC + IDC)		9.12	–	7.52	5.16	21.80
	Value Added Tax 10% of Labor & Eqpt.		3.99	–	3.83	2.00	9.82
	Bond/Insurance 1% of Total UC		1.04	–	0.86	0.59	2.49
	TOTAL UNIT COST/m³		105.33	–	87.38	59.37	252.08
	PERCENT (%)		42.00	--	35.00	23.00	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 10
Pay Item No. 103(4) Excavation Below Plan Elevation **Output: 4.5 m³/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1037	1.00 Crawler Crane 45T cap. @ P 979.01	P/Hr	979.01			489.50	1,468.51
1022	1.00 Water Pump 4"–6" @ 62.50		62.50		10.00	21.25	93.75
1095	Miscellaneous Hand Tools L.S. 40.00				40.00		40.00
	TOTAL A		1,041.51		50.00	510.75	1,602.26
	B. Labor						
2001	1.00 Foreman @ P 25.39	P/Hr			25.39		25.39
2003	1.00 Heavy Equipment Operator @ 23.39				23.39		23.39
2004	1.00 Light Equipment Operator @ 17.71				17.71		17.71
2006	4.00 Skilled Laborer @ 15.20				60.80		60.80
2007	2.00 Unskilled Laborer @ 12.68				25.36		25.36
	TOTAL B		–		152.65	–	152.65
	TOTAL A & B		1,041.51		202.65	510.75	1,754.91
	Output m³/hr. = 4.5						
	C. Unit Cost (Equipment & Labor)		231.45		45.03	113.50	389.98
	D. Material/Basis Item Qty. U.C.						
	Wooden Cofferdam L.S 94.33	P/m³			94.33	26.99	94.33
	Estimated Direct Cost (EDC)		231.45		139.36	113.50	484.31
	Indirect Cost 10% of EDC		23.14		13.94	11.35	48.43
	Profit 10% of (EDC + IDC)		25.46		15.33	12.49	53.27
	Value Added Tax 10% of Labor & Eqpt.		23.14		4.50	11.35	38.99
	Bond/Insurance 1% of Total UC		3.03		1.73	1.49	6.25
	TOTAL UNIT COST	P/m	306.22		174.86	150.17	631.25
	PERCENT (%)		48.51		27.70	23.79	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 11
Pay Item No. 105(1) Subgrade Preparation, Common

Output: 741 m²/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1011	1.00 Motor Grader 125 HP @ P 384.99	P/hr.	384.99			192.50	577.49
1023	1.00 Pneumatic Roller (11-24 tons) @ 836.03		836.03			418.01	1,254.04
	TOTAL A		1,221.02			610.51	1,831.53
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	2.00 Heavy Equip. Optr. @ 23.39				46.78		46.78
2006	2.00 Skilled Laborer @ 15.20				30.40		30.40
	TOTAL B				102.57		102.57
	TOTAL A & B		1,221.02		102.57	610.51	1,934.10
	Output m²/hr. = 741						
	C. Unit Cost (Equipment & Labor)	P/m²	1.65		0.14	0.82	2.61
	Estimated Direct Cost (EDC)		1.65		0.14	0.82	2.61
	Indirect Cost 10% of EDC		0.17		0.01	0.08	0.26
	Profit 10% of (EDC + IDC)		0.18		0.02	0.09	0.29
	Value Added Tax 10% of Labor & Eqpt.		0.17		0.01	0.08	0.26
	Bond/Insurance 1% of Total UC		0.02		0.00	0.01	0.03
	TOTAL UNIT COST/m³	P/m³	2.19		0.18	1.08	3.45
	PERCENT (%)		63.48		5.22	31.30	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 19
Pay Item No. 200 Aggregate Subbase Course

Output: 100 m³/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1011	0.50 HR Motor Grader 124HP @ P 384.99	P/hr.	192.50			96.25	288.75
1004	1.00 Sheepfoot Roller (single) @ 158.00		158.00			79.00	237.00
1023	0.50 Pneumatic Roller (11-24 tons) @ 836.03		418.02			209.01	627.03
1040	0.50 Water Pump 280 GPM @ 23.49		11.75			5.87	17.62
1050	1.00 Water Truck (3,000 gal. cap) @ 230.74		230.74			115.37	346.11
	TOTAL A	P/hr.	1,011.01			505.50	1,516.51
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2004	1.50 Light Equipment Operator @ 17.71				26.56		26.56
2005	3.00 Driver @ 15.20				15.20		15.20
2006	2.00 Skilled Laborer @ 15.20				30.40		30.40
2007	2.00 Unskilled Laborer @ 12.68				25.36		25.36
	TOTAL B				122.91		122.91
	TOTAL A & B		1,011.01		122.91	505.50	1,639.42
	Output in m³/hr. = 100						
	C. Unit Cost (Equipment & Labor)		10.11	–	1.23	5.06	16.39
	D. Material/Basic Item Qty. U.C						
4006	Coarse Aggregate for Sub. 1.25 161.24	P/m3	97.55		52.87	51.13	201.55
	TOTAL D		97.55		52.87	51.13	201.55
	Estimated Direct Cost (EDC)		107.66		54.10	56.19	217.94
	Indirect Cost 10% of EDC		10.77		5.41	5.62	21.79
	Profit 10% of (EDC + IDC)		11.84		5.95	6.18	23.97
	Value Added Tax 10% of Labor & EDC		1.01		0.12	0.51	1.64
	Bond/Insurance 1% of Total UC		1.31		0.66	0.68	2.65
	TOTAL UNIT COST	P/m	132.59		66.24	69.17	268.00
	PERCENT (%)		49.47	74.19	24.72	25.81	100

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 21
Pay Item No. 302 Bituminous Prime Coat, MC-70

Output: 4 MT/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1026	2.00 Power Broom @ P 555.96	P/hr.	1,111.92			556.00	1,667.92
1030	2.00 Mobile Air Compressor 500-600 CFM @ 713.40		1,426.80			713.40	2,140.20
1044	1.00 Asphalt Distributor @ 514.99		514.99			257.5	772.49
1009	Misc. Tools 20% of unskilled labor		–		15.22	–	15.22
	TOTAL A		3,053.71		15.22	1,526.90	4,595.83
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2004	3.00 Light Equipment Operator @ 17.71				53.13		53.13
2006	2.00 Skilled Laborer @ 15.20				30.40		30.40
2007	6.00 Unskilled Laborer @ 12.68				76.08		76.08
	TOTAL B				210.39		210.39
	TOTAL A & B		3,053.71		225.61	1,526.90	4,806.22
	Output in MT/HR = 4.00						
	C. Unit Cost (Equipment & Labor)	P/MT	763.43	–	56.40	381.73	1,201.56
	D. Material/Basic Item Qty. U.C	P/MT					
3002	Cutback Asphalt MC-70 1050 6.52		213.14	3,695.52	1,572.74	1,364.60	6,846.00
	TOTAL D		213.14	3,695.52	1,572.74	1,364.60	6,846.00
	Estimated Direct Cost (EDC)		976.57	3,695.52	1,629.14	1,746.33	8,047.56
	Indirect Cost 10% of EDC		97.66	369.55	162.91	174.63	804.76
	Profit 10% of (EDC + IDC)		107.42	406.51	179.21	192.10	885.23
	Value Added Tax 10% of Labor & EDC		76.34	0.00	5.64	38.17	120.16
	Bond/Insurance 1% of Total UC		12.58	44.72	19.77	21.51	98.58
	TOTAL UNIT COST	P/MT	1,270.57	4,516.30	1,996.68	2,172.74	9,956.29
	PERCENT (%)		12.76	45.68	20.06	21.82	100

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 23
Pay Item No. 304(1) Single Bituminus Surface Treatment (Asphalt Cement Pen. Grade 60 to 70)

Output: 25 Meter/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1002	2.00 Asphalt Mixing Plant @ P 511.12	P/hr.	1,022.24			511.12	1,533.36
1027	2.00 Wheel Loader 13/4m3 @ 372.00		744.00			372.00	1,116.00
1019	2.00 Asphalt Paver/Finisher @ 595.01		1,190.02			595.01	1,785.03
1023	2.00 Pneumatic Roller (7-20 tons) @ P 836.03		1,672.06			836.03	2,508.09
1020	1.50 Vibratory Drum Roller 7 tons @ 363.87		545.81			272.90	818.71
1021	1.50 Vibratory Tandem Roller 7 tons @ 546.99		820.48			410.24	1,230.72
1046	6.00 Dump Truck 10 tons Cap. @ 814.44		4,886.64			2,443.32	7,329.96
1050	1.00 Water Truck 3,000 Gal. Cap. @ 230.74		230.74			115.37	346.11
1009	Misc. tools 20% of Unskilled Labor				50.72		
	TOTAL A	P/hr.	11,111.99		50.72	5,555.99	16,667.98
	B. Labor						
2001	2.00 Foreman @ P 25.39	P/hr.			50.78		50.78
2003	6.00 Heavy Equip. Optr. @ 23.39				140.34		140.34
2004	5.00 Light Equip. Optr. @ 17.71				88.55		88.55
2005	7.00 Driver @ 15.20				106.40		106.40
2006	6.00 Skilled Laborer @ 15.20				91.20		91.20
2007	20.00 Unskilled Laborer @ 12.68				253.60		253.60
	TOTAL B	P/MT	–	–	730.87		730.87
	TOTAL A & B		11,111.99	–	781.49	5,555.99	17,449.57
	Output in MT/hr. = 25.00						
	C. Unit Cost (Equipment & Labor)	P/MT	444.48	–	31.26	222.24	697.98
	D. Material/Basic — Qty. — U.C						
304	Asphaltic Cement Penetration — 55 — 6.50		10.72	193.05	82.23	71.50	357.50
305	Additives — 0.75 — 115.00		–	43.99	29.32	12.94	86.25
4007	Crushed Agg. for PR — 0.60 — 240.00		76.32	–	28.80	38.80	144.00
	TOTAL D	P/MT	87.04	237.04	140.35	123.32	587.75
	Estimated Direct Cost (EDC)	P/MT	531.52	237.04	171.61	345.56	1285.73
	Indirect cost 10% of EDC		53.15	23.70	17.16	34.56	128.57
	Profit 10% of (EDC + IDC)		58.47	26.07	18.88	38.01	141.43
	Value Added Tax 10% of (Labor & Eqpt.)		44.45	–	3.13	22.22	69.80
	Bond/Insurance 1% of Total U.C.		6.88	2.87	2.11	4.40	16.26
	TOTAL UNIT COST		694.47	289.68	212.89	444.75	1641.79
	PERCENT (%)		42.30	17.64	12.97	27.09	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 24
Pay Item No. 310(1) Aggregate for Bituminous Concrete Wearing Course — Output: 15 m³/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1023	2.00 Pneumatic roller (11.24 tons) @ P 836.00	P/hr.	1,672.00			836.00	2,508.00
1027	2.00 Chips Spreader @ P 118.80 (5.5 Cyl.)		237.60			118.80	356.40
1026	1.00 Power Broom @ P 555.96		555.96			277.98	833.94
1030	1.00 Mobile Air Compressor @ 713.40 (500-600 CFM)		713.40			356.70	1,070.10
	TOTAL A		3,178.96			1,589.48	4,768.44
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2004	5.00 Light Equipment Optr. @ 17.71				88.55		88.55
2005	1.00 Driver @ 15.20				15.20		15.20
2006	4.00 Skilled Laborer @ 15.20				60.80		60.80
2007	10.00 Unskilled Laborer @ 12.68				126.80		126.80
	TOTAL B		–	–	342.13		342.13
	TOTAL A & B		3,178.96		342.13	1,589.48	5,110.57
	Output in m³/hr. = 15						
	C. Unit Cost (Equipment & Labor)		211.93	–	22.81	105.97	340.71
	D. Material/Basic — Qty. U.C						
4010	Crushed Aggregate for Bituminus Conc. 1.05 270	P/m³	144.59	–	66.62	72.29	283.50
	TOTAL D		144.59	–	66.62	72.29	283.50
	Estimated Direct Cost (EDC)		356.52	–	89.43	178.26	624.21
	Indirect Cost 10% of EDC		35.65	–	8.94	17.83	62.42
	Profit 10% of (EDC + IDC)		39.22	–	9.84	19.61	68.66
	Value Added Tax 10% of Labor & Eqpt.		21.19	–	2.28	10.60	34.07
	Bond/Insurance 1% of Total UC		4.53	–	1.10	2.26	7.89
	TOTAL UNIT COST	P/m³	457.11	–	111.60	228.55	797.26
	PERCENT (%)		57.32		13.99	28.69	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE DEVELOPMENT PROJECT

Reference No. 25
Pay Item No. 311 (1) Portland Cement Concrete Pavement (0.20 m THK) **Output: 150 m²/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1003	1.00 Concrete Batching Plant @ P 320.60	P/hr.	320.60			160.30	480.90
1011	1.00 Wheel Loader 1 3/4 m3 @ 372.00		372.00			186.00	558.00
1036	5.00 Transit Mixers (5 m³ cap) @ 943.01		4,715.05			2,357.52	7,072.57
1050	1.00 Water Truck (3,000 gal. cap) @ 230.74		230.74			115.37	346.11
1067	1.00 Concrete Cutter @ 42.21		42.21			21.10	63.31
1096	Miscellaneous Tools 5% of above		568.06			284.03	852.09
	TOTAL A		6,248.66	–	--	3,124.32	9,372.98
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	2.00 Heavy Equipment Operator @ 23.39				46.78		46.78
2005	4.00 Driver @ 15.20				60.80		60.80
2006	12.00 Skilled Laborer @ 15.20				182.40		182.40
2007	24.00 Unskilled Laborer @ 12.68				304.32		304.32
	TOTAL B				619.69		619.69
	TOTAL A & B		6,248.66		619.69	3,124.32	9,992.67
	Output in m²/hr. = 150						
	C. Unit Cost (Equipment & Labor)	P/m²	41.66	–	4.13	20.83	66.62
	D. Material/Basic Item Qty. U.C						
3006	Portland Cement 1.91 115.00		–	112.02	74.68	32.95	219.65
3007	Reinforcing Steel 0.40 15.72			2.96	2.69	0.64	6.29
3010	Lumber–Apitong 0.70 7.50			1.47	3.57	0.21	5.25
3015	Common Wire Nail 0.005 22.00			–	0.11	–	0.11
3004	Sand (Screened) 0.09 130.00		5.96	–	2.69	3.05	11.70
3006	Gravel (Crushed) 0.17 288.00		14.42	–	5.44	7.34	27.20
3015	Additives 0.06 5.90		–	–	0.35	–	0.35
3016	Incidentals 1% of above		0.20	1.16	0.90	0.44	2.70
	TOTAL D		20.58	117.61	90.43	44.63	273.25
	Estimated Direct Cost (EDC)		62.24	117.62	116.53	65.46	361.85
	Indirect Cost 10% of EDC		6.22	11.76	11.65	6.55	36.18
	Profit 10% of (EDC + IDC)		6.85	12.94	12.82	7.20	39.81
	Value Added Tax 10% of Labor & EDC		4.17	0.00	0.41	2.08	6.66
	Bond/Insurance 1% of Total UC		0.80	1.42	1.42	0.81	4.45
	TOTAL UNIT COST	P/m²	80.28	143.74	142.83	82.10	448.95
	PERCENT (%)		17.88	32.02	31.81	18.29	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 26
Pay Item No. 405(1) Concrete Class "A" (For Substructure) **Output: 10 cubic meter/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1003	1.00 Concrete Batching Plant @ P 320.60	P/hr	320.60			160.30	480.90
1036	2.00 Transit Mixers (5 m³ cap) @ 943.01		1,886.02			943.01	2,829.03
1011	1.00 Wheel Loader 1 3/4 m³ @ 372.00		372.00			186.00	558.00
1050	1.00 Water Truck (3,000 gal. cap.) @ 230.74		230.74			115.37	346.11
1095	Miscellaneous Tools 5% of above		140.47			70.23	210.70
	TOTAL A		2,949.83			1,474.91	4,424.74
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	2.00 Heavy Equipment Operator @ 23.39				46.78		46.78
2005	3.00 Driver @ 15.20				45.6		45.6
2006	12.00 Skilled Laborer @ 15.20				182.40		182.40
2007	24.00 Unskilled Laborer @ 12.68				304.32		304.32
	TOTAL B				604.49		604.49
	TOTAL A & B		2,949.83	0.00	604.49	1,474.91	5,029.23
	Output in m³/hr. = 10						
	C. Unit Cost (Equipment and Labor)		3.69		0.76	1.84	6.29
	D. Material/Basic Item Qty. U.C.	P/m³					
3006	Portland Cement 9.10 115.00		–	533.71	355.80	156.99	1,046.50
3004	Sand (Screened) 0.42 130.00		27.81	–	12.55	14.24	54.60
3006	Gravel (Crushed) 0.84 288.00		71.26	–	134.40	36.26	241.92
3015	Additives 0.20 5.90		–	–	1.18	–	1.18
3025	Formworks 60.00 10.00		–	168.00	408.00	24.00	600.00
3090	Incidentals 10% of above		9.91	70.17	91.19	23.15	194.42
	TOTAL D		108.98	771.88	1,003.12	254.64	2,138.62
	Estimated Direct Cost (EDC)		403.96	771.88	1,063.57	402.13	2,641.54
	Indirect Cost 10% of EDC		40.40	77.19	106.36	40.21	264.15
	Profit 10% of (EDC + IDC)		44.44	84.91	116.99	44.23	290.57
	Value Added Tax 10% of Labor & Eqpt.		29.50	0.00	6.04	14.75	50.29
	Bond Insurance 1% of Total UC		5.18	9.34	12.93	5.01	32.47
	TOTAL UNIT COST	P/m³	523.47	943.32	1,305.90	506.33	3,279.02
	PERCENT (%)		15.96	28.77	39.83	15.44	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 27
Pay Item No. 405(2) Concrete Class "A" (For Superstructure) **Output: 10 m³/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1003	1.00 Concrete Batching Plant @ P 320.60	P/hr	320.60			160.30	480.90
1004	1.00 Ancillary Equip. for Concrete Batching Plant @ 184.58						
1011	2.00 Wheel Loader 1 3/4 m³ @ 372.00						
1036	0.50 Transit Mixers (5 m³ cap) @ 943.01		1,886.02			943.01	2,829.03
1011	2.00 Wheel Loader 1 3/4 m³ @ 372.00		372.00			186.00	558.00
1050	1.00 Water Truck (3,000 gal. cap.) @ 230.74		230.74			115.37	346.11
1095	Miscellaneous Tools 5% of above		140.47			70.23	210.70
	TOTAL A		2,949.83			1,474.91	4,424.74
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	2.00 Heavy Equipment Operator @ 23.39				46.78		46.78
2005	3.00 Driver @ 15.20				45.6		45.6
2006	12.00 Skilled Laborer @ 15.20				182.40		182.40
2007	24.00 Unskilled Laborer @ 12.68				304.32		304.32
	TOTAL B				604.49		604.49
	TOTAL A & B		2,949.83	0.00	604.49	1,474.91	5,029.23
	Output in m³/hr. = 10						
	C. Unit Cost (Equipment and Labor)		3.69		0.76	1.84	6.29
	D. Material/Basic Item Qty. U.C.	P/m³					
3006	Portland Cement 9.10 115.00		–	533.71	355.80	156.99	1,046.50
3004	Sand (Screened) 0.42 130.00		27.81	–	12.55	14.24	54.60
3006	Gravel (Crushed) 0.84 288.00		71.26	–	134.40	36.26	241.92
3015	Additives 0.20 5.90		–	–	1.18	–	1.18
3025	Formworks 60.00 10.00		–	168.00	408.00	24.00	600.00
3090	Incidentals 10% of above		9.91	70.17	91.19	23.15	194.42
	TOTAL D		108.98	771.88	1,003.12	254.64	2,138.62
	Estimated Direct Cost (EDC)		403.96	771.88	1,063.57	402.13	2,641.54
	Indirect Cost 10% of EDC		40.40	77.19	106.36	40.21	264.15
	Profit 10% of (EDC + IDC)		44.44	84.91	116.99	44.23	290.57
	Value Added Tax 10% of Labor & Eqpt.		29.50	0.00	6.04	14.75	50.29
	Bond Insurance 1% of Total UC		5.18	9.34	12.93	5.01	32.47
	TOTAL UNIT COST	P/m³	523.47	943.32	1,305.90	506.33	3,279.02
	PERCENT (%)		15.96	28.77	39.83	15.44	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 28
Pay Item No. 500(76) RCPC, 76 cm diameter

Output: 2 meter/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1042	1.00 Vibratory Plate Compactor @ P 99.70	P/hr	99.70			49.85	149.55
1046	0.50 Dump Truck (10 tons cap.) @ 814.44		407.22			203.61	610.83
1095	Miscellaneous Tools 10% of above		50.69			25.35	76.04
	TOTAL A		557.61			278.81	836.42
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2005	0.50 Driver @ 15.20				7.60		7.60
2006	6.00 Skilled Laborer @ 15.20				91.20		91.20
2007	8.00 Unskilled Laborer @ 12.68				101.44		101.44
	TOTAL B				225.63		225.63
	TOTAL A & B		557.61		225.63	278.81	1,062.05
	Output in meter/hr. = 2						
	C. Unit Cost (Equipment and Labor)		278.81		112.82	139.41	531.03
	D. Material/Basic Item Qty. U.C.	P/m					
4015	RCPC 76 cm dia. Class 1 1.00 475.00		32.14	184.61	196.86	61.39	475.00
4017	Cement Mortar for RCPC 0.012 1,294.87		1.66	6.07	5.19	2.62	15.54
4005	Crushed Aggregate for Pipe 0.29 182.00		26.86	–	12.26	13.66	52.78
	TOTAL D		60.66	190.68	214.31	77.67	543.32
	Estimated Direct Cost (EDC)		339.47	190.68	327.31	217.08	1,074.35
	Indirect Cost 10% of EDC		33.95	19.07	32.71	21.71	107.43
	Profit 10% of (EDC + IDC)		37.34	20.97	35.98	23.88	118.18
	Value Added Tax 10% of Labor & Eqpt.		27.88	0.00	11.28	13.94	53.1
	Bond Insurance 1% of Total UC		4.39	2.31	4.07	2.77	13.53
	TOTAL UNIT COST	P/m	443.02	233.03	411.17	279.37	1,366.59
	PERCENT (%)		32.42	17.05	30.09	20.44	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 29
Pay Item No. 500(91) RCPC, 91 cm diameter **Output: 3 meter/l**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1046	1.00 Dump Truck (10 tons cap.) @ 814.44	P/m	814.44			407.22	1,221.6
1046	2.00 Vibratory Plate Compactor @ P 99.70		199.4			99.70	299.1
1042	Miscellaneous Tools 10% of above		101.38			50.69	152.07
	TOTAL A		1,115.22			557.61	1,672.83
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2004	2.00 Light Equipment Operator @ 17.71				35.42		35.42
2005	1.00 Driver @ 15.20				15.20		15.20
2006	7.00 Skilled Laborer @ 15.20				106.40		106.40
2007	10.00 Unskilled Laborer @ 12.68				126.80		126.80
	TOTAL B				334.60		334.60
	TOTAL A & B		1,115.22		334.60	557.61	2,007.43
	Output in meter/hr. = 3						
	C. Unit Cost (Equipment and Labor)		371.74		111.53	185.87	669.14
	D. Material/Basic Item Qty. U.C.	P/m					
4020	RCPC 107 cm dia. Class 1 1.00 780.27		52.80	303.25	323.38	100.84	780.27
4027	Cement Mortar for RCPC 0.016 1,294.87		2.21	8.09	6.93	3.49	20.72
4005	Crushed Aggregate for Pipe 0.37 182.00		34.27	–	15.64	17.43	67.34
	TOTAL D		89.28	311.34	345.95	121.76	868.33
	Estimated Direct Cost (EDC)		461.02	311.34	457.48	307.63	1,537.47
	Indirect Cost 10% of EDC		46.10	31.13	45.75	30.76	153.75
	Profit 10% of (EDC + IDC)		50.71	34.25	50.32	33.84	169.12
	Value Added Tax 10% of Labor & Eqpt.		37.17	0.00	11.15	18.59	33.91
	Bond Insurance 1% of Total UC		5.95	3.77	5.65	3.91	19.27
	TOTAL UNIT COST	P/m	600.95	380.49	570.35	394.73	1,946.52
	PERCENT (%)		30.87	19.55	29.30	20.28	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 30
Pay Item No. 500(107) RCPC, 107 cm diameter **Output: 4 meter/**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1035	1.00 Hydraulic Crane 25 tons cap. @ P 846.90	P/m	846.90			423.45	1,270.3
1046	1.00 Dump Truck (10 tons cap.) @ 814.44		814.44			407.22	1,221.6
1042	2.00 Vibratory Plate Compactor @ 99.70		199.40			99.70	299.1
	TOTAL A		1,860.74			930.37	2,791.1
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.3
2003	1.00 Heavy Equipment Operator @ 23.39				23.39		23.3
2004	2.00 Light Equipment Operator @ 17.71				35.42		35.4
2005	1.00 Driver @ 15.20				15.20		15.2
2006	8.00 Skilled Laborer @ 15.20				121.60		121.6
2007	12.00 Unskilled Laborer @ 12.68				152.16		152.1
	TOTAL B				373.16		373.16
	TOTAL A & B		1,860.74		373.16	930.37	3,164.27
	Output in meter/hr. = 4						
	C. Unit Cost (Equipment and Labor)		465.19		93.29	232.59	791.07
	D. Material/Basic Item Qty. U.C.	P/m					
4020	RCPC 107 cm dia. Class 1 1.00 1,065.77		72.12	414.21	441.70	137.74	1,065.77
4027	Cement Mortar for RCPC 0.018 1,294.87		2.49	9.10	7.80	3.92	23.31
4005	Crushed Aggregate for Pipe 0.430 182.00		39.83	–	18.17	20.26	78.26
	TOTAL D		114.44	423.31	467.67	161.92	1,167.34
	Estimated Direct Cost (EDC)		579.63	423.31	560.96	394.51	1,958.41
	Indirect Cost 10% of EDC		57.96	42.33	56.10	39.45	195.84
	Profit 10% of (EDC + IDC)		63.76	46.56	61.71	43.40	215.42
	Value Added Tax 10% of Labor & Eqpt.		46.52	0.00	9.33	23.26	79.11
	Bond Insurance 1% of Total UC		7.48	5.12	6.88	5.01	24.49
	TOTAL UNIT COST	P/m	755.34	517.33	694.97	505.63	2,473.27
	PERCENT (%)		30.54	20.92	28.10	20.44	100.00

Table 5–2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 31
Pay Item No. 500(120) RCPC, 120 cm diameter **Output: 6 meter/hr**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1035	2.00 Hydraulic Crane 25 tons cap. @ P 846.90	P/m	1,693.80			846.90	2,540.70
1046	2.00 Dump Truck (10 tons cap.) @ 814.44		1628.88			814.44	2,443.32
1042	3.00 Vibratory Plate Compactor @ 99.70		299.10			149.55	448.65
	TOTAL A		3,621.78			1,810.89	5,432.67
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2003	2.00 Heavy Equipment Operator @ 23.39				46.78		46.78
2004	3.00 Light Equipment Operator @ 17.71				53.13		53.13
2005	2.00 Driver @ 15.20				30.40		30.40
2006	12.00 Skilled Laborer @ 15.20				182.40		182.40
2007	18.00 Unskilled Laborer @ 12.68				228.24		228.24
	TOTAL B				591.73		591.73
	TOTAL A & B		3,621.78		591.73	1,810.89	6,024.40
	Output in meter/hr. = 6						
	C. Unit Cost (Equipment and Labor)		603.63		98.62	301.82	1,004.07
	D. Material/Basic Item Qty. U.C.	P/m					
4020	RCPC 120 cm dia. Class 1 1.00 1,432.56		96.94	556.76	593.72	185.14	1,432.56
4027	Cement Mortar for RCPC 0.02 1,271.65		2.72	9.93	8.50	4.28	25.43
4005	Crushed Aggregate for Pipe 0.49 182.00		45.38	–	20.71	23.09	89.18
	TOTAL D		145.04	566.69	622.93	212.51	1,547.17
	Estimated Direct Cost (EDC)		748.67	566.69	721.55	514.33	2,551.24
	Indirect Cost 10% of EDC		74.87	56.67	72.16	51.43	255.12
	Profit 10% of (EDC + IDC)		82.35	62.34	79.37	56.58	280.64
	Value Added Tax 10% of Labor & Eqpt.		60.36	0.00	9.86	30.18	100.41
	Bond Insurance 1% of Total UC		9.66	6.86	8.83	6.53	31.87
	TOTAL UNIT COST	P/m	975.92	692.55	891.77	659.04	3,219.28
	PERCENT (%)		30.32	21.51	27.70	20.47	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 32
Pay Item No. 502(10) Structural Concrete for Pipe Headwalls & Apron Slab **Output: 10 meter³/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUN
	A. Equipment						
1003	1.00 Concrete Batching Plant @ P 320.60	P/hr	320.60			160.30	480.
1036	2.00 Transit Mixers (5 m³ cap) @ 943.01		1,886.02			943.01	2,829.
1011	1.00 Wheel Loader 1 3/4 m³ @ 372.00		372.00			186.00	558.
1050	1.00 Water Truck (3,000 gal. cap.) @ 230.74		230.74			115.37	346.
	TOTAL A		2,809.36			1,404.68	4,214.
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.
2003	2.00 Heavy Equipment Operator @ 23.39				46.78		46.
2005	3.00 Driver @ 15.20				45.6		45.
2006	12.00 Skilled Laborer @ 15.20				182.40		182.4
2007	24.00 Unskilled Laborer @ 12.68				304.32		304.3
	TOTAL B (same as Item 405(1)				604.49		604.4
	TOTAL A & B		2,809.36	0.00	604.49	1,404.68	4,818.5
	Output in m³/hr. = 10						
	C. Unit Cost (Equipment and Labor)		280.93		60.45	140.47	481.8
	D. Material/Basic Item Qty. U.C.	P/m³					
3006	Portland Cement 9.10 115.00		–	533.71	355.80	156.99	1,046.5
3004	Sand (Screened) 0.42 130.00		27.81	–	12.55	14.24	54.6
3006	Gravel (Crushed) 0.84 288.00		71.26	–	134.40	36.26	241.9
3015	Additives 0.20 5.90		–	–	1.18	–	1.1
3025	Formworks 60.00 10.00		–	168.00	408.00	24.00	600.0
3090	Incidentals 10% of above		9.91	70.17	91.19	23.15	194.4
	TOTAL D		108.98	771.88	1,003.12	254.64	2,138.62
	Estimated Direct Cost (EDC)		389.91	771.88	1,063.57	395.11	2,620.47
	Indirect Cost 10% of EDC		38.99	77.19	106.36	39.51	262.05
	Profit 10% of (EDC + IDC)		42.89	84.91	116.99	43.46	288.25
	Value Added Tax 10% of Labor & Eqpt.		28.09	0.00	6.04	14.05	48.18
	Bond Insurance 1% of Total UC		5.00	9.34	12.93	4.92	32.19
	TOTAL UNIT COST	P/m	504.88	943.32	1,305.89	497.05	3,251.14
	PERCENT (%)		15.53	29.01	40.17	15.29	

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 33
Pay Item No. 502(11) Reinforcing Steel for Pipe Headwalls/Wingwalls — Output: 1 Metric Ton

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUNT
	A. Equipment						
1020	1.00 Bar Cutter @ P 75.00				750.00		750.0
1046	2.00 Service Truck @ 553.14		1,106.28		–	553.14	1,659.4
	Miscellaneous Tools 10% of above		110.63		75.00	55.31	240.9
	TOTAL A		1,216.91		825.00	608.45	2,650.3
	B. Labor						
2001	10.00 Foreman @ P 25.39				253.90		253.9
2006	30.00 Skilled Laborer @ 15.20				456.00		456.0
2007	30.00 Unskilled Laborer @ 12.68				380.40		380.40
	TOTAL B				1,090.30		1,090.30
	TOTAL A & B		1,216.91		1,915.30	608.45	3,740.66
	Output in kg/hr. = 1,000						
	C. Unit Cost (Equipment and Labor)	P/1 kg.	1.22		1.92	0.61	3.75
	D. Material/Basic Item Qty. U.C.						
	Reinforcing Steel 1.05 15.73				14.70	1.82	16.52
	Tie Wire 0.014 35.00				0.44	0.05	0.49
	TOTAL D				15.14	1.87	17.01
	Estimated Direct Cost (EDC)		1.22		17.06	2.48	20.76
	Indirect Cost 10% of EDC		0.12		1.71	0.25	2.08
	Profit 10% of (EDC + IDC)		0.13		1.88	0.27	2.28
	Value Added Tax 10% of Labor & Eqpt.		0.12		0.19	0.06	0.37
	Bond Insurance 1% of Total UC		0.02		0.21	0.03	0.25
	TOTAL UNIT COST	P/m	1.61		21.04	3.09	25.74
	PERCENT (%)		6.23		81.77	12.00	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 34
Pay Item No. 503(2) Removal, Cleaning, Replacement Salvage Pipe Culverts **Output: 10 m/hr.**

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component		Local Component	Taxes	TOTAL AMOUNT
			Direct	Indirect			
	A. Equipment						
1035	1.00 Crane 25 tons cap. @ P 846.90		846.90			423.45	1,270.35
1046	2.00 Dump Truck Hino 10 tons cap. @ 814.44		1,628.88		–	814.44	2,443.32
	Hand Tools 5% of above				185.68		185.68
	TOTAL A		2,475.78		185.68	1,237.89	3,899.35
	B. Labor						
2001	2.00 Foreman @ P 25.39				50.78		50.78
2003	1.00 Heavy Equipment Operator @ 23.39				23.39		23.39
2005	2.00 Driver @ 15.20				30.40		30.40
2006	4.00 Skilled Laborer @ 15.20				60.80		60.80
2007	6.00 Unskilled Laborer @ 12.68				76.08		76.08
	TOTAL B				241.45		241.45
	TOTAL A & B		2,475.78		427.13	1,237.89	4,140.80
	Output in m/hr. = 10						
	C. Unit Cost (Equipment and Labor)	P/m	247.58		42.71	123.79	414.08
	Estimated Direct Cost (EDC)		247.58		42.71	123.79	414.08
	Indirect Cost 10% of EDC		24.76		4.27	12.38	41.41
	Profit 10% of (EDC + IDC)		27.23		4.70	13.62	45.55
	Value Added Tax 10% of Labor & Eqpt.		24.76		4.27	12.38	41.41
	Bond Insurance 1% of Total UC		3.24		0.56	1.62	5.42
	TOTAL UNIT COST	P/m	327.57		56.51	163.79	547.87
	PERCENT (%)		59.79		10.32	29.89	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 35
Pay Item No. 504(5) Grouted Riprap

Output: 8 meter³/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component Direct	Foreign Component Indirect	Local Component	Taxes	TOTAL AMOUN
	A. Equipment						
1045	2.00 Dump Truck 608 CY Cap. @ P 736.71	P/hr	1,473.42			736.71	2,210.
	0.25 Wheel Loader 1 3/4 m³ @ 372.00		93.00			46.50	139.
	TOTAL A		1,566.42			783.21	2,349.
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.
2006	4.00 Skilled Laborer @ 15.20				60.80		60.
2007	4.00 Unskilled Laborer @ 12.68				50.72		50.
	TOTAL B				136.91		136.
	TOTAL A & B		1,566.42	0.00	136.91	783.21	2,486.
	Output in m³/hr. = 8						
	C. Unit Cost (Equipment and Labor)		195.80		17.12	97.90	310.8
	D. Material/Basic Item Qty. U.C.	P/m³					
	Boulders (m³) 1.15 150.00		51.75		94.88	25.87	172.
	Cement (Bags) 5.00 12.00			305.99	204	90.01	600.
	Sand (m³) 0.585 130.00		30.40	–	32.50	13.10	76.
	TOTAL D		82.15	305.99	331.38	128.98	848.
	Estimated Direct Cost (EDC)		277.95	305.99	348.50	226.88	1,159.
	Indirect Cost 10% of EDC		27.80	30.60	34.85	22.68	115.
	Profit 10% of (EDC + IDC)		30.57	33.66	38.34	24.96	127.
	Value Added Tax 10% of Labor & Eqpt.		19.58	0.00	1.71	9.79	31.
	Bond Insurance 1% of Total UC		3.56	3.71	4.23	2.84	14.
	TOTAL UNIT COST	P/m	359.46	373.96	427.63	287.15	1,448.
	PERCENT (%)		24.82	25.82	29.53	19.83	100.00

Table 5-2
DEVELOPMENT OF UNIT COSTS FOR PAY ITEMS
AURORA ROAD INFRASTRUCTURE FUND PROJECT

Reference No. 38
Pay Item No. 400(13) Precast Concrete Piles, Driven (40 cm x 40 cm) Output: 7.50 LM/hr.

Ref. No.	DESCRIPTION	Peso Per Unit	Foreign Component		Local Component	Taxes	TOTAL AMOUNT
			Direct	Indirect			
	A. Equipment						
	1.00 Crawler Crane 45 tons cap. @ P 979.01	P/hr	979.01		234.96	254.55	1,468.52
	1.00 Pile Hammer K25-DSL @ 938.94		938.94		225.35	244.12	1,408.41
	1.00 Mobile Crane 25 tons cap. @ 846.90		846.90		203.26	220.19	1,270.35
	TOTAL A		2,764.85		663.57	718.86	4,147.28
	B. Labor						
2001	1.00 Foreman @ P 25.39				25.39		25.39
2003	3.00 Heavy Equipment Operator @ 23.39				70.17		70.17
2006	6.00 Skilled Laborer @ 15.20				91.20		91.20
2007	2.00 Unskilled Laborer @ 12.68				25.36		25.36
	TOTAL B				212.12		212.12
	TOTAL A & B		2,764.85		875.69	718.86	4,359.40
	Output in LM/hr. = 7.50						
	C. Unit Cost (Equipment and Labor)		368.65		116.75	95.85	581.25
	Estimated Direct Cost (EDC)		368.65		116.75	95.85	581.25
	Indirect Cost 10% of EDC		36.87		11.67	9.58	58.12
	Profit 10% of (EDC + IDC)		40.55		12.84	10.55	63.94
	Value Added Tax 10% of Labor & Eqpt.		36.87		11.67	9.58	58.12
	Bond Insurance 1% of Total UC		4.83		1.53	1.25	7.61
	TOTAL UNIT COST	P/LM	487.77		154.46	126.81	769.04
	PERCENT (%)		63.42		20.08	16.50	

- Labor

  The composition of the construction team and its output based on actual work site experience per activity is considered in establishing the labor cost. Six (6) categories were classified for labor positions to represent the manpower requirement, namely: foreman, heavy equipment operator, light equipment operator, driver, skilled laborer, and unskilled laborer. The labor rates used in the estimates are based on current rates.

- Equipment

  Equipment costs used in the study are based on initial cost plus equipment depreciation and latest rates prepared by Associated Construction Equipment Lessors (ACEL) updated on December 1990.

5.2.2. Indirect Cost

The following indirect cost factors used in the estimates were based from recent feasibility studies prepared by the Consultant in the Philippines and from current DPWH data:

- Value Added Tax - 10% of equipment and labor cost
- Overhead Cost - 10% of direct cost
- Profit - 10% of (direct cost + overhead cost)
- Bond/Insurance - 1% of total unit cost

5.3 QUANTITIES

Construction quantities were computed according to the type of improvements required for each road segment. In segments where the existing alignment could be utilized and made part of the proposed improvement, quantities were calculated for widening and gradient improvements.

5.3.1 Earthworks

Quantities were calculated from typical cross-sections and actual survey data taken from the field.

5.3.2 Pavement Section

Computation for surfacing was made from the pavement design made. Where existing PCCP surface in good condition exists, unit quantities were adjusted to account for this surface.

5.3.3 Structures

Proposed new bridges and box culverts were estimated based on preliminary drainage and structural design. Quantities of major items were determined for these structures and their corresponding costs were estimated.

5.3.4 Drainage and Erosion Works

Quantities were estimated based on preliminary design of proposed culverts and cross drains and the proposed erosion control measures.

5.3.5 Incidental Works

Estimated quantities of incidental items were limited to roadway signs.

5.3.6 Right-of-Way

Land acquisition cost was estimated for all segments of the study road. The DPWH office in Baler indicated that 1991 right of way acquisition costs in Aurora Province are based on coconut land at ₱ 20,000 per ha.

5.4 CONSTRUCTION COST

This was made by applying the developed unit cost to the computed total quantity of work items.

5.5 COST OF IMPROVEMENTS

The costs of improving the project road are detailed in the attached tables. (Table 5-3 and Table 5-4). Construction costs have been developed for each road section and contain financial cost, economic cost, including foreign, local and tax components. Table 5-3 provides a cost summary for two alternate paving types per segment and Table 5-4 provides a detailed cost breakdown by road surface and road segment.

Table 5–3
SUMMARY OF COST

SEGMENT	DESCRIPTION	L (KM)	ESTIMATED COST									
			PCCP		AC		DBST		MIXED			
									PCCP/DBST		AC/DBST	
			ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS	ECONOMIC PESOS	FINANCIAL PESOS
1A	BALER–DIPACULAO	11.60	44,423,508	51,380,242	30,080,168	36,580,602						
1B	DIPACULAO–MA.AURORA	8.60	37,872,034	44,116,137	28,180,494	34,394,367						
1C	MA.AURORA–SAN LUIS	10.70	101,422,522	115,175,999	87,566,300	101,220,506						
1D	SAN LUIS–BALER	7.13	20,057,687	22,926,409	11,390,831	13,733,798						
	TOTAL		**203,775,751**	**233,598,787**	**157,217,793**	**185,929,273**						
2A	MA.AURORA–BAZAL	4.43			13,368,601	15,967,528	11,940,576	14,291,623				
2B1	BAZAL–KM. 38	13.78			48,657,680	58,120,503	46,463,177	55,589,198				
2B2	CANILI – KM. 38	11.70			75,966,297	92,547,181	74,605,714	91,011,992				
2C	PANTABANGAN – CANILI	26.89			89,277,680	107,654,415	69,593,860	84,183,826				
2D	RIZAL – PANTABANGAN	14.91			69,239,359	81,576,228	58,324,803	68,562,023				
	TOTAL				**296,509,617**	**355,865,855**	**260,928,130**	**313,638,662**				
3	SAN LUIS–DINGALAN	72.50	955,357,210	1,158,859,625	864,348,461	1,068,502,822						
3	SAN LUIS–DINGALAN	20.50	Km. of Walking Trail with Existing Logging Roads				(Walking Trail Only)		7,935,120	11,980,220		
4A	TABLANG–LAUR	7.60			20,609,870	24,469,412	19,873,923	23,953,034				
4B	LAUR–GABALDON	26.40			135,501,597	159,176,950	126,282,172	148,420,561				
4C	GABALDON–DINGALAN	13.43			45,659,365	55,086,097	39,608,410	47,809,212				
	TOTAL				**201,770,832**	**238,732,459**	**185,764,505**	**220,182,807**				
5A	PROVIN'L. BOUNDARY–KM.38	17.00			209,415,552	258,146,807			208,135,256	255,550,148		
5B	BONGABON–PROVIN'L. BDRY.	31.50	244,928,893	289,469,442	205,250,065	250,037,118						
5C	TABLANG–BONGABON	8.30	44,863,246	51,985,975	34,479,151	41,681,773						
	TOTAL		**289,792,139**	**341,455,417**	**449,144,768**	**549,865,698**						

Table 5-4
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	83,000.00	1.99	165,170.00	2.27	188,766.19	0.12	9,960.00	1.00	83,000.00	2.39	198,726.19	3.11	258,130.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	1,470.00	77.95	114,586.50	89.09	130,956.33	19.33	28,415.10	38.99	57,315.30	108.42	159,371.43	136.27	200,316.90
102 (1)	Unsuitable excavation	CU.M.	1,675.00	63.71	106,714.25	72.81	121,959.45	4.41	7,386.75	31.86	53,365.50	77.22	129,346.20	99.98	167,466.50
(2)	Common excavation	CU.M.	7,125.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.06	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.66	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	3,020.00	60.12	181,562.40	68.71	207,500.40	12.38	37,387.60	30.07	90,811.40	81.09	244,888.00	102.57	309,761.40
104 (1)	Embankment	CU.M.	7,125.00	62.06	442,177.50	70.93	505,346.98	24.81	176,771.25	33.80	240,825.00	95.74	682,118.23	120.67	859,773.75
(2)	Embankment, selected material	CU.M.	45,380.00	62.07	2,816,736.60	70.94	3,219,135.59	40.35	1,831,083.00	37.35	1,694,943.00	111.29	5,050,215.59	139.77	6,342,762.60
105 (1)	Subgrade preparation, common	SQ.M.	85,820.00	2.19	187,945.80	2.50	214,795.74	0.18	15,447.60	1.08	92,685.60	2.68	230,243.34	3.45	296,079.00
(2)	Subgrade preparation, extg. pavement	SQ.M.	1,470.00	4.38	6,438.60	5.01	7,358.42	0.46	676.20	2.16	3,175.20	5.47	8,034.62	7.00	10,290.00
	TOTAL TO EARTHWORK				4,021,331.65		4,595,819.09		2,107,127.50		2,316,121.00		6,702,946.59		8,444,580.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	3,605.00	132.59	504,504.95	151.53	576,578.53	66.24	252,043.20	69.17	263,191.85	217.77	828,621.73	268.00	1,019,740.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	10,520.00	129.67	1,364,128.40	148.19	1,559,007.78	233.84	2,459,996.80	70.64	743,132.80	382.03	4,019,004.58	434.15	4,567,258.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	54,040.00	224.02	12,106,040.80	256.02	13,835,509.79	142.83	7,718,533.20	82.10	4,436,684.00	398.85	21,554,042.99	448.95	24,261,258.00
(2)	Patching extg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				13,974,674.15		15,971,096.10		10,430,573.20		5,443,008.65		26,401,669.30		29,848,256.00
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 / 416.09	0.00 / 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 / 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00		0.00		0.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	905.00	105.33	95,323.65	120.38	108,941.59	87.38	79,078.90	59.37	53,729.85	207.76	188,020.49	252.08	228,132.40
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180,796.21	411.17	96,213.78	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,760.00	1.61	9,273.60	1.84	10,598.43	21.04	121,190.40	3.09	17,798.40	22.88	131,788.83	25.74	148,262.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00 / 0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P25)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.63	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				393,133.29		449,296.31		414,013.18		161,635.33		563,399.49		988,781.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.23	0.00	900.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	5.20	0.00
	TOTAL TO INCIDENTAL WORKS				15,423.08		17,626.42		8,562.15		11,998.77		26,188.57		35,984.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1A				18,404,562.17		21,033,837.92		12,960,276.03		7,952,763.75		33,994,113.95		39,317,601.95
	10% CONTINGENCIES				1,840,456.22		2,103,383.79		1,296,027.60		795,276.38		3,399,411.40		3,931,760.20
	SUB-TOTAL				20,245,018.39		23,137,221.71		14,256,303.63		8,748,040.13		37,393,525.35		43,249,362.15
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,024,501.84		2,313,722.17		1,425,630.36		874,804.01		3,739,352.53		4,324,936.21
	SUB-TOTAL				22,269,520.23		25,450,943.89		15,681,934.00		9,622,844.14		41,132,877.86		47,574,298.36
	8% SUPERVISION COST				1,781,561.62		2,036,075.51		1,254,554.72		769,827.53		3,290,630.23		3,805,943.87
	TOTAL SEGMENT COST				24,051,081.84		27,487,019.40		16,936,488.72		10,392,671.67		44,423,508.11		51,380,242.23

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	83,000.00	1.99	165,170.00	2.27	188,766.19	0.12	9,960.00	1.00	83,000.00	2.39	198,726.19	3.11	258,130.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	1,470.00	77.95	114,586.50	89.09	130,956.33	19.33	28,415.10	38.99	57,315.30	108.42	159,371.43	136.27	200,316.90
102 (1)	Unsuitable excavation	CU.M.	1,675.00	63.71	106,714.25	72.81	121,959.45	4.41	7,386.75	31.86	53,365.50	77.22	129,346.20	99.98	167,466.50
(2)	Common excavation	CU.M.	7,125.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.53	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	3,020.00	60.12	181,562.40	68.71	207,500.40	12.38	37,387.60	30.07	90,811.40	81.09	244,888.00	102.57	309,761.40
104 (1)	Embankment	CU.M.	7,125.00	62.06	442,177.50	70.93	505,346.98	24.81	176,771.25	33.80	240,825.00	95.74	682,118.23	120.67	859,773.75
(2)	Embankment, selected material	CU.M.	45,380.00	62.07	2,816,736.60	70.94	3,219,135.59	40.35	1,831,063.00	37.35	1,694,943.00	111.29	5,050,218.59	139.77	6,342,762.60
105 (1)	Subgrade preparation, common.	SQ.M.	85,820.00	2.19	187,945.80	2.50	214,795.74	0.18	15,447.60	1.08	92,685.60	2.68	230,243.34	3.45	296,079.00
(2)	Subgrade preparation, exep. pavement	SQ.M.	1,470.00	4.38	6,438.60	5.01	7,358.42	0.46	676.20	2.16	3,175.20	5.47	8,034.62	7.00	10,290.00
	TOTAL TO EARTHWORK				4,021,331.65		4,595,819.09		2,107,127.50		2,316,121.00		6,702,946.59		8,444,562.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	22,725.00	132.59	3,013,107.75	151.53	3,443,560.32	66.24	1,505,304.00	69.17	1,571,888.25	217.77	4,948,864.32	268.00	6,090,300.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	7,660.00	129.67	993,272.20	148.19	1,135,171.07	233.84	1,791,214.40	70.64	541,102.40	382.03	2,926,385.47	434.15	3,325,589.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	68.00	5,786.87	393,507.16	6,613.58	449,723.59	1,996.68	135,774.24	2,172.74	147,746.32	8,610.26	585,497.83	9,956.29	677,027.72
302 (3)	Bituminous tack coat, CSS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete											0.00		0.00	
	Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	54,040.00	75.92	4,102,716.80	86.77	4,688,830.92	42.12	2,276,164.80	37.96	2,051,358.40	128.89	6,964,995.72	0.00 156.00	8,430,240.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=₱28)		ECONOMIC (1$=₱32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	306.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				8,502,603.91		9,717,285.90		5,708,457.44		4,312,095.37		15,425,743.34		18,523,156.72
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,868.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.25	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00		0.00		0.00
	IV. DRAINAGE EROSION WORKS					0.00	0.00								
500 (1)	Backfill material, pipe culvert	CU.M.	905.00	105.33	95,323.65	120.38	108,941.59	87.38	79,078.90	59.37	53,729.85	207.76	188,020.49	252.08	228,132.40
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180,798.21	411.17	96,213.76	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,760.00	1.61	9,273.60	1.84	10,598.43	21.04	121,190.40	3.09	17,798.40	22.88	131,788.83	25.74	148,262.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1A: BALER – DIPACULAO

SECTION LENGTH: 11.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
[illegible]	Lined Ditch	L.M.		286.55	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				393,133.29		449,296.31		414,013.18		181,635.33		563,309.49		988,781.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				15,423.08		17,626.42		8,562.15		11,998.77		26,188.57		35,984.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1A		0.00	0.00	12,932,491.93		14,780,027.73	2.22	8,238,160.27		6,821,850.47		23,018,188.00		27,992,502.67
	10% CONTINGENCIES		0.00	0.00	1,293,249.19		1,478,002.77	0.22	823,816.03		682,185.05		2,301,818.80		2,799,250.27
	SUB-TOTAL				14,225,741.12		16,258,030.50		9,061,976.30		7,504,035.52		25,320,006.80		30,791,752.94
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,422,574.11		1,625,803.05		906,197.63		750,403.55		2,532,000.68		3,079,175.29
	SUB-TOTAL				15,648,315.24		17,883,833.55		9,968,173.93		8,254,439.07		27,852,007.48		33,870,928.23
	8% SUPERVISION COST				1,251,865.22		1,430,706.68		797,453.91		660,355.13		2,228,160.60		2,709,674.26
	TOTAL SEGMENT COST				16,900,180.45		19,314,540.23		10,765,627.84		8,914,794.19		30,080,168.07		36,580,602.49

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO– MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	80,800.00	1.99	160,792.00	2.27	183762.75	0.12	9,696.00	1.00	80,800.00	2.39	193,458.75	3.11	251,288.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	900.00	63.71	57,339.00	72.81	65530.45	4.41	3,969.00	31.86	28,674.00	77.22	69,499.45	99.98	89,982.00
(2)	Common excavation	CU.M.	3,830.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	445.00	60.12	26,753.40	68.71	30575.39	12.38	5,509.10	30.07	13,381.15	61.09	36,084.49	102.57	45,643.65
104 (1)	Embankment	CU.M.	3,830.00	62.06	237,689.80	70.93	271646.16	24.81	95,022.30	33.80	129,454.00	95.74	366,668.46	120.67	462,166.10
(2)	Embankment, selected material	CU.M.	63,260.00	62.07	3,926,548.20	70.94	4487494.88	40.35	2,552,541.00	37.35	2,362,761.00	111.29	7,040,035.88	139.77	8,841,850.20
105 (1)	Subgrade preparation, common	SQ.M.	67,010.00	2.19	146,751.90	2.50	167716.88	0.18	12,061.80	1.08	72,370.80	2.68	179,778.68	3.45	231,184.50
(2)	Subgrade preparation, exg. pavement	SQ.M.	5,190.00	4.38	22,732.20	5.01	25979.72	0.46	2,387.40	2.16	11,210.40	5.47	28,367.12	7.00	36,330.00
	TOTAL TO EARTHWORK				4,578,606.50		5,232,706.22		2,681,186.60		2,698,651.35		7,913,892.82		9,958,444.45
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	2,320.00	132.59	307,608.80	151.53	351553.79	66.24	153,676.80	69.17	160,474.40	217.77	505,230.59	268.00	621,760.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	6,590.00	129.67	854,525.30	148.19	976602.78	233.84	1,541,005.60	70.64	465,517.60	382.03	2,517,608.38	434.15	2,861,048.30
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.		5,786.87	0.00	6613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO–MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	43,455.00	224.02	9,734,789.10	256.02	11125501.07	142.83	6,206,677.65	82.10	3,567,655.50	398.85	17,332,178.72	448.95	19,509,122.25
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				10,896,923.20		12,453,657.65		7,901,360.05		3,193,647.50		20,355,017.70		22,991,930.75
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	868.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1676.34	0.00	1,405.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110680.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00		0.00		0.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	135.00	105.33	14,219.55	120.38	16250.95	87.38	11,796.30	59.37	8,014.95	207.76	28,047.25	252.08	34,030.80
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180798.21	411.17	96,213.78	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	[illegible]	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1655.09	148958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,400.00	1.61	8,694.00	1.84	9936.02	21.04	113,616.00	3.09	16,686.00	22.88	123,552.02	25.74	138,996.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.57	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO– MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		256.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				311,449.59		355,943.28		339,156.18		134,808.03		695,099.46		785,413.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1640.00	3280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1640.00	1640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6353.20	6353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				9,864.04		11,273.22		5,459.43		7,792.53		16,732.65		23,116.00
	VI. LAND ACQUISITION	SQ.M.			0.00		0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1B				15,796,843.33		18,053,580.37		10,927,162.26		7,034,899.41		28,980,742.63		33,758,905.00
	10% CONTINGENCIES				1,579,684.33		1,805,358.04		1,092,716.23		703,489.94		2,898,074.26		3,375,890.50
	SUB-TOTAL				17,376,527.66		19,858,938.40		12,019,878.49		7,738,389.35		31,878,816.89		37,134,795.50
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,737,652.77		1,985,893.84		1,201,987.85		773,838.94		3,187,881.69		3,713,479.55
	SUB-TOTAL				19,114,180.43		21,844,832.25		13,221,866.33		8,512,228.29		35,066,698.58		40,848,275.05
	8% SUPERVISION COST				1,529,134.43		1,747,586.58		1,057,749.31		680,978.26		2,805,335.89		3,267,862.00
	TOTAL SEGMENT COST				20,643,314.86		23,592,418.83		14,279,615.64		9,193,206.55		37,872,034.47		44,116,137.05

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO – MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	80,800.00	1.99	160,792.00	2.27	183762.75	0.12	9,696.00	1.00	80,800.00	2.39	193,458.75	3.11	251,288.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	900.00	63.71	57,339.00	72.81	65530.45	4.41	3,969.00	31.86	28,674.00	77.22	69,499.45	99.98	89,982.00
(2)	Common excavation	CU.M.	3,830.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	445.00	60.12	26,753.40	68.71	30575.39	12.38	5,509.10	30.07	13,381.15	81.09	36,084.49	102.57	45,643.65
104 (1)	Embankment	CU.M.	3,830.00	62.06	237,689.80	70.93	271646.16	24.81	95,022.30	33.80	129,454.00	95.74	366,668.46	120.67	462,166.10
(2)	Embankment, selected material	CU.M.	63,260.00	62.07	3,926,548.20	70.94	4487494.88	40.35	2,552,541.00	37.35	2,362,761.00	111.29	7,040,035.88	139.77	8,841,850.20
105 (1)	Subgrade preparation, common	SQ.M.	67,010.00	2.19	146,751.90	2.50	167716.88	0.13	12,061.80	1.08	72,370.80	2.68	179,778.68	3.45	231,184.50
(2)	Subgrade preparation, exg. pavement	SQ.M.	5,190.00	4.38	22,732.20	5.01	25979.72	0.46	2,387.40	2.16	11,210.40	5.47	28,367.12	7.00	36,330.00
	TOTAL TO EARTHWORK				4,578,606.50		5232706.22		2,681,186.60		2,698,651.35		7,913,892.82		9,958,444.45
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	20,715.00	132.59	2,746,601.85	151.53	3138981.39	66.24	1,372,161.60	69.17	1,432,856.55	217.77	4,511,142.99	268.00	5,551,620.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	6,160.00	129.67	798,767.20	148.19	912879.08	233.84	1,440,454.40	70.64	435,142.40	382.03	2,353,333.48	434.15	2,674,364.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	55.00	5,786.87	318,277.85	6613.58	363747.02	1,996.68	109,817.40	2,172.74	119,500.70	8,610.26	473,564.42	9,956.29	547,595.95
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	43,455.00	75.92	3,299,103.60	86.77	3770413.54	42.12	1,830,324.60	37.96	1,649,551.80	128.89	5,600,738.14	0.00 156.00	6,778,980.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO – MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	396.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				7,162,750.50		8,186,021.04		4,752,758.00		3,637,051.45		12,938,779.04		15,552,559.95
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00		0.00		0.00
	IV. DRAINAGE EROSION WORKS					0.00	0.00								
500 (1)	Backfill material, pipe culvert	CU.M.	135.00	105.33	14,219.55	120.38	16250.95	87.38	11,796.00	59.37	8,014.95	207.76	28,047.25	252.08	34,030.80
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180798.21	411.17	96,213.78	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1655.09	148958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,400.00	1.61	8,694.00	1.84	9936.02	21.04	113,616.00	3.09	16,686.00	22.88	123,552.02	25.74	138,996.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1B: DIPACULAO – MARIA AURORA

SECTION LENGTH: 8.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				311,449.59		355,943.28		339,156.18		114,808.03		695,099.46		785,413.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	703.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1640.00	3280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1640.00	1640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6353.20	6353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				9,864.04		11,273.22		5,459.43		7,792.53		16,732.65		23,116.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT1B				12,062,670.63		13,785,943.76		7,778,560.21		6,478,303.36		21,564,503.97		26,319,534.20
	10% CONTINGENCIES				1,206,267.06		1,378,594.38		777,856.02		647,830.34		2,156,450.40		2,631,953.42
	SUB-TOTAL				13,268,937.69		15,164,538.13		8,556,416.23		7,126,133.70		23,720,954.36		28,951,487.62
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,326,893.77		1,516,453.81		855,641.62		712,613.37		2,372,095.44		2,895,148.76
	SUB-TOTAL				14,595,831.46		16,680,991.95		9,412,057.85		7,838,747.07		26,093,049.80		31,846,636.38
	8% SUPERVISION COST				1,167,666.52		1,334,479.36		752,964.63		627,099.77		2,087,443.98		2,547,730.91
	TOTAL SEGMENT COST				15,763,497.98		18,015,471.30		10,165,022.48		8,465,846.83		28,180,493.78		34,394,367.29

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 5 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	100,870.00	1.99	200,731.30	2.27	229407.77	0.12	12,104.40	1.00	103,870.00	2.39	241,512.17	3.11	313,705.70
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	18,910.00	77.95	1,474,034.50	89.09	1684615.07	19.33	365,530.30	38.99	737,300.90	108.42	2,050,145.37	136.27	2,576,865.70
102 (1)	Unsuitable excavation	CU.M.	1,395.00	63.71	88,875.45	72.81	101572.20	4.41	6,151.95	31.86	44,444.70	77.22	107,724.15	99.98	139,472.10
(2)	Common excavation	CU.M.	5,920.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	700.00	60.12	42,084.00	68.71	48096.12	12.38	8,666.00	30.07	21,049.00	81.09	56,762.12	102.57	71,799.00
(2)	Bridge excavation	CU.M.	1,850.00	60.12	111,222.00	68.71	127111.17	12.38	22,903.00	30.07	55,629.50	81.09	150,014.17	102.57	189,754.50
(3)	Foundation fill	CU.M.	750.00	105.33	78,997.50	120.38	90283.08	87.36	65,535.00	59.37	44,527.50	207.76	155,818.08	252.08	189,060.00
(4)	Excavation below plan elevation	CU.M.	1,275.00	306.22	390,430.50	349.97	446207.40	174.86	222,946.50	150.17	191,466.75	524.83	669,153.90	631.25	804,843.75
(5)	Shoring, cribbing, etc.(Included in Item103(4)														
(6)	Pipe culvert excavation	CU.M.	210.00	60.12	12,625.20	68.71	14428.84	12.38	2,599.80	30.07	6,314.70	81.09	17,028.64	102.57	21,539.70
104 (1)	Embankment	CU.M.	5,920.00	62.06	367,395.20	70.93	419881.28	24.81	146,575.20	33.80	200,096.00	95.74	566,756.48	120.67	714,366.40
(2)	Embankment, selected material	CU.M.	45,550.00	62.07	2,827,288.50	70.94	3231194.94	40.35	1,837,942.50	37.35	1,701,292.50	111.29	5,069,137.44	139.77	6,366,523.50
105 (1)	Subgrade preparation, common	SQ.M.	66,740.00	2.19	146,160.60	2.50	167041.10	0.18	12,013.20	1.08	72,079.20	2.68	179,054.30	3.45	230,253.00
(2)	Subgrade preparation, extg. pavement	SQ.M.	18,910.00	4.38	82,825.80	5.01	94658.29	0.46	8,698.60	2.16	40,845.60	5.47	103,356.89	7.00	132,370.00
	TOTAL TO EARTHWORK				5,822,670.55		6654497.26		2,711,966.45		3,215,916.35		9,366,463.71		11,750,553.35
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	3,345.00	132.59	443,513.55	151.53	506873.90	66.24	221,572.80	69.17	231,373.65	217.77	728,446.70	268.00	896,560.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	9,480.00	129.67	1,229,271.60	148.19	1404885.34	233.84	2,216,803.20	70.64	669,667.20	382.03	3,621,668.54	434.15	4,115,742.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.		5,786.87	0.00	6613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		964.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2215.75	0.00	412.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	60,760.00	224.02	13,611,455.20	256.02	15555987.69	142.83	8,678,350.80	82.10	4,988,396.00	396.85	24,231,338.49	448.95	27,278,202.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				15,284,240.35		17,467,746.93		11,116,726.80		5,889,436.85		28,584,473.73		32,290,404.00
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	11,790.00	364.08	4,292,503.20	0.00 416.09	0.00 4905730.21	472.32	5,568,652.80	147.60	1,740,204.00	888.41	10,474,383.01	0.00 984.00	11,601,360.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	10,665.00	487.77	5,202,067.05	0.00 557.45	0.00 5945234.35	154.46	1,647,315.90	126.81	1,352,428.65	711.91	7,592,550.25	0.00 769.04	8,201,811.60
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.	1,125.00	487.77	548,741.25	557.45	627134.42	154.46	173,767.50	126.81	142,661.25	711.91	800,901.92	769.04	865,170.00
(22)	Load test	EA	4.00	23,665.50	94,662.00	27046.35	108185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	170,860.00	1.61	275,084.60	1.84	314383.19	21.04	3,594,894.40	3.09	527,957.40	22.88	3,909,277.59	25.74	4,397,936.40
405 (1)	Structural concrete, Class A	CU.M.	350.00	1,466.79	513,376.50	1676.34	586717.47	1,305.90	457,065.00	506.33	177,215.50	2,982.24	1,043,782.47	3,279.02	1,147,657.00
(2)	Structural concrete, Class P	CU.M.	1,100.00	1,615.30	1,776,830.00	1846.06	2030667.93	1,423.33	1,565,663.00	551.77	606,947.00	3,269.39	3,596,330.93	3,590.40	3,949,440.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				12,703,264.60		14,518,052.98		13,091,502.60		4,578,967.80		27,609,555.58		30,373,735.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	70.00	105.33	7,373.10	120.38	8426.42	87.38	6,116.60	59.37	4,155.90	207.76	14,543.02	252.08	17,645.60
(76)	RCPC, 76 cm diameter	L.M.	91.00	676.06	61,521.46	772.64	70310.42	411.17	37,416.47	279.37	25,422.67	1,183.81	107,726.59	1,366.60	124,360.60
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,796.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	45.00	1,448.20	65,169.00	1655.09	74479.04	1,305.89	58,765.05	497.05	22,367.25	2,960.96	133,244.09	3,251.14	146,301.30
(11)	Reinforcing steel for RCBC/RCPC	KG	2,800.00	1.61	4,508.00	1.84	5152.01	21.04	58,912.00	3.09	8,652.00	22.88	64,064.01	25.74	72,072.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00	56.51	0.00	163.79	0.00	0.00 430.86	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.	6,500.00	696.45	4,526,925.00	795.94	5173641.51	1,003.72	6,524,180.00	348.23	2,263,495.00	1,799.66	11,697,821.51	2,048.40	13,314,600.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				4,665,496.56		5,332,009.40		6,685,390.12		2,324,092.82		12,017,399.52		13,674,979.50
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	4.00	1,435.00	5,740.00	1640.00	6560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1640.00	3280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6353.20	12706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				19,728.08		22,546.43		10,918.86		15,585.06		33,465.29		46,232.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.20	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1C				38,495,400.14		43,994,853.00		33,616,504.83		16,023,998.88		77,611,357.83		88,135,903.85
	10% CONTINGENCIES				3,849,540.01		4,399,485.30		3,361,650.48		1,602,399.89		7,761,135.78		8,813,590.39
	SUB-TOTAL				42,344,940.15		48,394,338.30		36,978,155.31		17,626,398.77		85,372,493.62		96,949,494.24
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				4,234,494.02		4,839,433.83		3,697,815.53		1,762,639.88		8,537,249.36		9,694,949.42
	SUB-TOTAL				46,579,434.17		53,233,772.13		40,675,970.84		19,389,038.64		93,909,742.96		106,644,443.66
	8% SUPERVISION COST				3,726,354.73		4,258,701.77		3,254,077.67		1,551,123.09		7,512,779.44		8,531,555.49
	TOTAL SEGMENT COST				50,305,788.90		57,492,473.91		43,930,048.51		20,940,161.74		101,422,522.42		115,175,999.15

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	100,870.00	1.99	200,731.30	2.27	229407.77	0.12	12,104.40	1.00	100,870.00	2.39	241,512.17	3.11	313,705.70
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	18,910.00	77.95	1,474,034.50	89.09	1684615.07	19.33	365,530.30	38.99	737,300.90	108.42	2,050,145.37	136.27	2,576,865.70
102 (1)	Unsuitable excavation	CU.M.	1,395.00	63.71	88,875.45	72.81	101572.20	4.41	6,151.95	31.86	44,444.70	77.22	107,724.15	99.98	139,472.10
(2)	Common excavation	CU.M.	5,920.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	700.00	60.12	42,084.00	68.71	48096.12	12.38	8,666.00	30.07	21,049.00	81.09	56,762.12	102.57	71,799.00
(2)	Bridge excavation	CU.M.	1,850.00	60.12	111,222.00	68.71	127111.17	12.38	22,903.00	30.07	55,629.50	81.09	150,014.17	102.57	189,754.50
(3)	Foundation fill	CU.M.	750.00	105.33	78,997.50	120.38	90283.08	87.38	65,535.00	59.37	44,527.50	207.76	155,818.00	252.08	189,060.00
(4)	Excavation below plan elevation	CU.M.	1,275.00	306.22	390,430.50	349.97	446207.40	174.86	222,946.50	150.17	191,466.75	524.83	669,153.90	631.25	804,843.75
(5)	Shoring, cribbing, etc.(Included in Item10.3(4)														
(6)	Pipe culvert excavation	CU.M.	210.00	60.12	12,625.20	68.71	14428.84	12.38	2,599.80	30.07	6,314.70	81.09	17,028.64	102.57	21,539.70
104 (1)	Embankment	CU.M.	5,920.00	62.06	367,395.20	70.93	419681.28	24.81	146,875.20	33.80	200,096.00	95.74	566,756.48	120.67	714,366.40
(2)	Embankment, selected material	CU.M.	45,550.00	62.07	2,827,288.50	70.94	3231194.94	40.35	1,837,942.50	37.35	1,701,292.50	111.29	5,069,137.44	139.77	6,366,523.50
105 (1)	Subgrade preparation, common	SQ.M.	66,740.00	2.19	146,160.60	2.50	167041.10	0.18	12,013.20	1.08	72,079.20	2.66	179,054.30	3.45	230,253.00
(2)	Subgrade preparation, exg. pavement	SQ.M.	18,910.00	4.38	82,825.80	5.01	94658.29	0.46	8,698.60	2.16	40,845.60	5.47	103,356.89	7.00	132,370.00
	TOTAL TO EARTHWORK				5,822,670.55		6654497.26		2,711,966.45		3,215,916.35		9,366,463.71		11,750,553.35
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	28,500.00	132.59	3,778,815.00	151.53	4318656.51	66.24	1,887,840.00	69.17	1,971,345.00	217.77	6,206,496.51	268.00	7,638,000.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	8,610.00	129.67	1,116,458.70	148.19	1275955.99	233.84	2,013,362.40	70.64	608,210.40	382.03	3,289,318.39	434.15	3,738,031.50
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	76.00	5,786.87	439,802.12	6613.58	502632.25	1,996.68	151,747.68	2,172.74	165,128.24	8,610.26	654,379.93	9,956.29	756,678.04
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete											0.00		0.00	
	Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	60760	75.92	4,612,899.20	86.77	5271897.98	42.12	2,559,211.20	37.96	2,306,449.60	128.89	7,831,109.18	0.00 156.00	9,478,560.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				9,947,975.02		11,369,142.73		6,612,161.28		5,051,133.24		17,981,304.01		21,611,269.54
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	11,790.00	364.08	4,292,503.20	0.00 416.09	0.00 4905730.21	472.32	5,568,652.80	147.60	1,740,204.00	888.41	10,474,383.01	0.00 984.00	11,601,360.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	10,665.00	487.77	5,202,067.05	0.00 557.45	0.00 5945234.35	154.46	1,647,315.90	126.81	1,352,428.65	711.91	7,592,550.25	0.00 769.04	8,201,811.60
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.	1,125.00	487.77	548,741.25	557.45	627134.42	154.46	173,767.50	126.81	142,661.25	711.91	800,901.92	769.04	865,170.00
(22)	Load test	EA	4.00	23,665.50	94,662.00	27046.35	108185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	170,860.00	1.61	275,084.60	1.84	314383.19	21.04	3,594,894.40	3.09	527,957.40	22.88	3,909,277.59	25.74	4,397,936.40
405 (1)	Structural concrete, Class A	CU.M.	350.00	1,466.79	513,376.50	1676.34	586717.47	1,305.90	457,065.00	506.33	177,215.50	2,982.24	1,043,782.47	3,279.02	1,147,657.00
(2)	Structural concrete, Class P	CU.M.	1,100.00	1,615.30	1,776,830.00	1846.06	2030667.93	1,423.33	1,565,663.00	551.77	606,947.00	3,269.39	3,596,330.93	3,590.40	3,949,440.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110860.28	0.00	85,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				12,703,264.60		14,518,052.98		13,091,502.60		4,578,967.80	0.00	27,609,555.58		30,373,735.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	70.00	105.33	7,373.10	120.38	8426.42	87.38	6,116.60	59.37	4,155.90	207.76	14,543.02	252.08	17,645.60
(76)	RCPC, 76 cm diameter	L.M.	91.00	676.06	61,521.46	772.64	70310.42	411.17	37,416.47	279.37	25,422.67	1,183.81	107,726.89	1,366.60	124,360.60
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	45.00	1,448.20	65,169.00	1655.09	74479.04	1,305.89	58,765.05	497.05	22,367.25	2,960.98	133,244.09	3,251.14	146,301.30
(11)	Reinforcing steel for RCBC/RCPC	KG	2,800.00	1.61	4,508.00	1.84	5152.01	21.04	58,912.00	3.09	8,652.00	22.88	64,064.01	25.74	72,072.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1C: MARIA AURORA – SAN LUIS

SECTION LENGTH: 10.7 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.	6,500.00	696.45	4,526,925.00	795.94	5173641.51	1,003.72	6,524,180.00	348.23	2,263,495.00	1,799.66	11,697,821.51	2,048.40	13,314,600.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				4,665,496.56		5,332,009.40		6,685,390.12		2,324,092.82		12,017,399.52		13,674,979.50
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	4.00	1,435.00	5,740.00	1640.00	6560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1640.00	3280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6353.20	12706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				19,728.08		22,546.43		10,918.86		15,585.06		33,465.29		46,232.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1C				33,159,134.81		37,896,248.81		29,111,939.31		15,185,695.27		67,008,188.12		77,456,769.39
	10% CONTINGENCIES				3,315,913.48		3,789,624.88		2,911,193.93		1,518,569.53		6,700,818.81		7,745,676.94
	SUB-TOTAL				36,475,048.29		41,685,873.69		32,023,133.24		16,704,264.80		73,709,006.93		85,202,446.33
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				3,647,504.83		4,168,587.37		3,202,313.32		1,670,426.48		7,370,900.69		8,520,244.63
	SUB-TOTAL				40,122,553.12		45,854,461.06		35,225,446.57		18,374,691.28		81,079,907.62		93,722,690.96
	8% SUPERVISION COST				3,209,804.25		3,668,356.88		2,818,035.73		1,469,975.30		6,486,392.61		7,497,815.28
	TOTAL SEGMENT COST				43,332,357.37		49,522,817.94		38,043,482.29		19,844,666.58		87,566,300.23		101,220,506.24

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS – BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P26)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	48,350.00	1.99	96,216.50	2.27	109,961.99	0.12	5,802.00	1.00	48,350.00	2.39	115,763.99	3.11	150,368.50
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	3,660.00	77.95	285,297.00	89.09	326,054.53	19.33	70,747.80	38.99	142,703.40	198.42	396,802.33	136.27	498,748.20
102 (1)	Unsuitable excavation	CU.M.	995.00	63.71	63,391.45	72.81	72,447.55	4.41	4,387.95	31.86	31,700.70	77.22	76,835.50	99.98	99,480.10
(2)	Common excavation	CU.M.	2,100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	2,835.00	61.15	173,360.25	69.89	198,126.50	3.77	10,687.95	30.57	86,665.95	73.66	208,814.45	95.49	270,714.15
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	280.00	60.12	16,833.60	68.71	19,238.45	12.38	3,466.40	30.07	8,419.60	81.09	22,704.85	102.57	28,719.60
104 (1)	Embankment	CU.M.	2,100.00	62.06	130,326.00	70.93	148,944.37	24.81	52,101.00	33.80	70,980.00	95.74	201,045.37	120.67	253,407.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	22,320.00	2.19	48,880.80	2.50	55,863.91	0.18	4,017.60	1.08	24,105.60	2.68	59,881.51	3.45	77,004.00
(2)	Subgrade preparation, exig. pavement	SQ.M.	23,500.00	4.38	102,930.00	5.01	117,634.58	0.46	10,810.00	2.16	50,760.00	5.47	128,444.58	7.00	164,500.00
	TOTAL TO EARTHWORK				917,235.60		1,048,271.88		162,020.70		463,685.25		1,210,292.58		1,542,941.55
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	2,370.00	132.59	314,238.30	151.53	359,130.38	66.24	156,988.80	69.17	163,932.90	217.77	516,119.18	268.00	635,160.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	6,480.00	129.67	840,261.60	148.19	960,301.37	233.84	1,515,283.20	70.64	457,747.20	382.03	2,475,584.57	434.15	2,813,292.00
206	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.		5,786.87	0.00	6613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete											0.00		0.00	
	Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS – BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	26,795.00	224.02	6,002,615.90	256.02	6,860,149.61	142.83	3,827,129.85	82.10	2,199,869.50	398.85	10,687,279.46	448.95	12,029,615.25
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				7,157,115.80		8,179,581.36		5,499,401.85		2,821,549.60		13,678,983.21		15,478,067.25
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	201.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 / 416.09	0.00 / 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 / 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00		0.00		0.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	85.00	105.33	8,953.05	120.38	10,232.08	87.38	7,427.30	59.37	5,046.45	207.76	17,659.38	252.08	21,426.80
(76)	RCPC, 76 cm diameter	L.M.	104.00	676.06	70,310.24	772.64	80,354.76	411.17	42,761.68	279.37	29,054.48	1,183.81	123,116.44	1,366.60	142,126.40
(91)	RCPC, 91 cm diameter	L.M.	39.00	981.44	38,276.16	1121.65	43,744.29	570.35	22,243.65	394.73	15,394.47	1,692.00	65,987.94	1,946.52	75,914.28
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	55.00	1,448.20	79,651.00	1655.09	91,029.94	1,305.89	71,823.95	497.05	27,337.75	2,960.98	162,853.89	3,251.14	178,812.70
(11)	Reinforcing steel for RCBC/RCPC	KG	3,300.00	1.61	5,313.00	1.84	6,072.02	21.04	69,432.00	3.09	10,197.00	22.88	75,504.02	25.74	84,942.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00 / 0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS–BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				202,503.45		231,433.09		213,688.58		87,030.15		445,121.67		503,222.18
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	1.00	1,435.00	1,435.00	1640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6353.20	6,353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				8,429.04		9,633.21		4,673.86		6,597.10		14,307.07		19,700.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1D				9,205,871.39		9,468,919.55		5,879,784.99		3,378,862.10		15,348,704.54		17,543,930.98
	10% CONTINGENCIES				920,587.14		946,891.95		587,978.50		337,886.21		1,534,870.45		1,754,393.10
	SUB-TOTAL				10,126,458.53		10,415,811.50		6,467,763.49		3,716,748.31		16,883,574.99		19,298,324.08
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,012,645.85		1,041,581.15		646,776.35		371,674.83		1,688,357.50		1,929,832.41
	SUB-TOTAL				11,139,104.38		11,457,392.65		7,114,539.84		4,088,423.14		18,571,932.49		21,228,156.49
	8% SUPERVISION COST				891,128.35		916,591.41		569,163.19		327,073.85		1,485,754.60		1,698,252.52
	TOTAL SEGMENT COST				12,030,232.73		12,373,984.06		7,683,703.02		4,415,496.99		20,057,657.09		22,926,409.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS – BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	48,350.00	1.99	96,216.50	2.27	109,961.99	0.12	5,802.00	1.00	48,350.00	2.39	115,763.99	3.11	150,368.50
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	3,660.00	77.95	285,297.00	89.09	326,054.53	19.33	70,747.80	38.99	142,703.40	108.42	396,802.33	136.27	498,748.20
102 (1)	Unsuitable excavation	CU.M.	995.00	63.71	63,391.45	72.81	72,447.55	4.41	4,387.95	31.86	31,706.70	77.22	76,835.50	99.98	99,480.10
(2)	Common excavation	CU.M.	2,100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	2,835.00	61.15	173,360.25	69.89	198,126.50	3.77	10,687.95	30.57	86,665.95	73.66	208,814.45	95.49	270,714.15
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	280.00	60.12	16,833.60	68.71	19,238.45	12.38	3,466.40	30.07	8,419.60	81.09	22,704.85	102.57	28,719.60
104 (1)	Embankment	CU.M.	2,100.00	62.06	130,326.00	70.93	148,944.37	24.81	52,101.00	33.80	70,980.00	95.74	201,045.37	120.67	253,407.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	22,320.00	2.19	48,880.80	2.50	55,863.91	0.18	4,017.60	1.08	24,105.60	2.68	59,881.51	3.45	77,004.00
(2)	Subgrade preparation, exig. pavement	SQ.M.	23,500.00	4.38	102,930.00	5.01	117,634.58	0.46	10,810.00	2.16	50,760.00	5.47	128,444.58	7.00	164,500.00
	TOTAL TO EARTHWORK				917,235.60		1,048,271.88		162,020.70		463,685.25		1,210,292.58		1,542,941.55
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	8,490.00	132.59	1,125,689.10	151.53	1,286,505.04	66.24	562,377.60	69.17	587,253.30	217.77	1,848,882.64	268.00	2,275,320.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	3,800.00	129.67	492,746.00	148.19	563,139.69	233.84	888,592.00	70.64	268,432.00	382.03	1,451,731.69	434.15	1,649,770.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	34.00	5,786.87	196,753.58	6613.58	224,861.80	1,996.68	67,887.12	2,172.74	73,873.16	8,610.26	292,748.92	9,956.29	338,513.86
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	26795	75.92	2,034,276.40	86.77	2,324,893.13	42.12	1,128,605.40	37.96	1,017,138.20	128.89	3,453,498.53	0.00 156.00	4,180,020.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS – BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				3,849,465.08		4,399,399.66		2,647,462.12		1,946,696.66		7,046,861.78		8,443,623.86
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,170.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		0.00		0.00	0.00	0.00		0.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	85.00	105.33	8,953.05	120.38	10,232.08	87.38	7,427.30	59.37	5,046.45	207.76	17,659.38	252.08	21,426.80
(76)	RCPC, 76 cm diameter	L.M.	104.00	676.06	70,310.24	772.64	80,354.76	411.17	42,761.68	279.37	29,054.48	1,183.81	123,116.44	1,366.60	142,126.40
(91)	RCPC, 91 cm diameter	L.M.	39.00	981.44	38,276.16	1121.65	43,744.29	570.35	22,243.65	394.73	15,394.47	1,692.00	65,987.94	1,946.52	75,914.28
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	55.00	1,448.20	79,651.00	1655.09	91,029.94	1,305.89	71,823.95	497.05	27,337.75	2,960.98	162,853.89	3,251.14	178,812.70
(11)	Reinforcing steel for RCBC/RCPC	KG	3,300.00	1.61	5,313.00	1.84	6,072.02	21.04	69,432.00	3.09	10,197.00	22.88	75,504.02	25.74	84,942.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	374.37	0.00	56.51	0.00	163.79	0.00	430.88	0.00	547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 1D: SAN LUIS – BALER

SECTION LENGTH: 7.13 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				202,503.45		231,433.09		213,688.58		87,030.15		445,121.67		503,222.18
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	1.00	1,435.00	1,435.00	1640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6353.20	6,353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				8,429.04		9,633.21		4,673.86		6,597.10		14,307.07		19,700.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 1D				5,530,703.52		5,688,737.84		3,027,845.26		2,504,009.16		8,716,583.10		10,509,487.59
	10% CONTINGENCIES				553,070.35		568,873.78		302,784.53		250,400.92		871,658.31		1,050,948.76
	SUB-TOTAL				6,083,773.87		6,257,611.63		3,330,629.79		2,754,410.08		9,588,241.42		11,560,436.35
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				608,377.39		625,761.16		333,062.98		275,441.01		958,824.14		1,156,043.63
	SUB-TOTAL				6,692,151.26		6,883,372.79		3,663,692.76		3,029,851.08		10,547,065.56		12,716,479.98
	8% SUPERVISION COST				535,372.10		550,669.82		293,095.42		242,388.09		843,765.24		1,017,318.40
	TOTAL SEGMENT COST				7,227,523.36		7,434,042.62		3,956,788.19		3,272,239.17		11,390,830.80		13,733,798.38

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA – BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.		1.99	0.00	2.27	0.00	0.12	0.00	1.00	0.00	2.39	0.00	3.11	0.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.		63.71	0.00	72.81	0.00	4.41	0.00	31.86	0.00	77.22	0.00	99.98	0.00
(2)	Common excavation	CU.M.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	60.00	60.12	3,607.20	68.71	4,122.52	12.38	742.80	30.07	1,804.20	81.09	4,865.32	102.57	6,154.20
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.	20.00	105.33	2,106.60	120.38	2,407.55	87.38	1,747.60	59.37	1,187.40	207.76	4,155.15	252.08	5,041.60
(4)	Excavation below plan elevation	CU.M.	15.00	306.22	4,593.30	,349.97	5,249.50	174.86	2,622.90	150.17	2,252.55	524.83	7,872.40	631.25	9,468.75
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.		52.06	0.00	70.93	0.00	24.81	0.00	33.60	0.00	95.74	0.00	120.67	0.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	26,585.00	2.19	58,221.15	2.50	66,538.62	0.18	4,785.30	1.08	28,711.80	2.68	71,323.92	3.45	91,718.25
(2)	Subgrade preparation, exig. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				68,528.25		78,318.20		9,898.60		33,955.95		88,216.80		112,382.80
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	17,852.00	132.59	2,366,996.68	151.53	2,705,145.83	66.24	1,182,516.48	69.17	1,234,822.84	217.77	3,887,662.31	268.00	4,784,336.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	6,690.00	129.67	867,492.30	148.19	991,422.25	233.84	1,564,389.60	70.64	472,581.60	382.03	2,555,811.85	434.15	2,904,465.50
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bit.binder course (2" thick)	SQ.M.	26,580.00	75.92	2,017,953.60	86.77	2,306,238.45	42.12	1,119,549.60	37.96	1,008,976.80	128.89	3,425,788.05	156.00	4,146,480.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA–BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				5,252,442.58		6,002,806.53		3,866,455.68		2,716,381.24		9,869,262.21		11,835,279.50
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	4,660.00	1.61	7,502.60	1.84	8,574.42	21.04	98,046.40	3.09	14,399.40	22.88	106,620.82	25.74	119,948.40
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	42.00	1,615.30	67,842.60	1,846.06	77,534.59	1,423.33	59,779.86	551.77	23,174.34	3,269.39	137,314.45	3,590.40	150,796.80
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				75,345.20		86,109.02		157,826.26		37,573.74		243,935.28		270,745.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA – BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				0.00		0.00		0.00		0.00		0.00		0.00
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				16,858.08		19,266.43		9,347.72		13,194.20		28,614.15		39,400.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2A				5,413,174.11		6,186,500.16	2.22	4,043,528.26		2,801,105.13		10,230,028.42		12,257,807.50
	10% CONTINGENCIES				541,317.41		618,650.02	0.22	404,352.83		280,110.51		1,023,002.84		1,225,780.75
	SUB-TOTAL				5,954,491.52		6,805,150.18		4,447,881.09		3,081,215.64		11,253,031.27		13,483,588.25
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				595,449.15		680,515.02		444,788.11		308,121.56		1,125,303.13		1,348,358.83
	SUB-TOTAL				6,549,940.67		7,485,665.20		4,892,669.19		3,389,337.21		12,378,334.39		14,831,947.08
	8% SUPERVISION COST				523,995.25		598,853.22		391,413.54		271,146.98		990,266.75		1,186,555.77
	TOTAL SEGMENT COST				7,073,935.93		8,084,518.41		5,284,082.73		3,660,484.18		13,368,601.14		16,018,502.84

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA – BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.		1.99	0.00	2.27	0.00	0.12	0.00	1.00	0.00	2.39	0.00	3.11	0.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.		63.71	0.00	72.81	0.00	4.41	0.00	31.86	0.00	77.22	0.00	99.98	0.00
(2)	Common excavation	CU.M.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	60.00	60.12	3,607.20	68.71	4,122.52	12.38	742.80	30.07	1,804.20	81.09	4,865.32	102.57	6,154.20
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.	20.00	105.33	2,106.60	120.38	2,407.55	87.38	1,747.60	59.37	1,187.40	207.76	4,155.15	252.08	5,041.60
(4)	Excavation below plan elevation	CU.M.	15.00	306.22	4,593.30	349.97	5,249.50	174.86	2,622.90	150.17	2,252.55	524.83	7,872.40	631.25	9,468.75
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.		62.06	0.00	70.93	0.00	24.81	0.00	33.80	0.00	95.74	0.00	120.67	0.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	26,585.00	2.19	58,221.15	2.50	66,538.62	0.18	4,785.30	1.08	28,711.80	2.68	71,323.92	3.45	91,718.25
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				68,528.25		78,318.20		9,898.60		33,955.95		88,216.80		112,382.80
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	20,065.00	132.59	2,660,418.35	151.53	3,040,485.72	66.24	1,329,105.60	69.17	1,387,896.05	217.77	4,369,591.32	268.00	5,377,420.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	8,045.00	129.67	1,043,195.15	148.19	1,192,226.01	233.84	1,881,242.80	70.64	568,298.80	382.03	3,073,468.81	434.15	3,492,736.75
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	30.00	5,786.87	173,606.10	6,613.58	198,407.47	1,996.68	59,900.40	2,172.74	65,182.20	8,610.26	258,307.87	9,956.29	298,688.70
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.	88.00	1,938.78	170,612.64	2,215.75	194,966.36	419.39	36,906.32	876.16	77,102.08	2,635.14	231,892.68	3,234.33	284,621.04
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	1,330.00	457.11	607,956.30	522.41	694,808.94	111.60	148,428.00	228.55	303,971.50	634.01	843,236.94	797.26	1,060,355.80
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA – BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				4,655,788.54		5,320,914.49		3,455,583.12		2,402,450.63		8,776,497.61		10,513,822.29
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 964.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	4,660.00	1.61	7,502.60	1.84	8,574.42	21.04	98,046.40	3.09	14,399.40	22.88	106,620.82	25.74	119,948.40
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	42.00	1,615.30	67,842.60	1,846.06	77,534.59	1,423.33	59,779.86	551.77	23,174.34	3,269.39	137,314.45	3,590.40	150,796.80
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				75,345.20		86,109.02		157,826.26		37,573.74		243,935.28		270,745.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2A: MARIA AURORA – BAZAL

SECTION LENGTH: 4.43 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	257.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				0.00		0.00		0.00		0.00		0.00		0.00
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				16,858.08		19,266.43		9,347.72		13,194.20		28,614.15		39,400.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2A				4,816,520.07		5,504,608.13	2.22	3,632,655.70		2,487,174.52		9,137,263.83		10,936,350.29
	10% CONTINGENCIES				481,652.01		550,460.81	0.22	363,265.57		248,717.45		913,776.38		1,093,635.03
	SUB-TOTAL				5,298,172.08		6,055,068.94		3,995,921.27		2,735,891.97		10,050,990.21		12,029,985.32
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				529,817.21		605,506.89		399,592.13		273,589.20		1,005,099.02		1,202,998.53
	SUB-TOTAL				5,827,989.28		6,660,575.83		4,395,513.40		3,009,481.17		11,056,089.23		13,232,983.85
	8% SUPERVISION COST				466,239.14		532,846.07		351,641.07		240,758.49		884,487.14		1,058,638.71
	TOTAL SEGMENT COST				6,294,228.43		7,193,421.90		4,747,154.47		3,250,239.66		11,940,576.37		14,291,622.56

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL – KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	18,915.00	1.99	37,640.85	2.27	43,018.22	0.12	2,269.80	1.00	18,915.00	2.39	45,288.02	3.11	58,825.65
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	5,095.00	63.71	324,602.45	72.81	370,975.16	4.41	22,468.95	31.86	162,326.70	77.22	393,444.11	99.98	509,398.10
(2)	Common excavation	CU.M.	13,910.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus rock excavation	CU.M.	10,330.00	61.15	631,679.50	69.89	721,921.23	3.77	38,944.10	30.57	315,788.10	73.66	760,865.33	95.49	986,411.70
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,135.00	60.12	68,236.20	68.71	77,984.42	12.38	14,051.30	30.07	34,129.45	81.09	92,035.72	102.57	116,416.95
104 (1)	Embankment	CU.M.	13,910.00	62.06	863,254.60	70.93	986,579.15	24.81	345,107.10	33.80	470,158.00	95.74	1,331,686.25	120.67	1,678,519.70
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	132,305.00	2.19	289,747.95	2.50	331,141.34	0.18	23,814.90	1.08	142,889.40	2.68	354,956.24	3.45	456,452.25
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				2,215,161.55		2,531,619.53		446,656.15		1,144,206.65		2,978,275.68		3,806,024.35
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	44,100.00	132.59	5,847,219.00	151.53	6,682,552.71	66.24	2,921,184.00	69.17	3,050,397.00	217.77	9,603,736.71	268.00	11,818,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	20,810.00	129.67	2,698,432.70	148.19	3,083,930.80	233.84	4,866,210.40	70.64	1,470,018.40	382.03	7,950,141.20	434.15	9,034,661.50
206	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	90.00	5,786.87	520,818.30	6,613.58	595,222.40	1,996.68	179,701.20	2,172.74	195,546.60	8,610.26	774,923.60	9,956.29	896,066.10
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	82,680.00	75.92	6,277,065.60	86.77	7,173,807.19	42.12	3,482,481.60	37.96	3,138,532.80	128.89	10,656,288.79	156.00	12,898,080.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL – KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching eng. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.42	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				15,343,535.60		17,535,513.10		11,449,577.20		7,854,494.80		28,985,090.30		34,647,607.60
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	226.00	571.20	129,091.20	652.80	147,533.17	452.25	102,208.50	197.17	44,560.42	1,105.05	249,741.67	1,220.62	275,860.12
404	Reinforcing steel for bridges/box culvert	KG	61,050.00	1.61	98,290.50	1.84	112,332.28	21.04	1,284,492.00	3.09	188,644.50	22.88	1,396,824.28	25.74	1,571,427.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class F	CU.M.	550.00	1,615.30	888,415.00	1,846.06	1,015,333.97	1,423.33	782,831.50	551.77	303,473.50	3,269.39	1,798,165.47	3,590.40	1,974,720.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				1,115,796.70		1,275,199.42		2,169,532.00		536,678.42		3,444,731.42		3,822,007.12
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	340.00	105.33	35,812.20	120.38	40,928.33	87.38	29,709.20	59.37	20,185.80	207.76	70,637.53	252.08	85,707.20
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180,798.21	411.17	96,213.78	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,850.00	1.61	9,418.50	1.84	10,764.03	21.04	123,084.00	3.09	18,076.50	22.88	133,848.03	25.74	150,579.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL - KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
(3)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.62	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,300.00	286.05	371,865.00	326.92	424,989.63	170.46	221,598.00	115.11	149,643.00	497.38	646,587.63	571.62	743,106.00
	TOTAL TO DRAINAGE EROSION WORKS				705,631.74		806,438.29		588,135.08		298,012.38		1,394,573.37		1,591,779.20
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	500.00	396.00	198,000.00	452.57	226,286.28	247.36	123,780.00	346.56	173,280.00	700.13	350,066.28	990.12	495,060.00
605 (1)	Warning sign	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(2)	Regulatory signs	EA	8.00	1,435.00	11,480.00	1,640.00	13,120.03	785.57	6,284.56	1,195.43	9,563.44	2,425.57	19,404.59	3,416.00	27,328.00
(3)	Informatory Signs	EA	4.00	5,559.04	22,236.16	6,353.20	25,412.82	3,102.72	12,410.88	4,206.24	16,824.96	9,455.92	37,823.70	12,868.00	51,472.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				246,066.16		281,219.17		150,331.14		211,622.70		431,550.31		608,020.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2B1				19,626,191.75		22,429,939.50	2.22	14,804,231.57		10,045,014.95		37,234,221.07		44,475,438.27
	10% CONTINGENCIES				1,962,619.18		2,242,998.95	0.22	1,480,423.16		1,004,501.50		3,723,422.11		4,447,543.83
	SUB-TOTAL				21,588,810.93		24,672,988.45		16,284,654.73		11,049,516.45		40,957,643.18		48,922,982.10
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,158,881.09		2,467,298.85		1,628,465.47		1,104,951.64		4,095,764.32		4,892,298.21
	SUB-TOTAL				23,747,692.02		27,140,287.30		17,913,120.20		12,154,468.09		45,053,407.50		53,815,280.31
	8% SUPERVISION COST				1,899,815.36		2,171,222.98		1,433,049.62		972,357.45		3,604,272.60		4,305,222.42
	TOTAL SEGMENT COST				25,647,507.38		29,311,510.28		19,346,169.82		13,126,825.54		48,657,680.10		58,120,502.73

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL – KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	18,915.00	1.99	37,640.85	2.27	43,018.22	0.12	2,269.80	1.00	18,915.00	2.39	45,288.02	3.11	58,825.65
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	5,095.00	63.71	324,602.45	72.81	370,975.16	4.41	22,468.95	31.86	162,326.70	77.22	393,444.11	99.98	509,398.10
(2)	Common excavation	CU.M.	13,910.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	10,330.00	61.15	631,679.50	69.89	721,921.23	3.77	38,944.10	30.57	315,788.10	73.66	760,865.33	95.49	986,411.70
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,135.00	60.12	68,236.20	68.71	77,984.42	12.38	14,051.30	30.07	34,129.45	81.09	92,035.72	102.57	116,416.95
104 (1)	Embankment	CU.M.	13,910.00	62.06	863,254.60	70.93	986,579.15	24.81	345,107.10	33.80	470,158.00	95.74	1,331,686.25	120.67	1,678,519.70
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	132,305.00	2.19	289,747.95	2.50	331,141.34	0.18	23,814.90	1.08	142,889.40	2.68	354,956.24	3.45	456,452.25
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				2,215,161.55		2,531,619.53		446,656.15		1,144,206.65		2,978,275.68		3,806,024.35
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	62,430.00	132.59	8,277,593.70	151.53	9,460,130.74	66.24	4,135,363.20	69.17	4,318,283.10	217.77	13,595,493.94	268.00	16,731,240.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	25,100.00	129.67	3,254,717.00	148.19	3,719,685.87	233.84	5,869,384.00	70.64	1,773,064.00	382.03	9,589,069.87	434.15	10,897,165.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	90.00	5,786.87	520,818.30	6,613.58	595,222.40	1,996.68	179,701.20	2,172.74	195,546.60	8,610.26	774,923.60	9,956.29	896,066.10
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.	275.00	1,938.78	533,164.50	2,215.75	609,332.38	419.39	115,332.25	876.16	240,944.00	2,635.14	724,664.63	3,234.33	889,440.75
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	4,135.00	457.11	1,890,149.85	522.41	2,160,176.66	111.60	461,466.00	228.55	945,054.25	634.01	2,621,642.66	797.26	3,296,670.10
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL – KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				14,476,443.35		16,544,548.05		10,761,246.65		7,472,891.95		27,305,794.70		32,710,581.95
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	226.00	571.20	129,091.20	652.80	147,533.17	452.25	102,208.50	197.17	44,560.42	1,105.05	249,741.67	1,220.62	275,860.12
404	Reinforcing steel for bridges/box culvert	KG	61,050.00	1.61	98,290.50	1.84	112,332.28	21.04	1,284,492.00	3.09	188,644.50	22.88	1,396,824.28	25.74	1,571,427.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	550.00	1,615.30	888,415.00	1,846.06	1,015,333.97	1,423.33	782,831.50	551.77	303,473.50	3,269.39	1,798,165.47	3,590.40	1,974,720.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				1,115,796.70		1,275,199.42		2,169,532.00		536,678.42		3,444,731.42		3,822,007.12
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	340.00	105.33	35,812.20	120.38	40,928.33	87.38	29,709.20	59.37	20,185.80	207.76	70,637.53	252.08	85,707.20
(76)	RCPC, 76 cm diameter	L.M.	234.00	676.06	158,198.04	772.64	180,798.21	411.17	96,213.78	279.37	65,372.58	1,183.81	277,011.99	1,366.60	319,784.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	5,850.00	1.61	9,418.50	1.84	10,764.03	21.04	123,084.00	3.09	18,076.50	22.88	133,848.03	25.74	150,579.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B1: BAZAL – KM. 38(MA. AURORA-CANILI ROAD)

SECTION LENGTH: 13.78 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Groutal riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,300.00	286.05	371,865.00	326.92	424,989.63	170.46	221,598.00	115.11	149,643.00	497.38	646,587.63	571.62	743,106.00
	TOTAL TO DRAINAGE EROSION WORKS				705,631.74		806,438.29		588,135.08		296,012.38		1,394,573.37		1,591,779.20
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	500.00	396.00	198,000.00	452.57	226,286.28	247.56	123,780.00	346.56	173,280.00	700.13	350,066.28	990.12	495,060.00
605 (1)	Warning sign	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(2)	Regulatory signs	EA	8.00	1,435.00	11,480.00	1,640.00	13,120.03	785.57	6,284.56	1,195.43	9,563.44	2,425.57	19,404.59	3,416.00	27,328.00
(3)	Informatory Signs	EA	4.00	5,559.04	22,236.16	6,353.20	25,412.82	3,102.72	12,410.88	4,206.24	16,824.96	9,455.92	37,823.70	12,868.00	51,472.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				246,066.16		281,219.17		150,331.14		211,622.70		431,550.31		608,020.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.20	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2B1				18,759,099.50		21,439,024.45	2.22	14,115,901.02		9,663,412.10		35,554,925.47		42,538,412.62
	10% CONTINGENCIES				1,875,909.95		2,143,902.45	0.22	1,411,590.10		966,341.21		3,555,492.55		4,253,841.26
	SUB-TOTAL				20,635,009.45		23,582,926.90		15,527,491.12		10,629,753.31		39,110,418.02		46,792,253.88
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,063,500.95		2,358,292.69		1,552,749.11		1,062,975.33		3,911,041.80		4,679,225.39
	SUB-TOTAL				22,698,510.40		25,941,219.59		17,080,240.23		11,692,728.64		43,021,459.82		51,471,479.27
	8% SUPERVISION COST				1,815,880.83		2,075,297.57		1,366,419.22		935,418.29		3,441,716.79		4,117,718.34
	TOTAL SEGMENT COST				24,514,391.23		28,016,517.16		18,446,659.45		12,628,146.93		46,463,176.61		55,589,197.61

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI– KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	182,600.00	1.99	363,374.00	2.27	415,285.61	0.12	21,912.00	1.00	182,600.00	2.39	437,197.61	3.11	567,886.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	64,700.00	63.71	4,122,037.00	72.81	4,710,911.21	4.41	285,327.00	31.86	2,061,342.00	77.22	4,996,238.21	99.98	6,468,706.00
(2)	Common excavation	CU.M.	264,300.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	14,150.00	61.15	865,272.50	69.89	988,885.33	3.77	53,345.50	30.57	432,565.50	73.66	1,042,230.83	95.49	1,351,183.50
103 (1)	Structure excavation	CU.M.	670.00	60.12	40,280.40	68.71	46,034.86	12.38	8,294.60	30.07	20,146.90	81.09	54,329.46	102.57	68,721.90
(2)	Bridge excavation	CU.M.	310.00	60.12	18,637.20	68.71	21,299.71	12.38	3,837.80	30.07	9,321.70	81.09	25,137.51	102.57	31,796.70
(3)	Foundation fill	CU.M.	150.00	105.33	15,799.50	120.38	18,056.62	87.38	13,107.00	59.37	8,905.50	207.76	31,163.62	252.08	37,812.00
(4)	Excavation below plan elevation	CU.M.	125.00	306.22	38,277.50	349.97	43,745.82	174.86	21,857.50	150.17	18,771.25	524.83	65,603.32	631.25	78,906.25
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	540.00	60.12	32,464.80	68.71	37,102.72	12.38	6,685.20	30.07	16,237.80	81.09	43,787.92	102.57	55,387.80
104 (1)	Embankment	CU.M.	264,300.00	62.06	16,402,458.00	70.93	18,745,713.15	24.81	6,557,283.00	33.80	8,933,340.00	95.74	25,302,996.15	120.67	31,893,081.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	67,200.00	2.19	147,168.00	2.50	168,192.42	0.18	12,096.00	1.08	72,576.00	2.68	180,268.42	3.45	231,840.00
(2)	Subgrade preparation, exg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				22,045,768.90		25,195,227.45		6,983,745.60		11,755,806.65		32,178,973.05		40,785,321.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	18,350.00	132.59	2,433,026.50	151.53	2,780,608.67	66.24	1,215,504.00	69.17	1,269,269.50	217.77	3,996,112.67	268.00	4,917,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	9,600.00	129.67	1,244,832.00	148.19	1,422,668.70	233.84	2,244,864.00	70.64	678,144.00	382.03	3,667,532.70	434.15	4,167,840.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	53.00	5,786.87	306,704.11	6,613.58	350,519.86	1,996.68	105,824.04	2,172.74	115,155.22	8,610.26	456,343.90	9,956.29	527,683.37
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bitbinder course (2" thick)	SQ.M.	42,000.00	75.92	3,188,640.00	86.77	3,644,169.11	42.12	1,769,040.00	37.96	1,594,320.00	128.89	5,413,209.11	156.00	6,552,000.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI- KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				7,173,202.61		8,197,966.33		5,335,232.04		3,656,888.72		13,533,198.37		16,165,323.37
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	2,425.00	364.08	882,894.00	0.00 416.09	0.00 1,009,024.24	472.32	1,145,376.00	147.60	357,930.00	888.41	2,154,400.24	0.00 984.00	2,386,200.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	2,210.00	487.77	1,077,971.70	0.00 557.45	0.00 1,231,970.74	154.46	341,356.60	126.81	280,250.10	711.91	1,573,327.34	0.00 769.04	1,699,578.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.	215.00	487.77	104,870.55	557.45	119,852.36	154.46	33,208.90	126.81	27,264.15	711.91	153,061.26	769.04	165,343.60
(22)	Load test	EA	3.00	23,665.50	70,996.50	27,046.35	81,139.06	21,036.00	63,108.00	7,888.50	23,665.50	48,082.35	144,247.06	52,590.00	157,770.00
401	Concrete bridge railing	L.M.	170.00	571.20	97,104.00	652.80	110,976.28	452.25	76,882.50	197.17	33,518.90	1,105.05	187,858.78	1,220.62	207,505.40
404	Reinforcing steel for bridges/box culvert	KG	132,900.00	1.61	213,969.00	1.84	244,536.61	21.04	2,796,216.00	3.09	410,661.00	22.88	3,040,752.61	25.74	3,420,846.00
405 (1)	Structural concrete, Class A	CU.M.	580.00	1,466.79	850,738.20	1,676.34	972,274.66	1,305.90	757,422.00	506.33	293,671.40	2,982.24	1,729,696.66	3,279.02	1,901,831.60
(2)	Structural concrete, Class P	CU.M.	510.00	1,615.30	823,803.00	1,846.06	941,491.50	1,423.33	725,898.30	551.77	281,402.70	3,269.39	1,667,389.80	3,590.40	1,831,104.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				4,122,346.95		4,711,265.44		5,939,468.30		1,708,363.75		10,650,733.74		11,770,179.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	220.00	105.33	23,172.60	120.38	26,483.04	87.38	19,223.60	59.37	13,061.40	207.76	45,706.64	252.08	55,457.60
(76)	RCPC, 76 cm diameter	L.M.	150.00	676.06	101,409.00	772.64	115,896.29	411.17	61,675.50	279.37	41,905.50	1,183.81	177,571.79	1,366.60	204,990.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	[illegible]	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	7,600.00	1.61	12,236.00	1.84	13,984.03	21.04	159,904.00	3.09	23,484.00	22.88	173,888.03	25.74	195,624.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI- KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	120.00	733.42	88,010.40	838.20	100,583.57	427.63	51,315.60	287.15	34,458.00	1,265.83	151,899.17	1,448.20	173,784.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	700.00	286.05	200,235.00	326.92	228,840.57	170.46	119,322.00	115.11	80,577.00	497.38	348,162.57	571.62	400,134.00
	TOTAL TO DRAINAGE EROSION WORKS				555,401.00		634,745.59		528,970.80		238,220.40		1,163,716.39		1,322,592.20
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	400.00	396.00	158,400.00	452.57	181,029.02	247.56	99,024.00	346.56	138,624.00	700.13	280,053.02	990.12	396,048.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				203,958.08		233,095.53		124,083.12		175,726.80		357,178.65		503,768.00
	VI. LAND ACQUISITION	SQ.M.	124,870.00		0.00	0.00	0.00	2.00	247,740.00	0.20	24,774.00	2.00	247,740.00	2.20	272,514.00
	SUB-TOTAL TO SEGMENT 2B2A				34,100,677.54		38,972,300.33	2.22	19,159,239.86		17,559,780.32		58,131,540.19		70,819,697.72
	10% CONTINGENCIES				3,410,067.75		3,897,230.03	0.22	1,915,923.99		1,755,978.03		5,813,154.02		7,081,969.77
	SUB-TOTAL				37,510,745.29		42,869,530.37		21,075,163.85		19,315,758.35		63,944,694.21		77,901,667.49
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				3,751,074.53		4,286,953.04		2,107,516.38		1,931,575.84		6,394,469.42		7,790,166.75
	SUB-TOTAL				41,261,819.82		47,156,483.40		23,182,680.23		21,247,334.19		70,339,163.63		85,691,834.24
	8% SUPERVISION COST				3,300,945.59		3,772,518.67		1,854,614.42		1,699,786.73		5,627,133.09		6,855,346.74
	TOTAL SEGMENT COST				44,562,765.41		50,929,002.08		25,037,294.65		22,947,120.92		75,966,296.72		92,547,180.98

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI- KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	182,600.00	1.99	363,374.00	2.27	415,285.61	0.12	21,912.00	1.00	182,600.00	2.39	437,197.61	3.11	567,886.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	64,700.00	63.71	4,122,037.00	72.81	4,710,911.21	4.41	285,327.00	31.86	2,061,342.00	77.22	4,996,238.21	99.98	6,468,706.00
(2)	Common excavation	CU.M.	264,300.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	14,150.00	61.15	865,272.50	69.89	988,885.33	3.77	53,345.50	30.57	432,565.50	73.66	1,042,230.83	95.49	1,351,183.50
103 (1)	Structure excavation	CU.M.	670.00	60.12	40,280.40	68.71	46,034.86	12.38	8,294.60	30.07	20,146.90	81.09	54,329.46	102.57	68,721.90
(2)	Bridge excavation	CU.M.	310.00	60.12	18,637.20	68.71	21,299.71	12.38	3,837.80	30.07	9,321.70	81.09	25,137.51	102.57	31,796.70
(3)	Foundation fill	CU.M.	150.00	105.33	15,799.50	120.38	18,056.62	87.38	13,107.00	59.37	8,905.50	207.76	31,163.62	252.08	37,812.00
(4)	Excavation below plan elevation	CU.M.	125.00	306.22	38,277.50	349.97	43,745.82	174.86	21,857.50	150.17	18,771.25	524.83	65,603.32	631.25	78,906.25
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	546.00	60.12	32,464.80	68.71	37,102.72	12.38	6,685.20	30.07	16,237.80	81.09	43,787.92	102.57	55,387.80
104 (1)	Embankment	CU.M.	264,300.00	62.06	16,402,458.00	70.93	18,745,713.15	24.81	6,557,283.00	33.80	8,933,340.00	95.74	25,302,996.15	120.67	31,893,081.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	67,200.00	2.19	147,168.00	2.50	168,192.42	0.18	12,096.00	1.08	72,576.00	2.68	180,288.42	3.45	231,840.00
(2)	Subgrade preparation, excg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				22,045,768.90		25,195,227.45		6,983,745.60		11,755,806.65		32,178,973.05		40,785,321.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	30,350.00	132.59	4,024,106.50	151.53	4,598,990.35	66.24	2,010,384.00	69.17	2,099,309.50	217.77	6,609,374.35	268.00	8,133,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	10,450.00	129.67	1,355,051.50	148.19	1,548,634.16	233.84	2,443,628.00	70.64	738,188.00	382.03	3,992,262.16	434.15	4,536,867.50
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	53.00	5,786.87	306,704.11	6,613.58	350,519.86	1,996.68	105,824.04	2,172.74	115,155.22	8,610.26	456,343.90	9,956.29	527,683.37
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.	140.00	1,938.78	271,429.20	2,215.75	310,205.58	419.39	58,714.60	876.16	122,662.40	2,635.14	368,920.18	3,234.33	452,806.20
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	1,680.00	457.11	767,944.80	522.41	877,653.39	111.60	187,488.00	228.55	383,964.00	634.01	1,065,141.39	797.26	1,339,396.80
310 (1)	Bit.binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI- KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching extg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				6,725,236.11		7,686,003.34		4,806,038.64		3,459,279.12		12,492,041.98		14,990,553.87
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	2,425.00	364.08	882,894.00	0.00 / 416.09	0.00 / 1,009,024.24	472.32	1,145,376.00	147.60	357,930.00	888.41	2,154,400.24	0.00 / 984.00	2,386,200.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	2,210.00	487.77	1,077,971.70	0.00 / 557.45	0.00 / 1,231,970.74	154.46	341,356.60	126.81	280,250.10	711.91	1,573,327.34	0.00 / 769.04	1,699,578.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.	215.00	487.77	104,870.55	557.45	119,852.36	154.46	33,208.90	126.81	27,264.15	711.91	153,061.26	769.04	165,343.60
(22)	Load test	EA	3.00	23,665.50	70,996.50	27,046.35	81,139.06	21,036.00	63,108.00	7,868.50	23,665.50	48,082.35	144,247.06	52,590.00	157,770.00
401	Concrete bridge railing	L.M.	170.00	571.20	97,104.00	652.80	110,976.28	452.25	76,882.50	197.17	33,518.90	1,105.05	187,858.78	1,220.62	207,505.40
404	Reinforcing steel for bridges/box culvert	KG	132,900.00	1.61	213,969.00	1.84	244,536.61	21.04	2,796,216.00	3.09	410,661.00	22.88	3,040,752.61	25.74	3,420,846.00
405 (1)	Structural concrete, Class A	CU.M.	580.00	1,466.79	850,738.20	1,676.34	972,274.66	1,305.90	757,422.00	506.33	293,671.40	2,982.24	1,729,696.66	3,279.02	1,901,831.60
(2)	Structural concrete, Class P	CU.M.	510.00	1,615.30	823,803.00	1,846.06	941,491.50	1,423.33	725,898.30	551.77	281,402.70	3,269.39	1,667,389.80	3,590.40	1,831,104.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				4,122,346.95		4,711,265.44		5,939,468.30		1,708,363.75		10,650,733.74		11,770,179.60
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	220.00	105.33	23,172.60	120.38	26,483.04	87.38	19,223.60	59.37	13,061.40	207.76	45,706.64	252.08	55,457.60
(76)	RCPC, 76 cm diameter	L.M.	150.00	676.06	101,409.00	772.64	115,896.29	411.17	61,675.50	279.37	41,905.50	1,183.81	177,571.79	1,366.60	204,990.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	90.00	1,448.20	130,338.00	1,655.09	148,958.09	1,305.89	117,530.10	497.05	44,734.50	2,960.98	266,488.19	3,251.14	292,602.60
(11)	Reinforcing steel for RCBC/RCPC	KG	7,600.00	1.61	12,236.00	1.84	13,984.03	21.04	159,904.00	3.09	23,484.00	22.88	173,888.03	25.74	195,624.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00 / 0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2B2A: CANILI- KM38 (DIVERSION ROAD)

SECTION LENGTH: 7.0 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
(5)	Grouted riprap	CU.M.	120.00	733.42	88,010.40	838.20	100,583.57	427.63	51,315.60	287.15	34,458.00	1,265.83	151,899.17	1,448.20	173,784.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	700.00	286.05	200,235.00	326.92	228,8[illegible]).57	170.46	119,322.00	115.11	80,577.00	497.38	348,162.57	571.62	400,134.00
	TOTAL TO DRAINAGE EROSION WORKS				555,401.00		634,745.59		528,970.80		238,220.40		1,163,716.39		1,322,592.20
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	400.00	396.00	158,400.00	452.57	181,029.02	247.56	99,024.00	346.56	138,624.00	700.13	280,053.02	990.12	396,048.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				203,958.08		233,095.53		124,083.12		175,726.80		357,178.65		503,768.00
	VI. LAND ACQUISITION	SQ.M.	123,879.00		0.00	0.00	0.00	2.00	247,759.00	0.20	24,774.00	2.00	247,759.00	2.20	272,534.00
	SUB-TOTAL TO SEGMENT 2B2A				33,652,711.04		38,460,337.34	2.22	18,630,046.46		17,362,170.72		57,090,383.80		69,644,928.22
	10% CONTINGENCIES				3,365,271.10		3,846,033.73	0.22	1,863,004.65		1,736,217.07		5,709,038.38		6,964,492.82
	SUB-TOTAL				37,017,962.14		42,306,371.07		20,493,051.11		19,098,387.79		62,799,422.18		76,609,421.04
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				3,701,798.21		4,230,637.11		2,049,305.11		1,909,838.78		6,279,942.22		7,660,942.10
	SUB-TOTAL				40,719,780.36		46,537,008.18		22,542,356.22		21,008,226.57		69,079,364.40		84,270,363.15
	8% SUPERVISION COST				3,257,582.43		3,722,960.65		1,803,388.50		1,680,658.13		5,526,349.15		6,741,629.05
	TOTAL SEGMENT COST				43,977,362.79		50,259,968.83		24,345,744.71		22,688,884.70		74,605,713.55		91,011,992.20

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN – CANILI

SECTION LENGTH: 26.19 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	36,895.00	1.99	73,421.05	2.27	83,909.98	0.12	4,427.40	1.00	36,895.00	2.39	88,337.38	3.11	114,743.45
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	6,630.00	63.71	422,397.30	72.81	482,740.98	4.41	29,238.30	31.86	211,231.80	77.22	511,979.28	99.98	662,867.40
(2)	Common excavation	CU.M.	27,135.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	23,455.00	61.15	1,434,273.25	69.89	1,639,173.53	3.77	88,425.35	30.57	717,019.35	73.66	1,727,598.88	95.49	2,239,717.95
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.	27,135.00	62.06	1,683,998.10	70.93	1,924,574.07	24.81	673,219.35	33.80	917,163.00	95.74	2,597,793.42	120.67	3,274,380.45
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	258,130.00	2.19	565,304.70	2.50	646,064.13	0.18	46,463.40	1.08	278,780.40	2.68	692,527.53	3.45	890,548.50
(2)	Subgrade preparation, exrg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				4,179,394.40		4,776,462.68		841,773.80		2,161,089.55		5,618,236.48		7,182,257.75
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	108,365.00	132.59	14,368,115.35	151.53	16,420,744.31	66.24	7,178,097.60	69.17	7,495,607.05	217.77	23,598,841.91	268.00	29,041,820.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	40,605.00	129.67	5,265,250.35	148.19	6,017,444.02	233.84	9,495,073.20	70.64	2,868,337.20	382.03	15,512,517.22	434.15	17,628,660.75
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	202.00	5,786.87	1,168,947.74	6,613.58	1,335,943.61	1,996.68	403,329.36	2,172.74	438,893.48	8,610.26	1,739,272.97	9,956.29	2,011,170.58
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bitbinder course (2" thick)	SQ.M.	161,335.00	75.92	12,248,553.20	86.77	13,998,381.51	42.12	6,795,430.20	37.96	6,124,276.60	128.89	20,793,811.71	156.00	25,168,260.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN – CANILI

SECTION LENGTH: 24.89 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				33,050,866.64		37,772,513.45		23,871,930.36		16,927,114.33		61,644,443.81		73,849,911.33
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	30.00	571.20	17,136.00	652.80	19,584.05	452.25	13,567.50	197.17	5,915.10	1,105.05	33,151.55	1,220.62	36,618.60
404	Reinforcing steel for bridges/box culvert	KG	2,180.00	1.61	3,509.80	1.84	4,011.21	21.04	45,867.20	3.09	6,736.20	22.88	49,878.41	25.74	56,113.20
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,962.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	20.00	1,615.30	32,306.00	1,846.06	36,921.24	1,423.33	28,466.60	551.77	11,035.40	3,269.39	65,387.84	3,590.40	71,808.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				52,951.80		60,516.49		87,901.30		23,686.70		148,417.79		164,539.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	374.37	0.00	56.51	0.00	163.79	0.00	430.88	0.00	547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN – CANILI

SECTION LENGTH: 26.55 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	280.00	733.42	205,357.60	838.20	234,694.99	427.63	119,736.40	287.15	80,402.00	1,265.83	354,431.39	1,448.20	405,496.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				205,357.60		234,694.99		119,736.40		80,402.00		354,431.39		405,496.00
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	600.00	396.00	237,600.00	452.57	271,543.54	247.56	148,536.00	346.56	207,936.00	700.13	420,079.54	990.12	594,072.00
605 (1)	Warning sign	EA	15.00	1,435.00	21,525.00	1,640.00	24,600.06	785.57	11,783.55	1,195.43	17,931.45	2,425.57	36,383.61	3,416.00	51,240.00
(2)	Regulatory signs	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(3)	Informatory Signs	EA	5.00	5,559.04	27,795.20	6,353.20	31,766.02	3,102.72	15,513.60	4,206.24	21,031.20	9,455.92	47,279.62	12,868.00	64,340.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				315,620.20		360,709.70		191,544.55		270,807.25		552,254.25		777,972.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2C				37,904,190.64		43,204,897.31	2.22	25,112,886.41		19,463,099.83		68,317,783.72		82,380,176.88
	10% CONTINGENCIES				3,780,419.06		4,320,489.73	0.22	2,511,288.64		1,946,309.98		6,831,778.37		8,238,017.69
	SUB-TOTAL				41,584,609.70		47,525,387.05		27,624,175.05		21,409,409.81		75,149,562.10		90,618,194.57
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				4,158,460.97		4,752,538.70		2,762,417.51		2,140,940.98		7,514,956.21		9,061,819.46
	SUB-TOTAL				45,743,070.67		52,277,925.75		30,386,592.56		23,550,350.79		82,664,518.31		99,680,014.02
	8% SUPERVISION COST				3,659,445.65		4,182,234.06		2,430,927.40		1,884,028.06		6,613,161.46		7,974,401.12
	TOTAL SEGMENT COST				49,402,516.33		56,460,159.81		32,817,519.96		25,434,378.86		89,277,679.77		107,654,415.15

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN – CANILI

SECTION LENGTH: 24.59 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	36,895.00	1.99	73,421.05	2.27	83,909.98	0.12	4,427.40	1.00	36,895.00	2.39	88,337.38	3.11	114,743.45
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	6,630.00	63.71	422,397.30	72.81	482,740.98	4.41	29,238.30	31.86	211,231.80	77.22	511,979.28	99.98	662,867.40
(2)	Common excavation	CU.M.	27,135.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	23,455.00	61.15	1,434,273.25	69.89	1,639,173.53	3.77	88,425.35	30.57	717,019.35	73.66	1,727,598.88	95.49	2,239,717.95
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.	27,135.00	62.06	1,683,998.10	70.93	1,924,574.07	24.81	673,219.35	33.80	917,163.00	95.74	2,597,793.42	120.67	3,274,380.45
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	258,130.00	2.19	565,304.70	2.50	646,064.13	0.18	46,463.40	1.08	278,780.40	2.68	692,527.53	3.45	890,548.50
(2)	Subgrade preparation, exig. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				4,179,394.40		4,776,462.68		841,773.80		2,161,089.55		5,618,236.48		7,182,257.75
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	105,135.00	132.59	13,939,849.65	151.53	15,931,296.57	66.24	6,964,142.40	69.17	7,272,187.95	217.77	22,895,438.97	268.00	28,176,180.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	40,065.00	129.67	5,195,228.55	148.19	5,937,418.90	233.84	9,368,799.60	70.64	2,830,191.60	382.03	15,306,218.50	434.15	17,394,219.75
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	202.00	5,786.87	1,168,947.74	6,613.58	1,335,943.61	1,996.68	403,329.36	2,172.74	438,893.48	8,610.26	1,739,272.97	9,956.29	2,011,170.58
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.	540.00	1,938.78	1,046,941.20	2,215.75	1,196,507.22	419.39	226,470.60	876.16	473,126.40	2,635.14	1,422,977.82	3,234.33	1,746,538.20
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	8,230.00	457.11	3,762,015.30	522.41	4,299,456.81	111.60	918,468.00	228.55	1,880,966.50	634.01	5,217,924.81	797.26	6,561,449.80
310 (1)	Bit.binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN–CANILI

SECTION LENGTH: 26.89 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.65	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				25,112,982.44		28,700,623.11		17,881,209.96		12,895,365.93		46,581,833.07		55,889,558.33
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	30.00	571.20	17,136.00	652.80	19,584.05	452.25	13,567.50	197.17	5,915.10	1,105.05	33,151.55	1,220.62	36,618.60
404	Reinforcing steel for bridges/box culvert	KG	2,180.00	1.61	3,509.80	1.84	4,011.21	21.04	45,867.20	3.09	6,736.20	22.88	49,878.41	25.74	56,113.20
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	20.00	1,615.30	32,306.00	1,846.06	36,921.24	1,423.33	28,466.60	551.77	11,035.40	3,269.39	65,387.84	3,590.40	71,808.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				52,951.80		60,516.49		87,901.30		23,686.70		148,417.79		164,539.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2C: PANTABANGAN – CANILI

SECTION LENGTH: 74.89 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM No.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	280.00	733.42	205,357.60	838.20	234,691.99	427.63	119,736.40	287.15	80,402.00	1,265.83	354,431.39	1,448.20	405,496.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				205,357.60		234,694.99		119,736.40		80,402.00		354,431.39		405,496.00
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	600.00	396.00	237,600.00	452.57	271,543.54	247.56	148,536.00	346.56	207,936.00	700.13	420,079.54	990.12	594,072.00
605 (1)	Warning sign	EA	15.00	1,435.00	21,525.00	1,640.00	24,600.06	785.57	11,783.55	1,195.43	17,931.45	2,425.57	36,383.61	3,416.00	51,240.00
(2)	Regulatory signs	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(3)	Informatory Signs	EA	5.00	5,559.04	27,795.20	6,353.20	31,766.02	3,102.72	15,513.60	4,206.24	21,031.20	9,455.92	47,279.62	12,868.00	64,340.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				315,620.20		360,709.70		191,544.55		270,807.25		552,254.25		777,972.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT IC				29,866,306.44		34,133,006.98	2.22	19,122,166.01		15,431,351.43		53,255,172.99		64,419,823.88
	10% CONTINGENCIES				2,986,630.64		3,413,300.70	0.22	1,912,216.60		1,543,135.14		5,325,517.30		6,441,982.39
	SUB-TOTAL				32,852,937.08		37,546,307.68		21,034,382.61		16,974,486.57		58,580,690.29		70,861,806.27
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				3,285,293.71		3,754,630.77		2,103,438.26		1,697,448.66		5,858,069.03		7,086,180.63
	SUB-TOTAL				36,138,230.79		41,300,938.44		23,137,820.87		18,671,935.23		64,438,759.32		77,947,986.89
	8% SUPERVISION COST				2,891,058.46		3,304,075.08		1,851,025.67		1,493,754.82		5,155,100.75		6,235,838.95
	TOTAL SEGMENT COST				39,029,289.26		44,605,013.52		24,988,846.54		20,165,690.05		69,593,860.06		84,183,825.85

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.		1.99	0.00	2.27	0.00	0.12	0.00	1.00	0.00	2.39	0.00	3.11	0.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.		63.71	0.00	72.81	0.00	4.41	0.00	31.86	0.00	77.22	0.00	99.98	0.00
(2)	Common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
(3)	Surplus rock excavation	CU.M.		230.99	0.00	263.99	0.00	35.55	0.00	111.54	0.00	299.54	0.00	378.08	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.		62.06	0.00	70.93	0.00	24.81	0.00	33.80	0.00	95.74	0.00	120.67	0.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	143,150.00	2.19	313,496.50	2.50	358,284.90	0.18	25,767.00	1.08	154,602.00	2.68	384,051.90	3.45	493,867.50
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				313,498.50		358,284.90		25,767.00		154,602.00		384,051.90		493,867.50
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	60,100.00	132.59	7,968,659.00	151.53	9,107,061.62	66.24	3,981,024.00	69.17	4,157,117.00	217.77	13,088,085.62	268.00	16,106,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	22,520.00	129.67	2,920,168.40	148.19	3,337,343.66	233.84	5,266,076.80	70.64	1,590,812.80	382.03	8,603,420.46	434.15	9,777,058.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	112.00	5,786.87	648,129.44	6,613.58	740,721.21	1,996.68	223,628.16	2,172.74	243,346.88	8,610.26	964,349.37	9,956.29	1,115,104.48
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bitbinder course (2" thick)	SQ.M.	89,470.00	75.92	6,792,562.40	86.77	7,762,947.86	42.12	3,768,476.40	37.96	3,396,281.20	128.89	11,531,424.26	0.00 156.00	13,957,320.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				18,329,519.24		20,948,074.36		13,239,205.36		9,387,557.88		34,187,279.72		40,956,282.48
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	210.00	571.20	119,952.00	652.80	137,088.34	452.25	94,972.50	197.17	41,405.70	1,105.05	232,060.84	1,220.62	256,330.20
404	Reinforcing steel for bridges/box culvert	KG	56,850.00	1.61	91,528.50	1.84	104,604.26	21.04	1,196,124.00	3.09	175,666.50	22.88	1,300,728.26	25.74	1,463,319.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	514.00	1,615.30	830,264.20	1,846.06	948,875.74	1,423.33	731,591.62	551.77	283,609.78	3,269.39	1,680,467.36	3,590.40	1,845,465.60
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				1,041,744.70		1,190,568.35		2,022,688.12		500,681.98		3,213,256.47		3,565,114.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.	7,825.00	696.45	5,449,721.25	795.94	6,228,268.43	1,003.72	7,854,109.00	348.23	2,724,899.75	1,799.66	14,082,377.43	2,048.40	16,028,730.00
600	Lined Ditch	L.M.	1,490.00	286.05	426,214.50	326.92	487,103.50	170.46	253,985.40	115.11	171,513.90	497.38	741,068.90	571.62	851,713.80
	TOTAL TO DRAINAGE EROSION WORKS				5,875,935.75		6,715,371.93		8,108,094.40		2,896,413.65		14,823,466.33		16,880,443.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	400.00	396.00	158,400.00	452.57	181,029.02	247.56	99,024.00	346.56	138,624.00	700.13	280,053.02	990.12	396,048.00
605 (1)	Warning sign	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(2)	Regulatory signs	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(3)	Informatory Signs	EA	5.00	5,559.04	27,795.20	6,353.20	31,766.02	3,102.72	15,513.60	4,206.24	21,031.20	9,455.92	47,279.62	12,868.00	64,340.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				214,895.20		245,595.13		130,249.00		183,563.80		375,844.13		528,708.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2D				25,775,593.39		29,457,894.66	2.22	23,526,003.88		13,122,819.31		52,983,898.54		62,424,416.58
	10% CONTINGENCIES				2,577,559.34		2,945,789.47	0.22	2,352,600.39		1,312,281.93		5,298,389.85		6,242,441.66
	SUB-TOTAL				28,353,152.73		32,403,684.13		25,878,604.27		14,435,101.24		58,282,288.40		68,666,858.24
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,835,315.27		3,240,368.41		2,587,860.43		1,443,510.12		5,828,228.84		6,866,685.82
	SUB-TOTAL				31,188,468.00		35,644,052.54		28,466,464.69		15,878,611.37		64,110,517.24		75,533,544.06
	8% SUPERVISION COST				2,495,077.44		2,851,524.20		2,277,317.18		1,270,288.91		5,128,841.38		6,042,683.52
	TOTAL SEGMENT COST				33,683,545.44		38,495,576.74		30,743,781.87		17,148,900.27		69,239,358.61		81,576,227.59

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminus Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.		1.99	0.00	2.27	0.00	0.12	0.00	1.00	0.00	2.39	0.00	3.11	0.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.		63.71	0.00	72.81	0.00	4.41	0.00	31.86	0.00	77.22	0.00	99.98	0.00
(2)	Common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
(3)	Surplus rock excavation	CU.M.		230.99	0.00	263.99	0.00	35.55	0.00	111.54	0.00	299.54	0.00	378.08	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.66	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.		62.06	0.00	70.93	0.00	24.81	0.00	33.80	0.00	95.74	0.00	120.67	0.00
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	143,150.00	2.19	313,498.50	2.50	358,284.90	0.18	25,767.00	1.08	154,602.00	2.68	384,051.90	2.45	493,867.50
(2)	Subgrade preparation, exrg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				313,498.50		358,284.90		25,767.00		154,602.00		384,051.90		493,867.50
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	58,305.00	132.59	7,730,659.95	151.53	8,835,062.03	66.24	3,862,123.20	69.17	4,032,956.85	217.77	12,697,185.23	268.00	15,625,740.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	22,220.00	129.67	2,881,267.40	148.19	3,292,885.26	233.84	5,195,924.80	70.64	1,569,620.80	382.03	8,488,810.06	434.15	9,646,813.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	112.00	5,786.87	648,129.44	6,613.58	740,721.21	1,996.68	223,628.16	2,172.74	243,346.88	8,610.26	964,349.37	9,956.29	1,115,104.48
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.	300.00	1,938.78	581,634.00	2,215.75	664,726.23	419.39	125,817.00	876.16	262,848.00	2,635.14	790,543.23	3,234.33	970,299.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	4,565.00	457.11	2,086,707.15	522.41	2,384,814.13	111.60	509,454.00	228.55	1,043,330.75	634.01	2,894,268.13	797.26	3,639,491.90
310 (1)	Bit.binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				13,928,397.94		15,918,208.87		9,916,947.16		7,152,105.28		25,835,156.03		30,997,448.38
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.60	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 964.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.	210.00	571.20	119,952.00	652.80	137,088.34	452.25	94,972.50	197.17	41,405.70	1,105.05	232,060.84	1,220.62	256,330.20
404	Reinforcing steel for bridges/box culvert	KG	56,850.00	1.61	91,528.50	1.84	104,604.26	21.04	1,196,124.00	3.09	175,666.50	22.88	1,300,728.26	25.74	1,463,319.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.	514.00	1,615.30	830,264.20	1,846.06	948,875.74	1,423.33	731,591.62	551.77	283,609.78	3,269.39	1,680,467.36	3,590.40	1,845,455.60
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.26	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				1,041,744.70		1,190,568.35		2,022,688.12		500,681.98		3,213,256.47		3,565,114.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	L.M.		676.06	0.00	772.64	0.00	411.17	0.00	279.37	0.00	1,183.81	0.00	1,366.60	0.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 2D: RIZAL – PANTABANGAN

SECTION LENGTH: 14.91 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminus Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.	7,825.00	696.45	5,449,721.25	795.94	6,228,268.43	1,003.72	7,854,109.00	348.23	2,724,899.75	1,799.66	14,082,377.43	2,048.40	16,028,730.00
600	Lined Ditch	L.M.	1,490.00	286.05	426,214.50	326.92	487,103.50	170.46	253,965.40	115.11	171,513.90	497.38	741,088.90	571.62	851,713.80
	TOTAL TO DRAINAGE EROSION WORKS				5,875,935.75		6,715,371.93		8,108,094.40		2,896,413.65		14,823,466.33		16,880,443.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	400.00	396.00	158,400.00	452.57	181,029.02	247.56	99,024.00	346.56	138,624.00	700.13	280,053.02	990.12	396,048.00
605 (1)	Warning sign	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(2)	Regulatory signs	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(3)	Informatory Signs	EA	5.00	5,559.04	27,795.20	6,353.20	31,766.02	3,102.72	15,513.60	4,206.24	21,031.20	9,455.92	47,279.62	12,868.00	64,340.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				214,895.20		245,595.13		130,249.00		183,563.80		375,844.13		528,708.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 2D				21,374,472.09		24,428,029.17	2.22	20,203,745.68		10,887,364.71		44,631,774.85		52,465,582.48
	10% CONTINGENCIES				2,137,447.21		2,442,802.92	0.22	2,020,374.57		1,088,736.47		4,463,177.49		5,246,558.25
	SUB-TOTAL				23,511,919.30		26,870,832.09		22,224,120.25		11,976,101.18		49,094,952.34		57,712,140.73
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,351,191.93		2,687,083.21		2,222,412.02		1,197,610.12		4,909,495.23		5,771,214.07
	SUB-TOTAL				25,863,111.23		29,557,915.30		24,446,532.27		13,173,711.30		54,004,447.57		63,483,354.80
	8% SUPERVISION COST				2,069,048.90		2,364,633.22		1,955,722.58		1,053,896.90		4,320,355.81		5,078,668.38
	TOTAL SEGMENT COST				27,932,160.13		31,922,548.52		26,402,254.85		14,227,608.20		58,324,803.38		68,562,023.18

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	2,463,990.00	1.99	4,903,340.10	2.27	5,603,831.27	0.12	295,678.80	1.00	2,463,990.00	2.39	5,899,510.07	3.11	7,663,008.90
(3)	Tree Removal, Large	EA	6,300.00	56.27	354,501.00	64.31	405,145.01	103.21	650,223.00	28.19	177,597.00	167.52	1,055,368.01	187.67	1,182,321.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	879,685.00	63.71	56,044,731.35	72.81	64,051,281.67	4.41	3,879,410.85	31.86	28,026,764.10	77.22	67,930,692.52	99.98	87,950,906.30
(2)	Common excavation	CU.M.	3,387,710.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	467,920.00	61.15	28,613,308.00	69.89	32,701,005.18	3.77	1,764,058.40	30.57	14,304,314.40	73.66	34,465,063.58	95.49	44,681,680.80
103 (1)	Structure excavation	CU.M.	21,300.00	60.12	1,280,556.00	68.71	1,463,496.23	12.38	263,694.00	30.07	640,491.00	81.09	1,727,190.23	102.57	2,184,741.00
(2)	Bridge excavation	CU.M.	6,390.00	60.12	384,166.80	68.71	439,048.87	12.38	79,108.20	30.07	192,147.30	81.09	518,157.07	102.57	655,422.30
(3)	Foundation fill	CU.M.	11,080.00	105.33	1,167,056.40	120.38	1,333,782.08	87.38	968,170.40	59.37	657,819.60	207.76	2,301,952.48	252.08	2,793,046.40
(4)	Excavation below plan elevation	CU.M.	4,200.00	306.22	1,286,124.00	349.97	1,469,859.67	174.86	734,412.00	150.17	630,714.00	524.83	2,204,271.67	631.25	2,651,250.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,500.00	60.12	90,180.00	68.71	103,063.11	12.38	18,570.00	30.07	45,105.00	81.09	121,633.11	102.57	153,855.00
104 (1)	Embankment	CU.M.	3,387,710.00	62.06	210,241,282.60	70.93	240,276,352.23	24.81	84,049,085.10	33.80	114,504,598.00	95.74	324,325,437.33	120.67	408,794,965.70
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	696,000.00	2.19	1,524,240.00	2.50	1,741,992.93	0.18	125,280.00	1.08	751,680.00	2.68	1,867,272.93	3.45	2,401,200.00
(2)	Subgrade preparation, exrg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				305,889,456.25		349,588,858.26		92,827,690.75		162,395,220.40		442,416,549.01		561,112,397.40
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	42,775.00	132.59	5,671,537.25	151.53	6,481,773.06	66.24	2,833,416.00	69.17	2,958,746.75	217.77	9,315,189.06	268.00	11,463,700.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	104,520.00	129.67	13,553,108.40	148.19	15,489,305.47	233.84	24,440,956.80	70.64	7,383,292.80	382.03	39,930,262.27	434.15	45,377,358.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete											0.00		0.00	
	Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
														0.00	
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	435,000.00	224.02	97,448,700.00	256.02	111,370,221.28	142.83	62,131,050.00	82.10	35,713,500.00	398.85	173,501,271.28	448.93	195,293,250.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				116,673,345.65		133,341,299.81		89,405,422.80		46,055,539.55		222,746,722.61		252,134,308.00
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	11,340.00	364.08	4,128,667.20	0.00 / 416.09	0.00 / 4,718,488.60	472.32	5,356,108.80	147.60	1,673,784.00	888.41	10,074,597.40	0.00 / 984.00	11,158,560.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	10,210.00	487.77	4,980,131.70	0.00 / 557.45	0.00 / 5,691,593.31	154.46	1,577,036.60	126.81	1,294,730.10	711.91	7,268,629.91	0.00 / 769.04	7,851,898.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.	1,135.00	487.77	553,618.95	557.45	632,708.95	154.46	175,312.10	126.81	143,929.35	711.91	808,021.05	769.04	872,860.40
(22)	Load test	EA	8.00	23,665.50	189,324.00	27,046.35	216,370.83	21,036.00	168,288.00	7,888.50	63,108.00	48,082.35	384,658.83	52,590.00	420,720.00
401	Concrete bridge railing	L.M.	710.00	571.20	405,552.00	652.83	463,489.16	452.25	321,097.50	197.17	139,990.70	1,105.05	784,586.66	1,220.62	866,610.20
404	Reinforcing steel for bridges/box culvert	KG	597,300.00	1.61	961,653.00	1.84	1,099,034.75	21.04	12,567,192.00	3.09	1,845,657.00	22.88	13,666,226.75	25.74	15,374,302.00
405 (1)	Structural concrete, Class A	CU.M.	1,860.00	1,466.79	2,728,229.40	1,676.34	3,117,984.25	1,305.90	2,428,974.00	506.33	941,773.80	2,982.24	5,546,958.25	3,279.02	6,098,977.20
(2)	Structural concrete, Class P	CU.M.	2,100.00	1,615.30	3,392,130.00	1,846.06	3,876,729.69	1,423.33	2,988,993.00	551.77	1,158,717.00	3,269.39	6,865,722.69	3,590.40	7,539,840.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	66,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				17,339,306.25		19,816,399.54		25,583,002.00		7,261,687.95		45,399,401.54		50,183,998.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	750.00	105.33	78,997.50	120.38	90,283.08	87.38	65,535.00	59.37	44,527.50	207.76	155,818.08	252.08	189,060.00
(76)	RCPC, 76 cm diameter	L.M.	700.00	676.06	473,242.00	772.64	540,849.35	411.17	287,819.00	279.37	195,559.00	1,183.81	828,668.35	1,366.60	956,620.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	156.00	1,668.47	260,281.32	1,906.83	297,465.11	891.77	139,116.12	659.04	102,810.24	2,798.60	436,581.23	3,219.28	502,207.68
(10)	Structural concrete for box pipe headwalls	CU.M.	1,060.00	1,448.20	1,535,092.00	1,655.09	1,754,395.24	1,305.89	1,384,243.40	497.05	526,873.00	2,960.98	3,138,638.64	3,251.14	3,446,208.40
(11)	Reinforcing steel for RCBC/RCPC	KG	90,060.00	1.61	144,996.60	1.84	165,710.81	21.04	1,894,862.40	3.09	278,285.40	22.88	2,060,573.21	25.74	2,318,144.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00 / 0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS– DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	3,625.00	733.42	2,658,647.50	838.20	3,038,461.88	427.63	1,550,158.75	287.15	1,040,918.75	1,265.83	4,588,620.63	1,448.20	5,249,725.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	4,500.00	286.05	1,287,225.00	326.92	1,471,117.96	170.46	767,070.00	115.11	517,995.00	497.38	2,238,187.96	571.62	2,572,290.00
	TOTAL TO DRAINAGE EROSION WORKS				6,438,481.92		7,358,283.45		6,088,804.67		2,706,968.89		13,447,068.12		15,234,255.48
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	1,000.00	396.00	396,000.00	452.57	452,572.56	247.56	247,560.00	346.56	346,560.00	700.13	700,132.56	990.12	990,120.00
605 (1)	Warning sign	EA	15.00	1,435.00	21,525.00	1,640.00	24,600.06	785.57	11,783.55	1,195.43	17,931.45	2,425.57	36,383.61	3,416.00	51,240.00
(2)	Regulatory signs	EA	12.00	1,435.00	17,220.00	1,640.00	19,680.05	785.57	9,426.84	1,195.43	14,345.16	2,425.57	29,106.89	3,416.00	40,992.00
(3)	Informatory Signs	EA	8.00	5,559.04	44,472.32	6,353.20	50,825.64	3,102.72	24,821.76	4,206.24	33,649.92	9,455.92	75,647.40	12,868.00	102,944.00
610	Sodding	SQ.M.	65,000.00	1.72	111,800.00	1.97	127,771.75	4.02	261,300.00	2.46	159,900.00	5.99	389,071.75	8.20	533,000.00
	TOTAL TO INCIDENTAL WORKS				591,017.32		675,450.05		554,892.15		572,386.53		1,230,342.20		1,718,296.00
	VI. LAND ACQUISITION	SQ.M.	2,913,010.00		0.00	0.00	0.00	2.00	5,826,020.00	0.20	582,602.00	2.00	5,826,020.00	2.20	6,408,622.00
	SUB-TOTAL OF SEGMENT 3				446,931,637.39		510,780,291.11		220,285,832.37		219,574,407.32		731,066,123.48		886,791,877.08
	10% CONTINGENCIES				44,693,163.74		51,078,029.11		22,028,583.24		21,957,440.73		73,106,612.35		88,679,187.71
	SUB-TOTAL				491,624,801.13		561,858,320.22		242,314,415.61		241,531,848.05		804,172,735.83		975,471,064.79
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				49,162,480.11		56,185,832.02		24,231,441.56		24,153,184.81		80,417,273.58		97,547,106.48
	SUB-TOTAL				540,787,281.24		618,044,152.24		266,545,857.17		265,685,032.86		884,590,009.41		1,073,018,171.27
	8% SUPERVISION COST				43,262,982.50		49,443,532.18		21,323,668.57		21,254,802.63		70,767,200.75		85,841,453.70
	TOTAL SEGMENT COST				584,050,263.74		667,487,684.42		287,869,525.74		286,939,835.49		955,357,210.16		1,158,859,624.97

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	2,463,990.00	1.99	4,903,340.10	2.27	5,603,831.27	0.12	295,678.80	1.00	2,463,990.00	2.39	5,899,510.07	3.11	7,663,008.90
(3)	Tree Removal, Large	EA	6,300.00	56.27	354,501.00	64.31	405,145.01	103.21	650,223.00	28.19	177,597.00	167.52	1,055,368.01	187.67	1,182,321.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	879,685.00	63.71	56,044,731.35	72.81	64,051,281.67	4.41	3,879,410.85	31.86	28,026,764.10	77.22	67,930,692.52	99.98	87,950,906.30
(2)	Common excavation	CU.M.	3,387,710.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	467,920.00	61.15	28,613,308.00	69.89	32,701,005.18	3.77	1,764,058.40	30.57	14,304,314.40	73.66	34,465,063.58	95.49	44,681,680.80
103 (1)	Structure excavation	CU.M.	21,300.00	60.12	1,280,556.00	68.71	1,463,496.23	12.38	263,694.00	30.07	640,491.00	81.09	1,727,190.23	102.57	2,184,741.00
(2)	Bridge excavation	CU.M.	6,390.00	60.12	384,166.80	68.71	439,048.87	12.38	79,108.20	30.07	192,147.30	81.09	518,157.07	102.57	655,422.30
(3)	Foundation fill	CU.M.	11,080.00	105.33	1,167,056.40	120.38	1,333,782.08	87.38	968,170.40	59.37	657,819.60	207.76	2,301,952.48	252.08	2,793,046.40
(4)	Excavation below plan elevation	CU.M.	4,200.00	306.22	1,286,124.00	349.97	1,469,859.67	174.86	734,412.00	150.17	630,714.00	524.83	2,204,271.67	631.25	2,651,250.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,500.00	60.12	90,180.00	68.71	103,063.11	12.38	18,570.00	30.07	45,105.00	81.09	121,633.11	102.57	153,855.00
104 (1)	Embankment	CU.M.	3,367,710.00	62.06	210,241,282.60	70.93	240,276,352.23	24.81	84,049,085.10	33.80	114,504,598.00	95.74	324,325,437.33	120.67	408,794,965.70
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	696,000.00	2.19	1,524,240.00	2.50	1,741,992.93	0.18	125,280.00	1.08	751,680.00	2.68	1,867,272.93	3.45	2,401,200.00
(2)	Subgrade preparation, exig. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				305,889,486.25		349,588,858.26		92,827,690.75		162,395,220.40		442,416,549.01		561,112,397.40
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	232,000.00	132.59	30,760,880.00	151.53	35,155,379.32	66.24	15,367,680.00	69.17	16,047,440.00	217.77	50,523,059.32	268.00	62,176,000.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	109,475.00	129.67	14,195,623.25	148.19	16,223,609.99	233.84	25,599,634.00	70.64	7,733,314.00	382.03	41,823,243.99	434.15	47,528,571.25
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	545.00	5,786.87	3,153,844.15	6,613.58	3,604,402.33	1,996.68	1,088,190.60	2,172.74	1,184,143.30	8,610.26	4,692,592.93	9,956.29	5,426,178.05
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		964.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	435,000.00	75.92	33,025,200.00	86.77	37,743,180.07	42.12	18,322,200.00	37.96	16,512,600.00	128.89	56,065,380.07	0.00 156.00	67,860,000.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				81,135,547.40		92,726,571.70		60,377,704.60		41,477,497.30		153,104,276.30		182,990,749.30
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	11,340.00	364.08	4,128,667.20	0.00 / 416.09	0.00 / 4,718,488.60	472.32	5,356,108.80	147.60	1,673,784.00	888.41	10,074,597.40	0.00 / 984.00	11,158,560.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	10,210.00	487.77	4,980,131.70	0.00 / 557.45	0.00 / 5,691,593.31	154.46	1,577,036.60	126.81	1,294,730.10	711.91	7,268,629.91	0.00 / 769.04	7,851,898.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00 / 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.	1,135.00	487.77	553,618.95	557.45	632,708.95	154.46	175,312.10	126.81	143,929.35	711.91	808,021.05	769.04	872,860.40
(22)	Load test	EA	8.00	23,665.50	189,324.00	27,046.35	216,370.83	------	168,288.00	7,888.50	63,108.00	48,082.35	384,658.83	52,590.00	420,720.00
401	Concrete bridge railing	L.M.	710.00	571.20	405,552.00	652.80	463,489.16	452.25	321,097.50	197.17	139,990.70	1,105.05	784,586.66	1,220.62	866,640.20
404	Reinforcing steel for bridges/box culvert	KG	597,300.00	1.61	961,653.00	1.84	1,099,034.75	21.04	12,567,192.00	3.09	1,845,657.00	22.88	13,666,226.75	25.74	15,374,502.00
405 (1)	Structural concrete, Class A	CU.M.	1,860.00	1,466.79	2,728,229.40	1,676.34	3,117,984.25	1,305.90	2,428,974.00	506.33	941,773.80	2,982.24	5,546,958.25	3,279.02	6,098,977.20
(2)	Structural concrete, Class P	CU.M.	2,100.00	1,615.30	3,392,130.00	1,846.06	3,876,729.69	1,423.33	2,988,993.00	551.77	1,158,717.00	3,269.39	6,865,722.69	3,590.40	7,539,840.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	------	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				17,339,306.25		19,816,399.54		25,583,002.00		7,261,689.95		45,399,401.54		50,183,998.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	750.00	105.33	78,997.50	120.38	90,283.08	87.38	65,535.00	59.37	44,527.50	207.76	155,818.08	252.08	189,060.00
(76)	RCPC, 76 cm diameter	L.M.	700.00	676.06	473,242.00	772.64	540,849.35	411.17	287,819.00	279.37	195,559.00	1,183.81	828,668.35	1,366.60	956,620.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	156.00	1,668.47	260,281.32	1,906.83	297,465.11	891.77	139,116.12	659.04	102,810.24	2,798.60	436,581.23	3,219.28	502,207.68
(10)	Structural concrete for box pipe headwalls	CU.M.	1,060.00	1,448.20	1,535,092.00	1,655.09	1,754,395.24	1,305.89	1,384,243.40	497.05	526,873.00	2,960.98	3,138,638.64	3,251.14	3,446,208.40
(11)	Reinforcing steel for RCBC/RCPC	KG	90,060.00	1.61	144,996.60	1.84	165,710.81	21.04	1,894,862.40	3.09	278,285.40	22.88	2,060,573.21	25.74	2,318,144.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00 / 0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	3,625.00	733.42	2,658,647.50	838.20	3,038,461.88	427.63	1,550,158.75	287.15	1,040,918.75	1,265.83	4,588,620.63	1,448.20	5,249,725.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	4,500.00	286.05	1,287,225.00	326.92	1,471,117.96	170.46	767,070.00	115.11	517,995.00	497.38	2,238,187.96	571.62	2,572,290.00
	TOTAL TO DRAINAGE EROSION WORKS				6,438,481.92		7,358,283.45		6,068,804.67		2,706,968.89		13,447,088.12		15,234,255.48
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	1,000.00	396.00	396,000.00	452.57	452,572.56	247.56	247,560.00	346.56	346,560.00	700.13	700,132.56	990.12	990,120.00
605 (1)	Warning sign	EA	15.00	1,435.00	21,525.00	1,640.00	24,600.06	785.57	11,783.55	1,195.43	17,931.45	2,425.57	36,383.61	3,416.00	51,240.00
(2)	Regulatory signs	EA	12.00	1,435.00	17,220.00	1,640.00	19,680.05	785.57	9,426.84	1,195.43	14,345.16	2,425.57	29,106.89	3,416.00	40,992.00
(3)	Informatory Signs	EA	8.00	5,559.04	44,472.32	6,353.20	50,825.64	3,102.72	24,821.76	4,206.24	33,649.92	9,455.92	75,647.40	12,868.00	102,944.00
610	Sodding	SQ.M.	65,000.00	1.72	111,800.00	1.97	127,771.75	4.02	261,300.00	2.46	159 900.00	5.99	389,071.75	8.20	533,000.00
	TOTAL TO INCIDENTAL WORKS				591,017.32		675,450.05		554,892.15		572,386.53		1,230,342.20		1,718,296.00
	VI. LAND ACQUISITION	SQ.M.	2,913,010.00		0.00	0.00	0.00	2.00	5,826,020.00	0.20	582,602.00	2.00	5,826,020.00	2.20	6,408,622.00
	SUB-TOTAL OF SEGMENT 3				411,393,839.14		470,165,563.00		191,258,114.17		214,996,365.07		661,423,677.17		817,648,318.38
	10% CONTINGENCIES				41,139,383.91		47,016,556.30		19,125,811.42		21,499,636.51		66,142,367.72		81,764,831.84
	SUB-TOTAL				452,533,223.05		517,182,119.30		210,383,925.59		236,496,001.58		727,566,044.89		899,413,150.22
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				45,253,322.31		51,718,211.93		21,038,392.56		23,649,600.16		72,756,604.49		89,941,315.02
	SUB-TOTAL				497,786,545.36		568,900,331.23		231,422,318.15		260,145,601.73		800,322,649.38		989,354,465.24
	8% SUPERVISION COST				39,822,923.63		45,512,026.50		18,513,785.45		20,811,648.14		64,025,811.95		79,148,357.22
	TOTAL SEGMENT COST				537,609,468.99		614,412,357.73		249,936,103.60		280,957,249.87		864,348,461.33		1,068,502,822.46

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS–DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 1 m
PROPOSED SURFACE: Gravel

BASIS: 20 KM OF NEW TRAIL; 52.50 KM OF EXISTING LOGGING ROAD

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	100,000.00	1.99	199,000.00	2.27	227,429.14	0.12	12,000.00	1.00	100,000.00	2.39	239,429.14	3.11	311,000.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.		63.71	0.00	72.81	0.00	4.41	0.00	31.86	0.00	77.22	0.00	99.98	0.00
(2)	Common excavation	CU.M.	10,000.00	61.15	611,500.00	69.89	698,858.89	3.77	37,700.00	30.57	305,700.00	73.66	736,558.89	95.49	954,900.00
(3)	Surplus rock excavation	CU.M.		230.99	0.00	263.99	0.00	35.55	0.00	111.54	0.00	299.54	0.00	378.08	0.00
103 (1)	Structure excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culv . excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
104 (1)	Embankment	CU.M.		62.06	0.00	70.93	0.00	24.81	0.00	32.80	0.00	95.74	0.00	120.67	0.00
(2)	Embankment, selected material	CU.M.	10,000.00	62.07	620,700.00	70.94	709,373.20	40.35	403,500.00	37.35	373,500.00	111.29	1,112,873.20	139.77	1,397,700.00
105 (1)	Subgrade preparation, common	SQ.M.		2.19	0.00	2.50	0.00	0.18	0.00	1.08	0.00	2.68	0.00	3.45	0.00
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				1,431,200.00		1,635,661.23		453,200.00		779,200.00		2,088,861.23		2,663,600.00
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
201	Aggregate base course	CU.M.	3,000.00	132.59	397,770.00	151.53	454,595.42	66.24	198,720.00	69.17	207,510.00	217.77	653,315.42	268.00	804,000.00
202	Crushed aggregate base course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	156.00	0.00

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Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 1 m
PROPOSED SURFACE: Gravel

BASIS: 20 KM OF NEW TRAIL; 52.50 KM OF EXISTING LOGGING ROAD

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=₱28)		ECONOMIC (1$=₱32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				397,770.00		454,595.42		198,720.00		207,510.00		653,315.42		804,000.00
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Timber Structures	Sq.m.	540.00		0.00	0.00	0.00	5,000.00	2,700,000.00		0.00	4,500.00	2,430,000.00	5,000.00	2,700,000.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
405 (1)	Structural concrete, Class A	CU.M.		1,466.79	0.00	1,676.34	0.00	1,305.90	0.00	506.33	0.00	2,982.24	0.00	3,279.02	0.00
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				0.00		0.00		2,700,000.00		0.00		2,430,000.00		2,700,000.00
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(76)	RCPC, 76 cm diameter	Pc.	50.00		0.00	0.00	0.00	40,000.00	2,000,000.00		0.00		0.00	40,000.00	2,000,000.00
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.		1,448.20	0.00	1,655.09	0.00	1,305.89	0.00	497.05	0.00	2,960.98	0.00	3,251.14	0.00
(11)	Reinforcing steel for RCBC/RCPC	KG		1.61	0.00	1.84	0.00	21.04	0.00	3.09	0.00	22.88	0.00	25.74	0.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3: SAN LUIS – DINGALAN

SECTION LENGTH: 72.5 Kilometers
ROADWAY WIDTH: 1 m
PROPOSED SURFACE: Gravel

BASIS: 20 KM OF NEW TRAIL; 52.50 KM OF EXISTING LOGGING ROAD

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				0.00		0.00		2,000,000.00				0.00		2,000,000.00
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA		1,435.00	0.00	1,640.00	0.00	785.57	0.00	1,195.43	0.00	2,425.57	0.00	3,416.00	0.00
(2)	Regulatory signs	EA		1,435.00	0.00	1,640.00	0.00	785.57	0.00	1,195.43	0.00	2,425.57	0.00	3,416.00	0.00
(3)	Informatory Signs	L.S.			0.00	0.00	0.00		900,000.00		100,000.00		900,000.00	0.00	1,000,000.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				0.00		0.00		900,000.00		100,000.00		900,000.00		1,000,000.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT				1,828,970.00		2,090,256.65		6,251,920.00		1,066,710.00		6,072,176.65		9,167,600.00
	10% CONTINGENCIES				182,897.00		209,025.67		625,192.00		108,671.00		607,217.67		916,760.00
	SUB-TOTAL				2,011,867.00		2,299,282.32		6,877,112.00		1,195,381.00		6,679,394.32		10,084,360.00
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				201,186.70		229,928.23		687,711.20		119,538.10		667,939.43		1,008,436.00
	SUB-TOTAL				2,213,053.70		2,529,210.55		7,564,823.20		1,314,919.10		7,347,333.75		11,092,796.00
	8% SUPERVISION COST				177,044.30		202,336.84		605,185.86		105,193.53		587,786.70		887,423.68
	TOTAL SEGMENT COST				2,390,098.00		2,731,547.40		8,170,009.06		1,420,112.63		7,935,120.45		11,980,219.68

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG – LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching extg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				4,825,222.75		5,514,554.07		3,542,780.20		2,473,384.20		9,057,334.27		10,841,387.15
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	41,925.00	1.61	67,499.25	1.84	77,142.19	21.04	882,102.00	3.09	129,548.25	22.88	959,244.19	25.74	1,079,149.50
405 (1)	Structural concrete, Class A	CU.M.	465.00	1,466.79	682,057.35	1,676.34	779,496.06	1,305.90	607,243.50	506.33	235,443.45	2,982.24	1,386,739.56	3,279.02	1,524,744.30
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				749,556.60		856,638.26		1,489,345.50		364,991.70		2,345,983.76		2,603,893.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	210.00	105.33	22,119.30	120.38	25,279.26	87.38	18,349.80	59.37	12,467.70	207.76	43,629.06	252.08	52,936.80
(76)	RCPC, 76 cm diameter	L.M.	78.00	676.06	52,732.68	772.64	60,266.07	411.17	32,071.26	279.37	21,790.86	1,183.81	92,337.33	1,366.60	106,594.80
(91)	RCPC, 91 cm diameter	L.M.	26.00	981.44	25,517.44	1,121.65	29,162.86	570.35	14,829.10	394.73	10,262.98	1,692.00	43,991.96	1,946.52	50,609.52
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	39.00	1,668.47	65,070.33	1,906.83	74,366.28	891.77	34,779.03	659.04	25,702.56	2,798.60	109,145.31	3,219.28	125,551.92
(10)	Structural concrete for box pipe headwalls	CU.M.	225.00	1,448.20	325,845.00	1,655.09	372,395.22	1,305.89	293,825.25	497.05	111,836.25	2,960.98	666,220.47	3,251.14	731,506.50
(11)	Reinforcing steel for RCBC/RCPC	KG	14,300.00	1.61	23,023.00	1.84	26,312.07	21.04	300,872.00	3.09	44,187.00	22.88	327,184.07	25.74	368,062.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG – LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				4,825,222.75		5,514,554.07		3,542,780.20		2,473,384.20		9,057,334.27		10,841,387.15
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	41,925.00	1.61	67,499.25	1.84	77,142.19	21.04	882,102.00	3.09	129,548.25	22.88	959,244.19	25.74	1,079,149.50
405 (1)	Structural concrete, Class A	CU.M.	465.00	1,466.79	682,057.35	1,676.34	779,496.06	1,305.90	607,243.50	506.33	235,443.45	2,982.24	1,386,739.56	3,279.02	1,524,744.30
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,259.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				749,556.60		856,638.26		1,489,345.50		364,991.70		2,345,983.76		2,603,893.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	210.00	105.33	22,119.30	120.38	25,279.26	87.38	18,349.80	59.37	12,467.70	207.76	43,629.06	252.08	52,936.80
(76)	RCPC, 76 cm diameter	L.M.	78.00	676.06	52,732.68	772.64	60,266.07	411.17	32,071.26	279.37	21,790.86	1,183.81	92,337.33	1,366.60	106,594.80
(91)	RCPC, 91 cm diameter	L.M.	26.00	981.44	25,517.44	1,121.65	29,162.86	570.35	14,829.10	394.73	10,262.98	1,692.00	43,991.96	1,946.52	50,609.52
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	39.00	1,668.47	65,070.33	1,906.83	74,366.28	891.77	34,779.03	659.04	25,702.56	2,798.60	109,145.31	3,219.28	125,551.92
(10)	Structural concrete for box pipe headwalls	CU.M.	225.00	1,448.20	325,845.00	1,655.09	372,395.22	1,305.89	293,825.25	497.05	111,836.25	2,960.98	666,220.47	3,251.14	731,506.50
(11)	Reinforcing steel for RCBC/RCPC	KG	14,300.00	1.61	23,023.00	1.84	26,312.07	21.04	300,872.00	3.09	44,187.00	22.88	327,184.07	25.74	368,082.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG – LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	360.00	733.42	264,031.20	833.20	301,750.70	427.63	153,946.80	287.15	103,374.00	1,265.83	455,697.50	1,448.20	521,352.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				778,338.95		889,532.45		848,673.24		329,621.35		1,738,205.69		1,956,633.54
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6,353.20	6,353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				8,429.04		9,633.21		4,673.86		6,597.10		14,307.07		19,700.00
	VI. LAND ACQUISITION	SQ.M.		2.00	0.00	2.29	0.00	2.00	0.00	0.29	0.00	2.00	0.00	4.29	0.00
	SUB-TOTAL OF SEGMENT 4A				8,035,982.64		9,184,003.12		6,587,247.05		4,101,450.25		15,771,250.17		18,724,679.94
	10% CONTINGENCIES				803,598.26		918,400.31		658,724.71		410,145.03		1,577,125.02		1,872,467.99
	SUB-TOTAL				8,839,580.90		10,102,403.43		7,245,971.76		4,511,595.28		17,348,375.19		20,597,147.93
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				883,958.09		1,010,240.34		724,597.18		451,159.53		1,734,837.52		2,059,714.79
	SUB-TOTAL				9,723,538.99		11,112,643.78		7,970,568.93		4,962,754.80		19,083,212.71		22,656,862.73
	8% SUPERVISION COST				777,883.12		889,011.50		637,645.51		397,020.38		1,526,657.02		1,812,549.02
	TOTAL SEGMENT COST				10,501,422.11		12,001,655.28		8,608,214.44		5,359,775.19		20,609,869.72		24,469,411.75

Table 4-5 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG – LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				4,498,754.79		5,141,446.90		3,352,720.31		2,319,283.43		8,494,167.21		10,170,758.53
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	41,925.00	1.61	67,499.25	1.84	77,142.19	21.04	882,102.00	3.09	129,548.25	22.88	959,244.19	25.74	1,079,149.50
405 (1)	Structural concrete, Class A	CU.M.	465.00	1,466.79	682,057.35	1,676.34	779,496.06	1,305.90	607,243.50	506.33	235,443.45	2,982.24	1,386,739.56	3,279.02	1,524,744.30
(2)	Structural concrete, Class P	CU.M.		1,615.50	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				749,556.60		856,638.26		1,489,345.50		364,991.70		2,345,983.76		2,603,893.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	[illegible]0.00	105.33	22,119.30	120.38	25,279.26	87.38	18,349.80	59.37	12,467.70	207.76	43,629.06	252.08	52,936.80
(76)	RCPC, 76 cm diameter	L.M.	78.00	676.06	52,732.68	772.64	60,266.07	411.17	32,071.26	279.37	21,790.86	1,183.81	92,337.33	1,366.60	106,594.80
(91)	RCPC, 91 cm diameter	L.M.	26.00	981.44	25,517.44	1,121.65	29,162.86	570.35	14,829.10	394.73	10,262.98	1,692.00	43,991.96	1,946.52	50,609.52
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	39.00	1,668.47	65,070.33	1,906.83	74,366.28	891.77	34,779.03	659.04	25,702.56	2,798.50	109,145.31	3,219.28	125,551.92
(10)	Structural concrete for box pipe headwalls	CU.M.	225.00	1,448.20	325,845.00	1,655.09	372,395.22	1,305.89	293,825.25	497.05	111,836.25	2,960.98	666,220.47	3,251.14	731,506.50
(11)	Reinforcing steel for RCBC/RCPC	KG	14,300.00	1.61	23,023.00	1.84	26,312.07	21.04	300,872.00	3.09	44,187.00	22.68	327,184.07	25.74	368,082.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

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Table 4-5 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG – LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				4,498,754.79		5,141,446.90		3,352,720.31		2,319,283.43		8,494,167.21		10,170,758.53
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	868.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	41,925.00	1.61	67,499.25	1.84	77,142.19	21.04	882,102.00	3.09	129,548.25	22.88	959,244.19	25.74	1,079,149.50
405 (1)	Structural concrete, Class A	CU.M.	465.00	1,466.79	682,057.35	1,676.34	779,496.06	1,305.90	607,243.50	506.33	235,443.45	2,982.24	1,386,739.56	3,279.02	1,524,744.30
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				749,556.60		856,638.26		1,489,345.50		364,991.70		2,345,983.76		2,603,893.80
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	210.00	105.33	22,119.30	120.38	25,279.26	87.38	18,349.80	59.37	12,467.70	207.76	43,629.06	252.08	52,936.80
(76)	RCPC, 76 cm diameter	L.M.	78.00	676.06	52,732.68	772.64	60,266.07	411.17	32,071.26	279.37	21,790.86	1,183.81	92,337.33	1,366.60	106,594.80
(91)	RCPC, 91 cm diameter	L.M.	26.00	981.44	25,517.44	1,121.65	29,162.86	570.35	14,829.10	394.73	10,262.98	1,692.00	43,991.96	1,946.52	50,609.52
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	39.00	1,668.47	65,070.33	1,906.83	74,366.28	891.77	34,779.03	659.04	25,702.56	2,798.60	109,145.31	3,219.28	125,551.92
(10)	Structural concrete for box pipe headwalls	CU.M.	225.00	1,448.20	325,845.00	1,655.09	372,395.22	1,305.89	293,825.25	497.05	111,836.25	2,960.98	666,220.47	3,251.14	731,506.50
(11)	Reinforcing steel for RCBC/RCPC	KG	14,300.00	1.61	23,023.00	1.84	26,312.07	21.04	300,872.00	3.09	44,187.00	22.88	327,184.07	25.74	368,082.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

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Table 4-5 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4A: TABLANG– LAUR

SECTION LENGTH: 7.6 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	360.00	733.42	264,031.20	838.20	301,750.70	427.63	153,946.80	287.15	103,374.00	1,265.83	455,697.50	1,448.20	521,352.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				778,338.95		889,532.45		848,673.24		329,621.35		1,738,205.69		1,956,633.54
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(2)	Regulatory signs	EA	1.00	1,435.00	1,435.00	1,640.00	1,640.00	785.57	785.57	1,195.43	1,195.43	2,425.57	2,425.57	3,416.00	3,416.00
(3)	Informatory Signs	EA	1.00	5,559.04	5,559.04	6,353.20	6 353.20	3,102.72	3,102.72	4,206.24	4,206.24	9,455.92	9,455.92	12,868.00	12,868.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				8,429.04		9,633.21		4,673.86		6,597.10		14,307.07		19,700.00
	VI. LAND ACQUISITION	SQ.M.		2.99	0.00	2.29	0.00	2.00	0.00	0.20	0.00	2.00	0.00	4.20	0.00
	SUB-TOTAL OF SEGMENT 4A				7,709,514.68		8,810,895.95		6,397,187.16		3,947,349.48		15,208,083.11		18,054,051.32
	10% CONTINGENCIES				770,951.47		881,089.59		639,718.72		394,734.95		1,520,808.31		1,805,405.13
	SUB-TOTAL				8,480,466.15		9,691,985.54		7,036,905.88		4,342,084.43		16,728,891.42		19,859,456.45
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				848,046.61		969,198.55		703,690.59		434,208.44		1,672,889.14		1,985,945.65
	SUB-TOTAL				9,328,512.76		10,661,184.10		7,740,596.46		4,776,292.87		18,401,780.56		21,845,402.10
	8% SUPERVISION COST				746,281.02		852,894.73		619,247.72		382,103.43		1,472,142.44		1,747,632.17
	TOTAL SEGMENT COST				10,074,793.78		11,514,078.82		8,359,844.18		5,158,396.30		19,873,923.00		23,593,034.26

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	235,200.00	1.99	468,048.00	2.27	534,913.34	0.12	28,224.00	1.00	235,200.00	2.39	563,137.34	3.11	731,472.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	14,380.00	63.71	916,149.80	72.81	1,047,030.96	4.41	63,415.80	31.86	458,146.80	77.22	1,110,446.76	99.98	1,437,712.40
(2)	Common excavation	CU.M.	61,110.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	2,205.00	60.12	132,564.60	68.71	151,502.78	12.38	27,297.90	30.07	66,304.35	81.09	178,800.68	102.57	226,166.85
(2)	Bridge excavation	CU.M.	960.00	60.12	57,715.20	68.71	65,960.39	12.38	11,884.80	30.07	28,867.20	81.09	77,845.19	102.57	98,467.20
(3)	Foundation fill	CU.M.	580.00	105.33	61,091.40	120.38	69,818.92	87.38	50,680.40	59.37	34,434.60	207.76	120,499.32	252.08	146,206.40
(4)	Excavation below plan elevation	CU.M.	250.00	306.22	70,430.60	349.97	80,492.32	174.86	40,217.80	150.17	34,539.10	524.83	120,710.12	631.25	145,187.50
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,765.00	60.12	106,111.80	68.71	121,270.93	12.38	21,850.70	30.07	53,073.55	81.09	143,121.63	102.57	181,036.05
104 (1)	Embankment	CU.M.	61,110.00	62.06	3,792,456.60	70.93	4,334,281.24	24.81	1,516,139.10	33.80	2,065,518.00	95.74	5,850,420.34	120.67	7,374,143.70
(2)	Embankment, selected material	CU.M.	78,730.00	62.07	4,886,771.10	70.94	5,584,895.22	40.35	3,176,755.50	37.35	2,940,565.50	111.29	8,761,650.72	139.77	11,004,092.10
105 (1)	Subgrade preparation, common	SQ.M.	183,550.00	2.19	401,974.50	2.50	459,400.58	0.18	33,039.00	1.08	198,234.00	2.68	492,439.58	3.45	633,247.50
(2)	Subgrade preparation, exg. pavement	SQ.M.	47,265.00	4.38	207,020.70	5.01	236,595.68	0.46	21,741.90	2.16	102,092.40	5.47	258,337.58	7.00	330,855.00
	TOTAL TO EARTHWORK				11,100,364.30		12,686,162.34		4,991,246.90		6,216,975.50		17,677,409.24		22,308,586.70
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	70,600.00	132.59	9,360,854.00	151.53	10,698,145.60	66.24	4,676,544.00	69.17	4,883,402.00	217.77	15,374,689.60	268.00	18,920,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	30,510.00	129.67	3,956,231.70	148.19	4,521,418.96	233.84	7,134,458.40	70.64	2,155,226.40	382.03	11,655,877.36	434.15	13,245,916.50
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	190.00	5,786.87	1,099,505.30	6,613.58	1,256,580.63	1,996.68	379,369.20	2,172.74	412,820.60	8,610.26	1,635,949.83	9,956.29	1,891,695.10
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	0.00 634.01	0.00	0.00 797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	146,115.00	75.92	11,093,050.80	86.77	12,677,804.04	42.12	6,154,363.80	37.96	5,546,525.40	128.89	18,832,167.84	0.00 156.00	22,793,940.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQM		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQM		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	LM		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				25,509,641.80		29,153,949.23		18,344,735.40		12,997,974.40		47,496,684.63		56,852,351.60
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	LM		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,342.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	LM	8,940.00	364.08	3,254,875.20	0.00 416.09	0.00 3,719,866.67	472.32	4,222,540.80	147.60	1,319,544.00	888.41	7,942,407.47	0.00 984.00	8,796,960.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	LM	8,135.00	487.77	3,968,008.95	0.00 557.45	0.00 4,534,878.71	154.46	1,256,532.10	126.81	1,031,599.35	711.91	5,791,410.81	0.00 769.04	6,256,140.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	LM		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	LM	805.00	487.77	392,654.85	557.45	448,749.52	154.46	124,340.30	126.81	102,082.05	711.91	573,089.82	769.04	619,077.20
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	LM	640.00	571.20	365,568.00	652.80	417,793.04	452.25	289,440.00	197.17	126,188.80	1,105.05	707,233.04	1,220.62	781,196.80
404	Reinforcing steel for bridges/box culvert	KG	354,970.00	1.61	571,501.70	1.84	653,146.43	21.04	7,468,568.80	3.09	1,096,857.30	22.88	8,121,715.23	25.74	9,136,927.80
405 (1)	Structural concrete, Class A	CUM	2,300.00	1,466.79	3,373,617.00	1,676.34	3,855,571.92	1,305.90	3,003,570.00	506.33	1,164,559.00	2,982.24	6,859,141.92	3,279.02	7,541,746.00
(2)	Structural concrete, Class P	CUM	1,440.00	1,615.30	2,326,032.00	1,846.06	2,658,328.93	1,423.33	2,049,595.20	551.77	794,548.80	3,269.39	4,707,924.13	3,590.40	5,170,176.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	LS			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				14,346,919.70		16,396,520.65		18,496,731.20		5,666,933.30		34,895,251.85		38,512,584.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CUM	530.00	105.33	55,824.90	120.38	63,800.05	87.38	46,311.40	59.37	31,466.10	207.76	110,111.45	252.08	133,602.40
(76)	RCPC, 76 cm diameter	LM	26.00	676.06	17,577.56	772.64	20,088.69	411.17	10,690.42	279.37	7,263.62	1,183.81	30,779.11	1,366.60	35,531.60
(91)	RCPC, 91 cm diameter	LM		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	LM		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	LM	10.00	1,668.47	16,684.70	1,906.83	19,068.28	891.77	8,917.70	659.04	6,590.40	2,798.60	27,985.98	3,219.28	32,192.80
(10)	Structural concrete for box pipe headwalls	CUM	145.00	1,448.20	209,989.00	1,655.09	239,988.03	1,305.89	189,354.05	497.05	72,072.25	2,960.98	429,342.08	3,251.14	471,415.30
(11)	Reinforcing steel for RCBC/RCPC	KG	9,160.00	1.61	14,747.60	1.84	16,854.44	21.04	192,726.40	3.09	28,304.40	22.88	209,580.84	25.74	235,778.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	LM		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	2,190.00	733.42	1,606,189.80	838.20	1,835,650.07	427.63	936,509.70	287.15	628,858.50	1,265.83	2,772,159.77	1,448.20	3,171,558.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				1,921,013.56		2,195,449.56		1,384,509.67		774,555.27		3,579,959.23		4,080,078.50
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				22,598.08		25,826.44		12,490.00		17,975.92		38,316.44		53,064.00
	VI. LAND ACQUISITION	SQ.M.					0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 4B				52,900,537.44		60,457,908.22		43,231,713.17		25,674,414.39		103,689,621.39		121,806,665.00
	10% CONTINGENCIES				5,290,053.74		6,045,790.82		4,323,171.32		2,567,441.44		10,368,962.14		12,180,666.50
	SUB-TOTAL				58,190,591.18		66,503,699.04		47,554,884.49		28,241,855.83		114,058,583.53		133,987,331.50
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				5,819,059.12		6,650,369.90		4,755,488.45		2,824,185.58		11,405,858.35		13,3[illegible],733.15
	SUB-TOTAL				64,009,650.30		73,154,068.94		52,310,372.94		31,066,041.41		125,464,441.88		147,366,064.65
	8% SUPERVISION COST				5,120,772.02		5,852,325.52		4,184,829.83		2,485,283.31		10,037,155.35		11,790,885.17
	TOTAL SEGMENT COST				69,130,422.33		79,006,394.46		56,495,202.77		33,551,324.72		135,501,597.23		159,176,949.82

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	235,200.00	1.99	468,048.00	2.27	534,913.34	0.12	28,224.00	1.00	235,200.00	2.39	563,137.34	3.11	731,472.00
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	14,380.00	63.71	916,149.80	72.81	1,047,030.96	4.41	63,415.80	31.86	458,146.80	77.22	1,110,446.76	99.98	1,437,712.40
(2)	Common excavation	CU.M.	61,110.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	2,205.00	60.12	132,564.60	68.71	151,502.78	12.38	27,297.90	30.07	66,304.35	81.09	178,800.68	102.57	226,166.85
(2)	Bridge excavation	CU.M.	960.00	60.12	57,715.20	68.71	65,960.39	12.38	11,884.80	30.07	28,867.20	81.09	77,845.19	102.57	98,467.20
(3)	Foundation fill	CU.M.	580.00	105.33	61,091.40	120.38	69,818.92	87.38	50,680.40	59.37	34,434.60	207.76	120,499.32	252.08	146,206.40
(4)	Excavation below plan elevation	CU.M.	230.00	306.22	70,430.60	349.97	80,492.32	174.86	40,217.80	150.17	34,539.10	524.83	120,710.12	631.25	145,187.50
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,765.00	60.12	106,111.80	68.71	121,270.93	12.38	21,850.70	30.07	53,073.55	81.09	143,121.63	102.57	181,036.05
104 (1)	Embankment	CU.M.	61,110.00	62.06	3,792,486.60	70.93	4,334,281.24	24.81	1,516,139.10	33.80	2,065,518.00	95.74	5,850,420.34	120.67	7,374,143.70
(2)	Embankment, selected material	CU.M.	78,730.00	62.07	4,886,771.10	70.94	5,584,895.22	40.35	3,176,755.50	37.35	2,940,565.50	111.29	8,761,650.72	139.77	11,004,092.10
105 (1)	Subgrade preparation, common	SQ.M.	183,550.00	2.19	401,974.50	2.50	459,400.58	0.18	33,039.00	1.08	198,234.00	2.68	492,439.58	3.45	633,247.50
(2)	Subgrade preparation, extg. pavement	SQ.M.	47,265.00	4.38	207,020.70	5.01	236,595.68	0.46	21,741.90	2.16	102,092.40	5.47	258,337.58	7.00	330,855.00
	TOTAL TO EARTHWORK				11,100,364.30		12,686,162.34		4,991,246.90		6,216,975.50		17,677,409.24		22,308,586.70
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	95,050.00	132.59	12,602,679.50	151.53	14,403,098.29	66.24	6,296,112.00	69.17	6,574,608.50	217.77	20,699,210.29	268.00	25,473,400.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	32,010.00	129.67	4,150,736.70	148.19	4,743,710.94	233.84	7,485,218.40	70.64	2,261,186.40	382.03	12,228,929.34	[illegible]	13,897,141.50
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	[illegible]	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	185.00	5,786.87	1,070,570.95	6,613.58	1,223,512.72	1,996.68	369,385.80	2,172.74	401,956.90	8,610.26	1,592,898.52	9,956.29	1,841,913.65
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.	490.00	1,938.78	950,002.20	2,215.75	1,085,719.[illegible]	419.39	205,501.10	876.16	429,318.40	2,635.14	1,291,220.61	3,234.33	1,584,821.70
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.	7,305.00	457.11	3,339,188.55	522.41	3,816,225.03	111.60	815,238.00	228.55	1,669,557.75	0.00 634.01	4,631,463.03	0.00 797.26	5,823,984.30
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQM.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQM.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				22,113,177.90		25,272,266.49		15,171,455.30		11,336,627.95		40,443,721.79		48,621,261.15
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	8,940.00	364.08	3,254,875.20	416.09	3,719,866.67	472.32	4,222,540.80	147.60	1,319,544.00	888.41	7,942,407.47	984.00	8,796,960.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	8,135.00	487.77	3,968,008.95	557.45	4,534,878.71	154.46	1,256,532.10	126.81	1,031,599.35	711.91	5,791,410.81	769.04	6,256,140.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.	805.00	487.77	392,654.85	557.45	448,749.52	154.46	124,340.30	126.81	102,082.05	711.91	573,089.82	769.04	619,077.20
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.	640.00	571.20	365,568.00	652.80	417,793.04	452.25	289,440.00	197.17	126,188.80	1,105.05	707,233.04	1,220.62	781,196.80
404	Reinforcing steel for bridges/box culvert	KG	354,970.00	1.61	571,501.70	1.84	653,146.43	21.04	7,468,568.80	3.09	1,096,857.30	22.88	8,121,715.23	25.74	9,136,927.80
405 (1)	Structural concrete, Class A	CU.M.	2,300.00	1,466.79	3,373,617.00	1,676.34	3,855,571.92	1,305.90	3,003,570.00	506.33	1,164,559.00	2,982.24	6,859,141.92	3,279.02	7,541,746.00
(2)	Structural concrete, Class P	CU.M.	1,440.00	1,615.30	2,326,032.00	1,846.06	2,658,328.93	1,423.33	2,049,595.20	551.77	794,548.80	3,269.39	4,707,924.13	3,590.40	5,170,176.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				14,346,919.70		16,396,520.65		18,498,731.20		5,666,933.30		34,895,251.85		38,512,584.20
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	530.00	105.33	55,824.90	120.38	63,800.05	87.38	46,311.40	59.37	31,466.10	207.76	110,111.45	252.08	133,602.40
(76)	RCPC, 76 cm diameter	L.M.	26.00	676.06	17,577.56	772.64	20,088.69	411.17	10,690.42	279.37	7,263.62	1,183.81	30,779.11	1,366.60	35,531.60
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.	10.00	1,668.47	16,684.70	1,906.83	19,068.28	891.77	8,917.70	659.04	6,590.40	2,798.60	27,985.98	3,219.28	32,192.80
(10)	Structural concrete for box pipe headwalls	CU.M.	145.00	1,448.20	209,989.00	1,655.09	239,988.03	1,305.89	189,354.05	497.05	72,072.25	2,960.98	429,342.08	3,251.14	471,415.30
(11)	Reinforcing steel for RCBC/RCPC	KG	9,160.00	1.61	14,747.60	1.84	16,854.44	21.04	192,726.40	3.09	28,304.40	22.88	209,580.84	25.74	235,778.40
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	374.37	0.00	56.51	0.00	163.79	0.00	430.88	0.00	547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4B: LAUR – GABALDON

SECTION LENGTH: 26.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	2,190.00	733.42	1,606,189.80	838.20	1,835,650.07	427.63	936,509.70	287.15	628,858.50	1,265.83	2,772,159.77	1,448.20	3,171,558.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				1,921,013.56		2,195,449.96		1,384,509.67		774,555.27		3,579,959.23		4,080,078.50
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				22,598.08		25,826.44		12,490.00		17,975.92		38,316.44		53,064.00
	VI. LAND ACQUISITION	SQ.M.					0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 4B				49,504,073.54		56,576,225.49		40,058,433.07		24,013,067.94		96,634,658.56		113,575,574.55
	10% CONTINGENCIES				4,950,407.35		5,657,622.55		4,005,843.31		2,401,306.79		9,663,465.86		11,357,557.46
	SUB-TOTAL				54,454,480.89		62,233,848.03		44,064,276.38		26,414,374.73		106,298,124.41		124,933,132.01
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				5,445,448.09		6,223,384.80		4,406,427.64		2,641,437.47		10,629,812.44		12,493,313.20
	SUB-TOTAL				59,899,928.98		68,457,232.84		48,470,704.01		29,055,812.21		116,927,936.85		137,426,445.21
	8% SUPERVISION COST				4,791,994.32		5,476,578.63		3,877,656.32		2,324,464.98		9,354,234.95		10,994,115.62
	TOTAL SEGMENT COST				64,691,923.30		73,933,811.47		52,348,360.34		31,380,277.18		126,282,171.80		148,420,560.82

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				12,575,848.15		14,372,433.82		9,057,257.80		6,400,446.85		23,429,691.62		28,033,552.80
	III. STRUCTURES														
400 (4)	PC.PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC.PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	31,485.00	1.61	50,690.85	1.84	57932.54	21.04	662,444.40	3.09	97,288.65	22.88	720,376.94	25.74	810,423.90
405 (1)	Structural concrete, Class A	CU.M.	280.00	1,466.79	410,701.20	1676.34	469373.97	1,305.90	365,652.00	506.33	141,772.40	2,982.24	835,025.97	3,279.02	918,125.60
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110850.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				461,392.05		527,306.52		1,028,096.40		239,061.05		1,555,402.92		1,728,549.50
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	280.00	105.33	29,492.40	120.38	33,705.68	87.38	24,466.40	59.37	16,623.60	207.76	58,172.08	252.08	70,582.40
(76)	RCPC, 76 cm diameter	L.M.	143.00	676.06	96,676.58	772.64	110,487.80	411.17	58,797.31	279.37	39,949.91	1,183.81	169,285.11	1,366.60	195,423.80
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	200.00	1,448.20	289,640.00	1655.09	331,017.97	1,305.89	261,178.00	497.05	99,410.00	2,960.98	592,195.97	3,251.14	650,228.00
(11)	Reinforcing steel for RCBC/RCPC	KG	12,740.00	1.61	20,511.40	1.84	23,441.66	21.04	268,049.60	3.09	39,366.60	22.88	291,491.26	25.74	327,927.60
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	13,160.00	1.99	26,188.40	2.27	29,929.67	0.12	1,579.20	1.00	13,160.00	2.39	31,508.87	3.11	40,927.60
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	15,225.00	63.71	969,984.75	72.81	1,108,556.77	4.41	67,142.25	31.86	485,068.50	77.22	1,175,699.02	99.98	1,522,195.50
(2)	Common excavation	CU.M.	58,875.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	7,765.00	61.15	474,829.75	69.89	542,663.93	3.77	29,274.05	30.57	237,376.05	73.66	571,937.98	95.49	741,479.85
103 (1)	Structure excavation	CU.M.	1,575.00	60.12	94,689.00	68.71	108,216.27	12.38	19,498.50	30.07	47,360.25	81.09	127,714.77	102.57	161,547.75
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	700.00	60.12	42,084.00	68.71	48,096.12	12.38	8,666.00	30.07	21,049.00	81.09	56,762.12	102.57	71,799.00
104 (1)	Embankment	CU.M.	58,875.00	62.06	3,653,782.50	70.93	4,175,761.87	24.81	1,460,688.75	33.80	1,989,975.00	95.74	5,636,450.62	120.67	7,104,446.25
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	101,960.00	2.19	223,292.40	2.50	255,191.95	0.18	18,352.80	1.08	110,116.80	2.68	273,544.75	3.45	351,762.00
(2)	Subgrade preparation, exg. pavement	SQ.M.	21,890.00	4.38	95,878.20	5.01	109,575.36	0.46	10,069.40	2.16	47,282.40	5.47	119,644.76	7.00	153,230.00
	TOTAL TO EARTHWORK				5,580,729.00		6,377,991.94		1,615,270.95		2,951,388.00		7,993,262.89		10,147,387.95
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	32,595.00	132.59	4,321,771.05	151.53	4,939,179.26	66.24	2,159,092.80	69.17	2,254,596.15	217.77	7,098,272.06	268.00	8,735,460.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	15,035.00	129.67	1,949,588.45	148.19	2,228,106.66	233.84	3,515,784.40	70.64	1,062,072.40	382.03	5,743,891.06	434.15	6,527,445.25
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	95.00	5,786.87	549,752.65	6613.58	628,290.31	1,996.68	189,684.60	2,172.74	206,410.30	8,610.26	817,974.91	9,956.29	945,847.55
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete											0.00		0.00	
	Binder/wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	75,800.00	75.92	5,754,736.00	86.77	6,576,857.58	42.12	3,192,696.00	37.96	2,877,368.00	128.89	9,769,553.58	0.00 156.00	11,824,800.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,500.00	286.05	429,075.00	326.92	490,372.65	170.46	255,690.00	115.11	172,665.00	497.38	746,062.65	571.62	857,430.00
	TOTAL TO DRAINAGE EROSION WORKS				865,395.38		989,025.76		868,181.31		368,015.11		1,857,207.07		2,101,591.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	10.00	5,559.04	55,590.40	6353.20	63,532.04	3,102.72	31,027.20	4,206.24	42,062.40	9,455.92	94,559.24	12,868.00	128,680.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				61,330.40		70,092.06		34,169.48		46,844.12		104,261.54		142,344.00
	VI. LAND ACQUASITION	SQ.M.			0.00		0.00	2.00	0.00	0.29	0.00	2.90	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 4C				19,544,694.98		22,336,850.10		12,602,975.94		10,005,755.13		34,939,826.04		42,153,426.05
	10% CONTINGENCIES				1,954,469.50		2,233,685.01		1,260,297.59		1,000,575.51		3,493,982.60		4,215,342.61
	SUB-TOTAL				21,499,164.48		24,570,535.12		13,863,273.53		11,006,330.64		38,433,808.65		46,368,768.66
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,149,916.45		2,457,053.51		1,386,327.35		1,100,633.06		3,843,380.86		4,636,876.87
	SUB-TOTAL				23,649,080.93		27,027,588.63		15,249,600.89		12,106,963.71		42,277,189.51		51,005,645.52
	8% SUPERVISION COST				1,891,926.47		2,162,207.09		1,219,968.07		968,557.10		3,382,175.16		4,080,451.64
	TOTAL SEGMENT COST				25,541,007.40		29,189,795.72		16,469,568.96		13,075,520.80		45,659,364.68		55,086,097.16

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	13,160.00	1.99	26,188.40	2.27	29,929.67	0.12	1,579.20	1.00	13,160.00	2.39	31,508.87	3.11	40,927.60
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	15,225.00	63.71	969,984.75	72.81	1,108,556.77	4.41	67,142.25	31.86	485,068.50	77.22	1,175,699.02	99.98	1,522,195.50
(2)	Common excavation	CU.M.	58,875.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	7,765.00	61.15	474,829.75	69.89	542,663.93	3.77	29,274.05	30.57	237,376.05	73.66	571,937.98	95.49	741,479.85
103 (1)	Structure excavation	CU.M.	1,575.00	60.12	94,689.00	68.71	108,216.27	12.38	19,498.50	30.07	47,360.25	81.09	127,714.77	102.57	161,547.75
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.		306.22	0.00	349.97	0.00	174.86	0.00	150.17	0.00	524.83	0.00	631.25	0.00
(5)	Shoring, cribbing, etc.(Included in Item 103(4)).														
(6)	Pipe culvert excavation	CU.M.	700.00	60.12	42,084.00	68.71	48,096.12	12.38	8,666.00	30.07	21,049.00	81.09	56,762.12	102.57	71,799.00
104 (1)	Embankment	CU.M.	58,875.00	62.06	3,653,782.50	70.93	4,175,761.87	24.81	1,460,688.75	33.80	1,989,975.00	95.74	5,636,450.62	120.67	7,104,446.25
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	101,960.00	2.19	223,292.40	2.50	255,191.95	0.18	18,352.80	1.08	110,116.80	2.68	273,544.75	3.45	351,762.00
(2)	Subgrade preparation, exig. pavement	SQ.M.	21,890.00	4.38	95,878.20	5.01	109,575.36	0.46	10,069.40	2.16	47,282.40	5.47	119,644.76	7.00	153,230.00
	TOTAL TO EARTHWORK				5,580,729.00		6,377,991.94		1,615,270.95		2,951,388.00		7,993,262.89		10,147,387.95
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	35,715.00	132.59	4,735,451.85	151.53	5,411,958.50	66.24	2,365,761.60	69.17	2,470,406.55	217.77	7,777,720.10	268.00	9,571,620.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	18,660.00	129.67	2,419,642.20	148.19	2,765,312.28	233.84	4,363,454.40	70.64	1,318,142.40	382.03	7,128,766.68	434.15	8,101,239.00
208	Soil aggregate shoulder	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	95.00	5,786.87	549,752.65	6613.58	628,290.31	1,996.68	189,684.60	2,172.74	206,410.30	8,610.26	817,974.91	9,956.29	945,847.55
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.	255.00	1,938.78	494,388.90	2215.75	565,017.30	419.39	106,944.45	876.16	223,420.80	2,635.14	671,961.75	3,234.33	824,754.15
(2)	Aggregate for bituminous concrete Binder/wearing course	CU.M.	3,790.00	457.11	1,732,446.90	522.41	1,979,944.26	111.60	422,964.00	228.55	866,204.50	0.00 634.01	2,402,908.26	0.00 797.26	3,021,615.40
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	418.95	0.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				9,931,682.50		11,350,522.66		7,448,809.05		5,064,584.55		18,799,331.71		22,465,076.10
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	416.09	0.00	472.32	0.00	147.60	0.00	888.41	0.00	984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	31,485.00	1.61	50,690.85	1.84	57932.54	21.04	662,444.40	3.09	97,288.65	22.88	720,376.94	25.74	810,423.90
405 (1)	Structural concrete, Class A	CU.M.	280.00	1,466.79	410,701.20	1676.34	469373.97	1,305.90	365,652.00	506.33	141,772.40	2,982.24	835,025.97	3,279.02	918,125.60
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				461,392.05		527,306.52		1,028,096.40		239,061.05		1,555,402.92		1,728,549.50
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	280.00	105.33	29,492.40	120.38	33,705.68	87.38	24,466.40	59.37	16,623.60	207.76	58,172.08	252.08	70,582.40
(76)	RCPC, 76 cm diameter	L.M.	143.00	676.06	96,676.58	772.64	110,487.80	411.17	58,797.31	279.37	39,949.91	1,183.81	169,285.11	1,366.60	195,423.80
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	200.00	1,448.20	289,640.00	1655.09	331,017.97	1,305.89	261,178.00	497.05	99,410.00	2,960.98	592,195.97	3,251.14	650,228.00
(11)	Reinforcing steel for RCBC/RCPC	KG	12,740.00	1.61	20,511.40	1.84	23,441.66	21.04	268,049.60	3.09	39,366.60	22.88	291,491.26	25.74	327,927.60
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	374.37	0.00	56.51	0.00	163.79	0.00	430.88	0.00	547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 4C: GABALDON – DINGALAN

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Double Bituminous Surface Treatment

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,500.00	286.05	429,075.00	326.92	490,372.65	170.46	255,690.00	115.11	172,665.00	497.38	746,062.65	571.62	857,430.00
	TOTAL TO DRAINAGE EROSION WORKS				865,395.38		989,025.76		868,181.31		368,015.11		1,857,207.07		2,101,591.80
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	10.00	5,559.04	55,590.40	6353.20	63,532.04	3,102.72	31,027.20	4,206.24	42,062.40	9,455.92	94,559.24	12,868.00	128,680.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				61,330.40		70,092.06		34,169.48		46,844.12		104,261.54		142,344.00
	VI. LAND ACQUISITION	SQ.M.			0.00		0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL OF SEGMENT 4C				16,900,529.33		19,314,938.95		10,994,527.19		8,689,892.83		30,309,466.14		36,584,949.35
	10% CONTINGENCIES				1,690,052.93		1,931,493.90		1,099,452.72		868,989.28		3,030,946.61		3,658,494.94
	SUB-TOTAL				18,590,582.26		21,246,432.85		12,093,979.91		9,558,882.11		33,340,412.75		40,243,444.29
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,859,058.23		2,124,643.28		1,209,397.99		955,888.21		3,334,041.28		4,024,344.43
	SUB-TOTAL				20,449,640.49		23,371,076.13		13,303,377.90		10,514,770.32		36,674,454.03		44,267,788.71
	8% SUPERVISION COST				1,635,971.24		1,869,686.09		1,064,270.23		841,181.63		2,933,956.32		3,541,423.10
	TOTAL SEGMENT COST				22,085,611.73		25,240,762.22		14,367,648.13		11,355,951.95		39,608,410.35		47,809,211.81

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM 38(BAZAL-CANILE RD.)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	577,765.00	1.99	1,149,752.35	2.27	1,314,005.97	0.12	69,331.80	1.00	577,765.00	2.39	1,383,337.77	3.11	1,796,849.15
(3)	Tree Removal, Large	EA	5,700.00	56.27	320,739.00	64.31	366,559.77	103.21	588,297.00	28.19	160,683.00	167.52	954,856.77	187.67	1,069,719.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	206,270.00	63.71	13,141,461.70	72.81	15,018,850.92	4.41	909,650.70	31.86	6,571,762.20	77.22	15,928,501.62	99.98	20,622,874.60
(2)	Common excavation	CU.M.	794,360.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	109,720.00	61.15	6,709,378.00	69.89	7,667,879.74	3.77	413,644.40	30.57	3,354,140.40	73.66	8,081,524.14	95.49	10,477,162.80
103 (1)	Structure excavation	CU.M.	945.00	60.12	56,813.40	68.71	64,929.76	12.38	11,699.10	30.07	28,416.15	81.09	76,628.86	102.57	96,928.65
(2)	Bridge excavation	CU.M.	440.00	60.12	26,452.80	68.71	30,231.85	12.38	5,447.20	30.07	13,230.80	81.09	35,679.05	102.57	45,130.80
(3)	Foundation fill	CU.M.	150.00	105.33	15,799.50	120.38	18,056.62	87.38	13,107.00	59.37	8,905.50	207.76	31,163.62	252.08	37,812.00
(4)	Excavation below plan elevation	CU.M.	175.00	306.22	53,588.50	349.97	61,244.15	174.86	30,600.50	150.17	26,279.75	524.63	91,844.65	631.25	110,468.75
(5)	Shoring, cribbing, etc.(Included in Item103(4)).														
(6)	Pipe culvert excavation	CU.M.	1,260.00	60.12	75,751.20	68.71	86,573.02	12.38	15,598.80	30.07	37,888.20	81.09	102,171.82	102.57	129,238.20
104 (1)	Embankment	CU.M.	794,360.00	62.06	49,297,981.60	70.93	56,340,691.25	24.81	19,708,071.60	33.80	26,849,368.00	95.74	76,048,762.85	120.67	95,855,421.20
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	163,200.00	2.19	357,408.00	2.50	408,467.31	0.18	29,376.00	1.08	176,256.00	2.68	437,843.31	3.45	563,040.00
(2)	Subgrade preparation, exig. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				71,205,126.05		81,377,490.36		21,794,824.10		37,804,695.00		103,172,314.46		130,804,645.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	57,125.00	132.59	7,574,203.75	151.53	8,656,254.50	66.24	3,783,960.00	69.17	3,951,336.25	217.77	12,440,214.50	268.00	15,309,500.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	29,050.00	129.67	3,766,913.50	148.19	4,305,054.76	233.84	6,793,052.00	70.64	2,052,092.00	382.03	11,098,106.76	434.15	12,612,057.50
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	120.00	5,786.87	694,424.40	6,613.58	793,629.87	1,996.68	239,601.60	2,172.74	260,728.80	8,610.26	1,033,231.47	9,956.29	1,194,754.80
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bit.binder course (2" thick)	SQ.M.	102,000.00	75.92	7,743,840.00	86.77	8,850,124.98	42.12	4,296,240.00	37.96	3,871,920.00	128.89	13,146,364.98	0.00 156.00	15,912,000.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM.38(BAZAL-CANILE RD.)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	396.85	0.00	448.95	0.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				19,779,381.65		22,605,064.11		15,112,853.60		10,136,077.05		37,717,917.71		45,028,312.30
	III. STRUCTURES														
400 (4)	PC.PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	3,420.00	364.08	1,245,153.60	416.09	1,423,036.24	472.32	1,615,334.40	147.60	504,792.00	888.41	3,038,370.64	984.00	3,365,280.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	3,120.00	487.77	1,521,842.40	557.45	1,739,252.81	154.46	481,915.20	126.81	395,647.20	711.91	2,221,168.01	769.04	2,399,404.80
(14)	PC.PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(15)	Test piles, driven	L.M.	300.00	487.77	146,331.00	557.45	167,235.85	154.46	46,338.00	126.81	38,043.00	711.91	213,573.85	769.04	230,712.00
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.	260.00	571.20	148,512.00	652.80	169,728.42	452.25	117,585.00	197.17	51,264.20	1,105.05	287,313.42	1,220.62	317,361.20
404	Reinforcing steel for bridges/box culvert	KG	187,620.00	1.61	302,068.20	1.84	345,221.66	21.04	3,947,524.80	3.09	579,745.80	22.88	4,292,746.46	25.74	4,829,338.80
405 (1)	Structural concrete, Class A	CU.M.	815.00	1,466.79	1,195,433.85	1,676.34	1,366,213.53	1,305.90	1,064,308.50	506.33	412,658.95	2,982.24	2,430,522.03	3,279.02	2,672,401.30
(2)	Structural concrete, Class P	CU.M.	720.00	1,615.30	1,163,016.00	1,846.06	1,329,164.47	1,423.33	1,024,797.60	551.77	397,274.40	3,269.39	2,353,962.07	3,590.40	2,585,068.00
406 (1)	P.S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				5,817,019.05		6,648,038.39		8,381,947.50		2,410,979.55		15,029,965.89		16,609,946.10
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	510.00	105.33	53,718.30	120.38	61,392.50	87.38	44,563.80	59.37	30,278.70	207.76	105,956.30	252.08	128,560.80
(76)	RCPC, 76 cm diameter	L.M.	351.00	676.06	237,297.06	772.64	271,197.32	411.17	144,320.67	279.37	98,058.87	1,183.81	415,517.99	1,366.60	479,676.60
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	205.00	1,448.20	296,881.00	1,655.09	339,293.42	1,305.89	267,707.45	497.05	101,895.25	2,960.98	607,000.87	3,251.14	666,483.70
(11)	Reinforcing steel for RCBC/RCPC	KG	17,800.00	1.61	28,658.00	1.84	32,752.08	21.04	374,512.00	3.09	55,002.00	22.88	407,264.08	25.74	458,172.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM 38(BAZAL-CANILE RD.)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	120.00	733.42	88,010.40	838.20	100,583.57	427.63	51,315.60	287.15	34,458.00	1,265.83	151,899.17	1,448.20	173,784.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,700.00	286.05	486,285.00	326.92	555,755.68	170.46	289,782.00	115.11	195,687.00	497.38	845,537.68	571.62	971,754.00
	TOTAL TO DRAINAGE EROSION WORKS				1,190,849.76		1,360,974.56		1,172,201.52		515,379.82		2,533,176.08		2,878,431.10
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	1,000.00	396.00	396,000.00	452.57	452,572.56	247.56	247,560.00	346.56	346,560.00	700.13	700,132.56	990.12	990,120.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Seeding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.94	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				441,558.08		504,639.07		272,619.12		383,662.80		777,258.19		1,097,840.00
	VI. LAND ACQUISITION	SQ.M.	5,000.00		0.00	0.00	0.00	2.00	10,000.00	0.20	1,000.00	2.00	10,000.00	2.20	11,000.00
	SUB-TOTAL TO SEGMENT IC				98,433,934.59		112,496,206.49	2.22	47,754,445.84		51,352,794.22		160,250,652.33		197,541,174.65
	10% CONTINGENCIES				9,843,393.46		11,249,620.65	0.22	4,775,444.58		5,135,279.42		16,025,065.23		19,754,117.47
	SUB-TOTAL				108,277,328.05		123,745,827.13		52,529,890.42		56,488,073.64		176,275,717.56		217,295,292.12
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				10,827,732.80		12,374,582.71		5,252,989.04		5,648,807.36		17,627,571.76		21,729,529.21
	SUB-TOTAL				119,105,060.85		136,120,409.85		57,782,879.47		62,136,881.01		193,903,289.31		239,024,821.33
	8% SUPERVISION COST				9,528,404.87		10,889,632.79		4,622,630.36		4,970,950.48		15,512,263.15		19,121,985.71
	TOTAL SEGMENT COST				128,633,465.72		147,010,042.64		62,405,509.82		67,107,831.49		209,415,552.46		258,146,807.03

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM.38(BAZAL-CANILE RD.)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: PCCP/DBST

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	577,765.00	1.99	1,149,752.35	2.27	1,314,005.97	0.12	69,331.80	1.00	577,765.00	2.39	1,383,337.77	3.11	1,796,849.15
(3)	Tree Removal, Large	EA	5,700.00	56.27	320,739.00	64.31	366,559.77	103.21	588,297.00	28.19	160,683.00	167.52	954,856.77	187.67	1,069,719.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	206,270.00	63.71	13,141,461.70	72.81	15,018,850.92	4.41	909,650.70	31.86	6,571,762.20	77.22	15,928,501.62	99.98	20,622,874.60
(2)	Common excavation	CU.M.	794,360.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.	109,720.00	61.15	6,709,378.00	69.89	7,667,879.74	3.77	413,644.40	30.57	3,354,140.40	73.66	8,081,524.14	95.49	10,477,162.80
103 (1)	Structure excavation	CU.M.	945.00	60.12	56,813.40	68.71	64,929.76	12.38	11,699.10	30.07	28,416.15	81.09	76,628.86	102.57	96,928.65
(2)	Bridge excavation	CU.M.	440.00	60.12	26,452.80	68.71	30,231.85	12.38	5,447.20	30.07	13,230.80	81.09	35,679.05	102.57	45,130.80
(3)	Foundation fill	CU.M.	150.00	105.33	15,799.50	120.38	18,056.62	87.38	13,107.00	59.37	8,905.50	207.76	31,163.62	252.08	37,812.00
(4)	Excavation below plan elevation	CU.M.	175.00	306.22	53,588.50	349.97	61,244.15	174.86	30,600.50	150.17	26,279.75	524.83	91,844.65	631.25	110,468.75
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	1,260.00	60.12	75,751.20	68.71	86,573.02	12.38	15,598.80	30.07	37,888.20	81.09	102,171.82	102.57	129,238.20
104 (1)	Embankment	CU.M.	794,360.00	62.06	49,297,981.60	70.93	56,340,691.25	24.81	19,708,071.60	33.80	26,849,368.00	95.74	76,048,762.85	120.67	95,855,421.20
(2)	Embankment, selected material	CU.M.		62.07	0.00	70.94	0.00	40.35	0.00	37.35	0.00	111.29	0.00	139.77	0.00
105 (1)	Subgrade preparation, common	SQ.M.	163,200.00	2.19	357,408.00	2.50	408,467.31	0.18	29,376.00	1.08	176,256.00	2.68	437,843.31	3.45	563,040.00
(2)	Subgrade preparation, extg. pavement	SQ.M.		4.38	0.00	5.01	0.00	0.46	0.00	2.16	0.00	5.47	0.00	7.00	0.00
	TOTAL TO EARTHWORK				71,205,126.05		81,377,490.36		21,794,824.10		37,804,695.00		103,172,314.46		130,804,645.15
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	54,910.00	132.59	7,280,516.90	151.53	8,320,611.54	66.24	3,637,238.40	69.17	3,798,124.70	217.77	11,957,849.94	268.00	14,715,880.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	25,080.00	129.67	3,252,123.60	148.19	3,716,721.98	233.84	5,864,707.20	70.64	1,771,651.20	382.03	9,581,429.18	434.15	10,888,482.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	90.00	5,786.87	520,818.30	6,613.58	595,222.40	1,996.68	179,701.20	2,172.74	195,546.60	8,610.26	774,923.60	9,956.29	896,066.10
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.	240.00	1,938.78	465,307.20	2,215.75	531,780.99	419.39	100,653.60	876.16	210,278.40	2,635.14	632,434.59	3,234.33	776,239.20
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.	2,880.00	457.11	1,316,476.80	522.41	1,504,548.68	111.60	321,408.00	228.55	658,224.00	634.01	1,825,956.68	797.26	2,296,108.80
310 (1)	Bitbinder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.39	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM 38(BAZAL-CANILE RD)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: PCCP/DBST

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	30,000.00	224.02	6,720,600.00	256.02	7,680,704.92	142.83	4,284,900.00	82.10	2,463,000.00	398.85	11,965,604.92	448.95	13,468,500.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				19,555,842.80		22,349,590.50		14,388,608.40		9,096,824.90		36,738,198.90		43,041,276.10
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	3,420.00	364.08	1,245,153.60	0.00 / 416.09	0.00 / 1,423,036.24	472.32	1,615,334.40	147.60	504,792.00	888.41	3,038,370.64	0.00 / 984.00	3,365,280.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	3,120.00	487.77	1,521,842.40	0.00 / 557.45	0.00 / 1,739,252.81	154.46	481,915.20	126.81	395,647.20	711.91	2,221,168.01	0.00 / 769.04	2,399,404.80
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 / 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 / 769.04	0.00
(15)	Test piles, driven	L.M.	300.00	487.77	146,331.00	557.45	167,235.85	154.46	46,338.00	126.81	38,043.00	711.91	213,573.85	769.04	230,712.00
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,868.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.	260.00	571.20	148,512.00	652.80	169,728.42	452.25	117,585.00	197.17	51,264.20	1,105.05	287,313.42	1,220.62	317,361.20
404	Reinforcing steel for bridges/box culvert	KG	187,620.00	1.61	302,068.20	1.84	345,221.66	21.04	3,947,524.80	3.09	579,745.80	22.88	4,292,746.46	25.74	4,829,338.80
405 (1)	Structural concrete, Class A	CU.M.	815.00	1,466.79	1,195,433.85	1,676.34	1,366,213.53	1,305.90	1,064,308.50	506.33	412,658.95	2,982.24	2,430,522.03	3,279.02	2,672,401.30
(2)	Structural concrete, Class P	CU.M.	720.00	1,615.30	1,163,016.00	1,846.06	1,329,164.47	1,423.33	1,024,797.60	551.77	397,274.40	3,269.39	2,353,962.07	3,590.40	2,585,088.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				5,817,019.05		6,648,038.39		8,381,947.50		2,410,979.55		15,029,985.89		16,609,946.10
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	510.00	105.33	53,718.30	120.38	61,392.50	87.38	44,563.80	59.37	30,278.70	207.76	105,956.30	252.08	128,560.80
(76)	RCPC, 76 cm diameter	L.M.	351.00	676.06	237,297.06	772.64	271,197.32	411.17	144,320.67	279.37	98,058.87	1,183.81	415,517.99	1,366.60	479,676.60
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	691.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	205.00	1,448.20	296,881.00	1,655.09	339,293.42	1,305.89	267,707.45	497.05	101,895.25	2,960.98	607,000.87	3,251.14	666,483.70
(11)	Reinforcing steel for RCBC/RCPC	KG	17,800.00	1.61	28,658.00	1.84	32,752.08	21.04	374,512.00	3.09	55,002.00	22.88	407,264.08	25.74	458,172.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 / 374.37	0.00	56.51	0.00	163.79	0.00	0.00 / 430.88	0.00	0.00 / 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5A: PROVINCIAL BOUNDARY – KM.38(BAZAL-CANILE RD.)

SECTION LENGTH: 17 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: PCCP/DBST

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.	120.00	733.42	88,010.40	838.20	100,583.57	427.63	51,315.60	287.15	34,458.00	1,265.83	151,899.17	1,448.20	173,784.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,700.00	286.05	486,285.00	326.92	555,755.68	170.46	289,782.00	115.11	195,687.00	497.38	845,537.68	571.62	971,754.00
	TOTAL TO DRAINAGE EROSION WORKS				1,190,849.76		1,360,974.56		1,172,201.52		515,379.82		2,533,176.08		2,878,431.10
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	1,000.00	396.00	396,000.00	452.57	452,572.56	247.56	247,560.00	346.56	346,560.00	700.13	700,132.56	990.12	990,120.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.06	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	4.00	1,435.00	5,740.00	1,640.00	6,560.02	785.57	3,142.28	1,195.43	4,781.72	2,425.57	9,702.30	3,416.00	13,664.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				441,558.08		504,639.07		272,619.12		383,662.80		777,258.19		1,097,840.00
	VI. LAND ACQUISITION	SQ.M.	510,000.00		0.00	0.00	0.00	2.00	1,020,000.00	0.20	102,000.00	2.00	1,020,000.00	2.20	1,122,000.00
	SUB-TOTAL OF SEGMENT				98,210,395.74		112,240,732.88	2.22	47,030,200.64		50,313,542.07		159,270,933.52		195,554,138.45
	10% CONTINGENCIES				9,821,039.57		11,224,073.29	0.22	4,703,020.06		5,031,354.21		15,927,093.35		19,555,413.85
	SUB-TOTAL				108,031,435.31		123,464,806.16		51,733,220.70		55,344,896.28		175,198,026.87		215,109,552.30
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				10,803,143.53		12,346,480.62		5,173,322.07		5,534,489.63		17,519,802.69		21,510,955.23
	SUB-TOTAL				118,834,578.85		135,811,286.78		56,906,542.77		60,879,385.90		192,717,829.55		236,620,507.52
	8% SUPERVISION COST				9,506,766.31		10,864,902.94		4,552,523.42		4,870,350.87		15,417,426.36		18,929,640.60
	TOTAL SEGMENT COST				128,341,345.15		146,676,189.72		61,459,066.20		65,749,736.78		208,135,255.92		255,550,148.13

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	493,975.00	1.99	983,010.25	2.27	1,123,443.09	0.12	59,277.00	1.00	493,975.00	2.39	1,182,720.09	3.11	1,536,262.25
(3)	Tree Removal, Large	EA	500.00	56.27	28,135.00	64.31	32,154.37	103.21	51,605.00	28.19	14,095.00	167.52	83,759.37	187.67	93,835.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	119,720.00	63.71	7,627,361.20	72.81	8,717,006.02	4.41	527,965.20	31.86	3,814,279.20	77.22	9,244,971.22	99.98	11,969,605.60
(2)	Common excavation	CU.M.	508,775.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	4,725.00	60.12	284,067.00	68.71	324,648.81	12.38	58,495.50	30.07	142,080.75	81.09	383,144.31	102.57	484,643.25
(2)	Bridge excavation	CU.M.	710.00	60.12	42,685.20	68.71	48,783.21	12.38	8,789.80	30.07	21,349.70	81.09	57,573.01	102.57	72,824.70
(3)	Foundation fill	CU.M.	285.00	105.33	30,019.05	120.38	34,307.57	87.38	24,903.30	59.37	16,920.45	207.76	59,210.87	252.06	71,842.80
(4)	Excavation below plan elevation	CU.M.	355.00	306.22	108,708.10	349.97	124,238.14	174.86	62,075.30	150.17	53,310.35	524.83	186,313.44	631.25	224,093.75
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	475.00	60.12	28,557.00	68.71	32,636.65	12.38	5,880.50	30.07	14,283.25	81.09	38,517.15	102.57	48,720.75
104 (1)	Embankment	CU.M.	508,775.00	62.06	31,574,576.50	70.93	36,085,320.50	24.81	12,622,707.75	33.80	17,196,595.00	95.74	48,708,028.25	120.67	61,393,879.25
(2)	Embankment, selected material	CU.M.	106,580.00	62.07	6,615,420.60	70.94	7,560,499.59	40.35	4,300,503.00	37.35	3,980,763.00	111.29	11,861,002.59	139.77	14,896,686.60
105 (1)	Subgrade preparation, common	SQ.M.	276,415.00	2.19	605,348.85	2.50	691,828.99	0.18	49,754.70	1.08	298,528.20	2.68	741,583.69	3.45	953,631.75
(2)	Subgrade preparation, exig. pavement	SQ.M.	31,690.00	4.38	138,802.20	5.01	158,631.48	0.46	14,577.40	2.16	68,450.40	5.47	173,208.88	7.00	221,830.00
	TOTAL TO EARTHWORK				48,066,690.95		54,933,498.42		17,786,534.45		26,114,630.30		72,720,032.87		91,967,855.70
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	18,585.00	132.59	2,464,185.15	151.53	2,816,218.64	66.24	1,231,070.40	69.17	1,285,524.45	217.77	4,047,289.04	268.00	4,980,780.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	45,360.00	129.67	5,881,831.20	148.19	6,722,109.61	233.84	10,606,962.40	70.64	3,204,230.40	382.03	17,329,092.01	434.15	19,693,044.00
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	189,000.00	224.02	42,339,780.00	256.02	48,388,440.97	142.83	26,994,870.00	82.10	15,516,900.00	398.85	75,383,310.97	448.95	84,851,550.00
(2)	Patching exig. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				50,685,796.35		57,926,769.22		38,832,922.80		20,006,654.85		96,759,692.02		109,525,374.00
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	2,880.00	364.08	1,04[illegible],550.40	0.00 416.09	0.00 1,198,346.31	472.32	1,360,281.60	147.60	425,088.00	888.41	2,558,627.91	0.00 984.00	2,833,920.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	2,535.00	487.77	1,236,496.95	0.00 557.45	0.00 1,413,142.90	154.46	391,556.10	126.81	321,463.35	711.91	1,804,699.00	0.00 769.04	1,949,516.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.	345.00	487.77	168,280.65	557.45	192,321.22	154.46	53,283.70	126.81	43,749.45	711.91	245,609.92	769.04	265,318.80
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.	210.00	571.20	119,952.00	652.80	137,088.34	452.25	94,972.50	197.17	41,405.70	1,105.05	232,060.84	1,220.62	256,330.20
404	Reinforcing steel for bridges/box culvert	KG	180,000.00	1.61	289,800.00	1.84	331,200.83	21.04	3,787,200.00	3.09	556,200.00	22.88	4,118,400.83	25.74	4,633,200.00
405 (1)	Structural concrete, Class A	CU.M.	1,760.00	1,466.79	2,581,550.40	1,676.34	2,950,350.69	1,305.90	2,298,384.00	506.33	891,140.80	2,982.24	5,248,734.69	3,279.02	5,771,075.20
(2)	Structural concrete, Class P	CU.M.	580.00	1,615.30	936,874.00	1,846.06	1,070,715.02	1,423.33	825,531.40	551.77	320,026.60	3,269.39	1,896,247.22	3,590.40	2,082,432.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				6,476,166.40		7,401,351.53		8,895,358.30		2,630,627.90		16,296,709.83		18,002,152.60
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	145.00	105.33	15,272.85	120.38	17,454.73	87.38	12,670.10	59.37	8,608.65	207.76	30,124.83	252.08	36,551.60
(76)	RCPC, 76 cm diameter	L.M.	97.00	676.06	65,577.82	772.64	74,946.27	411.17	39,883.49	279.37	27,098.89	1,183.81	114,829.76	1,366.60	132,560.20
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	40.00	1,448.20	57,928.00	1,655.09	66,203.59	1,305.89	52,235.60	497.05	19,882.00	2,960.98	118,439.19	3,251.14	130,045.60
(11)	Reinforcing steel for RCBC/RCPC	KG	2,425.00	1.61	3,904.25	1.84	4,462.01	21.04	51,022.00	3.09	7,493.25	22.88	55,484.01	25.74	62,419.50
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.	1,500.00	286.05	429,075.00	326.92	490,372.65	170.46	255,690.00	115.11	172,665.00	497.38	746,062.65	571.62	857,430.00
	TOTAL TO DRAINAGE EROSION WORKS				571,757.92		653,439.26		411,501.19		235,747.79		1,064,940.45		1,219,006.90
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.	500.00	396.00	198,000.00	452.57	226,286.28	247.56	123,780.00	346.56	173,280.00	700.13	350,066.28	990.12	495,060.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(3)	Informatory Signs	EA	8.00	5,559.04	44,472.32	6,353.20	50,825.64	3,102.72	24,821.76	4,206.24	33,649.92	9,455.92	75,647.40	12,868.00	102,944.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				285,522.32		326,312.04		172,168.86		242,792.82		498,480.90		700,484.00
	VI. LAND ACQUISITION	SQ.M.	43,300.00		0.00	0.00	0.00	2.00	86,600.00	0.20	8,660.00	2.00	86,600.00	2.20	95,260.00
	SUB-TOTAL TO SEGMENT IC				106,085,933.94		121,241,370.46	2.22	66,185,085.60		49,239,113.66		187,426,456.06		221,510,133.20
	10% CONTINGENCIES				10,608,593.39		12,124,137.05	0.22	6,618,508.56		4,923,911.37		18,742,645.61		22,151,013.32
	SUB-TOTAL				116,694,527.33		133,365,507.51		72,803,594.16		54,163,025.03		206,169,101.67		243,661,146.52
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				11,669,452.73		13,336,550.75		7,280,359.42		5,416,302.50		20,616,910.17		24,366,114.65
	SUB-TOTAL				128,363,980.07		146,702,058.26		80,083,953.58		59,579,327.53		226,786,011.84		268,027,261.17
	8% SUPERVISION COST				10,269,118.41		11,736,164.66		6,406,716.29		4,766,346.20		18,142,880.95		21,442,180.89
	TOTAL SEGMENT COST				138,633,098.47		158,438,222.92		86,490,669.86		64,345,673.73		244,928,892.78		289,469,442.07

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	493,975.00	1.99	983,010.25	2.27	1,123,443.09	0.12	59,277.00	1.00	493,975.00	2.39	1,182,720.09	3.11	1,536,262.25
(3)	Tree Removal, Large	EA	500.00	56.27	28,135.00	64.31	32,154.37	103.21	51,605.00	28.19	14,095.00	167.52	83,759.37	187.67	93,835.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.		77.95	0.00	89.09	0.00	19.33	0.00	38.99	0.00	108.42	0.00	136.27	0.00
102 (1)	Unsuitable excavation	CU.M.	119,720.00	63.71	7,627,361.20	72.81	8,717,006.02	4.41	527,965.20	31.86	3,814,279.20	77.22	9,244,971.22	99.98	11,969,605.60
(2)	Common excavation	CU.M.	508,775.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	4,725.00	60.12	284,067.00	68.71	324,648.81	12.38	58,495.50	30.07	142,080.75	81.09	383,144.31	102.57	484,643.25
(2)	Bridge excavation	CU.M.	710.00	60.12	42,685.20	68.71	48,783.21	12.38	8,789.80	30.07	21,349.70	81.09	57,573.01	102.57	72,824.70
(3)	Foundation fill	CU.M.	285.00	105.33	30,019.05	120.38	34,307.57	87.38	24,903.30	59.37	16,920.45	207.76	59,210.87	252.08	71,842.80
(4)	Excavation below plan elevation	CU.M.	355.00	306.22	108,708.10	349.97	124,238.14	174.86	62,075.30	150.17	53,310.35	524.83	186,313.44	631.25	224,093.75
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	475.00	60.12	28,557.00	68.71	32,636.65	12.38	5,880.50	30.07	14,283.25	81.09	38,517.15	102.57	48,720.75
104 (1)	Embankment	CU.M.	508,775.00	62.06	31,574,576.50	70.93	36,085,320.50	24.81	12,622,707.75	33.80	17,196,595.00	95.74	48,708,028.25	120.67	61,393,879.25
(2)	Embankment, selected material	CU.M.	106,580.00	62.07	6,615,420.60	70.94	7,560,499.59	40.35	4,300,503.00	37.35	3,980,763.00	111.29	11,861,002.59	139.77	14,896,686.60
105 (1)	Subgrade preparation, common	SQ.M.	276,415.00	2.19	605,348.85	2.50	691,828.99	0.18	49,754.70	1.08	298,528.20	2.68	741,583.69	3.45	953,631.75
(2)	Subgrade preparation, exig. pavement	SQ.M.	31,690.00	4.38	138,802.20	5.01	158,631.48	0.46	14,577.40	2.16	68,450.40	5.47	173,208.88	7.00	221,830.00
	TOTAL TO EARTHWORK				48,066,690.95		54,933,498.42		17,786,534.45		26,114,630.30		72,720,032.87		91,967,855.70
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	100,100.00	132.59	13,272,259.00	151.53	15,168,333.92	66.24	6,630,624.00	69.17	6,923,917.00	217.77	21,798,957.92	268.00	26,826,800.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	47,565.00	129.67	6,167,753.55	148.19	7,048,878.82	233.84	11,122,599.60	70.64	3,359,991.60	382.03	18,171,478.42	434.15	20,650,344.75
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.	240.00	5,786.87	1,388,848.80	6,613.58	1,587,259.74	1,996.68	479,203.20	2,172.74	521,457.60	8,610.26	2,066,462.94	9,956.29	2,389,509.60
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.	189,000.00	75.92	14,348,880.00	86.77	16,398,761.00	42.12	7,960,680.00	37.96	7,174,440.00	128.89	24,359,441.00	156.00	29,484,000.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching extg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				35,177,741.35		40,203,233.48		26,193,106.80		17,979,806.20		66,396,340.28		79,350,654.35
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.	2,880.00	364.08	1,048,550.40	0.00 416.09	0.00 1,198,346.31	472.32	1,360,281.60	147.60	425,088.00	888.41	2,558,627.91	0.00 984.00	2,833,920.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.	2,535.00	487.77	1,236,496.95	0.00 557.45	0.00 1,413,142.90	154.46	391,556.10	126.81	321,463.35	711.91	1,804,699.00	0.00 769.04	1,949,516.40
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.	345.00	487.77	168,280.65	557.45	192,321.22	154.46	53,288.70	126.81	43,749.45	711.91	245,609.92	769.04	265,318.80
(22)	Load test	EA	4.00	23,665.50	94,662.00	27,046.35	108,185.41	21,036.00	84,144.00	7,888.50	31,554.00	48,082.35	192,329.41	52,590.00	210,360.00
401	Concrete bridge railing	L.M.	210.00	571.20	119,952.00	652.80	137,088.34	452.25	94,972.50	197.17	41,405.70	1,105.05	232,060.84	1,220.62	256,330.20
404	Reinforcing steel for bridges/box culvert	KG	180,000.00	1.61	289,800.00	1.84	331,200.83	21.04	3,787,200.00	3.09	556,200.00	22.88	4,118,400.83	25.74	4,633,200.00
405 (1)	Structural concrete, Class A	CU.M.	1,760.00	1,466.79	2,581,550.40	1,676.34	2,950,350.69	1,305.90	2,298,384.00	506.33	891,140.80	2,982.24	5,248,734.69	3,279.02	5,771,075.20
(2)	Structural concrete, Class P	CU.M.	580.00	1,615.30	936,874.00	1,846.06	1,070,715.82	1,423.33	825,531.40	551.77	320,026.60	3,269.39	1,896,247.22	3,590.40	2,082,432.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				6,476,166.40		7,401,351.53		8,895,358.30		2,630,627.90		16,296,709.83		18,002,152.60
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	145.00	105.33	15,272.85	120.38	17,454.73	87.38	12,670.10	59.37	8,608.65	207.76	30,124.83	252.08	36,551.60
(76)	RCPC, 76 cm diameter	L.M.	97.00	676.06	65,577.82	772.64	74,946.27	411.17	39,883.49	279.37	27,098.89	1,183.81	114,829.76	1,366.60	132,560.20
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structura. concrete for box pipe headwalls	CU.M.	40.00	1,448.20	57,928.00	1,655.09	66,203.59	1,305.89	52,235.60	497.05	19,882.00	2,960.98	118,439.19	3,251.14	130,045.60
(11)	Reinforcing steel for RCBC/RCPC	KG	2,425.00	1.61	3,904.25	1.84	4,462.01	21.04	51,022.00	3.09	7,493.25	22.88	55,484.01	25.74	62,419.50
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5B: BONGABON – PROVINCIAL BOUNDARY

SECTION LENGTH: 31.5 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CUM		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CUM		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	LM	1,500.00	286.05	429,075.00	326.92	490,372.65	170.46	255,690.00	115.1.	172,665.00	497.38	746,062.65	571.62	857,430.00
	TOTAL TO DRAINAGE EROSION WORKS				571,757.92		653,439.26		411,501.19		235,747.79		1,064,940.45		1,219,006.90
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	LM	500.00	396.00	198,000.00	452.57	226,286.28	247.56	123,780.00	346.56	173,280.00	700.13	350,066.28	990.12	495,060.00
605 (1)	Warning sign	EA	20.00	1,435.00	28,700.00	1,640.00	32,800.08	785.57	15,711.40	1,195.43	23,908.60	2,425.57	48,511.48	3,416.00	68,320.00
(2)	Regulatory signs	EA	10.00	1,435.00	14,350.00	1,640.00	16,400.04	785.57	7,855.70	1,195.43	11,954.30	2,425.57	24,255.74	3,416.00	34,160.00
(3)	Informatory Signs	EA	8.00	5,559.04	44,472.32	6,353.20	50,825.64	3,102.72	24,821.76	4,206.24	33,649.92	9,455.92	75,647.40	12,868.00	102,944.00
610	Sodding	SQM		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				285,522.32		326,312.04		172,168.86		242,792.82		498,480.90		700,484.00
	VI. LAND ACQUISTION	SQM	43,300.00		0.00	0.00	0.00	2.00	86,600.00	0.20	8,660.00	2.00	86,600.00	2.20	95,260.00
	SUB-TOTAL TO SEGMENT 5B				90,577,878.94		103,517,834.73	2.22	53,545,269.60		47,212,265.01		157,063,104.33		191,335,413.55
	10% CONTINGENCIES				9,057,787.89		10,351,783.47	0.22	5,354,526.96		4,721,226.50		15,706,310.43		19,133,541.36
	SUB-TOTAL				99,635,666.83		113,869,618.20		58,899,796.56		51,933,491.51		172,769,414.76		210,468,954.91
	10% GENERAL ITEMS, OFFICE, VEHICLE ETC.				9,963,566.68		11,386,961.82		5,889,979.66		5,193,349.15		17,276,941.48		21,046,895.49
	SUB-TOTAL				109,599,233.52		125,256,580.02		64,789,776.22		57,126,840.66		190,046,356.23		231,515,850.40
	8% SUPERVISION COST				8,767,938.68		10,020,526.40		5,183,182.10		4,570,147.25		15,203,708.50		18,521,268.03
	TOTAL SEGMENT COST				118,367,172.20		135,277,106.42		69,972,958.31		61,696,987.92		205,250,064.73		250,037,118.43

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5C: TABLANG–BONGABON

SECTION LENGTH: 8.3 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQ.M.	86,240.00	1.99	171,617.60	2.27	196,134.89	0.12	10,348.80	1.00	86,240.00	2.39	206,483.69	3.11	268,206.40
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQ.M.	16,970.00	77.95	1,322,811.50	89.09	1,511,788.35	19.33	328,030.10	38.99	661,660.30	108.42	1,839,818.45	136.27	2,312,501.90
102 (1)	Unsuitable excavation	CU.M.	1,475.00	63.71	93,972.25	72.81	107,397.13	4.41	6,504.75	31.86	46,993.50	77.22	113,901.88	59.98	147,470.50
(2)	Common excavation	CU.M.	6,265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CU.M.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CU.M.	1,260.00	60.12	75,751.20	68.71	86,573.02	12.38	15,598.80	30.07	37,888.20	81.09	102,171.82	102.57	129,238.20
(2)	Bridge excavation	CU.M.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CU.M.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CU.M.	504.00	306.22	154,334.88	349.97	176,383.16	174.86	88,129.44	150.17	75,685.68	524.83	264,512.60	631.25	318,150.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CU.M.	30.00	60.12	1,803.60	68.71	2,061.26	12.38	371.40	30.07	902.10	81.09	2,432.66	102.57	3,077.10
104 (1)	Embankment	CU.M.	6,265.00	62.06	388,805.90	70.93	444,350.71	24.81	155,434.65	33.80	211,757.00	95.74	599,785.36	120.67	755,997.55
(2)	Embankment, selected material	CU.M.	36,795.00	62.07	2,283,865.65	70.94	2,610,138.70	40.35	1,484,678.25	37.35	1,374,293.25	111.29	4,094,816.95	139.77	5,142,837.15
105 (1)	Subgrade preparation, common	SQ.M.	65,770.00	2.19	144,036.30	2.50	164,613.33	0.18	11,838.60	1.08	71,031.60	2.68	176,451.93	3.45	226,906.50
(2)	Subgrade preparation, exg. pavement	SQ.M.	16,970.00	4.38	74,328.60	5.01	84,947.18	0.46	7,806.20	2.16	36,655.20	5.47	92,753.38	7.00	118,790.00
	TOTAL TO EARTHWORK				4,711,327.48		5,384,387.72		2,106,740.99		2,603,106.83		7,493,128.71		9,423,175.30
	II. PAVEMENT														
200	Aggregate subbase course	CU.M.	4,900.00	132.59	649,691.00	151.53	742,505.86	66.24	324,576.00	69.17	338,933.00	217.77	1,067,081.86	268.00	1,313,200.00
201	Aggregate base course	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CU.M.	11,955.00	129.67	1,550,204.85	148.19	1,771,667.11	233.84	2,795,557.20	70.64	844,501.20	382.03	4,567,224.31	434.15	5,190,263.25
208	Soil aggregate shoulder (Incl. in Item 200)	CU.M.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CU.M.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	M.T.		5,786.87	0.00	6,613.58	0.00	1,996.68	0.00	2,172.74	0.00	8,610.26	0.00	9,956.29	0.00
302 (3)	Bituminous tack coat, CRS-2	M.T.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	M.T.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	M.T.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CU.M.		457.11	0.00	522.41	0.00	111.60	0.00	228.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQ.M.		75.92	0.00	86.77	0.00	42.12	0.00	37.96	0.00	128.89	0.00	0.00 156.00	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5C: TABLANG – BONGABON

SECTION LENGTH: 8.3 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQ.M.	49,800.00	224.02	11,156,196.00	256.02	12,749,970.16	142.83	7,112,934.00	82.10	4,088,580.00	398.85	19,862,904.16	448.95	22,357,710.00
(2)	Patching exg. PCC pavement	SQ.M.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	L.M.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				13,356,091.85		15,264,143.13		10,233,067.20		5,272,014.20		25,497,210.33		28,861,173.25
	III. STRUCTURES														
400 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	L.M.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	L.M.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 964.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	L.M.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	L.M.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	L.M.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	19,100.00	1.61	30,751.00	1.84	35,144.09	21.04	401,864.00	3.09	59,019.00	22.88	437,008.09	25.74	491,634.00
405 (1)	Structural concrete, Class A	CU.M.	135.00	1,466.79	198,016.65	1,676.34	226,305.31	1,305.90	176,296.50	506.33	68,354.55	2,982.24	402,601.81	3,279.02	442,667.70
(2)	Structural concrete, Class P	CU.M.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	L.S.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				228,767.65		261,449.40		578,160.50		127,373.55		839,609.90		934,301.70
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CU.M.	15.00	105.33	1,579.95	120.38	1,805.66	87.38	1,310.70	59.37	890.55	207.76	3,116.36	252.08	3,781.20
(76)	RCPC, 76 cm diameter	L.M.	4.00	676.06	2,704.24	772.64	3,090.57	411.17	1,644.68	279.37	1,117.48	1,183.81	4,735.25	1,366.60	5,466.40
(91)	RCPC, 91 cm diameter	L.M.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	L.M.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	L.M.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CU.M.	105.00	1,448.20	152,061.00	1,655.09	173,784.43	1,305.89	137,118.45	497.05	52,190.25	2,960.98	310,902.88	3,251.14	341,369.70
(11)	Reinforcing steel for RCBC/RCPC	KG	6,700.00	1.61	10,787.00	1.84	12,328.03	21.04	140,968.00	3.09	20,703.00	22.88	153,296.03	25.74	172,458.00
503 (2)	Removal, clearing, replacement, salvage pipe culverts	L.M.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5C: TABLANG – BONGABON

SECTION LENGTH: 8.3 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Portland Cement Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT FINANCIAL (1$=P28) UNIT COST (PESOS)	FOREIGN COMPONENT FINANCIAL (1$=P28) AMT.	FOREIGN COMPONENT ECONOMIC (1$=P32) UNIT COST (PESOS)	FOREIGN COMPONENT ECONOMIC (1$=P32) AMT.	LOCAL COMPONENT DIRECT UNIT COST (PESOS)	LOCAL COMPONENT DIRECT AMT.	TAXES UNIT COST (PESOS)	TAXES AMT.	ECONOMIC COST UNIT COST (PESOS)	ECONOMIC COST AMT.	FINANCIAL COST UNIT COST (PESOS)	FINANCIAL COST AMT.
(5)	Grouted riprap	CU.M.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CU.M.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				167,132.19		191,008.69		281,041.83		74,901.28		472,050.52		523,075.30
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.45	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQ.M.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				16,858.08		19,266.43		9,347.72		13,194.20		28,614.15		39,400.00
	VI. LAND ACQUISITION	SQ.M.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 5C				18,450,177.25		21,120,255.37	2.22	13,210,358.24		8,090,590.06		34,330,613.61		39,781,125.55
	10% CONTINGENCIES				1,848,017.73		2,112,025.54	0.22	1,321,035.82		809,059.01		3,433,061.36		3,978,112.56
	SUB-TOTAL				20,328,194.98		23,232,280.91		14,531,394.06		8,899,649.07		37,763,674.97		43,759,238.11
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				2,032,819.50		2,323,228.09		1,453,139.41		889,964.91		3,776,367.50		4,375,923.81
	SUB-TOTAL				22,361,014.47		25,555,509.00		15,984,533.47		9,789,613.97		41,540,042.47		48,135,161.92
	8% SUPERVISION COST				1,788,881.16		2,044,440.72		1,278,762.68		783,169.12		3,323,203.40		3,850[illegible]2.95
	TOTAL SEGMENT COST				24,149,895.63		27,599,949.72		17,263,296.15		10,572,783.09		44,863,245.87		5[illegible],985,974.87

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5C: TABLANG – BONGABON

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
	I. EARTHWORK														
100 (1)	Clearing and Grubbing	SQM.	86,240.00	1.99	171,617.60	2.27	196,134.89	0.12	10,348.80	1.00	86,240.00	2.39	206,483.69	3.11	268,206.40
(3)	Tree Removal, Large	EA		56.27	0.00	64.31	0.00	103.21	0.00	28.19	0.00	167.52	0.00	187.67	0.00
101 (1)	Removal of Structures and Obstructions	L.S.		0.00	0.00	0.00	0.00		0.00	28.19	0.00	0.00	0.00	28.19	0.00
(3)	Removal of Existing Concrete pavement	SQM.	16,970.00	77.95	1,322,811.50	89.09	1,511,788.35	19.33	328,030.10	38.99	661,660.30	108.42	1,839,818.45	136.27	2,312,501.90
102 (1)	Unsuitable excavation	CUM.	1,475.00	63.71	93,972.25	72.81	107,397.13	4.41	6,504.75	31.86	46,993.50	77.22	113,901.88	99.98	147,470.50
(2)	Common excavation	CUM.	6,265.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3)	Surplus common excavation	CUM.		61.15	0.00	69.89	0.00	3.77	0.00	30.57	0.00	73.66	0.00	95.49	0.00
103 (1)	Structure excavation	CUM.	1,260.00	60.12	75,751.20	68.71	86,573.02	12.38	15,598.80	30.07	37,888.20	81.09	102,171.82	102.57	129,238.20
(2)	Bridge excavation	CUM.		60.12	0.00	68.71	0.00	12.38	0.00	30.07	0.00	81.09	0.00	102.57	0.00
(3)	Foundation fill	CUM.		105.33	0.00	120.38	0.00	87.38	0.00	59.37	0.00	207.76	0.00	252.08	0.00
(4)	Excavation below plan elevation	CUM.	504.00	306.22	154,334.88	349.97	176,383.16	174.86	88,129.44	150.17	75,685.68	524.83	264,512.60	631.25	318,150.00
(5)	Shoring, cribbing, etc.(Included in Item103 (4)).														
(6)	Pipe culvert excavation	CUM.	30.00	60.12	1,803.60	68.71	2,061.26	12.38	371.40	30.07	902.10	81.09	2,432.66	102.57	3,077.10
104 (1)	Embankment	CUM.	6,265.00	62.06	388,805.90	70.93	444,350.71	24.81	155,434.65	33.80	211,757.00	95.74	599,785.36	120.67	755,997.55
(2)	Embankment, selected material	CUM.	36,795.00	62.07	2,283,865.65	70.94	2,610,138.70	40.35	1,484,678.25	37.35	1,374,293.25	111.29	4,094,816.95	139.77	5,142,837.15
105 (1)	Subgrade preparation, common	SQM.	65,770.00	2.19	144,036.30	2.50	164,613.33	0.18	11,838.60	1.08	71,031.60	2.68	176,451.93	3.45	226,906.50
(2)	Subgrade preparation, exg. pavement	SQM.	16,970.00	4.38	74,328.60	5.01	84,947.18	0.46	7,806.20	2.16	36,655.20	5.47	92,753.38	7.00	118,790.00
	TOTAL TO EARTHWORK				4,711,327.48		5,384,367.72		2,108,740.99		2,603,106.83		7,493,128.71		9,423,175.30
	II. PAVEMENT														
200	Aggregate subbase course	CUM.	26,560.00	132.59	3,521,590.40	151.53	4,024,684.80	66.24	1,759,334.40	69.17	1,837,155.20	217.77	5,784,019.20	268.00	7,118,080.00
201	Aggregate base course	CUM.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
202	Crushed aggregate base course	CUM.	12,535.00	129.67	1,625,413.45	148.19	1,857,620.02	233.84	2,931,184.40	70.64	885,472.40	382.03	4,788,804.42	434.15	5,442,070.25
208	Soil aggregate shoulder (Incl. in Item 200)	CUM.		132.59	0.00	151.53	0.00	66.24	0.00	69.17	0.00	217.77	0.00	268.00	0.00
300 (1)	Gravel surface course	CUM.		129.67	0.00	148.19	0.00	233.84	0.00	70.64	0.00	382.03	0.00	434.15	0.00
301	Bituminous prime coat, MC-70	MT.	65.00	5,786.87	376,146.55	6,613.58	429,882.85	1,996.68	129,784.20	2,172.74	141,228.10	8,610.26	559,667.05	9,956.29	647,158.85
302 (3)	Bituminous tack coat, CRS-2	MT.		4,279.87	0.00	4,891.29	0.00	1,476.72	0.00	1,606.92	0.00	6,368.01	0.00	7,363.51	0.00
304 (1)	Single bituminous surface treatment	MT.		984.15	0.00	1,124.75	0.00	212.89	0.00	444.75	0.00	1,337.64	0.00	1,641.79	0.00
304 (2)	Double bituminous surface treatment	MT.		1,938.78	0.00	2,215.75	0.00	419.39	0.00	876.16	0.00	2,635.14	0.00	3,234.33	0.00
(2)	Aggregate for bituminous concrete binder/ Wearing course	CUM.		457.11	0.00	522.41	0.00	111.60	0.00	225.55	0.00	634.01	0.00	797.26	0.00
310 (1)	Bituminous binder course (2" thick)	SQM.	49,800.00	75.92	3,780,816.00	86.77	4,320,943.37	42.12	2,097,576.00	37.96	1,890,408.00	128.89	6,418,519.37	156.00	7,768,800.00

(continued)

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 3C: TABLANG – BONGABON

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
311 (1)	Portland cement concrete pavement (0.20 meters thick)	SQM.		224.02	0.00	256.02	0.00	142.83	0.00	82.10	0.00	398.85	0.00	448.95	0.00
(2)	Patching exg. PCC pavement	SQM.		64.23	0.00	73.41	0.00	28.17	0.00	28.18	0.00	101.58	0.00	120.58	0.00
(2)	Sealing cracks, existing PCC pavement	LM.		8.95	0.00	10.23	0.00	11.32	0.00	3.43	0.00	21.55	0.00	23.70	0.00
	TOTAL TO PAVEMENT				9,303,966.40		10,633,131.04		6,917,879.00		4,754,263.70		17,551,010.04		20,976,109.10
	III. STRUCTURES														
300 (4)	PC/PS concrete piles, furnished (40 cm x 40 cm)	LM.		699.35	0.00	799.26	0.00	549.54	0.00	301.55	0.00	1,348.80	0.00	1,550.44	0.00
(5)	Precast concrete piles, furnished (40 cm x 40 cm)	LM.		364.08	0.00	0.00 416.09	0.00 0.00	472.32	0.00	147.60	0.00	888.41	0.00	0.00 984.00	0.00
(13)	Precast concrete piles, driven (40 cm x 40 cm)	LM.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(14)	PC/PS concrete piles, driven (40 cm x 40 cm)	LM.		487.77	0.00	0.00 557.45	0.00 0.00	154.46	0.00	126.81	0.00	711.91	0.00	0.00 769.04	0.00
(15)	Test piles, driven	LM.		487.77	0.00	557.45	0.00	154.46	0.00	126.81	0.00	711.91	0.00	769.04	0.00
(22)	Load test	EA		23,665.50	0.00	27,046.35	0.00	21,036.00	0.00	7,888.50	0.00	48,082.35	0.00	52,590.00	0.00
401	Concrete bridge railing	LM.		571.20	0.00	652.80	0.00	452.25	0.00	197.17	0.00	1,105.05	0.00	1,220.62	0.00
404	Reinforcing steel for bridges/box culvert	KG	19,100.00	1.61	30,751.00	1.84	35,144.09	21.04	401,864.00	3.09	59,019.00	22.88	437,008.09	25.74	491,634.00
405 (1)	Structural concrete, Class A	CUM.	135.00	1,466.79	198,016.65	1,676.34	226,305.31	1,305.90	176,296.50	506.33	68,354.55	2,982.24	402,601.81	3,279.02	442,667.70
(2)	Structural concrete, Class P	CUM.		1,615.30	0.00	1,846.06	0.00	1,423.33	0.00	551.77	0.00	3,269.39	0.00	3,590.40	0.00
406 (1)	P/S concrete girder, Type 4	EA		97,020.00	0.00	110,880.28	0.00	86,240.00	0.00	32,340.00	0.00	197,120.28	0.00	215,600.00	0.00
407 (1)	Rehabilitation of existing bridges	LS.			0.00	0.00	0.00		0.00		0.00	0.00	0.00	0.00	0.00
	TOTAL TO STRUCTURES				228,767.65		261,449.40		578,160.50		127,373.55		839,609.90		934,301.70
	IV. DRAINAGE EROSION WORKS														
500 (1)	Backfill material, pipe culvert	CUM.	15.00	105.33	1,579.95	120.38	1,805.66	87.38	1,310.70	59.37	890.55	207.76	3,116.36	252.08	3,781.20
(76)	RCPC, 76 cm diameter	LM.	4.00	676.06	2,704.24	772.64	3,090.57	411.17	1,644.68	279.37	1,117.48	1,183.81	4,735.25	1,366.60	5,466.40
(91)	RCPC, 91 cm diameter	LM.		981.44	0.00	1,121.65	0.00	570.35	0.00	394.73	0.00	1,692.00	0.00	1,946.52	0.00
(107)	RCPC, 107 cm diameter	LM.		1,272.67	0.00	1,454.48	0.00	694.97	0.00	505.63	0.00	2,149.45	0.00	2,473.27	0.00
(120)	RCPC, 120 cm diameter	LM.		1,668.47	0.00	1,906.83	0.00	891.77	0.00	659.04	0.00	2,798.60	0.00	3,219.28	0.00
(10)	Structural concrete for box pipe headwalls	CUM.	105.00	1,448.20	152,061.00	1,655.09	173,784.43	1,305.89	137,118.45	497.05	52,190.25	2,960.98	310,902.88	3,251.14	341,369.70
(11)	Reinforcing steel for RCBC/RCPC	KG	6,700.00	1.61	10,787.00	1.84	12,328.03	21.04	140,968.00	3.09	20,703.00	22.88	153,296.03	25.74	172,458.00
503 (2)	Removal, cleaning, replacement, salvage pipe culverts	LM.		327.57	0.00	0.00 374.37	0.00 0.00	56.51	0.00	163.79	0.00	0.00 430.88	0.00	0.00 547.87	0.00

Table 5-4 (continued)
COST ESTIMATE BREAKDOWN
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT
SEGMENT 5C: TABLANG – BONGABON

SECTION LENGTH: 13.4 Kilometers
ROADWAY WIDTH: 6 m Pavement + 1 m Shoulder
PROPOSED SURFACE: Asphalt Concrete Pavement

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	FOREIGN COMPONENT				LOCAL COMPONENT DIRECT		TAXES		ECONOMIC COST		FINANCIAL COST	
				FINANCIAL (1$=P28)		ECONOMIC (1$=P32)									
				UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.	UNIT COST (PESOS)	AMT.
(5)	Grouted riprap	CUM.		733.42	0.00	838.20	0.00	427.63	0.00	287.15	0.00	1,265.83	0.00	1,448.20	0.00
509	Gabions	CUM.		696.45	0.00	795.94	0.00	1,003.72	0.00	348.23	0.00	1,799.66	0.00	2,048.40	0.00
600	Lined Ditch	L.M.		286.05	0.00	326.92	0.00	170.46	0.00	115.11	0.00	497.38	0.00	571.62	0.00
	TOTAL TO DRAINAGE EROSION WORKS				167,132.19		191,008.69		281,041.83		74,901.28		472,050.52		523,075.30
	V. INCIDENTAL WORKS														
603 (3)	Metal beam guardrail	L.M.		396.00	0.00	452.57	0.00	247.56	0.00	346.56	0.00	700.13	0.00	990.12	0.00
605 (1)	Warning sign	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(2)	Regulatory signs	EA	2.00	1,435.00	2,870.00	1,640.00	3,280.01	785.57	1,571.14	1,195.43	2,390.86	2,425.57	4,851.15	3,416.00	6,832.00
(3)	Informatory Signs	EA	2.00	5,559.04	11,118.08	6,353.20	12,706.41	3,102.72	6,205.44	4,206.24	8,412.48	9,455.92	18,911.85	12,868.00	25,736.00
610	Sodding	SQM.		1.72	0.00	1.97	0.00	4.02	0.00	2.46	0.00	5.99	0.00	8.20	0.00
	TOTAL TO INCIDENTAL WORKS				16,858.06		19,266.43		9,347.72		13,194.20		28,614.15		39,400.00
	VI. LAND ACQUISITION	SQM.			0.00	0.00	0.00	2.00	0.00	0.20	0.00	2.00	0.00	2.20	0.00
	SUB-TOTAL TO SEGMENT 5C				14,428,051.80		16,489,243.28	2.22	9,895,170.04		7,572,839.56		26,384,413.32		31,896,061.40
	10% CONTINGENCIES				1,442,805.18		1,648,924.33	0.22	989,517.00		757,283.96		2,638,441.33		3,189,606.14
	SUB-TOTAL				15,870,856.98		18,138,167.61		10,884,687.04		8,330,123.52		29,022,854.65		35,085,667.54
	10% GENERAL ITEMS, OFFICE, VEHICLE, ETC.				1,587,065.70		1,813,816.76		1,068,468.70		833,012.35		2,902,285.47		3,508,566.75
	SUB-TOTAL				17,457,942.68		19,951,984.37		11,973,155.75		9,163,135.87		31,925,140.12		38,594,234.29
	8% SUPERVISION COST				1,396,635.41		1,596,158.75		957,852.46		733,050.87		2,554,011.21		3,087,538.74
	TOTAL SEGMENT COST				18,854,578.09		21,548,143.12		12,931,008.21		9,896,186.74		34,479,151.33		41,681,773.04

Project costs include additional amounts of 10% for contingencies and 10% for general items, office and service vehicles. Likewise, an additional 8% for construction supervision has been added to obtain the overall project cost of construction.

5.6 MAINTENANCE COST

An element far too often neglected when costing out a capital construction project is that of the recurring maintenance costs. The TOR indicated that the Consultant should assess and report on various elements relating to the Operation and Maintenance Organization and its capabilities to provide necessary resources to properly care for the new infrastructure. The Consultant developed a Maintenance Management Program for the three maintenance offices within the limits of the project area. Aurora Province has one DPWH maintenance district and Nueva Ecija has two districts. See Figure 5.1. The second district in Nueva Ecija is currently being developed and as of the time of this study, has only eight administrative personnel assigned. A small amount of heavy equipment is permanently assigned to each district with most of the maintenance equipment needed being assigned to a regional equipment pool.

Computation for the cost of road maintenance was based on 1991 unit prices. Road maintenance activities are classified into routine and periodic maintenance. Routine maintenance operations are performed regularly based on traffic volume and the road surface type while periodic maintenance operations are performed to restore the roadway to its original condition.

5.6.1 Existing Inventory and Resources

The detailed listing of facility inventory, equipment and personnel assigned in each district is shown in Table 5-5. Figure 5-1 shows the approximate district boundaries and location of facilities. This facility inventory is current as of July 1991. Any rehabilitation, construction or reconstruction of roads and bridges in either province will change the overall inventory as well as the nature of the work tasks necessary to maintain the new infrastructure.

A review of personnel assigned to the two operating districts reveals the following:

- Aurora Province - of the total 48 persons assigned, less than 24 are line personnel with job titles relating to day-to-day road and bridge maintenance activities. The remaining 24 personnel are administrative, engineering, or line personnel assigned to building type maintenance; e.g. painter, plumber, electrician, well driller.

- Nueva Ecija Province - of the total 66 persons assigned, less than 30 are line personnel with job titles relating to day-to-day road and bridge maintenance activities. The remaining 36 personnel are administrative, engineering, or line personnel assigned to building type maintenance; e.g. painter, plumber,

Table 5-5
ARIDP STREET, EQUIPMENT & LABOR INVENTORY

DESCRIPTION	UNIT	AURORA		NUEVA ECIJA			TOTAL	
		NATIONAL	PROV.	NAT. DIST-1	NAT. DIST 2	PROV.	NATIONAL	PROV.
I. STREET INVENTORY								
a. Classification in km.								
Portland Cement Pavement	Km.	5.42	0.00	64.70	119.23	34.76	189.35	34.76
Asphalt Cement Pavement	Km.	18.64	4.09	20.39	2.5	1.85	41.53	5.94
Gravel	Km.	201.45	111.83	81.30	52.64	660.87	335.39	772.70
Earth	Km.	0.00	115.92	0.00	0	0.00	0.00	115.92
b. Length of shoulder	Km.	460.14		442.60	354.26		1,257.00	
c. Traffic volume								
d. Number/Length of :								
Culverts	lm.	34.00		482.00	1,383.00		1,899.00	
RCP	lm.	3,799.00		4,003.00	6,231.00		14,033.00	
Ditch	Km.	451.02		332.78	348.74		1,132.54	
Bridges	units	24.00		50.00	51.00		125.00	
. EQUIPMENT INVENTORY								
Air Compressor	units			2			2	
Bulldozer	units	2		0			2	
Compactor Roller, Vib.	units			2			2	
Concrete Cutter	units			1			1	
Crane, Truck Mtd.	units			1			1	
Dump Truck	units	4		8			12	
Excavator	units			2			2	
Elect. Generator	units			2			2	
Hammer Drop	units			1			1	
Line Marker	units			1			1	
Lubricator	units			1			1	
Maintenance Shop Truck	units			1			1	
Multi-purpose Maintenance	units			1			1	
Pay Loader	units	1		3			4	
Port. Elect. Gen.	units			2			2	
Road Grader	units	2		5			7	
Road Roller	units			2			2	
Sand Blasting Machine	units			2			2	
Service Vehicle	units	7		23			30	
Sheepfoot Roller	units			1			1	
Truck, Stake Body	units			1			1	
Tricycle	units			2			2	

Table 5-5 (continued)
ARIDP STREET, EQUIPMENT & LABOR INVENTORY

DESCRIPTION	UNIT	AURORA		NUEVA ECIJA			TOTAL	
		NATIONAL	PROV.	NAT. DIST-1	NAT. DIST 2	PROV.	NATIONAL	PROV.
3. LABOR INVENTORY								
a. Number of manpower employed								
District Engineer	each	1		1	1		3	
Asst. District Engineer	each	1		1	1		3	
Engineer	each	15		23	4		42	
Architect	each			1			1	
Const. & Maint. Gen. Foreman	each	1		2			3	
Well Drilling Supervisor	each	1		1			2	
Draftsman	each	1		2			3	
Const. & Maint. Foreman	each	4		5			9	
Laboratory Technician	each	1		2			3	
Well Driller	each	1		1			2	
Const. & Maint. Capataz	each	8		9			17	
Electrician	each	1		1			2	
Insrtrumentman	each	1		1			2	
Plumber	each	1		1			2	
Painter	each	1		1			2	
Driver	each	4		6			10	
Cost. & Maint. Man	each	5		7			12	
Utility Worker	each	1		1			2	
Total		48		66	6		120	

Labor Inventory

The second Nueva Ecija Engineering District is a newly created district and has only a skeleton force comprised of eight personnel (six technical and two administrative) with approved budget on the current fiscal year.

Manpower needs of this district is supplied by other districts and regional offices. The number of its personnel can be obtained from its District Engineer, Engr. Leandro Lacsamana.

Equipment Inventory

The list and number of equipment in this table are those that are presently assigned to Aurora and Nueva Ecija Provinces. Other equipment are available from the Regional Office which is based in San Fernando, Pampanga.

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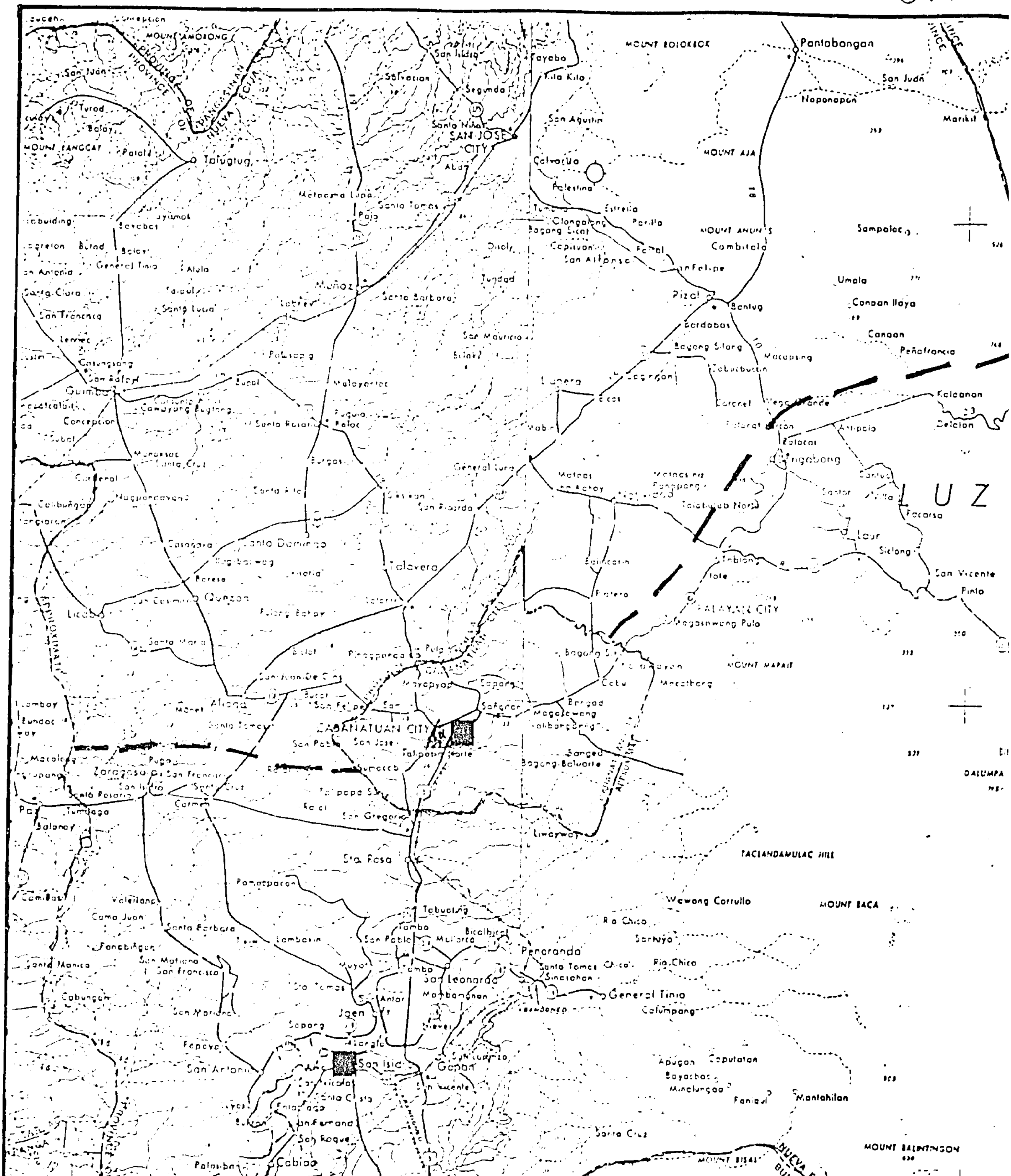
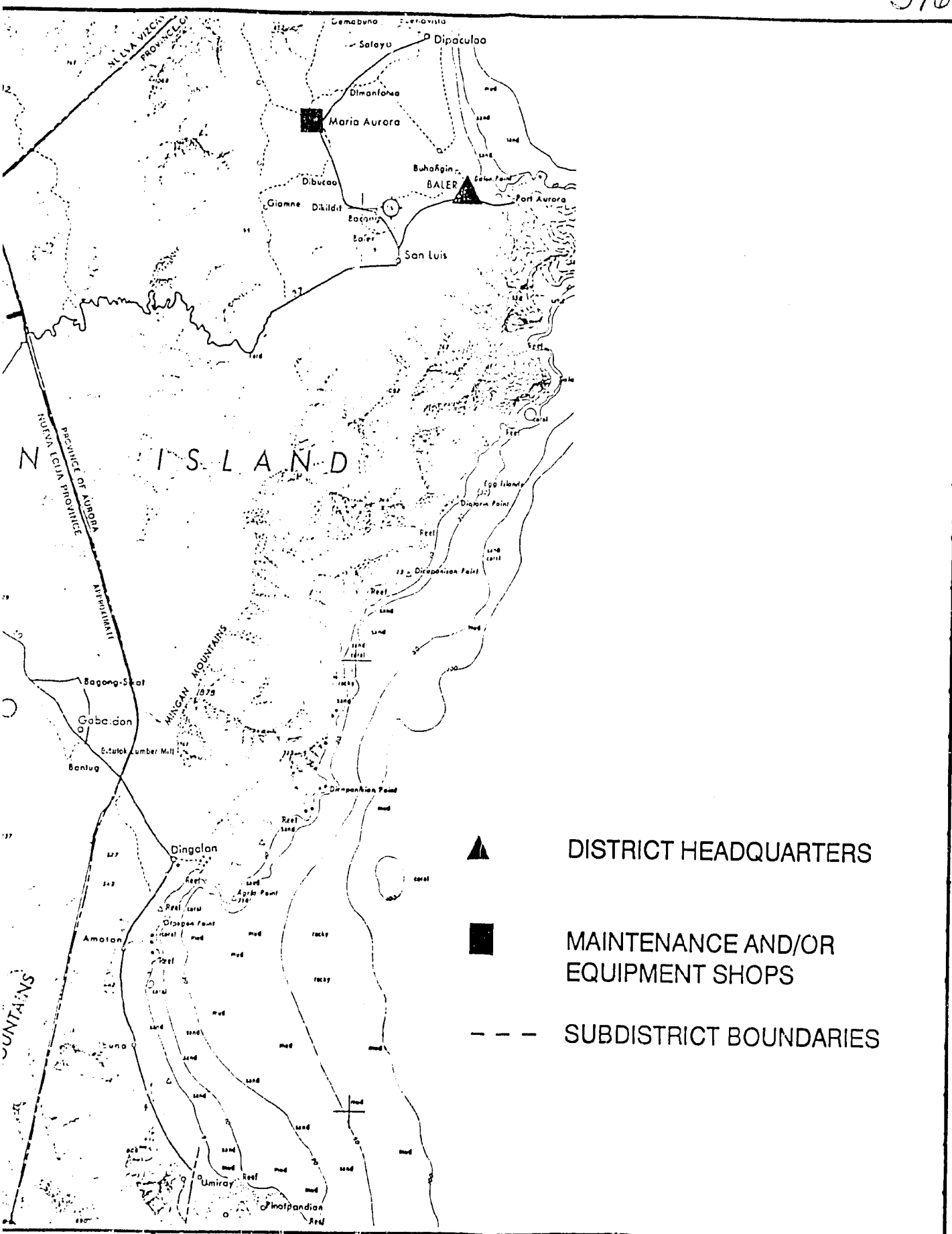


LOUIS BERGER INTERNATIONAL, INC.

- LOCKWOOD GREENE INT'L
- ERNST & YOUNG INT'L.
- GLOBETROTTERS ENG'G. CORP.
- TRANS-ASIA(PHIL.), INC.
- CONSULTANT MANAGEMENT SERVICES, INC.

PHILIPPINE ASSISTANCE PROGRA
UNITED STATES AGENCY FOR INTERNATION
CONTRACT 492-0452-C-00-009



SUPPORT DEVELOPMENT O	AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	MAINTENANCE DISTRICT BOUNDARIES	Figure 5–1

electrician, well driller.

5.6.1.1 Existing Maintenance Budget

The 1991 maintenance budget for each district is reflected in Table 5-6.

Table 5-6
1991 MAINTENANCE OPERATION BUDGET

DISTRICT	CATEGORY	BUDGET ₱	TOTAL ₱
Nueva Ecija			
I	Bridges	653,000	
	Roads	1,131,000	5,784,00
II	Bridges	1,096,000	
	Roads	6,263,000	7,399,000
Aurora			
I	Bridges	549,000	
	Roads	8,769,000	9,318,000

The total number of kilometers of roads assigned to each maintenance district and the average budgeted cost per km is reflected in Table 5-7.

Table 5-7
AVERAGE ROAD MAINTENANCE BUDGET

DISTRICT	TOTAL BUDGET ₱	KM OF ROADS	AVERAGE BUDGETED COST PER KM (₱)
Nueva Ecija			
I	5,784,00	174.4	33,165
II	7,359,000	166.4	44,225

			Average 38,565
Aurora			
I	9,318,000	226.3	41,175

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This budget level per km appears very high for the level of service provided. The most probable reason for this is the fact that salaries for administrative and engineering staff are included in the budget and these staff persons do not contribute directly to the maintenance. The Consultant's experience reflects that a reasonable level of maintenance should take into account the following average costs:

- Routine Maintenance
  - unpaved ₱ 10,000/km/yr.
  - paved ₱ 30-40,000/km/yr.
- Resurfacing
  - unpaved ₱ 10-15,000/km/yr.
  - paved ₱ 800-1,000,000/km/yr.

It is evident that since the existing DPWH budgets reflect both bridge and road maintenance elements and that the costs per km shown above are for road only, the annual maintenance budget allocated to each maintenance district is inadequate.

5.6.2 Proposed Work Program and Budget

In order to develop a reasonable Work Program and Budget, the Consultant determined the significant maintenance activities being performed or which should be performed to maintain the roadway system. Crew sizes were estimated both for size and for work classification. Daily work output criteria were established utilizing expected accomplishment for a given task. Equipment and materials requirements were estimated for each work task on an annual basis. From this composite of resources and work accomplishment criteria, an annual work program and budget was developed. The Work Program and Budget summary by maintenance district is shown in Table 5-6. Table 5-9 provides a detailed accounting of the necessary maintenance program by activity. Shown are inventory, effort level per task on annual basis, average daily production, crew size by labor class, equipment needs and materials requirements. Listed also is a month by month projection of labor needs based on each activity.

This annual budget reflects a total labor component of 45,777 labor days. Unallocated time (sick, holidays, vacation, non-productive) has been estimated at 17% of total labor days. Current staffing of 60± line personnel available for maintenance equates to less than 19,000 labor days (6 day work week) available annually or less than 16,000 labor days (5 day work week) available annually. Thus, the current maintenance organization is grossly understaffed to keep the existing infrastructure properly maintained.

REPORT DATE: 08/01/91
WPB31

Table 5-8

UPDATED: 07/31/91

DEPT. OF PUBLIC WORKS & HIGHWAYS
WORK PROGRAM AND BUDGET
ALL MANAGEMENT UNITS
1991 - 1992

ACTIVITY MGMT UNIT	AREA	INVENTORY QUANTITY	INVENT UNIT	EFFORT LEVEL	WORK QUANTITY	WORK UNIT	ADP	CREW DAYS	CREW SIZE	LABOR DAYS	LABOR $	EQUIP $	MATERIAL $	TOTAL $
PROGRAM: 1 - maintenance														
1 DITCH CLEANING														
AU	1	451	KM	2.00	902	KM	6.00	150	22.00	3307	13109	10475	0	23584
NE	1	333		2.00	666		6.00	111	22.00	2440	9673	7730	0	17403
NE	2	349		2.00	697		6.00	116	22.00	2558	10137	8100	0	18237
ACTIVITY TOTALS		1133		0.00	2265					8305	32919	26305	0	59224
2 GRASS CUTTING														
AU	1	45	HA	2.00	90	HA	1.20	75	21.00	1575	6204	6960	0	13164
NE	1	67		2.00	133		1.20	111	21.00	2331	9182	10301	0	19483
NE	2	105		2.00	209		1.20	174	21.00	3662	14424	16182	0	30605
ACTIVITY TOTALS		216		0.00	432					7568	29810	33442	0	63252
3 CULVERT CLEANING														
AU	1	3833	M	2.00	7666	M	500.00	15	12.00	194	760	1068	0	1828
NE	1	4435		2.00	8870		500.00	18	12.00	215	840	1250	0	2140
NE	2	7614		2.00	15228		500.00	30	12.00	366	1511	2122	0	3633
ACTIVITY TOTALS		15882		0.00	31764					765	3151	4441	0	7592
4 GRAVEL ROAD GRADING														
AU	1	202	KM	10.00	2015	KM	7.00	288	9.00	2591	11882	20650	0	32532
NE	1	81		10.00	813		7.00	116	9.00	1045	4724	8344	0	13133
NE	2	53		10.00	526		7.00	75	9.00	677	3104	5402	0	8507
ACTIVITY TOTALS		335		0.00	3354					4313	19781	34426	0	54207
5 GR RD SPOT REGRAVEL														
AU	1	302	KM.	1.00	302	KM.	0.50	403	7.00	2821	13605	108939	32250	154794
NE	1	81		1.00	81		0.50	163	7.00	1136	5479	43854	13012	62455
NE	2	53		1.00	53		0.50	165	7.00	737	3554	28459	8425	40433
ACTIVITY TOTALS		335		0.00	335					4694	22639	181352	53687	257682
6 GR RD SHOULDER GRADING														
AU	1	460	KM	2.00	920	KM	20.00	46	9.00	414	1999	3005	0	5004
NE	1	443		2.00	885		20.00	44	9.00	396	1827	3180	0	5007
NE	2	354		2.00	709		20.00	35	9.00	319	1463	2545	0	4008
ACTIVITY TOTALS		1257		0.00	2514					1131	5189	9030	0	14218
7 BIT SURFACE PATCHING														
AU	1	111840	SQ M	1.00	111840	SQ M	750.00	149	13.00	1939	8732	61616	12131	82480
NE	1	122340		1.00	122340		750.00	163	13.00	2121	9552	67401	13270	90224
NE	2	15000		1.00	15000		750.00	20	13.00	260	1171	8264	1627	11062
ACTIVITY TOTALS		249180		0.00	249180					4319	19456	137282	27028	183766

Table 5-8

DEPT. OF PUBLIC WORKS & HIGHWAYS
WORK PROGRAM AND BUDGET
ALL MANAGEMENT UNITS
1991 - 1992

ACTIVITY MGMT UNIT	AREA	INVENTORY QUANTITY	INVENT UNIT	EFFORT LEVEL	WORK QUANTITY	WORK UNIT	ADP	CREW DAYS	CREW SIZE	LABOR DAYS	LABOR $	EQUIP $	MATERIAL $	TOTAL $
PROGRAM: 1 - maintenance (continued)														
8 FOOP SLAB REPLACEMENT														
AU	1	32520	SQ M	0.05	1626	SQ M	100.00	16	17.00	276	1147	626	17777	19550
NE	1	388200		0.05	19410		1000.00	19	14.00	272	1224	9151	254479	264853
NE	2	715380		0.05	35769		1000.00	36	14.00	501	2255	16863	468957	488075
ACTIVITY TOTALS		1136100		0.00	56805					1049	4626	26639	741213	772478
9 FOOP SEALING OF JOINT														
AU	1	5420	M	0.16	867	M	640.00	1	5.00	7	31	0	104	135
NE	1	64700		0.16	10352		640.00	16	5.00	81	365	0	1243	1608
NE	2	119230		0.16	19077		640.00	30	5.00	149	673	0	2289	2962
ACTIVITY TOTALS		189350		0.00	30296					237	1068	0	3636	4705
10 GR RD REGRAVELLING														
AU	1	1209760	SQ M	0.25	302175	SQ M	4000.00	75	24.00	1813	7929	33673	161202	202804
NE	1	487800		0.25	121950		4000.00	30	24.00	732	3200	13591	65066	81857
NE	2	315340		0.25	78860		4000.00	20	24.00	474	2072	8799	42125	52996
ACTIVITY TOTALS		2012340		0.00	503085					3019	13201	56063	268393	337657
11 BIT SURFACE SEAL COAT														
AU	1	111840	SQ M	1.00	111840	SQ M	2400.00	47	7.00	326	1469	0	3057	4526
NE	1	122340		1.00	122340		2400.00	51	7.00	357	1607	0	3345	4952
NE	2	15000		1.00	15000		2400.00	6	7.00	44	197	0	410	607
ACTIVITY TOTALS		249180		0.00	249180					727	3273	0	6812	10085
12 BIT SINGLE OVERLAY														
AU	1	559	CU M	0.10	56	CU M	5.00	11	13.00	145	655	8887	1240	10782
NE	1	612		0.10	61		5.00	12	13.00	159	716	9721	1357	11794
NE	2	75		0.10	8		5.00	2	13.00	20	88	1192	166	1447
ACTIVITY TOTALS		1246		0.00	125					324	1459	19800	2764	24023
13 BIT SURFACE OVERLAY														
AU	1	2796	CU M	0.10	280	CU M	5.00	56	13.00	727	3275	44450	6204	53929
NE	1	3060		0.10	306		5.00	61	13.00	795	3583	48631	6786	59001
NE	2	375		0.10	38		5.00	8	13.00	98	439	5962	832	7233
ACTIVITY TOTALS		6230		0.00	623					1620	7297	99042	13824	120163
14 PAVEMENT MARKING														
AU	1	100	SQ M	1.00	100	SQ M	200.00	1	6.00	3	15	0	46	61
NE	1	1198		1.00	1198		200.00	6	6.00	36	179	0	555	734
NE	2	2208		1.00	2208		200.00	11	6.00	66	330	0	1022	1353
ACTIVITY TOTALS		3506		0.00	3506					105	525	0	1623	2148

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Table 5-8

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DEPT. OF PUBLIC WORKS & HIGHWAYS
WORK PROGRAM AND BUDGET
ALL MANAGEMENT UNITS
1991 - 1992

ACTIVITY MGMT UNIT	AREA	INVENTORY QUANTITY	INVENT UNIT	EFFORT LEVEL	WORK QUANTITY	WORK UNIT	ADF	CREW DAYS	CREW SIZE	LABOR DAYS	LABOR $	EQUIP $	MATERIAL $	TOTAL $
PROGRAM: 1 - maintenance (continued)														
99 UNALLOCATED TIME														
AU	1	3200	MANDAYS	1.00	3200	MANDAYS	7.00	457	7.00	3200	16238	0	0	16238
NE	1	2400		1.00	2400		7.00	343	7.00	2400	12178	0	0	12178
NE	2	2000		1.00	2000		7.00	286	7.00	2000	10148	0	0	10148
ACTIVITY TOTALS		7600		0.00	7600					7600	38564	0	0	38564
PROGRAM TOTALS										45777	202976	627822	1118982	1949780
GRAND TOTALS										45777	202976	627822	1118982	1949780

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance

1 DITCH CLEANING

Lump Sum Total Cost: 0.00

Inventory: 451.00 KM
x Effort Level: 2.00
Work Quantity: 902.00 KM

Average Daily Production: 6.00 KM

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	20.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 22.00 Crew Days: 150 Unit Cost: $26.15 Budget: $23,584

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	9	8	8	9	8	8	8	7	100
Labor Days	298	298	265	298	298	265	265	298	265	265	265	232	3307

2 GRASS CUTTING

Lump Sum Total Cost: 0.00

Inventory: 45.00 HA
x Effort Level: 2.00
Work Quantity: 90.00 HA

Average Daily Production: 1.20 HA

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	7 UNSK. LABORER	20.00	0.47
E	4 PORT. CUTTER	20.00	0.58

Crew Size: 21.00 Crew Days: 75 Unit Cost: $146.27 Budget: $13,164

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	142	142	126	142	126	126	142	126	126	126	126	126	1575

3 CULVERT CLEANING

Lump Sum Total Cost: 0.00

Inventory: 3833.00 M
x Effort Level: 2.00
Work Quantity: 7666.00 M

Average Daily Production: 500.00 M

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	10.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 12.00 Crew Days: 15 Unit Cost: $0.24 Budget: $1,829

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	17	17	15	17	15	15	17	15	15	15	15	15	184

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

4 GRAVEL ROAD GRADING

Lump Sum Total Cost: 0.00

Inventory: 201.50 KM
x Effort Level: 10.00
Work Quantity: 2015.00 KM

Average Daily Production: 7.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 288 Unit Cost: $16.16 Budget: $32,563

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	233	233	207	233	207	207	233	207	207	207	207	207	2591

5 GR RD SPOT REGRAVELL

Lump Sum Total Cost: 0.00

Inventory: 201.50 KM.
x Effort Level: 1.00
Work Quantity: 201.50 KM.

Average Daily Production: 0.50 KM.

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	2.00	0.47
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL	1.00	6.10
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	7.50	10.67

Crew Size: 7.00 Crew Days: 403 Unit Cost: $768.21 Budget: $154,794

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	254	254	226	254	226	226	254	226	226	226	226	226	2821

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

6 GR RD SHOULDER GRAD'G

Lump Sum Total Cost: 0.00

Inventory: 460.00 KM
x Effort Level: 2.00
Work Quantity: 920.00 KM

Average Daily Production: 20.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 46 Unit Cost: $5.66 Budget: $5,204

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
ercent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	37	37	33	37	33	33	37	33	33	33	33	33	414

7 BIT SURFACE PATCHING

Lump Sum Total Cost: 0.00

Inventory: 111840.00 SQ M
x Effort Level: 1.00
Work Quantity: 111840.00 SQ M

Average Daily Production: 750.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	10	V-DRUM ROLLER	1.00	7.60
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.60	10.67
M	4	ASPHALT	90.00	0.24

Crew Size: 13.00 Crew Days: 149 Unit Cost: $0.74 Budget: $82,480

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	174	174	155	174	155	155	174	155	155	155	155	155	1939

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

8 PCCP SLAB REPLACEMENT

Lump Sum Total Cost: 0.00

Inventory: 32520.00 SQ M
x Effort Level: 0.05

Work Quantity: 1626.00 SQ M

Average Daily Production: 100.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	6	SK. LABORER	4.00	0.56
L	7	UNSK. LABORER	12.00	0.47
E	14	CONC. CUTTER	1.00	2.31
E	16	CONC. MIXER	1.00	2.50
M	1	CEMENT	191.00	4.26
M	2	SAND	9.00	4.81
M	3	C. AGGREGATE	17.00	10.67
M	5	REBARS	40.00	0.58
M	6	LUMBER	70.00	0.44
M	7	NAILS	1.00	0.93

Crew Size: 17.00 Crew Days: 16 Unit Cost: $12.02 Budget: $19,550

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	25	25	22	25	22	22	25	22	22	22	22	22	276

9 PCCP SEALING OF JOINT

Lump Sum Total Cost: 0.00

Inventory: 5420.00 M
x Effort Level: 0.16

Work Quantity: 867.20 M

Average Daily Production: 640.00 M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	7	UNSK. LABORER	4.00	0.47
M	4	ASPHALT	320.00	0.24

Crew Size: 5.00 Crew Days: 1 Unit Cost: $0.16 Budget: $135

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	1	1	1	1	1	1	1	1	1	1	1	1	7

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

10 GR RD REGRAVELLING

Lump Sum Total Cost: 0.00

Inventory: 1208700.00 SQ M
x Effort Level: 0.25

Work Quantity: 302175.00 SQ M

Average Daily Production: 4000.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	3.00	0.56
L	6	SK. LABORER	8.00	0.56
L	7	UNSK. LABORER	10.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL	1.00	6.10
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	2.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	200.00	10.67

Crew Size: 24.00 Crew Days: 76 Unit Cost: $0.67 Budget: $202,804

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	163	163	145	163	145	145	163	145	145	145	145	145	1813

11 BIT SURFACE SEAL COAT

Lump Sum Total Cost: 0.00

Inventory: 111840.00 SQ M
x Effort Level: 1.00

Work Quantity: 111840.00 SQ M

Average Daily Production: 2400.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
M	3	C. AGGREGATE	3.00	10.67
M	4	ASPHALT	140.00	0.24

Crew Size: 7.00 Crew Days: 47 Unit Cost: $0.04 Budget: $4,526

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	29	29	26	29	26	26	29	26	26	26	26	26	326

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

12 DBST SINGLE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 559.00 CU M
x Effort Level: 0.10

Work Quantity: 55.90 CU M

Average Daily Production: 5.00 CU M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.78
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 11 Unit Cost: $192.88 Budget: $10,782

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	13	13	12	13	12	12	13	12	12	12	12	12	145

13 BIT SURFACE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 2796.00 CU M
x Effort Level: 0.10

Work Quantity: 279.60 CU M

Average Daily Production: 5.00 CU M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.78
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 56 Unit Cost: $192.88 Budget: $53,929

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	65	65	58	65	58	58	65	58	58	58	58	58	727

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
AURORA
1991 - 1992

PROGRAM: 1 maintenance (continued)

14 PAVEMENT MARKING

Lump Sum Total Cost: 0.00

Inventory: 100.00 SQ M
x Effort Level: 1.00
Work Quantity: 100.00 SQ M

Average Daily Production: 200.00 SQ M

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	8 PAINTER	5.00	0.56
M	8 PAINT	10.00	9.26

Crew Size: 6.00 Crew Days: 1 Unit Cost: $0.61 Budget: $61

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
ercent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	0	0	0	0	0	0	0	0	0	0	0	0	3

99 UNALLOCATED TIME

Lump Sum Total Cost: 0.00

Inventory: 3200.00 MANDAYS
x Effort Level: 1.00
Work Quantity: 3200.00 MANDAYS

Average Daily Production: 7.00 MANDAYS

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	2 CARPENTER	1.00	0.65
L	3 MASON	1.00	0.60
L	4 EQPT OPTR	1.00	0.66
L	5 DRIVER	1.00	0.56
L	6 SK. LABORER	1.00	0.56
L	7 UNSK. LABORER	1.00	0.47

Crew Size: 7.00 Crew Days: 457 Unit Cost: $5.07 Budget: $16,239

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
ercent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	288	288	256	288	256	256	288	256	256	256	256	256	3200

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Table 5-9

UPDATED: 07/31/91

DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance

1 DITCH CLEANING

Lump Sum Total Cost: 0.00

Inventory: 332.78 KM
x Effort Level: 2.00

Work Quantity: 665.56 KM

Average Daily Production: 6.00 KM

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	20.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 22.00 Crew Days: 111 Unit Cost: $26.15 Budget: $17,403

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	9	8	8	9	8	8	8	7	100
Labor Days	220	220	195	220	220	195	195	220	195	195	195	171	2440

2 GRASS CUTTING

Lump Sum Total Cost: 0.00

Inventory: 66.60 HA
x Effort Level: 2.00

Work Quantity: 133.20 HA

Average Daily Production: 1.20 HA

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	7 UNSK. LABORER	20.00	0.47
E	4 PORT. CUTTER	20.00	0.58

Crew Size: 21.00 Crew Days: 111 Unit Cost: $146.27 Budget: $19,483

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	210	210	186	210	186	186	210	186	186	186	186	186	2331

3 CULVERT CLEANING

Lump Sum Total Cost: 0.00

Inventory: 4485.00 M
x Effort Level: 2.00

Work Quantity: 8970.00 M

Average Daily Production: 500.00 M

RESOURCES

Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	10.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 12.00 Crew Days: 18 Unit Cost: $0.24 Budget: $2,140

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	19	19	17	19	17	17	19	17	17	17	17	17	215

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

4 GRAVEL ROAD GRADING

Lump Sum Total Cost: 0.00

Inventory: 81.30 KM
x Effort Level: 10.00
Work Quantity: 813.00 KM

Average Daily Production: 7.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 116 Unit Cost: $16.16 Budget: $13,138

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	94	94	84	94	84	84	94	84	84	84	84	84	1045

5 GR RD SPOT REGRAVELL

Lump Sum Total Cost: 0.00

Inventory: 81.30 KM.
x Effort Level: 1.00
Work Quantity: 81.30 KM.

Average Daily Production: 0.50 KM.

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	2.00	0.47
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL.	1.00	6.16
E	7	PNEUMA ROLLER	1.00	5.09
E	8	WATER TRUCK	1.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	7.50	10.67

Crew Size: 7.00 Crew Days: 163 Unit Cost: $768.21 Budget: $62,455

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	102	102	91	102	91	91	102	91	91	91	91	91	1138

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

6 GR RD SHOULDER GRAD'G

Lump Sum Total Cost: 0.00

Inventory: 442.60 KM
x Effort Level: 2.00
Work Quantity: 885.20 KM

Average Daily Production: 20.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 44 Unit Cost: $5.66 Budget: $5,007

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	36	36	32	36	32	32	36	32	32	32	32	32	398

7 BIT SURFACE PATCHING

Lump Sum Total Cost: 0.00

Inventory: 122340.00 SQ M
x Effort Level: 1.00
Work Quantity: 122340.00 SQ M

Average Daily Production: 750.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	10	V-DRUM ROLLER	1.00	7.60
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.60	10.67
M	4	ASPHALT	90.00	0.24

Crew Size: 13.00 Crew Days: 163 Unit Cost: $0.74 Budget: $90,224

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	191	191	170	191	170	170	191	170	170	170	170	170	2121

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

8 PCCP SLAB REPLACEMENT

Lump Sum Total Cost: 0.00

Inventory: 388200.00 SQ M
x Effort Level: 0.05
Work Quantity: 19410.00 SQ M

Average Daily Production: 1000.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	2.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	2	BATCHING PLT.	1.00	8.33
E	8	WATER TRUCK	1.00	13.22
E	12	LOADER	1.00	16.67
E	13	TRAN. MIXER	1.00	18.40
E	14	CONC. CUTTER	1.00	2.31
M	1	CEMENT	2290.00	4.26
M	2	SAND	108.00	4.81
M	3	C. AGGREGATE	204.00	10.67
M	5	REBARS	480.00	0.58
M	6	LUMBER	840.00	0.44
M	7	NAILS	12.00	0.93

Crew Size: 14.00 Crew Days: 19 Unit Cost: $13.65 Budget: $264,853

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	24	24	22	24	22	22	24	22	22	22	22	22	272

9 PCCP SEALING OF JOINT

Lump Sum Total Cost: 0.00

Inventory: 64700.00 M
x Effort Level: 0.16
Work Quantity: 10352.00 M

Average Daily Production: 640.00 M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	7	UNSK. LABORER	4.00	0.47
M	4	ASPHALT	320.00	0.24

Crew Size: 5.00 Crew Days: 16 Unit Cost: $0.16 Budget: $1,608

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	7	7	6	7	6	6	7	6	6	6	6	6	81

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

10 GR RD REGRAVELLING

Lump Sum Total Cost: 0.00

Inventory: 487800.00 SQ M
x Effort Level: 0.25
Work Quantity: 121950.00 SQ M

Average Daily Production: 4000.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	3.00	0.56
L	6	SK. LABORER	8.00	0.56
L	7	UNSK. LABORER	10.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL	1.00	6.10
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	2.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	200.00	10.67

Crew Size: 24.00 Crew Days: 30 Unit Cost: $0.67 Budget: $81,857

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	66	66	59	66	59	59	66	59	59	59	59	59	732

11 BIT SURFACE SEAL COAT

Lump Sum Total Cost: 0.00

Inventory: 122340.00 SQ M
x Effort Level: 1.00
W k Quantity: 122340.00 SQ M

Average Daily Production: 2400.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
M	3	C. AGGREGATE	3.00	10.67
M	4	ASPHALT	140.00	0.24

Crew Size: 7.00 Crew Days: 51 Unit Cost: $0.04 Budget: $4,952

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	32	32	29	32	29	29	32	29	29	29	29	29	357

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

12 DBST SINGLE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 611.74 CU M
x Effort Level: 0.10

Work Quantity: 61.17 CU M

Average Daily Production: 5.00 CU M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.75
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 12 Unit Cost: $192.81 Budget: $11,794

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	14	14	13	14	13	13	14	13	13	13	13	13	159

13 BIT SURFACE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 3058.75 CU M
x Effort Level: 0.10

Work Quantity: 305.88 CU M

Average Daily Production: 5.00 CU M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.75
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 61 Unit Cost: $192.89 Budget: $59,001

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	72	72	64	72	64	64	72	64	64	64	64	64	795

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

14 PAVEMENT MARKING

Lump Sum Total Cost: 0.00

Inventory: 1198.00 SQ M
x Effort Level: 1.00

Work Quantity: 1198.00 SQ M

Average Daily
Production: 200.00 SQ M

RESOURCES			Quantity	Rate
Class				
L	1	FOREMAN	1.00	0.94
L	8	PAINTER	5.00	0.56
M	8	PAINT	10.00	9.26

Crew Size: 6.00 Crew Days: 6 Unit Cost: $0.61 Budget: $734

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	3	3	3	3	3	3	3	3	3	3	3	3	36

99 UNALLOCATED TIME

Lump Sum Total Cost: 0.00

Inventory: 2400.00 MANDAYS
x Effort Level: 1.00

Work Quantity: 2400.00 MANDAYS

Average Daily
Production: 7.00 MANDAYS

RESOURCES			Quantity	Rate
Class				
L	1	FOREMAN	1.00	0.94
L	2	CARPENTER	1.00	0.65
L	3	MASON	1.00	0.50
L	4	EQPT OPTR	1.00	0.68
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	1.00	0.56
L	7	UNSK. LABORER	1.00	0.47

Crew Size: 7.00 Crew Days: 343 Unit Cost: $5.07 Budget: $12,170

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	216	216	192	216	192	192	216	192	192	192	192	192	2400

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance

1 DITCH CLEANING

Lump Sum Total Cost: 0.00

Inventory: 348.74 KM
x Effort Level: 2.00
Work Quantity: 697.48 KM

Average Daily Production: 6.00 KM

RESOURCES			
Class		Quantity	Rat
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	20.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 22.00 Crew Days: 116 Unit Cost: $26.15 Budget: $18,237

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	230	230	205	230	205	205	230	205	205	205	205	205	2558

2 GRASS CUTTING

Lump Sum Total Cost: 0.00

Inventory: 104.62 HA
x Effort Level: 2.00
Work Quantity: 209.24 HA

Average Daily Production: 1.20 HA

RESOURCES			
Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	7 UNSK. LABORER	20.00	0.47
E	4 PORT. CUTTER	20.00	0.58

Crew Size: 21.00 Crew Days: 174 Unit Cost: $146.27 Budget: $30,605

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	330	330	293	330	293	293	330	293	293	293	293	293	3662

3 CULVERT CLEANING

Lump Sum Total Cost: 0.00

Inventory: 7614.00 M
x Effort Level: 2.00
Work Quantity: 15228.00 M

Average Daily Production: 500.00 M

RESOURCES			
Class		Quantity	Rate
L	1 FOREMAN	1.00	0.94
L	5 DRIVER	1.00	0.56
L	7 UNSK. LABORER	10.00	0.47
E	1 DUMP TRUCK	1.00	8.71

Crew Size: 12.00 Crew Days: 30 Unit Cost: $0.24 Budget: $3,633

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	33	33	25	33	29	29	33	29	29	29	29	29	366

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

4 GRAVEL ROAD GRADING

Lump Sum Total Cost: 0.00

Inventory: 52.64 KM
x Effort Level: 10.00
Work Quantity: 526.40 KM

Average Daily Production: 7.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 75 Unit Cost: $16.16 Budget: $8,507

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	61	61	54	61	54	54	61	54	54	54	54	54	677

5 GR RD SPOT REGRAVELL

Lump Sum Total Cost: 0.00

Inventory: 52.64 KM.
x Effort Level: 1.00
Work Quantity: 52.64 KM.

Average Daily Production: 0.50 KM.

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	2.00	0.47
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL	1.00	6.10
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	7.50	10.67

Crew Size: 7.00 Crew Days: 105 Unit Cost: $768.21 Budget: $40,439

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	66	66	59	66	59	59	66	59	59	59	59	59	737

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

6 GR RD SHOULDER GRAD'G

Lump Sum Total Cost: 0.00

Inventory: 354.26 KM
x Effort Level: 2.00
Work Quantity: 708.52 KM

Average Daily Production: 20.00 KM

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
E	5	GRADER	1.00	8.98

Crew Size: 9.00 Crew Days: 35 Unit Cost: $5.66 Budget: $4,008

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	29	29	26	29	26	26	29	26	26	26	26	26	319

7 BIT SURFACE PATCHING

Lump Sum Total Cost: 0.00

Inventory: 15000.00 SQ M
x Effort Level: 1.00
Work Quantity: 15000.00 SQ M

Average Daily Production: 750.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	10	V-DRUM ROLLER	1.00	7.60
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.60	10.67
M	4	ASPHALT	90.00	0.24

Crew Size: 13.00 Crew Days: 20 Unit Cost: $0.74 Budget: $11,062

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	23	23	21	23	21	21	23	21	21	21	21	21	260

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

8 PCCP SLAB REPLACEMENT

Lump Sum Total Cost: 0.00

Inventory: 715380.00 SQ M
x Effort Level: 0.05
Work Quantity: 35769.00 SQ M

Average Daily
Production: 1000.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	2.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	2	BATCHING PLT.	1.00	8.33
E	8	WATER TRUCK	1.00	13.22
E	12	LOADER	1.00	16.67
E	13	TRAN. MIXER	1.00	18.40
E	14	CONC. CUTTER	1.00	2.31
M	1	CEMENT	2290.00	4.26
M	2	SAND	108.00	4.81
M	3	C. AGGREGATE	204.00	10.67
M	5	REBARS	480.00	0.55
M	6	LUMBER	840.00	0.44
M	7	NAILS	12.00	0.93

Crew Size: 14.00 Crew Days: 35 Unit Cost: $13.65 Budget: $488,075

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	45	45	40	45	40	40	45	40	40	40	40	40	501

9 PCCP SEALING OF JOINT

Lump Sum Total Cost: 0.00

Inventory: 119230.00 M
x Effort Level: 0.16
Work Quantity: 19076.80 M

Average Daily
Production: 640.00 M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	7	UNSK. LABORER	4.00	0.47
M	4	ASPHALT	320.00	0.24

Crew Size: 5.00 Crew Days: 30 Unit Cost: $0.16 Budget: $2,962

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	13	13	12	13	12	12	13	12	12	12	12	12	149

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DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

10 GR RD REGRAVELLING

Lump Sum Total Cost: 0.00

Inventory: 315840.00 SQ M
x Effort Level: 0.25
Work Quantity: 78960.00 SQ M

Average Daily Production: 4000.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	3.00	0.56
L	6	SK. LABORER	8.00	0.56
L	7	UNSK. LABORER	10.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	5	GRADER	1.00	8.98
E	6	SHEEP FT ROLL	1.00	6.10
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	2.00	13.22
E	9	WATER PUMP	1.00	0.47
M	3	C. AGGREGATE	200.00	10.67

Crew Size: 24.00 Crew Days: 20 Unit Cost: $0.67 Budget: $52,996

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	43	43	38	43	38	38	43	38	38	38	38	38	474

11 BIT SURFACE SEAL COAT

Lump Sum Total Cost: 0.00

Inventory: 15000.00 SQ M
x Effort Level: 1.00
Work Quantity: 15000.00 SQ M

Average Daily Production: 2400.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	6	SK. LABORER	2.00	0.56
L	7	UNSK. LABORER	4.00	0.47
M	3	C. AGGREGATE	3.00	10.67
M	4	ASPHALT	140.00	0.24

Crew Size: 7.00 Crew Days: 6 Unit Cost: $0.04 Budget: $607

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	4	4	4	4	4	4	4	4	4	4	4	4	44

REPORT DATE: 08/01/91 Table 5-9 UPDATED: 07/31/91

DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

12 DBST SINGLE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 75.00 CU M
x Effort Level: 0.10

Work Quantity: 7.50 CU M

Average Daily Production: 5.00 CU M

Class		RESOURCES	Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.78
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 2 Unit Cost: $192.88 Budget: $1,447

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	2	2	2	2	2	2	2	2	2	2	2	2	20

13 BIT SURFACE OVERLAY

Lump Sum Total Cost: 0.00

Inventory: 375.00 CU M
Effort Level: 0.10

Work Quantity: 37.50 CU M

Average Daily Production: 5.00 CU M

Class		RESOURCES	Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	4	EQPT OPTR	2.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	3.00	0.56
L	7	UNSK. LABORER	6.00	0.47
E	1	DUMP TRUCK	1.00	8.71
E	3	ASPHALT PAVER	1.00	21.69
E	7	PNEUMA ROLLER	1.00	5.02
E	8	WATER TRUCK	1.00	13.22
E	10	V-DRUM ROLLER	1.00	7.60
E	11	V-TANDEM ROLL	1.00	7.78
E	12	LOADER	1.00	16.67
E	15	ASPHALT MIXER	1.00	18.67
M	3	C. AGGREGATE	5.00	10.67
M	4	ASPHALT	240.00	0.24

Crew Size: 13.00 Crew Days: 8 Unit Cost: $192.88 Budget: $7,233

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	9	9	8	9	8	8	9	8	8	8	8	8	98

REPORT DATE: 08/01/91 | Table 5-9 | UPDATED: 07/31/91

DEPT. OF PUBLIC WORKS & HIGHWAYS
ACTIVITY PLANS
NUEVA ECIJA
1991 - 1992

PROGRAM: 1 maintenance (continued)

14 PAVEMENT MARKING

Lump Sum Total Cost: 0.00

Inventory: 2208.00 Sw M
x Effort Level: 1.00
Work Quantity: 2208.00 SQ M

Average Daily Production: 200.00 SQ M

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	8	PAINTER	5.00	0.56
M	8	PAINT	10.00	9.26

Crew Size: 6.00 Crew Days: 11 Unit Cost: $0.61 Budget: $1,353

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	6	6	5	6	5	5	6	5	5	5	5	5	66

99 UNALLOCATED TIME

Lump Sum Total Cost: 0.00

Inventory: 2000.00 MANDAYS
x Effort Level: 1.00
Work Quantity: 2000.00 MANDAYS

Average Daily Production: 7.00 MANDAYS

RESOURCES

Class			Quantity	Rate
L	1	FOREMAN	1.00	0.94
L	2	CARPENTER	1.00	0.65
L	3	MASON	1.00	0.60
L	4	EQPT OPTR	1.00	0.66
L	5	DRIVER	1.00	0.56
L	6	SK. LABORER	1.00	0.56
L	7	UNSK. LABORER	1.00	0.47

Crew Size: 7.00 Crew Days: 286 Unit Cost: $5.07 Budget: $10,148

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Percent	9	9	8	9	8	8	9	8	8	8	8	8	100
Labor Days	180	180	160	180	160	160	180	160	160	160	160	160	2000

CHAPTER 6

ECONOMIC EVALUATION

CHAPTER 6

ECONOMIC EVALUATION

The proposed ARIDP program must meet certain economic criteria to demonstrate that available investment capital will be well spent. For this reason, an economic evaluation was performed for each traffic section and pavement design option. The evaluation procedure compared project benefits to project costs in terms of net present value (NPV), the internal rate of return (IRR) and the benefit-cost (B-C) ratio.

6.1 BASIC INPUTS AND ASSUMPTIONS FOR THE EVALUATION OF THE PROPOSED IMPROVEMENTS

The economic feasibility of each road section was analyzed using procedures similar to the methodology employed by the Consultant on the recently completed Rural Infrastructure Fund (RIF) Project and the 1990 General Santos City (GSC) Road Project. The procedures were modified in some areas (e.g. in shadow pricing) and all costs (vehicle operating costs, maintenance costs, etc.) were estimated in 1991 prices. Development benefits and construction costs were also estimated in 1991 prices. These cost elements were evaluated using the Consultant's spread-sheet based economic model which compares the present value of the difference between "with" and "without" project improvement costs (project benefits) to the present value of the estimated construction costs.

The spreadsheet model estimates vehicle operating costs (VOCs) based on pavement type and condition (standard practice in the Philippines, especially for screening a large number of road projects), but also based on traffic speeds. Thus, if traffic is light, comparable results to the simple screening model are obtained. If traffic levels are heavy or variable, the model will more closely approximate actual operating costs. VOCs are high at low speeds, decline to a minimum, and then rise at high rates of speed.

6.1.1 Assumptions

The model contains two key assumptions regarding surface roughness and vehicle operating speeds. Pavement conditions, as measured by a roughness index, deteriorate over time as accumulated axle loads build up. Roughness increases up to a maximum value before resurfacing is required, at which time roughness decreases. VOCs are a function of roughness and traffic speeds. As roughness increases, traffic speeds decline and VOC rises. Traffic speeds also decline as volume increases relative to roadway capacity.

The roughness progression curve employed by the model is from the Highway Design and Maintenance Standards Model (HDM-III) developed by the World Bank. The speed curve is from the Transportation Research Board, Special Report No. 209, Washington D.C., 1985, modified to reflect the effect of roughness on operating speeds on Philippine roads.

6.1.2 Model Inputs

The basis for analysis is the homogeneous traffic section which has approximately uniform levels of traffic and vehicle types. Sometimes it is necessary to analyze traffic sections at the subsection level because pavement conditions or terrain features vary. In these cases, benefits from each subsection must be added together before a benefit-cost evaluation can be made. For each alternative section, the model inputs are:

- Traffic forecasts "with" and "without" the proposed upgrade by type of vehicle;
- Roadway geometrics "with" and "without" the proposed upgrade (roadway cross section, grade, curvature and length);
- Pavement conditions "with" and "without" the proposed upgrade (surface type, condition, and modified structural number reflecting surface and subsurface strength);
- Maintenance costs "with" and "without" the project (see Chapter 5);
- Vehicle operating costs by type of vehicle for different degrees of roughness and operating speeds;
- Construction costs (including project management costs); and
- Development benefits (see 6.3.2).

6.1.3 Model Output

The spreadsheet model forecasts vehicle operation and time cost savings by type of traffic. Development benefits are calculated separately and are linked to the summary table evaluating the traffic section. Discounting to present value uses the following conventions:

- Project costs are distributed over two years unless staged construction over a longer period is planned;
- Project costs and benefits are in constant 1991 pesos;

- Project benefits extend for 20 years after construction has been completed;
- Annual costs and benefits are realized at the end of the year; and
- The opportunity cost of capital, after inflation, is 15 percent.

Other benefits such as tourism benefits, accident reductions, improved access to health care, and income distribution effects are discussed in the context of the traffic section under review.

6.2 SHADOW PRICES

Shadow pricing is the practice of adjusting quoted or financial prices so as to obtain an estimate of the true market price for the value of the resource. Quoted prices can differ from true or free-market prices unless conditions of perfect competition, full employment of all resources, and mobility of capital and labor prevail.

In previous feasibility studies, the Consultant made the following shadow price adjustments:

- The social discount rate (opportunity cost of capital) was assumed to be 15 percent; and
- Government taxes and subsidies were treated as transfers, i.e., economic prices were obtained by removing all taxes, duties, and subventions from the financial prices.

The Consultant conferred with the staff of the National Economic and Development Authority (NEDA) as well as the staff from the Philippine Institute for Development Studies (PIDS) and decided on the following additional shadow price adjustments:

- Given that a large segment of the labor force is currently unemployed or underemployed in the project area, the shadow wage rate is estimated to be 60 percent of the prevailing wage rate for unskilled labor and 100 percent of the prevailing wage rate for skilled labor.
- The shadow exchange rate of the peso is estimated to be ₱ 32 for one dollar (assuming a phaseout of the 9 percent import duty).

The above shadow price adjustments are the same adjustments used in the recently completed Makar Wharf Feasibility Study. Appendix C-1 presents background on these additional shadow price adjustments.

6.3 PROJECT BENEFITS

6.3.1 Traffic Benefits

The traffic benefits of the improved road were calculated from the difference in vehicle operating cost "with" and "without" the project. VOCs were calculated for a wide range of roughness indicators and operating speeds by type of vehicle. These VOCs were calculated using the latest available prices and are in economic terms, i.e., factor prices have been adjusted to reflect their estimated true market values. Appendix C-2 presents the prices of vehicles, fuel, and tires used with the HDM-III model to obtain the operating costs. Other parameters that are required by HDM-III and the result of the calculations are also shown in Appendix C-2.

Unit running costs, in pesos per kilometer, were computed for five vehicle categories according to average running speed and road roughness. The vehicle types used were 1) motorcycles and tricycles, 2) cars and vans, 3) jeepneys, 4) buses, and 5) trucks. Initial roughness and the change in roughness values over time were estimated using the appropriate roadway deterioration curve. The specifications of these curves is shown in Appendix C-3.

The unit cost data was used to compute "with" and "without" vehicle operating costs for each year of the 20-year project life. The figures vary from year to year due to changes in pavement roughness, average running speeds, and traffic volumes. The difference between the two cost streams constitute the roadway user benefits before they are discounted to present value.

Traffic benefits accruing to the proposed improvements were estimated separately for normal, diverted and generated traffic. These traffic types include:

6.3.1.1 Normal Traffic

Normal traffic is the level of traffic projected to occur even if the roadway project is not undertaken. User benefits from normal traffic are the full difference in the vehicle operating costs "with" and "without" the project. Normal traffic benefits are the basic gains achieved by roadway user should the upgrade be constructed.

6.3.1.2 Diverted Traffic

Unlike normal traffic which occurs irrespective of improvements, diverted traffic occurs only if the road is upgraded. An improved roadway will encourage a shift of persons or goods traveling by other routes (or by other transport modes) onto the upgraded section. The shift will occur if transport costs on the improved road are lower. Diverted traffic benefits are the difference in transport costs between the previous route (or transport mode) and the upgraded road.

6.3.1.3 Generated Traffic

Generated traffic also occurs only if the roadway is improved. Generated traffic benefits occur because lower transport costs encourage increased production in the zone of influence (ZOI). Based on a general consensus of transport economists, the benefits from generated traffic are half the difference in the vehicle operating costs "with" and "without" the upgrade. The so-called 50 Percent-Rule is based on the presumed shapes of the supply and demand curves for transportation services.

6.3.1.4 Passenger Time Savings

Benefits from passenger time savings were also estimated on the basis of increases in travel speed that will result from the proposed road improvements. Time savings occur principally because of reduced roughness (a smoother riding surface). Other improvements that contribute to time savings include road shortening, improvements in horizontal and vertical alignments, and a widened carriageway.

The value of passenger time is based on the average income of Aurora Province and Nueva Ecija Province. The source data on provincial incomes is the National Statistical Office's (NSO) 1988 Family Income and Expenditures Study. The 1988 income figures from the NSO report were updated to 1991 levels by the growth rates of Gross Regional Domestic Product. The figure used in the evaluation of the ARIDP roads was 4.22 pesos per passenger hour. The road sections were evaluated "with" and "without" passenger time savings. Appendix C-2 includes the methodology for calculating the value of passenger time.

6.3.2 Development Benefits

6.3.2.1 Development Benefits from Agriculture

The proposed upgrading of roads in Aurora and Nueva Ecija provinces will have only a marginal effect on agricultural production in the ZOI of the project road. Because the ZOI is served by

barangay roads and tracks that become impassable during several months of the year during the monsoon, the price effect of an improved main road is likely to be small. Increases in production are likely to be marginal. Some agricultural benefits will occur because of reduced spoilage due to a more reliable transport system, but this will have no effect on the losses of stored crops, which may exceed 20 percent per annum in remote barangays due to rats, insects and dampness. Some increases in farmgate prices may occur if the interprovincial roads are improved.

One of the existing road sectors is a mainly gravel circumferential road linking Baler and the municipalities of Dipaculao, Maria Aurora and San Luis. The road passes through the relatively developed agricultural area of the central Maria Aurora alluvial plain. There are large areas of irrigated and rain-fed palay, with extensive coconut plantations. Backyard poultry and small livestock are found, as well as vegetable gardens. Improvement of the circumferential road will not by itself significantly improve the present levels of agricultural production, and for this section no agricultural benefits were computed.

The second road sector is the interprovincial link between Rizal, Pantabangan and Maria Aurora. From Rizal, the road passes an area of sustained cultivation of palay and corn then starts to climb to Pantabangan through eroded de-forested hills with little cultivation. It then continues through the Sierra Madre mountains through de-forested slopes with a small population of hill farmers. The section terminates at the edge of the Maria Aurora flood plain.

Improvement of the above interprovincial link would have a positive effect on the movement of goods and passengers between Aurora and Nueva Ecija provinces. An improved road would lower VOC and should marginally lower the prices of consumer goods and transport cost of passengers. It should also reduce spoilage. Some small benefits have been calculated for this section.

The third road sector concerns upgrading of the existing road between Palayan and Dingalan/ Paltic. The road, which was damaged by the 1990 earthquake and is subject to seasonal floods, passes along the Coronel River valley where scattered areas of cultivation exist. Palay and corn are the chief crops. However, the valley is subject to flash floods carrying river wash of rocks and gravel which are slowly reducing the cultivated areas. Only marginal agricultural benefits were considered for this section.

The fourth road sector concerns a third interprovincial link. This is partially an alternative route to the existing Palayan-Baler National Road. The project road under study consist of the improvement of the portion of the National Highway from Tablang to Km Post 170, about one kilometer west of the provincial boundary, the construction of a new road that will run northward parallel to the Cabatangan River to merge with the Maria Aurora-Canili road at Km Post 38, and the improvement of the Km Post 38-Maria Aurora section.

This alternative route will provide shorter travel time between Baler and Cabanatuan City, Nueva Ecija's active trading center. The construction of the non-existing link between the two interprovincial roads is expected to attract immigrants and induce some agricultural development

of the traversed area. However, with the limited potential of the zone of influence due to its topography, the road will only bring about marginal development benefits.

The section from Km 38 to Maria Aurora traverses part of the Maria Aurora central flood plain which has a limited potential for development based on the extensive study of the AIADP. The existing road is mainly gravel-surfaced, mostly in bad condition. The improvement of this road section, complemented by the construction of an all-weather shorter road link to Nueva Ecija, is expected to induce development of the limited potential of the zone of influence due to higher farmgate prices resulting from increased trading competition and lower transport costs. Thus, development benefits have been computed for this road section.

The proposed San Luis-Dingalan road covers the improvement of the existing logging road to a foot trail. The existing logging tracks pass through virtually uninhabited country between Dingalan and San Luis. While the Land Use Opportunity Map of Bureau of Soils indicates the presence of idle, less utilized lands that have potential for various forms of well managed agricultural uses, topographic maps and aerial video footages suggest that this will require substantial capital investment. No development benefits were considered for this section which also appears unacceptable on environmental grounds.

The effects of the project roads are discussed in Appendix B-3 (Agricultural Development Benefits). Increases in areas planted in the central Maria Aurora alluvial plain will be very limited in the absence of any surplus low lands. Moreover, production may be affected by increased flash floods, diminished stream-flows, silting and deposits of river wash caused by forest destruction and consequent erosion.

It should not be appreciated that the northern (Casiguran) zone of Aurora was excluded from the ARIDP. This zone is a significant producer of palay (52 percent of the provincial total), of coconuts and peanuts, and its inclusion would have increased the overall development benefits. As mentioned in Chapter 2, consideration should be given to a Phase II study of connecting Casiguran to Baler with an all weather road.

Appendix B-3 presents the agricultural development benefits expected from the improvement of Km 38-Maria Aurora road section. Table 6-1 presents the estimated impact on farmgate prices for the ZOI's affected by the improved road sectors.

Figure 6-1 illustrates the current agricultural commodity flows in Aurora province.

6.3.2.2 Generated Traffic Benefits vs. Development Benefits

To include both generated traffic benefits (measured as VOC savings) and development benefits (measured as net value added) would double count the benefits of generated traffic. To evaluate these benefits for the proposed ARIDP roads, two mutually exclusive scenarios were considered:

- a scenario showing the economic IRR, NPV, and B-C ratio with generated traffic benefits but <u>without development benefits</u>; and

Table 6–1
THE ROAD'S IMPACT ON AGRICULTURE

	PALAY	CORN	COCONUT	BANANA	COFFEE	OTHER CROPS	LIVE-STOCK	POULTRY	FISH
WITHOUT ROAD									
Wholesale price – financial	5,030	4,080	3,500	4,500	25,680	9,200	41,850	41,940	31,330
– economic	3,018	4,080	4,515	4,500	25,680	9,200	41,850	41,940	31,330
Marketing charges	840	760	1,437	1,640	4,200	2,370	10,400	3,670	5,780
% of wholesale	16.7%	18.6%	41.1%	36.4%	16.4%	25.8%	24.9%	8.8%	18.4%
Farm Price – financial	4,190	3,320	2,063	2,860	21,480	6,830	31,450	38,270	25,550
– economic	2,178	3,320	3,078	2,860	21,480	6,830	31,450	38,270	25,550
WITH ROAD									
Reduction in marketing charges	168	152	287.4	328	840	474	2080	734	1,156
Farm price – financial	4,358	3,472	2,350	3,188	22,320	7,304	33,530	39,004	26,706
– economic	2,346	3,472	3,365	3,188	22,320	7,304	33,530	39,004	26,706
Increase in Farm Price	7.7%	4.6%	9.3%	11.5%	3.9%	6.9%	6.6%	1.9%	4.5%
Long-run elasticity of supply	0.5	0.65	0.5	0.5	0.75	0.8	0.75	1.00	0.75
Increase in production	3.9%	3.0%	4.7%	5.7%	2.9%	5.6%	5.0%	1.9%	3.4%
Years without change	0	0	5	1	5	2	2	2	0
Years of adjustment	3	3	4	4	5	3	4	4	5
Increase per year	1.3%	1.0%	1.2%	1.4%	0.6%	1.9%	1.2%	0.5%	0.7%

Source: Consultant's Estimates

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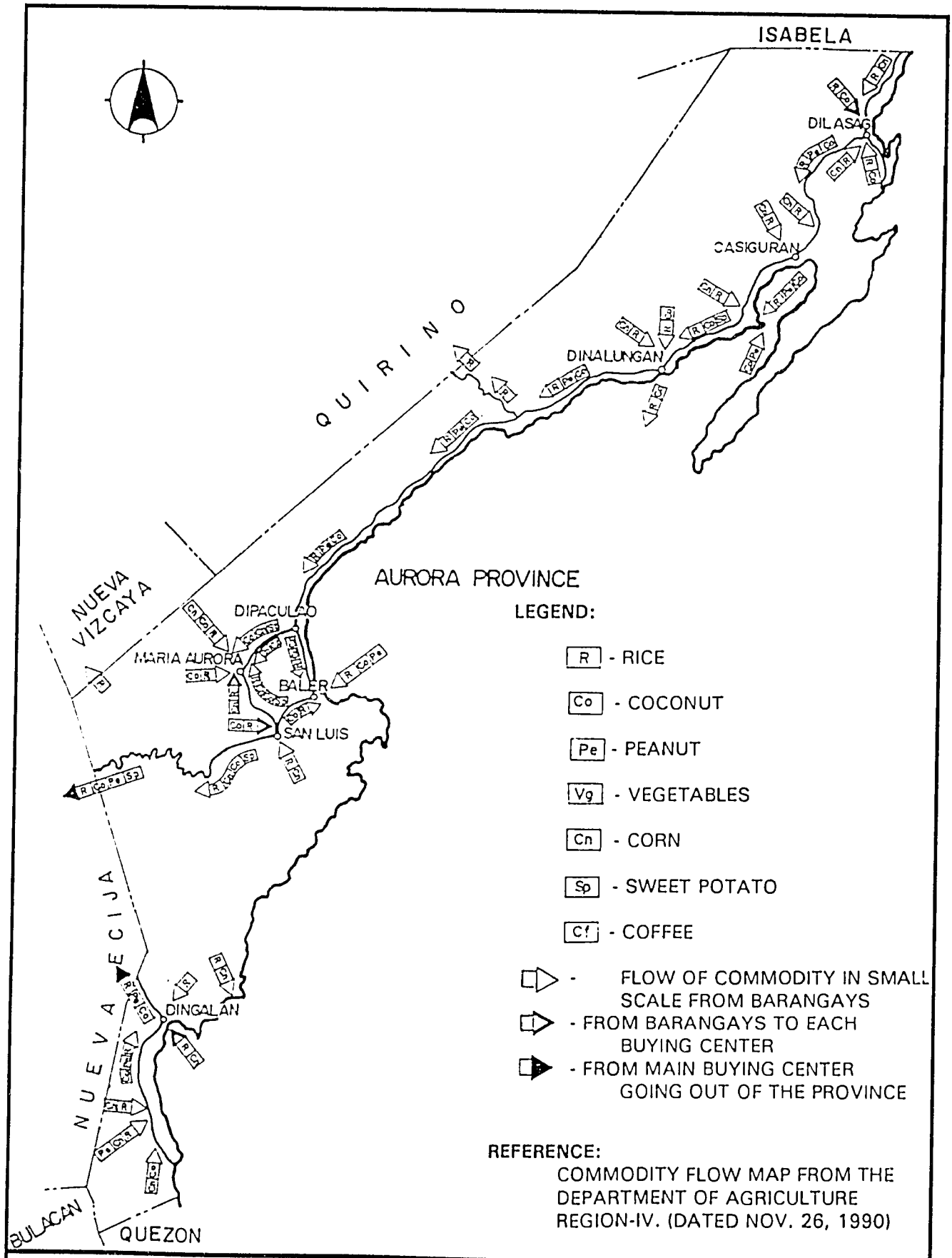

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	GEOGRAPHIC FLOW OF COMMODITY	FIGURE 6-1

- a scenario showing the economic IRR, NPV, and B-C ratio without generated traffic benefits but with development benefits.

6.3.3 Road Maintenance Benefits

One of the benefits from an upgraded road is a reduction in maintenance costs, especially when the upgrade is to PCC. The reduction in maintenance costs constitutes a roadway benefit that should be included in the economic analysis. In practice, the roadway width and shoulders are often widened from the existing carriageway and this widening usually off-sets some of the maintenance benefits because a greater area must be maintained.

For the ARIDP roads project, a "good" maintenance policy was assumed for both "with" and "without" project. Roadway roughness, operating speeds, and VOCs were based on such a maintenance program. For sensitivity analysis, a "poor" maintenance policy was also assumed (see Section 6.8).

The cost elements used in the RIF and GSC Road Projects were updated to 1991 pesos for the ARIDP road project. Certain additional costs were estimated for those road sections susceptible to flooding. Also, known timber and bailey bridges that will need to be replaced were costed as part of the analysis. The methodology for estimating the routine and periodic costs by roadway type is found in Chapter 5.

6.4 TRAFFIC MOVEMENTS BY SHIP

Three separate interviews were conducted in Baler and two in Dingalan in June and July of this year. The findings of these interviews are summarized below.

6.4.1 Dingalan Ship Traffic

Sea-borne traffic at Dingalan is limited to the export of logs and the import of fish. Logs are both brought in for processing at the Dingalan sawmill and towed out to larger ships for movement to Manila. Fish catches are brought in for local consumption and shipment to Cabanatuan. The lack of an ice plant and fish smoking facilities limit the fish shipments inland. There are two shipments per week of fish to Cabanatuan. A shipment consists of eight styrofoam boxes containing ice and 40 kilos of fish per box. The ice and boxes are provided by the fish dealer in Cabanatuan. There is potential for more trade in fish if an ice plant and better landing facilities were available.

Currently, fish catch is brought in by beaching the fishing boat and carrying the catch from the boat to the shore. Local residents have expressed a desire for both a wharf and an ice plant. According to the Philippine Ports Authority, a new wharf has been proposed for development to the Japanese Overseas Economic Cooperation Fund. Vehicular traffic would increase if these two facilities were built. The potential movements are limited, however, due to overfishing (see Chapter 2).

6.4.2 Baler Ship Traffic

There are two loading/unloading areas for bancas (motorized boats) in Baler. Both are located near the Doongan Bridge in the Sabang area of the city. The small pier in Port Aurora (Cemento) to the south is not utilized, perhaps because it is quite far from Baler. (There is no connecting bridge over the Suklayin River). The two piers in Baler are relatively sheltered from the sea and are close to local markets.

The two wharfs in Baler can each berth two 15 meter bancas at a time. There are typically two bancas waiting to reach dockside, two at the dock, in addition to an occasional fishing boat that arrives to use one of the two concrete wharfs on the Baler Creek. Stevedores are present at the wharfs for loading and unloading cargo; their fees are fixed and based on the type of commodity being shipped.

Scheduling of berth space is conducted by the banca owners/wharf operators themselves on a first-come, first-serve basis. The city does not seem to be involved, nor does it charge any fee for the use of the berths. There is no fixed schedule of arrivals and departures, but the traffic is fairly regular with two bancas arriving and departing each day. Ship waiting time at the berths and awaiting berth space is considerable. On average, waiting time is over one week. This length of ship's time seems to indicate that additional berths are needed. However, there is adequate storage space at the existing berths so any additional berths would not decrease waiting time very much.

As with stevedore charges, goods and passenger shipping fees are uniformly fixed for the regular banca trips. These trips are almost entirely between Baler and Casiguran. Casiguran, in the northern part of Aurora Province, is only occasionally accessible by land due to many river crossings between it and Baler and the heavy rainfall experienced by the province. Bancas transport cargo principally, due to their design; however, passengers are also transported. Transportation charges are shown in Table 6-4. Additional details are provided in Appendix C-4.

Table 6-2
BANCA SHIPPING CHARGES
(Baler - Casiguran)

COMMODITY	CHARGE (₱)
Bottled Beverages (Case)	10.00
Biscuits (40 kilo box)	10.00
Sugar (sack)	15.00
Cement (bag)	10.00
Rice (cavan)	10.00
Copra (50 kilo bag)	17.50
Passengers (each)	80.00
Passenger bags (each)	7.00

Source: Consultant's Survey

There is no regular banca traffic between Baler and Dingalan to the south. Charter trips can be arranged for approximately 6,000 pesos. If 15 passengers (maximum capacity) were to charter a banca, the cost would come to 400 pesos per passenger. This is five times the cost of the fee to travel to Casiguran (passenger costs are defrayed by cargo charges.) The market in banca traffic can be characterized as close to free market conditions with some public assistance needed for port improvements in Dingalan. The lack of banca traffic between Baler and Dingalan strongly suggests that a road between Baler and Dingalan is not necessary to accommodate existing demand.

6.5 PROJECT COSTS

6.5.1 Construction Costs

The economic evaluation was made by using economic costs which are derived from financial costs by removing all taxes, duties and subsidies and by using the shadow price adjustments described earlier. Construction cost by traffic sections were developed using unit costs and typical pavement sections as shown in Chapter 5. Environmental mitigation costs, principally erosion control measures, were included in the project construction costs.

6.5.2 Project Management Costs

In addition to construction costs, project management costs should also be included as part of project costs. Project management costs have three components:

- overall coordination of the implementation phase of the project by the executing agency in charge;
- detailed design; and
- construction supervision. For costing purposes, it was assumed that both foreign and local construction companies would be involved in supervision and actual construction.

Project management costs were estimated to be 8 percent of construction costs. Project management costs were in addition to the 10 percent contingency and 10 percent office and vehicle costs included in the construction cost estimates.

6.5.3 Allocation of Project Costs

It was assumed that the completion year for the infrastructure projects will be 1993, and that the roads will be open to traffic as early as 1994 or as late as 1996. Project costs (construction costs and project management costs) were allocated according to the proposed construction schedule, generally on a case-by-case basis. For example, Table 6-3 shows a three-year construction project.

Table 6-3
ALLOCATION OF PROJECT COSTS

YEAR	CONSTRUCTION COST	MANAGEMENT COST
1992	30 %	30 %
1993	35 %	35 %
1994	35 %	35 %

For a phased construction schedule, an appropriate allocation was used except that project benefits extend 20 years into the future after the last phase of the project.

6.6 SCENARIOS AND SELECTION CRITERION

Four base-case scenarios are presented below for each road section. The base case results differ in what is included in the definition of benefits. Including development benefits requires that generated traffic benefits be excluded, and vice versa. The value of passenger time is sometimes included and other times excluded. Hence, there are four base-case situations. These base cases are:

- VOC benefits, road maintenance benefits, time savings, and development benefits;
- VOC benefits, road maintenance benefits, and development benefits;
- VOC benefits, road maintenance benefits, time savings, and generated traffic benefits; and
- VOC benefits, road maintenance benefits, and generated traffic benefits.

The economic evaluation found in 6.7 includes the NPV of the project at 10, 15 and 20 percent interest rates, the IRR, and the B-C ratio at 10, 15 and 20 percent. These performance statistics are all in economic terms. The criterion used to establish economic feasibility was an IRR of at least 15 percent, with all benefits (including passenger time) included. The larger of development or generated traffic benefits was used to determine economic feasibility.

6.7 RESULTS

The results of the economic evaluation are described below by traffic section grouped by road segment. The figures quoted are economic figures (costs, benefits, IRRs, etc.). Financial figures are found in Chapter 5 and Section 6.10. In all cases for which development benefits have been estimated, the generated traffic benefits were found to be higher. The IRRs and other economic criteria thus included benefits from generated traffic and also include benefits from passenger time savings.

6.7.1 Segment 1 - The Circumferential Road

Segment 1 consists of four homogenous traffic sections for which benefits and costs have quantified. These sections are as follows:

6.7.1.1 Baler-Dipaculao (11.6 kilometers)

The section from Baler to Dipaculao consists of two sub-sections: 2.4 km of PCC in flat terrain in good condition and 9.2 km of gravel in flat terrain in good condition.

There were two pavement designs for this section: PCC and AC. Improving the existing gravel road to PCC standards was estimated to cost 44.4 million pesos or 4.8 million pesos a kilometer. Improving the gravel surface to AC standards was estimated to cost 30.1 million pesos or 3.3 million pesos a kilometer.

Table 6-4 presents the results of the economic analysis for this section for the "Full Road" analysis. The results show an economic IRR below the required 15 percent rate of return. The net present value is negative and the benefit-cost ratios are below 1.0 for the range of interest rates from 10 to 20 percent.

Table 6-4
SUMMARY OF ECONOMIC RESULTS
BALER-DIPACULAO
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	0.8%	3.0%
NPV (15%)	-21.3	12.7
B/C (15%)	0.26	0.34
B/C (10%)	0.38	0.50
B/C (20%)	0.18	0.25

Note: NPV is in millions of pesos.

6.7.1.2 Dipaculao-Maria Aurora (8.6 kilometers)

The section from Dipaculao to Maria Aurora consists of four subsections, all in flat terrain: 4.3 km of gravel in bad condition, 2.6 km of gravel in good condition, 0.5 km of DBST in bad condition and 1.2 km of PCC in good condition.

PCC and AC were the proposed pavement designs. Upgrading the existing road to PCC standards was estimated to cost 37.9 million pesos or 5.1 million pesos per kilometer. Upgrading to AC standards was estimated to cost 28.2 million pesos or 3.8 million pesos per kilometer.

Table 6-5 shows the results of the economic evaluation for the "Full Road" analysis. The economic IRRs are below the required 15 percent. The IRR for the AC pavement design, 11.3 percent, is the highest for the traffic sections comprising the circumferential road. The NPV and the B/C ratios at 15 percent are below required level. Only the B/C ratio evaluated at 10 percent shows the AC option to be feasible. However, a 10 percent rate of return is below the required 15 percent return on investment.

Table 6-5
SUMMARY OF ECONOMIC RESULTS
DIPACULAO-MARIA AURORA
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	8.6%	11.3%
NPV (15%)	-9.7	-4.3
B/C (15%)	0.60	0.76
B/C (10%)	0.89	1.11
B/C (20%)	0.44	0.56

Note: NPV is in millions of pesos.

6.7.1.3 Maria Aurora-San Luis (10.7 kilometers)

The section from Maria Aurora to San Luis consists of five subsections in flat terrain with many river crossings: 5.1 km of gravel in good condition, 4.2 km of gravel in good condition, 0.6 km of DBST in fair condition, 0.3 km of AC in bad condition and 0.5 km of PCC in good condition.

Two pavement designs were considered for this section: PCC and AC. Improving the existing road to PCC standards was estimated to cost 101.4 million pesos or 9.9 million pesos per kilometer. Improving the road to AC standards was estimated to cost 87.6 million pesos or 8.6 million pesos per kilometer.

Table 6-6 presents the results of the economic analysis for the "Full Road" traffic projection. The IRRs range from 6.6 percent for the PCC design to 7.7 percent for the AC design. NPVs and the B/C ratios also show below accepted rates of return. The low rates are due to low traffic levels and the high cost of structures on this section.

Table 6-6
SUMMARY OF ECONOMIC RESULTS
MARIA AURORA-SAN LUIS
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	6.6%	7.7%
NPV (15%)	-35.0	-26.5
B/C (15%)	0.50	0.57
B/C (10%)	0.74	0.82
B/C (20%)	0.37	0.42

Note: NPV is in millions of pesos.

6.7.1.4 San Luis-Baler (7.2 kilometers)

The section from San Luis to Baler has four subsections in flat terrain: 0.3 km of gravel in bad condition, 0.7 km of DBST in fair condition, 3.8 km of DBST in good condition and 2.4 km of PCC in good condition.

The proposed pavement designs were PCC and AC. Upgrading the existing road to PCC standards was estimated to cost 20.1 million pesos or 4.2 million pesos a kilometer. Upgrading to AC standards was estimated to cost 11.4 million pesos or 2.4 million pesos a kilometer.

Table 6-7 shows the results of the economic analysis for this section using the "Full Road" alternative. The IRRs are low, reflecting the fair to good conditions of the existing road. The IRR for PCC is negative 0.7 percent and the IRR for AC is 1.9 percent. Other economic criteria show similar results: a very low return on investment.

Table 6-7
SUMMARY OF ECONOMIC RESULTS
SAN LUIS-BALER
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	-0.7%	1.9%
NPV (15%)	-10.9	-5.5
B/C (15%)	0.22	0.31
B/C (10%)	0.33	0.45
B/C (20%)	0.16	0.23

Note: NPV is in millions of pesos.

6.7.1.5 Circumferential Road (38.1 kilometers)

Table 6-8 shows the economic results for the four sections, described above, comprising the circumferential road in the Baler area. The IRRs of 5.6 percent and 7.5 percent, respectively, for PCC and AC, show the proposed improvements to be economically not feasible. The "With Gap" analysis is omitted because there are fewer diverted traffic benefits than the "Full Road" analysis and thus would have lower IRRs than the ones show in Tables 6-4 through 6-8.

Table 6-8
SUMMARY OF ECONOMIC RESULTS
CIRCUMFERENTIAL ROAD
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	5.6%	7.5%
NPV (15%)	-76.3	-48.5
B/C (15%)	0.45	0.55
B/C (10%)	0.66	0.80
B/C (20%)	0.32	0.40

Note: NPV is in millions of pesos.

6.7.2 Segment 2 - Rizal to Maria Aurora

Segment 2 consists of three homogeneous traffic sections. Benefits and costs have been quantified for these sections assuming the "With Gap" traffic projections. In the case of Segment 2, the "With Gap" traffic projections are higher than the "Full Road" traffic projections. The traffic sections are as follows:

6.7.2.1 Rizal-Canili (41.8 kilometers)

The section from Rizal to Canili has five subsections with the following conditions: 17.4 km of bad gravel in flat terrain, 5.9 km of fair gravel in flat terrain, 6.1 km of bad gravel in hilly terrain, 6.3 km of fair gravel in hilly terrain and 6.1 km of bad gravel in mountainous terrain.

Two pavement designs, AC and DBST, were proposed for this section with an overlay after 10 years. The cost of the AC design was estimated to be 158.5 million pesos or 3.8 million pesos a kilometer. The cost of the DBST design was estimated to be 127.9 million pesos or 3.1 million pesos a kilometer.

Table 6-9 shows the results of the economic evaluation using the "With Gap" traffic projection. The IRRs are above the required 15.0 percent. The IRR for AC is 17.7 percent and the IRR for DBST is 20.9 percent. The NPV ranges from 19.7 million for AC to 35.7 million for DBST. The B/C ratios are above 1.0 except for AC evaluated at 20 percent. Improving this section is economically feasible.

Table 6-9
SUMMARY OF ECONOMIC RESULTS
RIZAL-CANILI
WITH GAP

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	17.7%	20.9%
NPV (15%)	19.7	35.7
B/C (15%)	1.15	1.37
B/C (10%)	1.68	2.00
B/C (20%)	0.85	1.01

Note: NPV is in millions of pesos.

6.7.2.2 Canili-Km Post 38 (11.7 kilometers)

The section from Canili to Km Post 38 consists of four subsections with the following characteristics: 2.7 km of bad earth surface in hilly terrain, 3.0 km of fair gravel in hilly terrain, 3.2 km of bad gravel in mountainous terrain and 2.8 km of good gravel in mountainous terrain.

Two pavement designs were considered for this section: AC and DBST. The cost of the AC design was estimated to be 76.0 million pesos. The design calls for a new alignment that shortens the distance from 11.7 kilometers to 7.0 km. The cost per kilometer is 10.9 million pesos. The DBST option on the new alignment was estimated to cost 74.6 million pesos or 10.7 million per kilometer.

Table 6-10 summarizes the results of the economic evaluation under the "With Gap" projection. The IRRs for AC and DBST are 13.4 percent and 13.5 percent, respectively. By itself, this section is not economically feasible due to the requirement for a new bridge on the new alignment. NPVs are negative and the B/C ratios are below unity. However, an upgrade of this section is necessary if trucks are to use Segment 2.

Table 6-10
SUMMARY OF ECONOMIC RESULTS
CANILI-KM POST 38
WITH GAP

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	13.4%	13.5%
NPV (15%)	-5.4	-5.1
B/C (15%)	0.90	0.90
B/C (10%)	1.29	1.30
B/C (20%)	0.67	0.67

Note: NPV is in millions of pesos.

6.7.2.3 Km Post 38 - Maria Aurora (15.2 Kilometers)

The traffic section from Km Post 38 to Maria Aurora has three subsections: 7.4 km of bad gravel in mountainous terrain, 4.9 km of fair gravel in flat terrain and 2.9 km of fair gravel in flat terrain.

Two pavement designs, AC and DBST, were considered for this section. The AC option was estimated to cost 62.0 million pesos or 4.1 million pesos a kilometer. The DBST option was estimated to cost 58.4 million pesos or 3.8 million pesos a kilometer.

Table 6-11 presents the economic results for this section under the "With Gap" traffic projection. The IRRs of 22.8 percent and 23.1 percent for AC and DBST, respectively, show that the proposed improvements to be economically feasible. NPV is nearly 25 million pesos and the B/C ratio ranges from 2.55 to 2.62.

TABLE 6-11
SUMMARY OF ECONOMIC RESULTS
KM POST 38-MARIA AURORA
WITH GAP

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	22.8%	23.1%
NPV (15%)	24.8	24.9
B/C (15%)	1.68	1.72
B/C (10%)	2.55	2.62
B/C (20%)	1.19	1.21

Note: NPV is in millions of pesos.

6.7.2.4 Segment 2 (68.7 kilometers)

Table 6-12 displays the overall economic performance criteria for improving the three sections, described above, from Rizal to Maria Aurora. The IRRs range from 17.9 percent for an AC surface to 19.5 percent for a DBST surface. The NPVs range from 42.2 million pesos to 58.6 million pesos. Segment 2 is economically feasible with AC as the preferred surface.

TABLE 6-12
SUMMARY OF ECONOMIC RESULTS
SEGMENT 2
WITH GAP

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	17.9%	19.5%
NPV (15%)	42.2	58.6
B/C (15%)	1.22	1.35
B/C (10%)	1.82	2.01
B/C (20%)	0.88	0.97

Note: NPV is millions of pesos.

6.7.3 Segment 3 - Baler to Dingalan

This segment was dropped from consideration after initial costs were estimated to be 1.3 billion pesos for an AC pavement (17.9 million pesos per kilometer) with little economic benefits and expected environmental problems.

6.7.4 Segment 4 - Tablang Junction to Dingalan

Segment 4 consists of two homogenous traffic sections for which benefits and costs have been quantified. These sections are as follows:

6.7.4.1 Tablang Junction-Laur-Gabaldon (33.2 kilometers)

The section from Tablang Junction to Gabaldon consists of three subsections in flat terrain: 11.9 km of partially completed PCC roadway, 5.0 km of gravel in good condition and 16.3 km of gravel in fair condition.

Two pavement designs were proposed for this section: DBST with an AC overlay after 10 years, and AC (also with an overlay after 10 years). The cost of the AC option was estimated to be 156.1 million pesos or 7.3 million pesos per kilometer. The cost of the DBST option was estimated to be 146.2 million pesos or 6.9 million pesos per kilometer.

Table 6-13 displays the results of the economic evaluation. The IRR ranges from 8.5 percent for AC to 9.0 percent for DBST. The NPVs are negative and the B/C ratios indicate the improvements would be not economically feasible even with a 10 percent rate of return.

Table 6-13
SUMMARY OF ECONOMIC RESULTS
TABLANG JUNCTION-GABALDON
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	8.5%	9.0%
NPV (15%)	-38.3	-34.0
B/C (15%)	0.59	0.61
B/C (10%)	0.88	0.91
B/C (20%)	0.42	0.43

Note: NPV is in millions of pesos.

6.7.4.2 Gabaldon-Dingalan (14.2 kilometers)

The section from Gabaldon to Dingalan consists of six subsections with the following characteristics: 1.9 km of gravel in bad condition in flat terrain, 0.4 km of gravel in fair condition in flat terrain, 3.3 km of gravel in good condition in flat terrain, 1.2 km of PCC in good condition in flat terrain, 3.3 km of gravel in bad condition in mountainous terrain and 4.1 km of gravel in fair condition in mountainous terrain.

Two pavement designs were proposed for this section: DBST with an AC overlay after 10 years, and AC (also with an overlay after 10 years). The cost of the AC option was estimated to be 45.7 million pesos or 3.5 million pesos per kilometer. The cost of the DBST option was estimated to be 39.6 million pesos or 3.0 million pesos per kilometer.

Table 6-14 shows the findings of the economic analysis. The IRRs range from 6.0 percent for AC to 7.4 percent for DBST. The NPVs are negative for both pavement options. The B/C ratios show the upgrade of this section to be not economically feasible for the range of interest rates from 10 to 20 percent.

Table 6-14
SUMMARY OF ECONOMIC RESULTS
GABALDON-DINGALAN
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	6.0%	7.4%
NPV (15%)	-14.3	-10.7
B/C (15%)	0.47	0.54
B/C (10%)	0.69	0.80
B/C (20%)	0.34	0.40

Note: NPV is in millions of pesos.

6.7.4.3 Segment 4 (47.4 kilometers)

Table 6-15 displays the economic results for the two sections that together make up Segment 4. The IRRs of 8.0 percent and 8.7 percent for AC and DBST, respectively, show the proposed improvements for Segment 4 to be economically not feasible.

Table 6-15
SUMMARY OF ECONOMIC RESULTS
SEGMENT 4

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	8.0%	8.7%
NPV (15%)	-52.6	-44.7
B/C (15%)	0.56	0.59
B/C (10%)	0.83	0.89
B/C (20%)	0.40	0.43

Note: NPV is in millions of pesos.

6.7.5 Segment 5 - Tablang Junction to Maria Aurora

Segments 5 consists of four homogeneous traffic sections for which benefits and costs have been quantified. Tourism benefits associated with this new route into Maria Aurora have been prorated on kilometer basis. Agricultural benefits have been assigned to the 17.0 km of the proposed new road section described below.

6.7.5.1 Tablang Junction-Bongabon (8.3 kilometers)

This homogenous traffic section from Tablang Junction near Palayan City to Bongabon has six subsections, all in flat terrain. These are: 2.0 km of gravel in fair condition, 1.6 km of AC in bad condition, 0.2 km of AC in fair condition, 1.1 km of AC in good condition, 0.9 km of PCC in bad condition and 2.5 km of PCC in good condition.

Two pavement designs were considered for this section: PCC and AC. The estimated cost of the PCC option was 44.9 million pesos or 7.7 million per kilometer. The estimated cost of the AC option was 34.5 million pesos or 5.9 million pesos per kilometer.

Table 6-16 presents the results of the economic evaluation under the "Full Road" scenario. The IRRs for PCC and AC are 0.2 percent and 1.4 percent, respectively. The NPVs are negative and the B/C ratios are below 1.0 for the range of interest rates from 10 to 20 percent.

Table 6-16
SUMMARY OF ECONOMIC RESULTS
TABLANG JUNCTION-BONGABON
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	0.2%	1.4%
NPV (15%)	-23.5	-17.1
B/C (15%)	0.25	0.29
B/C (10%)	0.37	0.42
B/C (20%)	0.18	0.21

Note: NPV is in millions of pesos.

6.7.5.2 Bongabon-Km Post 170 (31.5 kilometers)

The traffic section from Bongabon to Km Post 170 near the provincial boundary consists of six subsections as follows: 2.9 km of good gravel in flat terrain, 2.9 km of good AC in flat terrain, 1.3 km of good PCC in flat terrain, 6.0 km of fair gravel in hilly terrain, 3.2 km of bad gravel in mountainous terrain and 15.2 km of fair gravel in mountainous terrain.

These were two pavement designs for this section: PCC and AC. The cost of a PCC standard pavement was estimated to be 244.9 million pesos or 8.1 million pesos a kilometer. The cost of an AC surface was estimated to be 205.3 million pesos or 6.8 million pesos a kilometer.

Table 6-17 shows the results of the economic analysis based on the "Full Road" traffic projection. The IRRs indicate the improvement of the road to be economically not feasible with a 7.8 percent return for PCC and a 9.2 percent return for AC. The NPVs are negative and B/C ratios below 1.0 for all cases.

Table 6-17
SUMMARY OF ECONOMIC RESULTS
BONGABON-KM POST 170
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	7.8%	9.2%
NPV (15%)	-70.8	-48.6
B/C (15%)	0.55	0.63
B/C (10%)	0.82	0.94
B/C (20%)	0.40	0.46

Note: NPV is in millions of pesos.

6.7.5.3 Km Post 170-Km Post 38 (17.0 kilometers)

This new roadway from Km Post 170 near the provincial boundary on the Bongabon-Baler highway to Km Post 38 on the Canili-Maria Aurora road is proposed as a short-cut to the Baler area. It is comprised of two subsections: 5.0 km of mountainous terrain and 12.0 km of hilly terrain.

Two pavement designs were considered for construction: 1) AC for 17.0 km and 2) DBST for 12.0 km of hilly terrain and PCC for 5.0 km of mountainous terrain. The costs of the AC design were estimated to be 209.4 million pesos; the costs of the alternative design were estimated to be 208.1 million pesos. Both design options average 12.3 million pesos per kilometer.

Table 6-18 displays the economic results for the proposed new road. Both pavement designs have an IRR of 18.6 percent because of large roadway user savings in diverted traffic. This new road section is economically feasible.

Table 6-18
SUMMARY OF ECONOMIC RESULTS
KM POST 170-KM POST 38

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	18.6%	18.6%
NPV (15%)	35.3	35.7
B/C (15%)	1.28	1.29
B/C (10%)	1.93	1.93
B/C (20%)	0.91	0.91

Note: NPV is in millions of pesos.

6.7.5.4 Km Post 38-Maria Aurora (15.2 kilometers)

The traffic section from Km Post 38 to Maria Aurora has three subsections: 7.4 km of bad gravel surface in mountainous terrain, 4.9 km of fair gravel surface in flat terrain and 2.9 km of fair gravel surface in flat terrain.

Two pavement designs, AC and DBST, were considered for this section. The AC option was estimated to cost 61.3 million pesos or 4.0 million pesos a kilometer. The DBST option was estimated to cost 58.4 million pesos or 3.8 million pesos a kilometer.

Table 6-19 presents the economic results for this section under the "Full Road" traffic projection. The IRRs of 28.5 percent and 29.1 percent for AC and DBST, respectively, demonstrate economic feasibility--if the new roadway between the interprovincial roads is built. The NPVs are positive and the B/C ratios show the upgrade to be feasible even at a 20 percent discount rate. For the "With Gap" analysis, see Section 6.7.2.3.

Table 6-19
SUMMARY OF ECONOMIC RESULTS
KM POST 38-MARIA AURORA
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	28.5%	29.1%
NPV (15%)	45.4	45.2
B/C (15%)	2.23	2.31
B/C (10%)	3.36	3.47
B/C (20%)	1.59	1.64

Note: NPV is in millions of pesos.

6.7.5.5 Segment 5 (75.0 kilometers)

Table 6-20 shows the overall economic performance criteria for improving the four sections, described above, from Tablang Jct. to Maria Aurora. The IRRs range from 14.6 percent for construction to mostly PCC standards (with some AC/DBST) to 15.7 percent for AC. The NPVs are negative and the B/Cs ratios are below 1.0 except for the AC pavement option.

Table 6-20
SUMMARY OF ECONOMIC RESULTS
SEGMENT 5
FULL ROAD

CRITERION	PAVEMENT OPTION	
	AC	DBST
IRR	14.6%	15.7%
NPV (15%)	-11.3	16.9
B/C (15%)	0.97	1.05
B/C (10%)	1.47	1.59
B/C (20%)	0.68	0.75

Note: NPV is in millions of pesos.

Table 6-21 presents a logical alternative to Segment 5. This alternative begins in Bongabon (instead of Tablang Jct.) and continues to Dipaculao (instead of Maria Aurora). Two pavement designs were considered: 1) PCC from Bongabon-Km Post 170 and extending 5.0 kilometers

on the new road, DBST for 12.0 kilometers to Km Post 38, AC to Maria Aurora and PCC to Dipaculao and 2) AC from Bongabon to Maria Aurora and PCC to Dipaculao. Both design options are economically feasible with IRRs of 15.1 percent for the mostly PCC design and 16.0 for the mostly AC design.

Table 6-21
SUMMARY OF ECONOMIC RESULTS
BONGABON-DIPACULAO
FULL ROAD

CRITERION	PAVEMENT OPTION	
	MOSTLY PCC	MOSTLY AC
IRR	15.1	16.0%
NPV (15%)	2.5	24.8
B/C (15%)	1.01	1.08
B/C (10%)	1.52	1.63
B/C (20%)	0.71	0.77

Note: NPV is in millions of pesos.

6.8 SENSITIVITY ANALYSIS

6.8.1 Maintenance Assumptions

The evaluation of the project roads "with" and "without" the proposed improvements was done assuming a good maintenance schedule. For gravel roads, this means regular grading and a four-year cyle of regraveling. For flexible pavements, this means an overlay every ten years. If a maintenance is poor, the estimated IRRs found in this study would change as follows:

- Existing Gravel Road vs. Proposed PCC Pavement

  The IRRs would increase nearly five percent with poor maintenance because the gravel road would become nearly impassible while the PCC road would deteriorate only in spots.

- Existing Gravel Road vs. Proposed Flexible Pavement

  The IRRs would increase approximately three percent for the same reason as with PCC, except the benefit stream would extend for only 10 years and not 20 as with PCC.

- Existing Flexible Pavement vs. Proposed PCC Pavement

  The benefit stream would be unchanged for the first 10 years, but would be higher for the second 10 years. Hence, IRRs would be higher than shown in this report. The difference is probably not more than two percent.

6.8.2 Growth Rates Required to Reach 15 Percent IRR

The growth rates used in this study were approximately two percent growth per annum in population and two percent growth per annum in real per capita income. One set of growth rates that shows the upgrade of Segment 1 to be economically feasible is 3.0 percent population growth per annum with 5.5 percent growth per annum in real per capita income.

The Tablang Jct.-Dingalan road (Segment 4) becomes economically feasible with the following growth rates: 3.0 percent population growth per annum with 2.9 percent growth per annum in real capital income.

6.8.3 Benefits Increased 15 Percent and Decreased 15 Percent

Tables 6-22 through 6-28 present the base case and alternative scenarios for the road segments. The scenarios include the base case with benefits 15 percent higher than expected, the base case with benefits 15 percent lower than expected and a worst-case scenario where benefits are 15 percent lower and costs are 15 percent higher.

- Segment 1 results are in Table 6-22 and 6-23. Table 6-22 displays the PCC option; Table 6-23 displays the AC option.

- Segment 2 results and its variations are shown in Tables 6-24 and 6-25. The AC option is considered in Table 6-24; the DBST option is considered in Table 6-25.

- Segment 4 results for both AC and DBST are shown in Table 6-26.

- Segment 5 results are shown in Table 6-27 for the mostly PCC option and in Table 6-28 for the mostly AC option.

Segment 1 is not feasible for PCC or AC under the most favorable case. The closest any one section gets to 15 percent is the Dipaculao-Maria Aurora section for the AC option with a 15 percent increase in benefits. In this scenario, the IRR becomes 13.1 percent.

Segment 2 is economically feasible under the base case for both pavement options. It is feasible with the additional costs of paving to Dipaculao. Under the recommended AC option, the upgrade is feasible with a 15 decrease in benefits. The DBST option is feasible under the worst case scenario.

Segment 4 from Tablang Jct. to Dingalan is not economically feasible even with a 15 percent increase in benefits. In this case, the IRR is at the 10 percent level.

Segment 5 shows higher IRRs when generated traffic benefits are used instead of development benefits. The mostly PCC option is not feasible and has an IRR of 14.6 percent. Dropping the Tablang Jct-Bongabon section and adding the Maria Aurora-Dipaculao section renders the upgrade feasible with an economic IRR of 15.1 percent. Unexpected benefits could place the IRR ar 17.2 percent, but any increase in costs or lower than expected benefits drops the IRR below 15 percent. The AC option raises the margin for error, but by less than 1.0 percent in overall IRRs.

6.9 RECOMMENDATIONS

The Consultant recommends the construction to mostly PCC standards of the Bongabon-Dipaculao road.

Specifically, the Bongabon-Km Post 170 section is recommended to upgraded to a PCC standard and constructed over three years, and from there, the first 5.0 kilometers of the new road (Km 170 to Km 38) is recommended to be PCC while the remaining 12.0 kilometers to Km Post 38 is recommended to be DBST. The construction phase of this new road is expected to last four years. The Km Post 38-Maria Aurora section is recommended to be AC, constructed over four years. The Maria Aurora-Dipaculao section is recommended to be PCC, constructed over three years.

If an environmental mitigation plan is not agreed to and funded, the Consultant instead recommends the upgrading of the Rizal-Canili-Maria Aurora road to AC standards and the construction to PCC standards of the Maria Aurora-Dipaculao section. Construction would take three years.

The recommended road improvement project has a base-case IRR of 15.1 percent as shown in Table 6-27. The alternative improvement project has a base case IRR of 16.0 percent as shown in Table 6-28.

Table 6-22
Economic Sensitivity Analysis
Segment 1
Internal Rates of Return

Section/ Alternative Full Road Pavement Type: PCC	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Baler-Dipaculao	0.8%	-0.8%	0.8%	-0.8%	1.9%	0.3%	1.9%	0.3%
Dipaculao-Ma. Aurora	8.6%	6.8%	8.6%	6.8%	10.2%	8.3%	10.2%	8.3%
Ma. Aurora-San Luis	6.6%	5.2%	6.6%	5.2%	8.1%	6.7%	8.1%	6.7%
San Luis-Baler	-0.7%	-1.9%	-0.7%	-1.9%	0.5%	-0.7%	0.5%	-0.7%
Circumferential Road	5.6%	4.1%	5.6%	4.1%	6.9%	5.4%	6.9%	5.4%

Section/ Alternative Full Road Pavement Type: PCC	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Baler-Dipaculao	-0.5%	-2.1%	-0.5%	-2.1%	-1.6%	-3.1%	-1.6%	-3.1%
Dipaculao-Ma. Aurora	6.9%	5.2%	6.9%	5.2%	5.5%	3.9%	5.5%	3.9%
Ma. Aurora-San Luis	4.9%	3.6%	4.9%	3.6%	3.6%	2.4%	3.6%	2.4%
San Luis-Baler	-2.0%	-3.1%	-2.0%	-3.1%	-3.1%	-4.2%	-3.1%	-4.2%
Circumferential Road	4.1%	2.7%	4.1%	2.7%	2.8%	1.5%	2.8%	1.5%

Table 6-23
Economic Sensitivity Analysis
Segment 1
Internal Rates of Return

Section/ Alternative Full Road Pavement Type: AC	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Baler-Dipaculao	3.0%	0.9%	3.0%	0.9%	4.2%	2.0%	4.2%	2.0%
Dipaculao-Ma. Aurora	11.3%	9.1%	11.3%	9.1%	13.1%	10.7%	13.1%	10.7%
Ma. Aurora-San Luis	7.7%	6.1%	7.7%	6.1%	9.3%	7.6%	9.3%	7.6%
San Luis-Baler	1.9%	0.1%	1.9%	0.1%	3.1%	1.3%	3.1%	1.3%
Circumferential Road	7.5%	5.8%	7.5%	5.8%	9.0%	7.1%	9.0%	7.1%

Section/ Alternative Full Road Pavement Type: AC	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Baler-Dipaculao	1.6%	-0.4%	1.6%	-0.4%	0.4%	-1.4%	0.4%	-1.4%
Dipaculao-Ma. Aurora	9.3%	7.3%	9.3%	7.3%	7.8%	5.8%	7.8%	5.8%
Ma. Aurora-San Luis	6.0%	4.5%	6.0%	4.5%	4.6%	3.2%	4.6%	3.2%
San Luis-Baler	0.5%	-1.1%	0.5%	-1.1%	-0.6%	-2.2%	-0.6%	-2.2%
Circumferential Road	5.9%	4.3%	5.9%	4.3%	4.6%	3.0%	4.6%	3.0%

Table 6-24
Economic Sensitivity Analysis
Segment 2
Internal Rates of Return

Section/ Alternative With Gap Pavement Type: AC	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Rizal-Canili	17.7%	14.9%	17.7%	14.9%	20.1%	17.0%	20.1%	17.0%
Canili-Km Post 38	13.4%	11.3%	13.4%	11.3%	15.5%	13.2%	15.5%	13.2%
Km Post 38-Ma. Aurora	22.6%	19.4%	22.6%	19.4%	25.0%	21.7%	25.0%	21.7%
Segment 2	17.9%	15.2%	17.9%	15.2%	20.0%	17.1%	20.0%	17.1%
Segment 2 (AC) plus Ma. Aurora on to Dipaculao (PCC)	17.0%	14.4%	17.0%	14.4%	19.1%	16.3%	19.1%	16.3%

Section/ Alternative With Gap Pavement Type: AC	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Rizal-Canili	15.2%	12.6%	15.2%	12.6%	13.2%	10.8%	13.2%	10.8%
Canili-Km Post 38	11.2%	9.2%	11.2%	9.2%	9.5%	7.6%	9.5%	7.6%
Km Post 38-Ma. Aurora	20.0%	17.0%	20.0%	17.0%	17.9%	15.1%	17.9%	15.1%
Segment 2	15.6%	13.2%	15.6%	13.2%	13.8%	11.5%	13.8%	11.5%
Segment 2 (AC) plus Ma. Aurora on to Dipaculao (PCC)	14.8%	12.5%	14.8%	12.5%	13.1%	10.8%	13.1%	10.8%

Table 6-25
Economic Sensitivity Analysis
Segment 2
Internal Rates of Return

Section/ Alternative With Gap Pavement Type: DBST	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Rizal-Canili	20.9%	18.1%	20.9%	18.1%	23.5%	20.5%	23.5%	20.5%
Canili-Km Post 38	13.5%	11.4%	13.5%	11.4%	15.5%	13.3%	15.5%	13.3%
Km Post 38-Ma. Aurora	23.1%	19.8%	23.1%	19.8%	25.6%	22.1%	25.6%	22.1%
Segment 2	19.5%	16.8%	19.5%	16.8%	17.4%	15.0%	17.4%	15.0%
Segment 2 (DBST) plus Ma. Aurora on to Dipaculao (PCC)	18.3%	15.9%	18.3%	15.9%	20.5%	17.9%	20.5%	17.9%

Section/ Alternative With Gap Pavement Type: DBST	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Rizal-Canili	18.1%	15.5%	18.1%	15.5%	15.9%	13.5%	15.9%	13.5%
Canili-Km Post 38	11.3%	9.4%	11.3%	9.4%	9.5%	7.7%	9.5%	7.7%
Km Post 38-Ma. Aurora	20.4%	17.4%	20.4%	17.4%	18.3%	15.5%	18.3%	15.5%
Segment 2	17.1%	14.7%	17.1%	14.7%	15.2%	12.9%	15.2%	12.9%
Segment 2 (DBST) plus Ma. Aurora on to Dipaculao (PCC)	16.0%	13.8%	16.0%	13.8%	14.2%	12.1%	14.2%	12.1%

Table 6-26
Economic Sensitivity Analysis
Segment 4
Internal Rates of Return

Section/ Alternative	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
Pavement Type: AC and DBST	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Gabaldon (AC)	8.5%	6.9%	8.5%	6.9%	10.1%	8.4%	10.1%	8.4%
Gabaldon-Dingalan (AC)	6.0%	3.7%	6.0%	3.7%	7.4%	5.0%	7.4%	5.0%
Segment 4 (AC)	8.0%	6.2%	8.0%	6.2%	10.0%	8.1%	10.0%	8.1%
Tablang Jct.-Gabaldon (DBST)	9.0%	7.3%	9.0%	7.3%	10.5%	8.8%	10.5%	8.8%
Gabaldon-Dingalan (DBST)	7.4%	5.1%	7.4%	5.1%	9.0%	6.5%	9.0%	6.5%
Segment 4 (DBST)	8.7%	6.9%	8.7%	6.9%	10.7%	8.8%	10.7%	8.8%

Section/ Alternative	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
Pavement Type: AC and DBST	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Gabaldon (AC)	6.9%	5.3%	6.9%	5.3%	5.5%	4.0%	5.5%	4.0%
Gabaldon-Dingalan (AC)	4.4%	2.3%	4.4%	2.3%	3.1%	1.1%	3.1%	1.1%
Segment 4 (AC)	6.8%	5.1%	6.8%	5.1%	5.7%	4.1%	5.7%	4.1%
Tablang Jct.-Gabaldon (DBST)	7.3%	5.7%	7.3%	5.7%	5.9%	4.4%	5.9%	4.4%
Gabaldon-Dingalan (DBST)	5.8%	3.5%	5.8%	3.5%	4.4%	2.3%	4.4%	2.3%
Segment 4 (DBST)	7.4%	5.7%	7.4%	5.7%	6.3%	4.7%	6.3%	4.7%

Table 6-27
Economic Sensitivity Analysis
Segment 5
Internal Rates of Return

Section/ Alternative Full Road Pavement Type: PCC	Base Case				With Benefits Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Bongabon	-1.3%	-1.8%	0.2%	-0.3%	-0.1%	-0.7%	1.4%	0.8%
Bongabon-Km Post 170	5.7%	4.5%	7.8%	6.4%	7.1%	5.8%	9.3%	7.9%
Km Post 170-Km Post 38 (PCC/DBST)	17.0%	15.1%	18.6%	16.3%	19.1%	17.1%	20.9%	18.3%
Km Post 38-Maria Aurora (AC)	25.5%	22.1%	28.5%	24.8%	28.2%	24.6%	31.5%	27.6%
Segment 5 (Mostly PCC)	12.7%	11.0%	14.6%	12.5%	14.7%	12.8%	16.6%	14.4%
Bongabon-Ma. Aurora to Dipaculao (PCC)	13.2%	11.5%	15.1%	13.1%	15.2%	13.3%	17.2%	17.2%

Section/ Alternative Full Road Pavement Type: PCC	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Bongabon	-2.5%	-3.0%	-1.1%	-1.6%	-3.5%	-4.1%	-2.1%	-2.7%
Bongabon-Km Post 170	4.1%	2.9%	6.1%	4.8%	2.8%	1.7%	4.8%	3.5%
Km Post 170-Km Post 38 (PCC/DBST)	14.7%	13.0%	16.3%	14.1%	12.9%	11.3%	14.4%	12.3%
Km Post 38-Maria Aurora (AC)	22.5%	19.4%	25.3%	21.9%	20.2%	17.3%	22.7%	19.6%
Segment 5 (Mostly PCC)	11.0%	9.4%	12.7%	10.8%	9.6%	8.1%	11.3%	9.4%
Bongabon-Ma. Aurora to Dipaculao (PCC)	11.5%	9.8%	13.2%	11.3%	10.1%	8.5%	11.7%	9.9%

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Table 6-28
Economic Sensitivity Analysis
Segment 5
Internal Rates of Return

Section/ Alternative	Base Case				With Benefits Increased by 15 Percent			
Full Road	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
Pavement Type: AC	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Bongabon	-0.3%	-1.0%	1.4%	0.7%	0.8%	0.2%	2.6%	1.9%
Bongabon-Km Post 170	6.9%	5.3%	9.2%	7.5%	8.4%	6.7%	10.9%	9.0%
Km Post 170-Km Post 38	16.9%	15.0%	18.6%	16.2%	19.0%	17.0%	20.8%	18.2%
Km Post 38-Maria Aurora	25.5%	22.1%	28.5%	24.8%	28.2%	24.6%	31.5%	27.6%
Segment 5 (All AC)	13.8%	11.9%	15.7%	13.5%	12.2%	10.5%	14.1%	12.0%
Bongabon-Ma. Aurora to Dipaculao (PCC)	14.1%	12.2%	16.0%	13.8%	12.5%	10.7%	14.4%	14.4%

Section/ Alternative	With Benefits Reduced by 15 Percent				With Benefits Reduced by 15 Percent and Costs Increased by 15 Percent			
Full Road	With Dev't Benefits		W/O Dev't Benefits		With Dev't Benefits		W/O Dev't Benefits	
Pavement Type: AC	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings	With Time Savings	W/O Time Savings
Tablang Jct.-Bongabon	-1.6%	-2.2%	0.1%	-0.6%	-2.6%	-3.3%	-1.0%	-1.7%
Bongabon-Km Post 170	5.2%	3.8%	7.5%	5.9%	3.9%	2.5%	6.0%	4.5%
Km Post 170-Km Post 38	14.7%	12.9%	16.2%	14.0%	12.9%	11.2%	14.3%	12.2%
Km Post 38-Maria Aurora	22.5%	19.4%	25.3%	21.9%	20.2%	17.3%	22.7%	19.6%
Segment 5 (All AC)	12.0%	10.2%	13.8%	11.8%	10.6%	8.9%	12.3%	10.4%
Bongabon-Ma. Aurora to Dipaculao (PCC)	12.3%	10.5%	14.1%	12.0%	10.8%	9.1%	12.5%	10.6%

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6.10 FINANCIAL COSTS

The financial cost of improving the Bongabon-Maria Aurora-Dipaculao road to a mostly PCC standard is 663.2 million pesos. The financial cost of the alternative improvements (mostly AC) to the Rizal-Canili-Maria Aurora-Dipaculao road is 400.0 million pesos.

CHAPTER 7

ENVIRONMENTAL

CHAPTER 7

ENVIRONMENTAL

7.1 ARIDP ENVIRONMENTAL STUDIES

7.1.1 Introduction and Terms of Reference

The ARIDP Terms of Reference (TOR) direct the Consultant both to incorporate environmental considerations into overall feasibility analysis of the proposed project and to prepare a detailed environmental assessment of its impacts conforming to U.S. and Philippine environmental regulations and procedures. A formal assessment of ARIDP environmental impacts under US 22 CFR Part 216, PD 1586, and other operative US, USAID and Philippine policy, regulatory and procedural directives is underway. Results of this assessment will be presented separately in the ARIDP Environmental Assessment/Environmental Impact Statement (EA/EIS) which is in preparation.

This chapter describes the incorporation of environmental considerations in ARIDP feasibility studies. It accesses studies, analyses, and preliminary findings of the ARIDP environmental assessment to identify and evaluate those environmental factors and concerns significant to overall feasibility analysis.

The TOR additionally specified that the Consultant place "special emphasis on adverse environmental effects on the forest reserves that may be traversed with the construction of the new highway, and recommended mitigation measures which may be appropriate" (TOR III-E). This chapter addresses potential adverse ARIDP effects on forests and suggests possible responses in project design, implementation and operation.

These mitigations and other environmental management and monitoring components of an Environmental Plan of Action under development in the ARIDP environmental assessment are considered to comprise potential elements of the "complementary investments needed to assure the success of the initial investments" (TOR I, paragraph 2) which may be recommended in the ARIDP project package evaluated by the Feasibility Study. Upcoming consultations and completion of the ARIDP Preliminary EA/EIS are expected to provide a framework for recommended measures and the ARIDP Draft EA/EIS will outline the rationale and identify the elements of complementary investments in natural resources management and other activities that would contribute to project success.

The Consultant was further directed to "conduct the overall study in two stages, to be developed in progressive order: (i) preliminary general gathering of data, field reconnaissance, and review of all available information to develop, (ii) a comprehensive feasibility study of the ARIDP

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based on analyses of economic, engineering or technical, environmental, financial factors and implementation concerns" (TOR III.F). Results of first stage Environmental Studies were presented in the ARIDP Feasibility Study Preliminary Report and the ARIDP Scoping Session Report.

Section IV of the TOR, "Scope of the Study", outlined the general, economic, engineering and technical, financial and environmental considerations to be included in the Feasibility Study itself and directed the Consultant to:

- subject the proposed and alternative routes to an initial determination of environmental impact;
- provide a "sampling" of identified alternative routes and compare these with the proposed route in terms of environmental effects, technical or engineering soundness and cost effectiveness; and
- provide an opinion based on technical, economic, and environmental aspects as to the practicality and complexity of constructing the ARIDP.

Section IV of the TOR also detailed the scope, content and procedural aspects of the Environmental Assessment and directed the Consultant to:

- prepare a Final Work Plan based on consultation with DENR/EMB, CODA, and USAID;
- coordinate with local representatives of DENR/EMB, CODA and USAID concerning the Critical Project/Area designation, the USAID Threshold Decision, Initial Environmental Examination, the holding of Scoping Sessions, and the preparation of the EA/EIS as required by US and Philippine regulations;
- gather data and perform field work necessary to determine existing environmental conditions and effect a Critical Project/Area determination;
- develop a matrix and criteria for evaluation of project alternatives which identifies generic environmental problems and provides the basis for both an Initial Environmental Examination (IEE) of selected alternatives and a Scoping Session to focus on primary issues;
- prepare a Preliminary-Draft EA/EIS addressing topics and containing discussions as specified in TOR Sections IV E.5 and 6;
- screen and review, on the basis of the preliminary environmental assessment, engineering and design options and determine if revisions of preliminary designs are needed to mitigate impacts;

- develop a detailed mitigation plan;
- revise the Draft EA/EIS in response to Agency comment and prepare a Final EA/EIS; and
- prepare necessary documentation for use by the DENR/EMB EIS Review Committee to obtain an Environmental Compliance Certificate (ECC).

In response to these requirements the Consultant met with USAID and DENR/EMB when the project began and prepared an eight (8) step Final Work Plan specifying associated tasks, staffing, schedules, and deliverables. This Final Work Plan was submitted to USAID in the ARIDP Inception Report for Agency, DENR/EMB, and CODA comment.

The accomplishment of TOR requirements outlined above, the status of ARIDP Environmental Studies and activities, and progress to date in each of the major tasks identified in the Final Work Plan which had begun at the time of writing are described below in Sections 7.1.2 - 7.1.8.

Succeeding Section 7.2 reviews potential ARIDP environmental impacts identified in the Scoping process.

Section 7.3 summarizes results of field studies undertaken to assess ARIDP environmental impacts and presents preliminary findings.

Section 7.4 summarizes ARIDP environmental issues and outlines environmental analyses underway in the ARIDP environmental assessment.

Section 7.5 reviews tropical forest and biodiversity concerns and the applicability of US Foreign Assistance Act Sections 118 and 119.

Section 7.6 describes remaining ARIDP Environmental Studies tasks and activities.

7.1.2 Organization of Environmental Studies

Detailed consultation with the Feasibility Study Team Leader and ARIDP economic, engineering, and technical staff at the outset of the project established the interface between environmental and other dimensions of the feasibility analysis and determined the desired timing and content of environmental study inputs to the Feasibility Study.

Initial review of the ARIDP TOR and reconnaissance of the Project Area guided Environmental Study Team staffing and mobilization, creation of project environmental files and database and the collection and review of existing information.

Initial liaison was established with USAID and DENR/EMB to clarity procedures and requirements. Notice of prior USAID Threshold Decision and IEE determination of a "positive finding" requiring an Environmental Assessment under Section 216.5, 22 CFR was received. In Critical Project/Area determination discussions with DENR/EMB it was agreed that ARIDP would require a full EIS pursuant to PD 1586 and other Philippines regulations.

A draft consolidated Environmental Assessment/Environmental Impact Statement format was developed to comply with US and Philippine regulations and submitted for review by appropriate agencies in the ARIDP Inception Report. Associated data requirements determined scope and appropriate methodologies for field studies and environmental analysis.

A Final Work Plan for ARIDP Environmental Studies outlining tasks, work schedule, activities, outputs, and deliverables was prepared and submitted for USAID, DENR/EMB, and CODA review in the ARIDP Inception Report.

Liaison with key national-level NGO's, appropriate line agencies, and local government officials, agencies, NGO's and communities in the Project Area was established to prepare for field studies and Scoping Sessions.

Scoping Session dates, venues, and preliminary invitation lists were determined and English and Pilipino invitations, background materials including an ARIDP project description, a summary of US and Philippine environmental regulations and procedures, project location and vegetation maps, and an initial matrix of potential ARIDP environmental impacts was prepared and distributed to an initial list of more than 80 invitees in Manila and the Project Area.

7.1.3 Field Studies of Existing Environment

Reconnaissance survey of the Project Area and identified Project Alternatives by helicopter overflight and video documentation was carried out by a combined team of ARIDP environmental and feasibility study staff on June 3, 1991.

Field studies by the Environmental Study Team were conducted from June 4-15, 1991 to review the Project Area and initial ARIDP Alternatives, profile the existing environment, validate the accuracy of existing information, establish a baseline for subsequent impact assessment, and identify trends.

To facilitate NGO participation in ARIDP Scoping Sessions and liaison with NGOs and PO's in the Project Area the ARIDP Environmental Studies Team was accompanied during field studies by two representatives of Tanggol Kalikasan, the Environmental Defense Law Office of the Haribon Foundation for the Conservation of Natural Resources, a major Philippine Conservation NGO and active member of Green Forum, a national coalition of several hundred Philippine environmental and development organizations.

Consultation with local governments, provincial and municipal representatives of national agencies, NGO's, and affected communities in the Project Area were conducted to disseminate information on the project, collect data, confirm dates and locations of local Scoping Sessions, and identify additional prospective invitees. Several hundred Scoping Session invitations were distributed directly or provided to local governments and NGOs for subsequent distribution.

7.1.4 Scoping Session/Consultations

Consultations with USAID were held to determine overall Scoping Session requirements and ascertain the principal environmental issues identified in the Agency's positive IEE determination that would form the nucleus of the Scoping Session agenda. In addition to these technical and content-related findings, USAID recommendations highlighted the significance of the Scoping Session and its role in the environmental assessment process. USAID's process-related concerns emphasized the establishment of genuine consultation between the ARIDP Environmental Studies Team and interested, involved, or affected sectors, institutions and agencies; and included concerns addressing representation of relevant experts, collaborative interaction with NGO's, and participation of local communities.

Philippine EIS procedures also emphasize attention to public concerns and popular perspectives in affected communities, and it was determined in discussions with the EMB Director and EMB's EIS staff that the DENR/EMB-required Perception Survey could provide a valuable complement to the Scoping process if employed in conjunction with Scoping Session discussions in the Project Area.

In response to these concerns the Consultant designed and implemented a Scoping process that provided access to pre-identified and potential local, national, and international representatives and encouraged their informed participation. Four Scoping Session/Consultations were organized; one in the Manila area and the remainder in the central communities of the Project Area's three subregions: Baler and Dingalan, Aurora Province and Gabaldon, Nueva Ecija Province.

The purpose of the Scoping Session/Consultations for the proposed ARIDP were to aid in the conduct of the environmental assessment by:

- starting the process of communication early in project planning,
- involving parties that might be potentially affected by the project,
- identifying local concerns,
- focussing on those issues that require in depth-study; and
- identifying issues of a lesser significance.

The Scoping Session/Consultations were also intended to initiate a process of dialogue and consultation with project area residents, the scientific community, and interested and involved Non-Governmental Organizations that would continue through subsequent phases of the environmental assessment.

Representatives of Manila-based national and international NGO's were provided the opportunity to contribute to Scoping Session/Consultations preparations, invited to accompany the Consultant's Environmental Studies Team as observer/participants in the three local sessions, and offered assistance in coordinating transportation to and accommodations in the Project Area. DENR/EMB, USAID and CODA representatives were offered similar assistance.

In addition to detailed information provided with the Scoping Session invitation, extensive background materials including audio-visual aids, flipcharts, handouts, and exhibits were developed to support the Manila and local meetings. For the sessions in the Project Area many of the materials, the text of exhibits, and the DENR/EMB Perception Survey were prepared in both Pilipino and English versions. Two-way translation between Pilipino and English was also provided in the meetings.

All sessions were structured to provide a review of initially defined ARIDP potential environmental impacts, to identify additional potential impacts and environmental issues, and to elicit comment on and discussion of the relative significance of impacts identified. The agenda of each session included the introduction of all participants, an explanation of the purposes and objectives of the Scoping Session/Consultations, a review of USAID and Philippine environmental regulations and procedures, an ARIDP project description provided by the Feasibility Study Team Leader, an overview of proposed ARIDP Environmental Studies, a summary of environmental impacts and issues identified to date, and open discussion and public comment. In the local Scoping Session/Consultations participants were divided into small groups to complete the Perception Survey and encourage discussion. Environmental Study Team members facilitated small group discussions and groups selected a spokesperson who reported to the session as a whole when it reconvened for open discussion.

The National Scoping Session was held on June 25, 1991 at the Philippine Social Science Center in Quezon City. Twenty-five participants representing national and international scientific and conservation NGO's; government agencies including DPWH, OSCC, AIADP, and CODA; local governments, and the press attended.

The Baler, Aurora Scoping Session/Consultation was held on June 27, 1991 at the Baler Municipal Hall with 81 registered participants including representatives of local and regional offices of government line agencies; provincial, municipal, and barangay officials; Project Areas NGO's, citizens of affected communities, and the press. At the request of Project Area NGOs an additional meeting was held the following day, June 28, 1991, to discuss NGO concerns.

To permit further NGO study and review of ARIDP impacts, consultations with membership, and the preparation of organization comments a follow-up session with NGO leaders was scheduled and held on July 17, 1991 at Mt. Carmel College in Baler, Aurora. In response to NGO concerns expressed in that meeting, the Consultant agreed to participate in an additional Public Forum on the proposed ARIDP on August 6, 1991. More than 500 citizens, students, NGO and PO representatives, and local government officials attended this Public Forum which was held in Baler at the Mt. Carmel College Auditorium.

The Dingalan, Aurora Scoping Session/Consultation was held on June 29, 1991 in the lobby of the Dingalan Municipal building with 89 registered participants including municipal officials and employees; barangay leaders; local representatives of national government agencies; NGO, church, and civic representatives; representatives of the Dumagat community of Matawe, Dingalan; professionals; and citizens of affected communities.

The Gabaldon, Nueva Ecija Scoping Session/Consultation was held on July 1, 1991 in the Gabaldon Barangay Hall with 74 registered participants including representatives of local government, local offices of national line agencies, cooperatives, NGO's, church and other civic organizations, and citizens of affected communities.

The Environmental Studies Team returned to Manila on July 2, 1991 upon completion of the local sessions and began tabulation of Perception Survey responses and processing and review of comments from the Scoping Session/Consultations. In addition to the verbal comments and presentations recorded at the Scoping Session/Consultations a large number of written submissions and other communications were also received during the Scoping period from provincial, national, and international conservation and social justice NGOs, People's Organizations in the Project Area, local officials, government agencies, research institutions and scientific organizations. These were carefully considered and evaluated in conjunction with other Scoping Session comments.

Environmental considerations identified in the initial matrix of potential ARIDP environmental impacts were re-evaluated, refined, and revised to incorporate the additional impacts, insights, approaches and other recommendations provided by the Scoping Session/Consultations, the DENR/EMB Perception Survey, and the additional submissions. Potential impacts were ranked by frequency of identification, severity and magnitude, and significance. A preliminary comparative environmental review of ARIDP alternatives was also performed. Results of these analyses helped to focus and prioritize field work objectives and guided the final design of field studies and selection of methodologies to assess ARIDP environmental impacts. They are discussed in Section 7.2.

As required by USAID regulations, results of the Scoping Session/Consultations and supporting documentation, including video and audio recordings were compiled. Associated analyses, minutes of the sessions and transcripts of discussions, invitation and attendance lists, submissions, and other exhibits were contained in the ARIDP Scoping Report. This report was submitted for USAID review, distributed to interested or affected agencies, and provided for participant and public comment.

7.1.5 Field Studies of ARIDP Environmental Impacts

Guided by the results and recommendations of the Scoping Session/Consultations, review of existing information, the findings of initial field studies undertaken June 4 to June 15, 1991 to profile the existing environment of the Project Area, and a second series of helicopter overflights on July 14, 1991 the ARIDP Environmental Studies Team returned to the Project Area from July 17 to August 8, 1991 for focused field studies of prioritized projected ARIDP impacts and detailed assessment of the ARIDP Project Alternatives identified by the Feasibility Study and described in this report.

The Consultant's Environmental Studies staff, both as individual specialists and as an assessment team, carried out a coordinated program of ecological, socio-economic, and cultural investigations and data collection. The objective of these studies was to confirm or reject and then assess, as appropriate, the set of potential impacts identified in the Scoping process, as discussed in Section 7.2.4; and to identify and assess other potential impacts associated with the proposed ARIDP.

Receptive observational methodologies including rapid rural appraisal and other assessment techniques were employed in conjunction with focused survey protocols and instruments designed to obtain the specialized informations required for the assessment of certain impacts. Specific survey foci included forest conditions, wildlife, biodiversity, residents perceptions, sociological and economic characteristics including land use and tenure status, ethnic factors, archaeological and historical resources, and scenic and aesthetic features. In addition to comprehensive reconnaissance-level survey of the existing or proposed alignment corridors of all Project Alternatives, field studies included detailed survey visits to selected communities, natural areas, and road segments.

ARIDP environmental survey occurred in three Aurora municipalities. In Maria Aurora Barangays Bayanihan, Cadayacan, Wenceslao, Dianawan, and Canili were surveyed; in San Luis, Barangays Diteki, Dibut, Dibayabay, Dimanayat, and Villa Aurora; and in Dingalan, the coastal barangays to Umiray.

Natural areas surveyed included the Provincial boundary area between Nueva Ecija and Aurora, the northwestern borders of the Aurora Memorial Par, the Aurora Memorial Park, the Cabatangan and Malupa River valleys, and the coastal areas between Baler and Dingalan.

Road segments receiving detailed survey included those comprising the Maria Aurora-Canili-Pantabangan road (Segments 2A and 2B) and the Aurora Memorial Park segments of the Bongabon-Baler National Highway (Segments 5B and 6), and the Palayan City-Dingalan National Highway (Segments 4A, B and C).

In addition to or in conjunction with these assessment surveys, field study activities also included:

- extensive interviews, both structural and open-ended, with Project Area residents in both Aurora and Nueva Ecija.
- formal and informal consultations with communities, including a major Public Forum on ARIDP attended by more than 500 citizens, NGO and PO representatives, and Public Officials on August 4, 1991 in Baler.
- meetings with local government leaders in affected barangays.
- video and photo documentation.
- discussions with Municipal and Provincial officials in Aurora and Nueva Ecija, including the Governor and Provincial Board Members of Aurora, and area military commanders.
- meetings with NGO representatives and tribal organizations and leaders.
- technical consultations with regional and local line agency and other officials including DENR regional staff, Aurora PENRO and CENRO personnel, the Superintendent of the Aurora Memorial Park, the Office of Southern Cultural Communities, and Aurora Integrated Area Development Project staff.

The field studies component of the ARIDP environmental assessment concluded on August 8, 1991. Results of these studies are discussed in Section 7.3.

7.1.6 ARIDP Feasibility Study Preliminary Report

Status and accomplishments of ARIDP Environmental Studies, including the completion of study organization, field studies to profile the existing environment, and the conduct of Scoping Session/Consultations were reported in the ARIDP Feasibility Study Preliminary Report submitted to the Client July 22, 1991.

The Consultant reviewed the ARIDP TOR, the USAID IEE positive determination, generic impacts of rural road projects, and recent experience in environmental studies of 37 Philippine road projects to prepare an initial matrix of potential ARIDP environmental impacts. This initial identification was re-evaluated in response to comments, recommendations, and submissions received during the Scoping process, findings of initial field studies, helicopter overflights and other resources. This re-evaluation produced a final ranking of potential ARIDP impacts by degree of significance.

Based on the identification of potential ARIDP impacts and preliminary environmental review of Project Alternatives the Consultant found and reported a significant likelihood that Sections 118(c)(14)(B), 118(c)(16)(B) and (C), and 119(g)(8) and (10) of the US Foreign Assistance Act may apply to proposed ARIDP actions.

The Consultant also provided an environmental review of the proposed ARIDP Project Alternatives and prepared a preliminary ranking of nine (9) Alternatives by significance of potential environmental impacts associated with each.

Environmental considerations derived from the above, as well as initial findings of impact assessment field studies then underway, were incorporated in the preliminary feasibility analysis. Environmental factors contributed to the decision to drop the proposed Dingalan - San Luis road (Segment 3) from further feasibility consideration and the recommendation to explore other alternatives including improved boat traffic to enhance rural accessibility in the coastal barangays of San Luis and Dingalan.

Preliminary economic analysis also emphasized the significance of the forestry sector and natural resources management to provincial development and indicated the precarious state of the Project Area economy, the likely decline of the forest industry, and the severe socio-economic and ecological repercussions that were likely to ensue. Economic studies underscored the paramount importance of environmental problems in the evaluation of potential ARIDP development benefits, suggested that the Project Area was near or had surpassed economic limits of sustainable development, and concluded that only marginal benefits, at best, could be expected from proposed road improvements and that without vigorous conservation activities the project was likely to accelerate environmental degradation.

These and other findings of the ARIDP Feasibility Study Preliminary Report were also considered in the design and emphasis of remaining impact assessment field studies and subsequent environmental analysis. Feasibility Study recommendations to develop an "outlet"-oriented ARIDP package, for example, directed environmental study attention to inter-provincial linkages and Segments 2, 5, and 6.

7.1.7 Environmental Analysis

Environmental analysis to evaluate ARIDP impacts and Project Alternatives began on August 12, 1991 at the conclusion of field studies and return of the Environmental Studies Team to Manila. In addition to the compilation, processing, and analysis of data gathered during field surveys, environmental analysis also complied and initiated review of environmental issues identified in earlier project phases, in comments on the ARIDP Scoping Report, in comments and recommendations provided by the Client's review of the ARIDP Feasibility Study Preliminary Report, and in additional submissions from Project Area and Manila NGOs and POs, local governments, citizens, and others. Results of environmental analysis will be incorporated in the Preliminary EA/EIS and the ARIDP Environmental Plan of Action. The set of issues identified and under examination is detailed in Section 7.4.

Activities during the on-going environmental analysis phase have also included follow-up data gathering, additional discussions with national and international NGOs, review of video and photo documentation from helicopter overflights and ground survey, and evaluation of cross-sectoral impact linkages and cumulative impacts of both potential ARIDP project packages and of ARIDP in conjunction with other development initiatives in the Project Area and region.

The environmental analysis phase of ARIDP is expected to conclude in October with the submission of the ARIDP Feasibility Study Draft Final Report and completion of the ARIDP Preliminary EA/EIS, which is in preparation. Results of environmental analysis available at the time of writing are summarized in Section 7.4.

7.1.8 Preliminary EA/EIS

The ARIDP Preliminary EA/EIS is in preparation. This report will present a profile of the existing Project Area environment and an assessment of impacts expected from construction and operation of individual ARIDP Project Alternatives and the ARIDP project package as a whole.

The ARIDP Preliminary EA/EIS is intended as a background document for a second series of major consultations with interested and affected agencies, local governments, NGOs and POs, and the public. It will help to both establish the scope, scale, and objectives of environmental mitigation, monitoring, and management measures required and to identify potential participants in the ARIDP Environmental Plan of Action to be developed in the consultations. A decision to proceed with these consultations will be made on the basis of the ARIDP Draft Final Feasibility Study findings, and the Clients comments and recommendations.

Completion of the Preliminary EA/EIS is expected in October 1991. A revised ARIDP Preliminary EA/EIS including the Environmental Plan of Action will comprise the ARIDP Draft EA/EIS. Discussion of the projected Environmental Plan of Action, Draft and Final EA/EIS's, and Environmental Compliance Certificate, and other remaining ARIDP Environmental studies activities is provided in Section 7.6.

7.2 POTENTIAL ENVIRONMENTAL IMPACTS IDENTIFIED

7.2.1 Initial Environmental Examination

In the Initial Environmental Examination (IEE) by USAID the proposed ARIDP project package received a "positive finding" in the Threshold Decision. Penetration road building or road improvements, new lands development, and activities affecting endangered plant and animal species and their critical habitat (wetlands, tropical forests, protected areas, etc.) are classed as actions normally affecting the environment which require Environmental Assessments under U.S. regulations. The principal environmental concerns identified in the IEE by USAID and

communicated to the Consultant were potential ARIDP impacts on tropical forest and Tribal Filipinos. Tribal Filipino concerns included land-tenure insecurity, the displacement of indigenous communities and project impacts on Ancestral Land claims. A vegetation map of the Project Area indicating forest types and cover and a map of Tribal Filipino groups and indigenous peoples in the Project Area illustrating these concerns are provided in Figures 7-1 and 7-2.

7.2.2 Preliminary Identification of Environmental Impacts

The environmental concerns identified by USAID in the IEE and ARIDP TOR specification of "special emphasis on adverse environmental effects on the forest reserves that may be traversed" provided the initial set of potential environment impacts to be considered in ARIDP Environmental Studies.

Review of literature and standard environmental checklists for impacts assessment established typical "generic" impacts of rural road construction and improvement which were also consulted. Recent experience of the Consultant in the Environmental Studies of 37 Philippine road projects in the USAID - supported Rural Infrastructure Fund Project and the General Santos City/South Cotabato Development Project, including assessment of the proposed Madela - Casiguran road project in Aurora were also reviewed for guidance and provided valuable assistance.

Consultation with ARIDP Feasibility Study engineering and technical staff identified the potential scope of the proposed project and project design, construction, and operation activities with potential impacts on the environment. On the basis of this evaluation and the above information, the Consultant prepared an initial matrix of potential ARIDP environmental impacts (See Figure 7-3) which assessed potential effects of 22 project activities and components in ARIDP design, construction, and operation phases on 47 environmental components representing key features or concerns of the physical and biological environment, natural resources, and the socio-economic and cultural/aesthetic environment. Analysis of interactions in this initial matrix and simple ranking of impacting project activities and potentially impacted environmental components was performed.

ARIDP activities and components expected to exert major impacts included planning and design phase decisions on project routing and the location of new alignments; design standards for erosion control, slope stability, type of construction, and labor methods. Right-of-way clearing, borrow pits, siting and operation of construction camps, and potential relocation/displacements were identified as major impacting activities of the construction phase. Aspects of ARIDP project operation phase expected to have major impacts included increases in traffic and overall access and egress, maintenance, and erosion control. Secondary impacts associated with increased access/egress, routing and alignment of new roads, increased traffic, construction camps, and right-of-way clearing ranked highest in significance.

LEGEND:

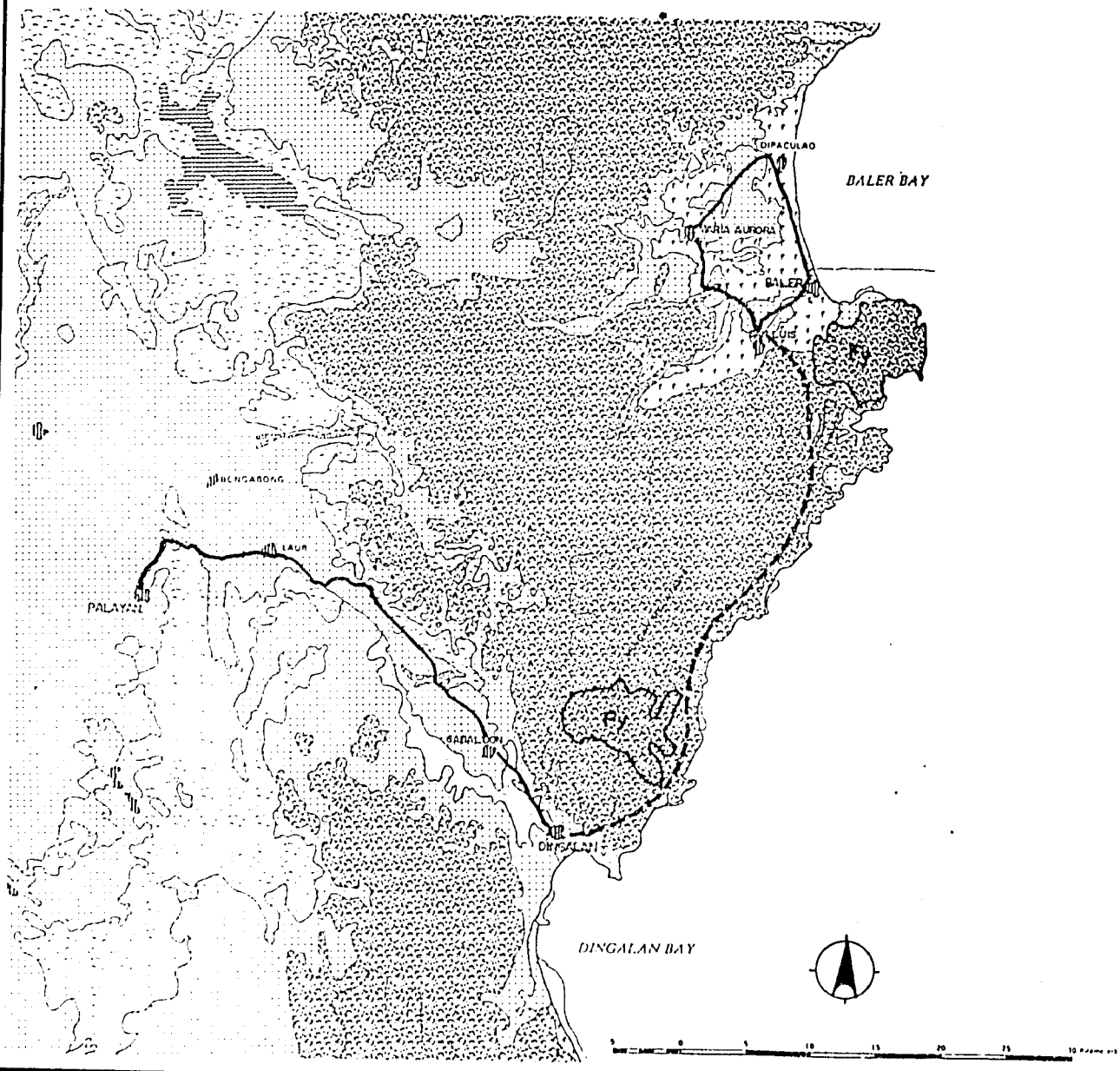
- F FOREST
  - forest trees and reproduction brush < 10 % cultivated and other open areas
  - Fp pine forest
  - Fj mossy forest
  - Fd dipterocarp and/or other broad leaved forest
  - Fdc closed canopy, mature trees covering > 50 %
  - Fdo open canopy, mature trees covering < 50 %
  - Fm mangrove vegetation
- E EXTENSIVE LAND USE
  - populated areas in uplands and grasslands > 10 % cultivated and other open areas < 70 % cultivated area
  - A cultivated and other open areas in forest, each symbol representing 50 hectares
  - Ec cultivated area mixed with brush and grassland
  - Eg grassland, grass covering > 70 %
- I INTENSIVE LAND USE
  - crop lands, plantations and fishponds > 70 % cultivated area
  - Ip plantations larger than 100 hectares
  - Ipc coconut plantations
  - Ipo other plantations
  - Ic arable land, crops mainly cereals and sugar
  - Im mixed intensive cultivation (crop land and plantations less than 100 hectares)
  - Imc crop land mixed with coconut plantations
  - Imo crop land mixed with other plantations
  - If fishponds
  - Ifm fishponds derived from mangrove
  - Ifo other fishponds
- N NON VEGETATED LAND
  - Ne eroded area
  - e symbol for minor eroded spot
  - Nq quarry
  - q symbol for minor quarry
  - No other barren land
  - Nr riverbeds
- B BUILT UP AREA
- M MARSHY AREA AND SWAMP
- L LAKE
- S SILTATION PATTERN IN LAKE OR ALONG THE COAST
- C CORAL REEF

SOURCE:

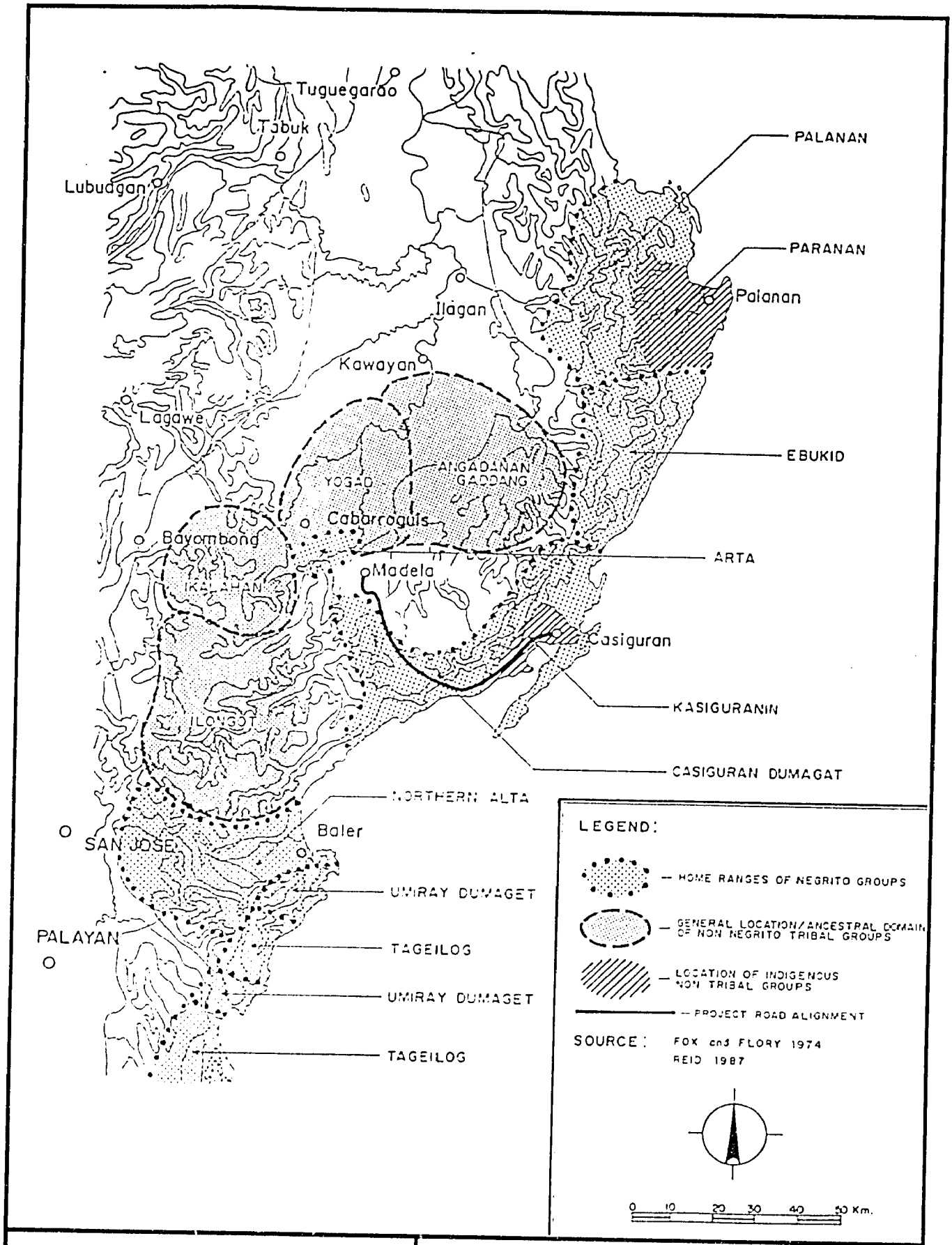
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY August 1988 — compiled from 1987 SPOT Satellite images by the Swedish Space Corporation in cooperation with the Natural Resources Management Center. Ground truth from May to June 1987.

ARIDP PROPOSED PROJECTS

- EXISTING ROAD
- NEW ROAD



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	VEGETATION MAP	Figure 7-1



AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY	APPROXIMATE LOCATIONS AND HOME RANGES OF TRIBAL FILIPINO GROUPS AND INDIGENOUS PEOPLES OF THE PROJECT AREA	FIGURE 7-2

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT FEASIBILITY STUDY

ARIDP FEASIBILITY STUDY
INITIAL MATRIX OF POTENTIAL ENVIRONMENTAL IMPACTS

FIGURE 7-3

PROJECT ACTIVITIES AND COMPONENTS / ENVIRONMENTAL COMPONENTS	PHYSICAL AND BIOLOGICAL ENVIRONMENT/NATURAL RESOURCES																							SOCIO ECONOMIC ENVIRONMENT																CULTURAL/AESTHETIC ENVIRONMENT							
	Climate	Geology	Soils	Slope Stability	Air Quality	Noise	Surface Water	Ground Water	Hydrology/Drainage	Forests/Vegetation	Forest Cover	Wildlife	Biodiversity	National Parks/Protected Areas	Coastal Ecosystems	Wetlands	Fisheries	Mangroves	Coral	River and Stream Ecosystems	Environmental Services	Natural Hazards	Energy/Mineral Resources	Population	Migration	Land-use/Regional Planning	Environmental Health	Employment	Livelihood	Income	Quality of Life	Public Services	Transportation	Communication	Education	Health	Housing	Enterprises	Tourism	Agriculture	Ethnic and Tribal Conditions	Solid/Hazardous/Toxic Wastes	Archaeological Resources	Historical Resources	Aesthetic Resources	Cultural Communities	Ancestral Land Claims
Planning and Design Phase																																															
. Soil Testing			•																																												
. Surveying										•																																					
. Environmental Studies																																															
. Routing/Alignment (new roads)	•	•	⊙	⊙	•	•	⊙	•	⊙	⊙	⊙	⊙	⊙	●	⊙	?	•	?	?	●	⊙	⊙	●	⊙	⊙	⊙	•	•	•	•	●	•	⊙	●	⊙	⊙	⊙	●	⊙	⊙	⊙	•	⊙	?	⊙	⊙	⊙
. Routing/Alignment (existing roads)			●	●	•	•	●	•	●	●	●	●	•	●	•	●	•	?	?	●	•	•	•	•	•	•	•	•	•	•	•	•	●	•	•	•	•	•	•	•	●	•	•	?	•	●	●
. Bridges/Stream Crossings			●				⊙		⊙			•	•		●	●				⊙	•					•	•						•	•									●				
. Surfacing			●		●		•		•						•				•			●									•		•									•			•		
. Drainage, Shoulders, Culverts			●	●			●		⊙						●	●		?	?	⊙	•	●					•						•							●							
. Labor/Work Force				●			●			●		●	•	•	•	•		?	?	•				•	●		●	●	●	●		•	•			•	⊙		•	•	●	●			●	●	
Improvement/Construction Phase																																															
. Right-of-Way Clearing	⊙	•	⊙	⊙	•	•	⊙	•	⊙	⊙	⊙	⊙	⊙	⊙	●	⊙	•	?	?	⊙	●	●		●			●													⊙	●	⊙	⊙	?	⊙	●	●
. Borrow Pits			⊙	⊙	•	•	⊙	•	●	•		•	•		●					⊙		●	●				●												•				●	?	●		
. Spoil Areas				⊙	•		⊙		●			•	•		•	●			?			•					•												•			●			●		
. Blasting		●	⊙	⊙	•	⊙						●					•																						•						•		
. Construction Camps			●		•	•	⊙	⊙		⊙	⊙	⊙	●	⊙	⊙	●	•	?	?	●		⊙	●	⊙	⊙	⊙	●	●	●	●		●	●		●	●	⊙		•	•	⊙	⊙	•	?	⊙	⊙	⊙
. Construction Wastes					•		⊙							⊙				?	?	●							⊙								●				•	●		⊙			●		
. Relocation/Displacement										●	●	●	●	●											●	●	●		●	●		⊙				●		●	●	●	⊙				●	⊙	⊙
. Reclamation/Restoration			⊙	⊙			⊙	●	●	●	•	•	•	•	●			?	?	⊙		⊙					•											●	•	•					●		
Operation Phase																																															
. Traffic					⊙	⊙	⊙			⊙	⊙	●	●	●	⊙	●	•	?	?	●	•	●	●	•	⊙	⊙	⊙	⊙	⊙	⊙	●	⊙	⊙	●	●	●	•	⊙	⊙	⊙	⊙	⊙	•	?	●	⊙	⊙
. Maintenance			⊙	⊙			⊙		⊙						⊙			?	?	●	•	⊙			•		•	•	•	•	●	⊙	⊙	•	•	•		●	⊙	⊙					⊙		
. Erosion Control			⊙	⊙	•		⊙		⊙	●					⊙		•	?	?	●	•	⊙									•	●			•			●	⊙						⊙		
. Pedestrian Movement							•			•	•	•						?	?			•			•		•	•	•	•	●	●		•					•	•	•				•		
. Increased Access/Egress			●	●	●	●	●	?		⊙	⊙	⊙	⊙	⊙	●	●	●	?	?	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	•	?	⊙	⊙	⊙

Legend: • - Low ● - Moderate ⊙ - High

Project Area physical, biological and natural resource environmental components expected to receive major impacts from ARIDP project activities included soils, slope stability, surface water, hydrology/drainage, forests/vegetation, wildlife, coastal ecosystems, river and stream ecosystems, and natural hazards. Environmental health and aesthetic resources were the principal components of socio-economic and cultural/aesthetic environment expected to receive significant impacts closely followed by impacts on transportation, tourism, agriculture, ethnic and tribal conditions, solid and hazardous wastes, cultural communities and Ancestral Land claims. Potential impacts on surface water; aesthetic resources; soils; and river, stream and coastal ecosystems ranked highest in significance.

Where cells in the initial matrix contained question marks insufficient information existed to determine potential impacts. Additional study of these components was considered an immediate priority.

7.2.3 Results of the Scoping Session/Consultations

Under U.S. environmental regulations the Scoping Session is one if the first steps in an Environmental Assessment. As described in Section 7.1.4, it has a number of purposes. Overall, it provides an opportunity to identify local concerns and planning conflicts that may result in potentially significant delays in project implementation or serious negative impacts as a result of project completion if not addressed. It also initiates a process of communications, consultation, and dialogue with Project Area residents, the scientific community, interested and involved agencies and NGOs, and others that may be potentially affected by the project. With respect to preparation of the Environmental Assessment the Scoping Session, under U.S. regulations, helps to identify and define the significant issues relating to the proposed project actions and to determine the scope of issues to be addressed. It thus functions to focus EA analysis on primary and major issues, narrowing its scope by eliminating those issues which are insignificant from detailed study.

Philippine environmental procedures do not employ a scoping mechanism enabling a similar narrowing of focus. Under Philippine regulations EIS scope and data requirements are universal and not project-specific. As the Consultant is obliged to comply with requirements of both governments and will prepare a consolidated EA/EIS, the specific utility of the Scoping Session in delimiting the EA Scope of Work is somewhat reduced. As a means of communication and of initiating consultation and dialogue, however, and as a way of identifying both local concerns and important issues that might otherwise be missed or neglected Scoping remains a valuable tool that contributes to the determination of emphasis and relative allocation of effort in environmental impact study and analysis.

In the ARIDP case, environmental studies are occurring concurrently with the project Feasibility Study. Remoteness of the Project Area, distance from Manila, the unreliability of the postal service and a variety of other logistical considerations necessitated that Scoping Session arrangements be commenced at the project's outset. Preparation of the project description and other background materials, therefore, occurred prior to the completion of preliminary economic, technical, and engineering investigations and the final identification of the Project

Alternatives investigated in feasibility analysis. Materials prepared for the Scoping Session profiled only the three original primary proposed road improvements or new constructions initially identified for study in the ARIDP TOR. Recognizing that additional alternatives were likely to be identified and that the mix of subprojects that would comprise the final project package to be proposed was subject to change in the course of the study, the Consultant's initial environmental approach was to treat ARIDP as a package rather that as a set of discrete or unrelated projects. Preliminary identification of potential impacts therefore began with typical or generic impacts generally associated with rural road projects and then addressed the range of potential impacts that could be expected from either improvements to existing roads or new road construction in the Project Area environment itself. It was this set of potential impacts, as presented in the initial matrix of potential ARIDP impacts described in the previous section, that was provided to Scoping Session participants for review and comment.

Subsequent determination by the Feasibility Study of the need to address in greater detail the provision of an improved inter-provincial link or "outlet" to central Aurora and the identification of the Maria Aurora - Canili - Pantanbangan - Rizal road (Segment 2), the Bongabon - San Luis National Highway (Segment 5B, 5C, and 6), and the Aurora Memorial Park - Cabatangan/Malupa River Valley road (Segment 5A) as potential alternatives had not yet occurred. Scoping Session discussions therefore were not explicitly directed toward these possibilities although some comments related to them were received.

While many comments were directed at particular elements of the original three road set with, not unexpectedly, proposed new construction of the Dingalan - San Luis road attracting most attention, much of the discussions was more general, addressing conditions and concerns common to the Project Area rather than specifics of the individual component projects.

Discussions in the three local Scoping Session/Consultations, moreover, were surprisingly unparochial. Participants did not restrict their comments to only that subproject in their immediate locality and frequently addressed the entire ARIDP package. Summaries of each of the three meetings held in the Project Area and the National Scoping Session with transcripts of discussions are provided in the ARIDP Scoping Report.

In addition to the verbal comments and presentations recorded in the Scoping Session/Consultations a substantial number of written submissions and other communications were also received during the Scoping period from provincial, national, and international conservation and social justice NGOs, People's Organizations in the Project Area, local officials, government agencies, research institutions and scientific organizations. The eighteen (18) submissions or other communications include:

- APA/Alyansa ng mga Pesante sa Aurora (Alliance of Peasants in Aurora), an umbrella association of P.O.'s in Aurora representing peasants, women, youth, tribal peoples, and fishermen.

- Environmental Research Division of the Manila Observatory, Ateneo University, Quezon City.

- Protected Areas and Wildlife Bureau of the Department of Environment and Natural Resources, Quezon City
- Mayor of Palayan City, Nueva Ecija.
- Columbian Father's Peace and Justice Office/Philippine Development Forum, Washington D.C.
- Indigenous Community Division, Special Concerns, Office of the Department of Environment and Natural Resources, Quezon City
- Aurora Integrated Area Development Project, Baler, Aurora
- Haribon Foundation - Tanggol Kalikasan, Manila
- UGAT (Anthropological Association of the Philippines), Quezon City
- Conservation International, Manila
- Green Forum, Manila
- Aurora Chapter, Lingkod Tao-Kalikasan (In the Service of Man and Earth Community); Baler, Aurora
- PANLIPI/Tanggapang Panligal ng Katutubong Pilipino, Legal Office of Tribal Filipinos, Manila
- San Luis, Aurora Chapter of the League of Barangay Councilmen of the Philippines
- Barangay Council of Real; San Luis, Aurora
- International Council for Bird Preservations (ICBP)
- SKSM/Samahan ng mga Katutubo sa Sierra Madre (Organization of Tribal Filipinos in Sierra Madre); Baler, Aurora
- International Center for Living Aquatic Resources Management (ICLARM), Manila

The Alliance of Peasants in Aurora (APA) opposed the proposed Dingalan-San Luis road on grounds of its potential contribution to forest and wildlife destruction, reduced livelihood, watershed degradation, soil erosion and destruction of agricultural and coastal resources, displacement of Tribal Filipinos, and increased foreign debt. APA favored improvements to existing roads rather than new construction and recommended ARIDP consideration of upgrades to the Bongabon-Baler National Highway and the Maria Aurora-Canili-Pantabangan-Rizal road.

The Environmental Research Division of the Manila Observatory also raised concerns with the Dingalan-San Luis road emphasizing that forests critical to the ecological well being of the entire Sierra Madre including important stands of old growth Dipterocarps and mossy forest, among the last on Luzon, occur along the proposed alignment. In addition to serious and extremely significant threats to the unique and barely studied biodiversity of these rare forests, the Environmental Research Division questioned the need of the road and suggested the project would enhance accessibility of legal and illegal loggers, exacerbate natural hazards, and increase erosion. Concerns general to ARIDP as a whole were also expressed including impacts on cultural communities, and the vulnerability of infrastructure investments in the Project Area to impacts of environmental degradation such as flooding.

The Protected Areas and Wildlife Bureau (PAWB) also identified potential impacts of Dingalan-San Luis road construction. PAWB concerns included forest-clearing, wildlife and biodiversity losses and possible threats to the Philippine Eagle.

The Mayor of Palayan City enthusiastically endorsed the ARIDP and the League of Barangay Councilmen of San Luis, Aurora and Barangay Council of Real, San Luis strongly supported the Dingalan-San Luis road and urged its approval and construction.

The Columbian Fathers Peace and Justice Office/ Philippine Development Forum recommended consultation with Conservation International. Conservation International requested addition information on ARIDP and registered preliminary diversity, illegal logging and overall natural resource management concerns.

The Indigenous Community Division of DENR's Special Concerns Office identified potential Dingalan-San Luis and ARIDP impacts on indigenous cultural communities including displacement and exploitation as significant concerns. Delineation of Ancestral Lands and measures to increase tenure security of Tribal Filipinos were recommended.

PANLIPI also recommended recognition of indigenous land and resource rights and tenure and security for forest occupants prior to road construction, an identified major potential impacts on cultural communities in Aurora and Nueva Ecija associated with ARIDP.

AIADP provided information on the Project Area environment and drew attention to potential watershed degradation, deforestation, illegal logging and log transport, squatter influx, and natural hazard/landslide impacts of the Dingalan-San Luis road.

Green Forum endorsed the Haribon Foundation - Tanggol Kalikasan recommendations and expressed an additional concern with the ARIDP Scoping process and the extent to which the NGO community and other interested sectors were represented and provided the opportunity to participate .

UGAT also emphasized the significance of indigenous cultural community, NGO, and PO participation in ARIDP planning highlighting potential ARIDP impacts and the need for adequate field studies to ensure protection of the right to Ancestral Domain of communities affected.

The Aurora chapter of Lingkod Tao-Kalikasan registered opposition to the Dingalan-San Luis road and expressed biodiversity, forest-destruction, watershed degradation, illegal logging, cultural community, soil erosion, and flooding/natural hazard concerns with ARIDP proposals.

The Organization of Tribal Filipinos in Sierra Madre also opposed Dingalan-San Luis and expressed general concern with ARIDP impacts on Ancestral Land rights.

The International Council for Bird Preservation underscored overall diversity concerns expressed at the National Scoping Session and recommended caution with both Dingalan-San Luis construction and ARIDP and other infrastructure development in the Sierra Madre.

The International Center for Living Aquatic Resources Management acknowledged receipt of the Scoping Session invitation and apologized for being unable to participate on the date scheduled.

Written submissions to the Scoping Session/Consultations were reproduced in the ARIDP Scoping Report.

The remainder of this section summarizes discussions, comments, and submissions received during the four Scoping Session/Consultations and relevant aspects of the DENR/EMB Perception Survey administered in the three local sessions. It presents local concerns, highlights new impacts or issues which were identified, and assesses the completeness of preliminary identification of ARIDP impacts and the relative significance of the environmental concerns and issues depicted therein.

The primary environmental concerns, issues or potential impacts associated with ARIDP raised in the Scoping Session/Consultations listed in declining order by frequency with which they were expressed were:

- forest destruction
- illegal and legal logging
- displacement of tribal communities
- accelerated in-migration
- watershed degradation, hydrological changes, and flooding
- soil erosion, sedimentation
- vulnerability to natural hazards
- need for reforestation/environmental rehabilitation
- destruction of wildlife/biodiversity

- improvement in project selection process and public consultation
- destruction of wildlife/biodiversity losses
- slope stability/landslides
- degradation of coastal ecosystems
- loss of agricultural lands and reduced productivity

Potential forest destruction and a variety of forest-related issues were by far the most frequently raised concerns. Impacts of new road construction through forested areas were most noted with concern less on direct impacts of construction itself and more on secondary impacts associated with increased access to forest areas. Increased access to illegal logging provided by both new roads and road improvements was identified as a major issue as were the benefits to the logging industry ARIDP might provide. Migration made possible by both road-related access and development induced by the project was a related concern with consequent increased settlement in upland areas, forest-clearing and kaingin.

Increase in-migration associated with expanded forest access and induced development were viewed as major threats to the indigenous tribal communities in the Project Areas which lack both land security and right to Ancestral Lands. Potential displacement of these groups, increased poverty, and a deterioration of inter-ethnic relations received considerable comment.

Another major nexus of interrelated concerns and potential impacts was associated with the effects of forest destruction, most prominent among them watershed degradation. Again, concern was predominantly with secondary or indirect effects of ARIDP. Hydrological and drainage impacts resulting in accelerated run-off and increased flooding were often expressed, closely followed by related increased erosion, soil loss, and downstream sedimentation with destructive consequences on lowland agricultural areas. The relation of road alignments to designated or proposed critical watersheds drew attention.

The relation of proposed ARIDP projects to natural hazards was another foci of comment. In addition to flooding, concern with road constructions impacts on slope stability and incidence of landslides was expressed. Many comments also addressed the vulnerability of both proposed infrastructure and potential settlement and development associated with them to flooding, typhoons, and earthquakes. In this regard a frequent comment was the need for reforestation, environmental rehabilitation, and more effective environmental management; in several cases accompanied by the suggestion that such measures were of greater immediate urgency to the Project Area than the road improvements.

Potential impacts on wildlife and biodiversity were noted by many both as a result of habitat loss associated with forest destruction, and expanded access leading to overexploitation. Commentators emphasized the area's rich wildlife and biodiversity resources and urged consideration of the cumulative impacts of development including ARIDP on the Sierra Madre system as a whole.

Numerous concerns associated with the process of project identification, public participation, and project funding were expressed. "Who" was behind the project, how and why it had been selected for study, the role of the United States, and how a decision about its feasibility and possible construction would be made were common. Skepticism of the Scoping process and sincerity of the consultations was also expressed with some comments alleging that they were only a formality or a charade. Criticisms of Scoping Session notification, selection of invitees, and the time given to participants to study the issues and consult memberships in the case of NGO's and other organizations were also received. Considerable concerns also surrounded potential ARIDP funding with many comments expressing reservations about loans which would increase Philippine indebtedness.

Potential adverse impacts on coastal ecosystems associated with river and stream flow alterations were noted as was the potential impact of expanded exploitation and illegal fishing associated with improved coastal access. Potential impacts of port development in Dingalan which might ensue with road improvements were expressed, particularly with respect to displacement of communities in the possible port site and the impacts of industrialization on the quality of life.

Impacts on agricultural lands from road construction or widening and compensation concerns were also stated.

The DENR/EMB Perception Survey administered by the Consultant in the Project Area in conjunction with Baler, Dingalan, and Gabaldon Scoping Session/Consultations provides a complementary perspective on many of these concerns.

Nearly all respondents reported observing significant recent environmental change in their communities. Paralleling concerns discussed in the Scoping Session/Consultations citizens ranked loss of forest cover, lowland flooding, and deteriorating marine and coastal resources as the three most important changes observed. Most indicated an awareness of the proposed ARIDP. More respondents reported positive than negative expectations of the project, but overall results were mixed. Increased employment, income, community solidarity, and improved power supply were perceived ARIDP benefits.

Major potential negative impacts perceived if the project was implemented were depletion of forest cover; flooding; water pollution; decrease in crop, fish and shellfish harvest; and human health hazards. The vast majority also held the opinion that the proposed ARIDP would help the community and local residents and indicated that, given the chance, they would work for the project.

In relation to the preliminary identification of potential ARIDP impacts developed in the initial matrix (Figure 7-3) the Scoping Session/Consultations and DENR/EMB Perception Survey generally confirmed those potential impacts identified by USAID in the Threshold Decision/IEE and ARIDP TOR and by the Consultant. Scoping results also introduced new impacts, issues, and concerns. Illegal logging, for example, was not recognized initially to be as significant an aspect of potential ARIDP-related forest degradation as it now appears.

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Scoping recommendations suggested that forest-related impacts and issues generally should be at the center of ARIDP environmental studies, and that forest access concerns associated with ARIDP road construction and road improvement are extremely significant. Many of the other potential impacts identified are less products of the proposed roads and more the indirect consequence of their effects on forest accessibility. Scoping Session/Consultation comments on the inadequacies of current natural resource management also suggested an important dimension of the access issue.

Another determinant of the potential impacts of increased access highlighted in Scoping comments was the degree of security enjoyed by current residents. Like the forest, the indigenous communities in the Project Area are highly vulnerable. They and most other residents lack security of tenure. Scoping recommendations confirmed initial attention to Ancestral Lands, cultural communities, and tribal and ethnic relations and elevated the significance of potential tribal displacements.

Coastal concerns and potential impacts also rose in relative ranking while environmental health and aesthetic resources fell. Wildlife and biological diversity concerns were amplified by Scoping comments and assumed much greater significance. Aurora is the Philippine's most heavily forested province. The Project Area contains habitat of many threatened avian and other species and verified recent sightings of the Philippine Eagle have been recorded. It also contains substantial stands of old growth, mossy, and relatively undegraded residual forest which may be essential to maintaining the biodiversity of the entire Sierra Madre.

Scoping results also suggested that the direct impacts of the road project, while not insignificant, are less of concern impacting than its potential secondary and indirect consequences. While not minimizing design and construction concerns and impacts, Scoping comments directed attention to the project's operation and suggested increased additional emphasis to the social environment. The relocation/compensation issue and land speculation rose in significance reflecting local concerns and potential project impacts on agricultural and other lands.

Natural hazards issues were underscored by Scoping comments, in particular the potential hazards to proposed infrastructure posed by environmental change in the Project Area. Scoping comments recommending reforestation and environmental restoration to protect the road investment were instructive.

Impacts on upland area and potential in-migration associated with ARIDP received greater significance from Scoping comments. Another concern that was reinforced was that of cumulative impacts of collateral developments induced by or associated with ARIDP. The Dingalan port and Palayan City plans to establish an industrial estate are good examples.

Other major concerns introduced in the Scoping Sessions, although less associated with project impacts, required consideration in the design and conduct of the EA/EIS. Principal among them were the process-related concerns which suggested that greater attention be paid to ensuring full, fair, and informed participation by citizens and communities in the Project Area and the NGO community.

7.2.4 Summary of Potential Environmental Impacts

The Consultant carefully considered the Scoping Session/Consultation comments, submissions and the results of the DENR/EMB Perception Survey and re-evaluated the preliminary identification of potential ARIDP impacts and the original scope of studies and work plan derived from it. The Consultant also considered;

- data collected by the Environmental Studies Team in field studies of the existing Project Area environment,
- interviews with citizens and experts outside the Scoping process itself,
- numerous direct observations by project staff,
- A second series of helicopter overflights; and
- findings of a preliminary coastal survey conducted after the Scoping Session/Consultations.

Upon a thorough review of this information the Consultant improved and strengthened his identification of potential impacts of ARIDP road improvements, produced a revised ranking of impact significance and carried out a preliminary environmental review of proposed project Alternatives. Additional potential impacts associated with those Project Alternatives determined since the Scoping Sessions were also identified.

The revised ranking of environmental components receiving potential ARIDP impacts is presented below in declining order and grouped into classes of high, moderate, and low relative significance. Significance was determined on the basis of magnitude and severity of potential impacts; legislative and legal requirements such as Sections 118 and 119 of the U.S, Foreign Assistance Act, whose applicability to proposed ARIDP actions is discussed in Section 7.5; and degree of public and community concern.

Potentially impacted environmental components of high significance were identified as:

- wildlife and biodiversity
- national parks and protected areas
- forest cover, plant communities, and vegetation
- population distribution and migration
- land use, proposed land uses and regional planning
- cultural communities and ancestral lands
- agriculture
- aesthetic resources and tourism

- private employment
- archaeological and historical resources
- watersheds
- environmental services

Potentially impacted environmental components of moderate significance were identified as:

- transportation
- quality of life
- soils
- river and streams ecology
- hydrology and drainage
- occupational distribution
- energy resources
- livelihood
- ethnic and tribal factors
- slope stability
- public services
- communication
- income

Potentially impacted environmental components of low significance were identified as:

- solid/hazardous/toxic waste
- environmental health/mobility and mortality
- coastal ecosystems
- wetlands
- fisheries
- mangroves
- coral
- geology
- mineral resources
- income distribution
- education
- public employment
- air quality
- housing
- groundwater
- noise
- climate

On the basis of this final identification of potential ARIDP impacts from considerations discussed in Scoping Session results, review of the preliminary impact identification, the TOR, and the IEE the Consultant essentially completed the primary tasks of the Scoping phase of the ARIDP Environmental Studies Work Plan. Effort and activities shifted from impact identification to

impact assessment on July 17, 1991 when impact assessment field studies were commenced. Approach, scope, research priorities, methodologies and level of effort in field investigations were guided by these findings.

Subsequent work plan tasks, staffing and schedules were also revised to reflect new understandings. Adjustments in projected environmental analysis and preparation of the preliminary EA/EIS; design and development of an appropriate environmental management, mitigation and monitoring plan; and the Draft and Final EA/EIS were effected.

Although the Scoping phase concluded, the process of communication, consultation and dialogue it initiated continued and was enhanced in response to public concerns. Review of Preliminary, Draft, and Final EA/EIS findings is also structured to include the participation of interested, involved, and affected parties; and to permit collaborative workshops in both Manila and the Project Area incorporating this participation in the design and development of management, mitigation and monitoring measures appropriate to actions proposed in the Draft/Final Feasibility Study Report and the recommendations of the Client.

7.3 ASSESSMENT OF ARIDP ENVIRONMENTAL IMPACTS

7.3.1 Environmental and Natural Resources Impacts

Field Studies confirmed that ARIDP construction and operation could be expected to have high direct and indirect impacts on forest cover, plant communities and vegetation; wildlife and biodiversity; the Aurora Memorial Park and other potential protected areas; watersheds and environmental services; and natural hazards.

Major direct impacts on forests would occur in both new construction segments (3 and 5A), where right-of-way clearing for new alignments would require substantial forest clearance and destruction of high-quality residual dipterocarp forests, and in road improvement to existing segments which pass through forested areas (5B and C, 6, and potentially 2B). ARIDP operation would also have high impacts on forests in these Segments associated with increased access to forest resources, illegal logging, and settlement. Indirect impacts on eastern slope Sierra Madre forests of Segment 4 may also occur to the extent proposed road improvements lower costs of legal and illegal log and lumber transport and encourage in-migration.

High wildlife and biodiversity impacts would also accompany both habitat destruction resulting from new construction and, to an only slightly lesser degree, from improvements to the existing National Highway through the Aurora Memorial Park. Indirect impacts of the project on wildlife and biodiversity associated with forest destruction or degradation adjacent to the roads and intensified exploitation of marketable and edible species are also expected.

The Aurora Memorial Park itself would receive major impacts from construction of Segment 5A and/or improvement of Segments 5B and 6 producing substantial direct degradation of park amenities. Indirect consequences of increased traffic and access would increase park vulnerability to illegal logging and associated extraction of forest and wildlife products and to encroachment by squatters. Potential protected areas in the Sierra Madre Range between Dingalan and San Luis, Aurora would also be impacted by Segment 3.

Watershed and environmental services impacts were assessed as high. Segment 3 would cut across critical watershed areas and, as a result of direct deforestation produced by construction and indirect loss of forest cover expected from the access impacts of operation, is likely to result in significant watershed degradation. Construction of Segment 5A would similarly degrade upper portions of the Cabatangan River watershed. Moderate to high watershed impacts would also occur from proposed improvements to Segments 5B and 6, in both construction and operational phases. Watershed impacts in the above segments will both increase natural hazards associated with downstream flooding and aggravate landslides and slope stability problems above and below alignments in mountainous sections.

Road improvements to Nueva Ecija sections of Segment 4 and 5B would also be extremely vulnerable to existing natural hazard impacts in these largely denuded flood and landslide-prone areas. These threats may be increased by indirect impacts of project operation which promote additional deforestation. Segment 1 is also vulnerable to flooding and other damage that may increase with continuing upstream watershed degradation associated, in part, with illegal logging. Hilly portions of Segment 2B are likely to be affected by receding forests above the alignment. Segment 1C improvements may contribute slightly to illegal logging operations active in the area but otherwise Segments 1 and 4 have very low to minimal impacts on forests, wildlife biodiversity, watersheds, national parks and protected areas. To the extent that Segment 1 improves egress from Northern Aurora via Dipaculao and the improved cross-mountain "outlet" to be provided by Segment 2, 5, or 6, it will contribute to additional extraction of forest products along the present track to Casiguran.

Moderate potential impacts on slope stability; soils; hydrology, drainage, and surface water; river and stream ecosystems; and energy resources were identified in the Scoping process. Field survey and assessment confirmed that moderate slope stability impacts on Segments 6 could be expected from improvements to the existing alignment. Slope stability impacts from new construction were re-evaluated as high for Segments 3 and 5B where steep topography is likely to require major earthworks. Slope stability problems are also likely along Segment 2 but improvements along this poorly engineered and already eroding alignment may have positive benefits which reduce this problem. Segments 4 and 1 are existing alignments crossing primarily flat terrain and are not expected to have significant slope stability impacts.

Soils impacts from road improvements to Segment 1 and 4 are also expected to be minimal and temporary during construction, as are the direct and indirect impacts on soils associated with their operation. Existing soil erosion problems on Segment 2 immediately associated with the existing road are likely to be reduced with proposed improvements. Moderate indirect impacts on soils may result from continued roadside forest conversions to agriculture. Steep topography,

high erodibility, and frontal exposure to typhoons are expected to contribute to high to moderate soil erosion during Segment 3 construction depending on final design and mitigation. Soil loss during Segment 3 operation is likely to continue and increase at a rate proportional to deforestation.

Existing Segments 5 and 6 are likely to be similarly impacting given the scale of cuts and fills and other improvements required to bring these routes to DPWH Standards. Segment 5A, new construction, which drops steeply down the narrow Cabatangan valley would also have from high to moderate construction-related soil impacts, and erosion would remain a persistent process affecting faces and embankments. Indirect impacts from forest clearance, illegal logging, and kaingin would accelerate soil loss during operation.

ARIDP hydrology, drainage, and surface water impacts range from minimal to moderate with indirect impacts from project-induced land-use changes likely to be the most significant determinant. Segment 1 will increase surface water run-off and contribute marginally to local flooding, and may impede surface drainage depending on design, construction, and maintenance of drainage structures.

Similar minimal impacts and drainage concerns occur on Segment 4, much of which is already subject to heavy flooding. Without reforestation and enforcement to prevent additional forest loss, hydrological conditions in adjacent watersheds are likely to continue to deteriorate, accelerating run-off and posing an ever-escalating threat to both roads and structures on this segment. Segment 2 faces a similar future although road improvements proposed would impact positively on the inadequate drainage of the existing road.

Construction and other direct impacts on hydrology, drainage, and surface water of Segment 3 and 5A are low to modulate and localized; however indirect project inputs associated with deforestation are likely to be high and would be accentuated by the short tight drainages of the steep coastal watersheds and the Cabatangan River. Improvements to existing sections of Segment 5 and 6 will produce low overall direct impacts; although they may encourage settlement and associated land use changes with potentially high impacts on downstream areas and agricultural lands.

Impacts on river and stream ecosystems are likely to parallel the above. Moderate to high, but localized and largely temporary, impacts associated with silt and sediments from exposed soils will occur with construction, particularly at crossings. Least impacts will be generated by Segments 1 and 4. New construction in Segments 3 and 5A will exert the highest impacts. The short river systems of the small coastal watersheds of Segment 3 are especially sensitive, and major impacts would be expected from Segment 5-A on the Cabatangan River which is essentially pristine at present. Rates of deforestation and erosion induced would determine indirect impacts of both on river stream ecology. Intensified exploitation of aquatic resources would also be slightly promoted.

Proposed improvements to Segment 2 could initially improve current ecological conditions in cross streams. It and Segment 5 B,C and 6 are likely to have moderate impacts on rivers and stream ecosystems during construction, and slight direct impacts during operation. Project-associated land use changes will contribute low to moderate indirect impacts depending on their extent. Moderate potential impacts on energy resources were identified by Scoping results but were re-evaluated as minimal on the basis of field study. Existing energy resources are primarily wood-derived, principally charcoal, which will be unaffected. Forests cleared for right-of-ways in construction may temporarily increase this resource. No known potential energy resources will be affected by the project.

Field studies and assessment generally confirmed the low potential impacts on coastal ecosystems, wetlands, fisheries, mangroves, coral, geology, mineral resources, air quality, groundwater, noise, and climate identified by the Scoping process.

Coastal conditions including steep coastal slopes, high wave action, limited shelf, strong tides and currents, and storm exposure limit the development of mangroves, corals, and coastal wetlands. Adaptation to these stresses reduces the sensitivity of coastal ecosystems and provides natural mitigations for silt and sediment. Segment 3 impacts would be low even with significant road-induced erosion. Exploitation of coastal and near shore marine resources made accessible would increase in both this segment and in Dingalan Bay, in conjunction with Segment 4. Other Segments are relatively removed from the coast and would indirectly impact these resources only slightly via their contribution of silt and sediments. Fisheries are unlikely to be significantly impacted by the project. Proposed improvements to Segment 4 may encourage port development in Dingalan with high localized coastal impacts there.

Segment 3 may also increase access to and development of mineral resources producing potentially serious secondary impacts.

Air quality would be negatively impacted during construction but improved with paving and is not considered significantly impacted. Noise would increase in both construction and operation phases but is also not significant. Project impacts on groundwater are not expected

7.3.2 Socio-cultural Impacts

Results of the Scoping process identified population distribution and migration; land use, proposed land uses, and regional planning; agriculture; private employment, and cultural communities and Ancestral Lands as potentially impacted environmental components of high relative significance.

New road construction proposed in Segments 3 and 5A will have major impacts on population distribution and settlement patterns, and encourage migration into roadside lands made accessible to pioneer settlers and others. Coastal barangays in San Luis and Dingalan would experience significant population increase, and migrants will increase and move further up the Cabatangan River. Environmental consequences may be pronounced as lands suitable for agricultural are

both extremely limited and essentially settled. Illegal logging followed by kaingin will accelerate deforestation watershed degradation, and erosion in upland forested areas.

Demographic impacts of other Segments are less severe and specific but likely to be significant. Improvements proposed to the interprovincial "outlets", Segments 2, 4, 6, and the new link of 5A will increase the ease of entrance to and attractiveness of the Project Area generally to migrants from Luzon and other Philippine regions which, in the context of Pinatubo-related and other displacements, may be especially significant. Road improvements generally will increase the attractiveness of roadside settlement with localized effects. Recent completion of Segment 2 has already engendered substantial in-migration and forest clearing which would increase with improvements. Segment 1, as an existing road in an extensively developed area, is likely to be least impacting except in the Segment 1-C area where moderate population movements impacts may occur. Demographic impacts along Segment 4 are similarly expected to be light. Construction labor and the location of ARIDP work camps and facilities will have high construction phase inputs and possible long term effects.

ARIDP impacts on land-use follow, for the most part, population movements and are likely to parallel those described above in distribution. Conversion of agricultural land to urban uses may be encouraged with improvements to Segment 1. Conversion of forest land to unsustainable agricultural uses followed by reversion to unproductive brush and grasslands will be slightly accelerated along the still forested perimeter of the Baler Basin. Similar but more extensive impacts would occur in Segments 3 and 5-A. Segment 4 land uses are not likely to be significantly impacted, although an industrial estate is likely to be promoted in Eastern Nueva Ecija in conjunction with road improvements.

Agriculture, as discussed above, is likely to expand at the expense of forests in newly accessible areas opened by Segment 3 and 5A, as has already occurred in recently completed Segment 2. This process will slightly accelerated by improvements to that Segment.

Segments 5B and C and 6 may also experience additional encroachment of agriculturalists into forested areas and the Aurora Memorial Park as a result of improvements. Agricultural potential has largely been achieved in suitable areas served by Segments 1 and 4 and feasibility analysis indicated that road improvements are not likely to result in significant agricultural intensification. Agricultural lands and productivity along these segments are likely to be impaired by continuing watershed degradation in both areas which may be accelerated by increased illegal logging and other project-stimulated deforestation in upper watershed areas of Segments 2, 5 and 6.

Private employment will increased significantly during project construction phases. Population increase associated with ARIDP road improvements will be accompanied by increased employment in retailing and service sectors. Improved access to forested areas provided by new construction will temporarily increase employment in illegal logging and other forest product extraction followed by declines as forest resources are depleted. Overall, employment inputs of the project are expected to be slight.

Field studies and assessment also confirmed the likelihood of significant project effects on Tribal Filipinos, Ancestral Land claims, and the indigenous cultural communities (ICCs) of the Project Areas, identified as potentially high impacts by the Scoping process. Considerable displacements of ICCs have occurred historically and in the region and the substantial minority tribal population of the Project Areas continues to lack basic land security. Insecurity of tribal tenure is likely to increase with future development and migrant settlement, and to the extent that these are encouraged by the proposed ARIDP improvements in the road network, they are likely to contribute to continued ICC displacements.

All Segments occur in areas which contain or could be considered to contain Ancestral domains of groups native to the region, and more recent movements into the Project Area by tribal populations from the Cordillera and Cagayan Valley interject an additional layer of potential ICC land claims which would be affected by project actions. Proposed improvements to existing roads, particularly Segment 1, will exert the least negative impacts on ICC's as those groups have largely withdrawn from the immediate areas and been replaced by lowland Filipino communities. Indirect impacts, however, remain likely. Segments 2, 4, 5B and C and 6 are expected to have low direct impacts on Project Area ICCs.

Impacts of new construction proposed in Segment 5-A is also likely to be low. Major impacts would occur in Segment 3 which has a high tribal population. Dumagat communities along this coast are unusually vulnerable to socio-cultural disruption and displacement and induced developments associated with this Segment would be likely to aggravate rather than alleviate socio-economic problems of these groups and increase their pressures on upland forests and resources with potentially serious environmental consequences.

Land conflicts between migrant and native communities are likely to be increased if the proposed project is implemented and future resolution of ICC Ancestral Land Claims will be made more complex unless these are delineated prior to project construction. Tenure security problems also characterize most lands in the Project Area occupied by both recent settlers and many long time residents. Displacements and land speculation impacts related to ARIDP road improvements are not limited to ICCs although they are likely to be less serious.

Potentially impacted socio-economic components of moderate relative significance identified by Scoping results included transportation, quality of life, occupational distribution, livelihood, ethnic and tribal factors, public services, and income. Transportation impacts are primarily positive and will be most dramatic in the coastal barangays to be served by Segment 3. Transportation services are likely to be marginally increased in all existing Segments and time and travel cost savings will also occur. Quality-of-life, similarly, will be positively impacted especially in the short-term for most groups and segments. qualified by potential negative impacts on ICC's, land conflicts and frontier conflicts occasioned by opening the coastal area to additional settlement. Environmental degradation associated with improved access to natural resources and accelerated unsustainable extraction and illegal activities are likely to diminish quality of life over the longer term.

Ethnic and tribal factor impacts have been discussed above. Inter-ethnic relations may deteriorate overall and especially in high-impacted Segment 3. Measures to address ICC concerns and recognize Ancestral Land claims may engender antagonisms associated with envy and perceived favoritism in non-tribal communities unless measures to address tenure problems of these groups are also taken.

Employment and occupational distribution impacts are not expected to be significant except during construction phases although the localization of maintenance functions during project operation in communities served could contribute to new employment in the now-roadless areas. Current employment in boat-based transportation sectors is not expected to be impacted significantly. Slight increases in forest-related employment sectors may occur associated with improved "access" but these are likely to be short-lived and unsustainable under current practices. Forest protection and other resource management occupations could increase under alternate scenarios, but needs generated by project-induced environmental changes are not likely to be responded to without major changes in current policies and conditions. Livelihood impacts are likely to be similar to the above with positive impacts most pronounced in communities linked by proposed new construction in Segment 3.

Public services associated with project maintenance will increase in demand as will forest protection and natural resource management as noted above, especially in relation to the Aurora Memorial Park. It is unlikely that these needs will be met. Road extensions proposed along the coast, and, to a more limited degree, improvement of other segments, coupled with settlement and increased populations may create demands which exceed available government services. Communication will improve dramatically in Segment 3 and less significantly in existing segments. Overall income is not likely to be significantly impacted by the project as shown by feasibility study economic analysis, with the localized exception of Segment 3 where slight improvement may occur.

Potentially impacted socio-economic components of low relative significance identified by the Scoping process included solid/hazardous/toxic waste, environmental health, income distribution, public employment, and housing. Field survey and assessment generally confirmed the likelihood of minimal impacts on these components by most segments and ARIDP network improvements as a whole.

Toxic/hazardous waste impacts associated with project construction are likely to be minimal and are amenable to mitigations to be contained in construction contracts. The project is not expected to significantly increase manufacturing or other industrial activity. Project impacts on health are expected to be generally positive with benefits in accessibility associated with road improvement. Increased migration to the Project Area and new construction proposed may increase populations-at-risk of environmentally related-diseases such as malaria although lack of epidemiological data makes this factor, expected to be small, difficult to assess. In-migration and pioneer settlement may also increase local sanitation problems in some cases.

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Impacts on income distribution are expected to be minimal and largely negative with respect to equity. Project beneficiaries are likely to be those with the resources to take advantage of its opportunities such as vehicle operators, traders and sectors most immediately subsidized by road improvements including logging and the wood products industry. Public employment impacts have been discussed above. Housing impacts are not expected to be significant.

7.3.3 Cultural and Aesthetic Impacts

Components of the cultural and aesthetic environment potentially impacted by the project were identified as cultural communities and Ancestral Lands, archaeological and historical resources, and aesthetic resources and tourism. Impacts upon all were expected to be significant.

Cultural communities and Ancestral Land claims impacts were reviewed in Section 7.3.2 above.

Field survey and assessment of archaeological and historical resources indicated minimal direct or indirect impacts on all project segments with the exception of Segment 3 where project impacts on Dibut Bay, an important WW II historical site, are likely to be significant. Positive benefits to be public from improved access will occur although increased overall access to the area may degrade the environmental setting and potential tourism value of this historical resource.

Impacts on aesthetic and tourism resources were assessed as moderate to low. Negative impacts would occur with construction of Segment 3 both directly and in association with indirect impacts on forests, wildlife, waterfalls and other features generated by increased settlement, illegal logging and kaingin. Coastal scenic values are also likely to be diminished. Positive benefits associated with tourism development are possible but unlikely in the short term given current conditions and the necessity of related investments. Proposed improvements to the inter-provincial outlet segments will slightly encourage tourist visits.

Improvements to existing segments 5B, 5C and 6 may also negatively impact scenic resources as forest clearance and cuts required would be widely visible from most of the central plain and Baler in Aurora. The impact of both these improvements and the impacts of new construction of 5A will have major impacts on the Aurora Memorial Park, similar to the case of Dibut Bay above. Scenic values are likely to be degraded and other aesthetic resource associated with forests, wildlife, and biodiversity are likely to be negatively impacted under current conditions. Potential positive impacts associated with access and tourism development may be achieved under alternate scenarios that include complementary investments in park development and management.

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7.3.4 Preliminary Impacts Assessment Findings

Field studies to assess ARIDP environmental impacts were carried out from July 17 to August 8, 1991. These studies were guided by the results and recommendations of the Scoping Session/Consultations, review of existing information, findings of initial fieldwork undertaken from June 4-15, 1991 to profile the existing Project Area environment, and a second series of helicopter overflights.

Field studies included both focused environmental surveys of prioritized projected ARIDP impacts and detailed assessment of ARIDP Project Alternatives identified by the ARIDP Feasibility Study. The objective of these studies was the confirmation or rejection and assessment, when appropriate, of those impacts identified by the Scoping process; and the identification and assessment of other additional potential impacts associated with the proposed ARIDP. These investigations are described in Section 7.1.5. Although the length of studies was insufficient to provide more a preliminary assessment in many cases, the Consultant believes they provide a sufficient basis for the identification of potential project impacts and the confirmation of impact significance, and an adequate foundation for the recommendations that follow.

Detailed presentation of field studies data and discussion will be provided in the ARIDP Preliminary EA/EIS which is in preparation. The purpose of the Preliminary EA/EIS, which is comprised of a description of the existing Project Area environment and an assessment of ARIDP impacts upon it, is to determine the scope and outline the scale of necessary mitigation and other measures which may be required and to identify appropriate participants in the design and implementation of these mitigations and the ARIDP Environmental Plan of Action. Review of the Preliminary EA/EIS and design of mitigations, monitoring, and environmental management measures of the Environmental Plan of Action will occur in upcoming consultations with interested or affected agencies, local governments, NGO's and community representatives to be held in Manila and two locations in the Project Area should Feasibility Study results and Client recommendations warrant them. The Environmental Plan of Action developed in these consultation together with the revised Preliminary EA/EIS comprise the Draft ARIDP EA/EIS which will be submitted for Client review and comment .

This section summarizes information and results of field studies available at the time of writing from the Preliminary EA/EIS in preparation to provide an overview of expected ARIDP impacts. It considers ARIDP as a whole; that is, as a set of or program of road improvements and new construction intended to upgrade the Project Area transportation network rather than as separate or unrelated projects. An individual environmental review of each Project Alternative will be provided in the Draft EA/EIS. Mitigations are also considered generally, pending additional specification in the consultations and development of the Environmental Plan of Action. Findings presented here, therefore, are indicative, tentative and conditional, and costings are discussed qualitatively.

Field studies generally confirmed potential ARIDP impacts identified in the Scoping process. Assessment of these impacts, as described above in Sections 7.3.1 to 7.3.3, indicates that the project is expected to have significant impacts on physical and biological, natural resources, socio-economic, and cultural/aesthetic components of the environment.

Major impacts on the physical and biological environment and natural resources include deforestation, wildlife reductions and biodiversity losses, watershed degradation, degradation of the Aurora Memorial Park, diminished environmental services, and increased natural hazard from flooding and landslides. Reduced slope stability; accelerated soil erosion; hydrological, drainage, and surface water impacts; degradation of river and stream ecosystems and impairment of agricultural productivity were assessed as significant.

Major impacts expected on the socio-economic environment include increased mitigation, changes in settlement pattern and land use, displacement of tribal communities, land conflicts and deterioration of inter-ethnic relations, the undermining of proposed land uses and regional plans, increased illegal logging, and intensification of demands on public services.

Significant impacts on the cultural and aesthetic environment include degradation of scenic, historical, and tourism resources.

Taken together, these impacts indicate that the proposed ARIDP has highly significant and very substantial social, economic and cultural and ecological costs. A large but yet to be fully determined portion of these environmental costs can potentially be prevented, reduced, or otherwise mitigated. Impacts most amenable to these measures are principally those associated with the direct impacts of road construction and improvement. Many impacts, however, are unavoidable, irreversible, and essentially permanent. They include destruction of tropical forest in right-of-way clearance and alignment improvements, biodiversity losses, and degradation of the Aurora Memorial Park. Several hundred hectares of relatively undegraded forest, for example, would be destroyed by new construction proposed for Segment 5A alone.

Thus, even with maximum success of all potential mitigations, environmental impacts and costs of the project will remain high. Field assessment and preliminary identification of mitigations and other measures required, moreover, indicated that ARIDP mitigations are likely to be both costly and complex. Complexity is high because a large proportion of the impacts expected are generated indirectly by project effects on the social and cultural environment and their secondary or tertiary impacts which are largely beyond the control of the project itself. Management and mitigation of these impacts will demand a wide array of coordinated actions by government at many levels, communities, and citizens.

The scope and scale of mitigations required are likely, in fact, to be larger than the project itself; establishing a mitigation, monitoring, and environmental management superstructure dwarfing the road improvements of the original project.

Coupled with the high unavoidable environmental costs, costs and complexity of mitigations are likely to make the project unacceptably expensive. The environmental costs of the project are also likely to be excessive from a policy perspective. Sections 118 and 119 at the US Foreign Assistance Act, for example, prohibit US assistance to activities which degrade tropical forests, national parks, or biodiversity.

When environmental, mitigation, and project costs are considered together in relation to expected project benefits ARIDP becomes an increasingly questionable investment. Economic analysis in feasibility study has shown that overall project benefits are low and, for many Segments, insufficient to justify construction. With internalization of environmental and mitigation costs projected benefits are likely to disappear. It is very likely that costs may exceed benefits.

On this basis, preliminary findings of ARIDP impacts assessment indicate that the project, as presently constituted, is environmentally infeasible and would not be recommended by the ARIDP EA/EIS for implementation.

Dropping the most problematic Segments from the project alone (Segments 3, 5, and 6) is unlikely to either significantly reduce these costs, eliminate assistance prohibitions, or reverse this determination.

7.4 ENVIRONMENTAL ANALYSIS

7.4.1 ARIDP Environmenatal Issues

In addition to the potential environmental impacts of the proposed ARIDP identified for assessment during field survey, the Scoping process also identified a number of issues for further study in the Environmental Analysis phase of ARIDP Environmental Studies. Although environmental impacts and issues of ARIDP overlap and are not mutually exclusive, issues are taken to comprise cross-cutting topics, special concerns, or more complex considerations requiring judgements, examinations, analyses, or investigations beyond or in addition to simple or direct assessment of specific impacts of Project Alternatives.

Both the ARIDP Feasibility Study TOR and the EA/EIS format adopted in consultation with DENR/EMB and USAID, for example, direct the Consultant to address mitigation, monitoring, and environmental management aspects of the proposed project. The TOR also specifies the consideration of possible complementary investments necessary to ensure project success.

The USAID IEE, the Consultant's review of existing information, and other pre-Scoping initial evaluation of potential ARIDP impacts also identified issues for special examination; among them tropical forest, biodiversity, and illegal logging and Tribal Filipino and Ancestral Land claim concerns.

The Scoping Session/Consultations, as intended, also contributed to the identification of issues requiring further environmental analysis; amplifying some of those topics already identified, delineating others for examination, and raising additional questions for investigation. Field studies by the Consultant also identified additional dimensions of earlier concerns and contributed new issues. Further, the Consultant was also directed by the Client to investigate, examine or evaluate a number of topics, questions, and concerns in Client comments on the ARIDP Feasibility Study Preliminary Report (CCSC, 7/3/91; CCSC 8/2/91; CCSC 8/8/91), the ARIDP Scoping Report, the August 8, 1991 presentation of ARIDP preliminary findings and recommendations to CODA (CODA, 8/8/91), and other consultations.

The Consultations review of issues identified from the above sources established an agenda for environmental analysis that included:

- sustainable development
- forest, biodiversity, and natural resources management
- socio-cultural concerns
- bioregional considerations
- project design factors

These issues are outlined below in Sections 7.4.2 - 7.4.6. Preliminary findings of environmental analyses available at the time of writing were incorporated in Section 7.3.4. Final Results of analyses will be incorporated in the ARIDP Draft EA/EIS.

7.4.2 Sustainable Development

Sustainable development issues are those concerned with environmental aspects of the overall relation of the proposed ARIDP to actual or potential development opportunities in the Project Area. They include ARIDP orientation and objectives, the role and contribution of road improvements in achieving development potential, the determination of development potential itself, the types of development benefits expected, the relation of the proposed project to other development initiatives, the scope and character of potential complementary investments, and the consideration of the project in relation to possible alternatives.

Environment-related development issues identified for analyses included the following interrelated economic and ecological concerns:

- Sustainability

  The ARIDP TOR and EA/EIS requirements direct the Consultant to examine the sustainability of both the project itself and the project in the context of overall

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sustainability of development in the Project Area and the carrying capacity of the environment. Section 118 and 119 of the U.S. Foreign Assistance and Client comments (CCSC 7/31/91) also direct attention to issue of sustainable economic growth.

- Short Term Use vs. Long Term Productivity

  The TOR and EA/EIS require the Consultant to analyze long term effects of the project and to evaluate its relation to local short term uses of and the maintenance and enhancement of long term environmental productivity.

- Irreversibility

  TOR and EA/EIS requirements direct the Consultant to evaluate the extent to which the project curtails or expands beneficial uses of the environment and any irreversible or significant commitment of resources or damage that may ensue. Scoping session comments also raised this issue.

- Cumulative effects

  The TOR and EA/EIS require the Consultant to examine the growth-inducing potential of the project and to evaluate whether its incremental impacts will exceed environmental carrying capacity. Scoping Session comments amplified this concern and suggested attention to the extent the project would or could induce development in the Project Area and to the kinds of development it might support or engender and their additional impacts on the environment.

Other development issues identified concern project-specific environmental considerations and the Project Area environment as a potential opportunity rather than a constraint to development. These included:

- Development Potential

  Reinvestigation of development potential was recommended in Client comments (CCSC, 8/2/91) which agreed with the Consultant's preliminary economic analyses, presented in the ARIDP Feasibility Study Preliminary Report, that found environmental problems of paramount importance in considering road improvements and asserted that, under present practices, economic limits to sustainable provincial development determined by the quality of physical resources were either close to being reached or had been surpassed. In response the Client urged the Consultant to "look deeper and harder to determine resource potentials that would warrant future development investments." Additional Client Comments (CCSC 8/8/91) reinforced this issue, noting that economic evaluations had concentrated on benefits derived from agriculture, road maintenance benefits, vehicle operating cost reductions, and traffic and suggesting a reorientation of

study approach from farm to market and resource utilization to a broader look at potential development of the area and an investigation of potential economic benefits to be derived from other environmental resources such as the area's unique flora, fauna, cultural groups and landscape.

- Determination of Development Benefits and Project Justification

In the event that no potential resources existed for development, the Client suggested an additional shift in study approach and recommended that the Consultant investigate the project's potential contribution to the reduction of disbenefits from social costs of further deterioration of peace and order associated with poverty, seeming neglect and inaction by the government, and insurgency and the environmental and economic costs of additional forest destruction and its consequences such as loss of soil fertility, diminished agricultural productivity, and increased vulnerability to natural hazards (CCSC, 8/2/91).

- Role of roads in development

Client comments (CCSC, 8/2/91) also recommended reconsideration of the role of road improvements in the overall development program for the Project Area. The Consultant was requested to examine the impact of roads in solving development problems and to consider road improvements in the context of an integrated area development approach to increase impacts and accelerate economic recovery where roads are not implemented in isolation but simultaneously supported by or in support of other projects such as agro-forestry, fisheries development, or industrial expansion.

- Eco-development alternatives

Client comments during the ARIDP Preliminary Feasibility Study presentation (CODA, 8/8/91) directed the Consultant to consider the potential development benefits that might be derived form the exemplary biodiversity, scenery, wildlife and other natural and cultural values of the Project Area and the existing National Park. The Consultant was directed, as per the TOR, to examine tourism and in particular the potential for naturalist-oriented or eco-tourism and requested to consider possible complementary activities or measures including a debt-for-nature swap, a trail system and other related infrastructure or supporting investments, that might be implemented as part of or in conjunction with the proposed ARIDP.

7.4.3 Forest , Biodiversity, and Natural Resources Management

Forest, biodiversity, and natural resources management issues were identified in the ARIDP TOR, the USAID IEE, the Scoping Process, and in Client comments. Forest-related concerns are central features of ARIDP Environmental Studies particularly those pertaining to potential ARIDP impacts on forest reserves, illegal logging, access provided by road improvements, and impacts on endangered species, biodiversity, and national parks prescribed by Sections 118 and 119 of the U.S. Foreign Assistance Act. Key issues identified for environmental analysis include:

- Illegal logging

  Pre-scoping review of existing information and field studies to profile the existing environment initially identified illegal logging as a key consideration in potential ARIDP impacts, and this issue was one of the most frequently raised concerns in the Scoping Session/Consultations and submissions by interested parties. Client comments (CCSC, 7/31/91) also recommended investigation of illegal logging and forest products activity, the forest products component of current road use, the proportion of legal and illegal traffic, and the potential legal benefits to DENR plans for sustainable growth of the proposed road. The client also requested the Consultant's recommendations for enforcing laws applying to logging network.

- Forest economics

  In addition to the examination of illegal logging and the Client's directive to evaluate development potentials in the project area associated with the forest, the role and contribution of forest resources to the Project Area economy was repeatedly identified as an issue of great bearing on the proposed road program. Discussion at the ARIDP Preliminary Feasibility Report presentation included concern with the potential collapse of the local logging and wood products industry and the need for a transition including other sources of raw materials, and reforestation preserve employment.

- Forest tenure

  Insecurity of tenure of Tribal Filipinos and other forest occupants was identified as an issue in the USAID IEE and the Scoping process that required examination in relation to the proposed project and its impacts on forest management.

- Biodiversity

  EA/EIS requirements mandate attention to biodiversity and biodiversity issues and wildlife concerns were identified in the Consultant's initial examination of

potential ARIDP impacts and reinforced by Scoping comments. Identification of new Project Alternatives directly or indirectly impacting the Aurora Memorial Park in preliminary feasibility analysis findings augmented biodiversity concerns, and with the potential applicability of U.S. FAA Sections 118 and 119 necessitated additional examination and analysis; a need confirmed by Client comments (CCSC, 7/31/91).

- Wildlife

Field studies including wildlife and habitat survey identified other Section 119 Endangered Species and additional wildlife-related biodiversity issues for detailed analysis. Client comments (CCSC, 8/8/91; CODA 8/8/91) also requested the Consultant to evaluate potential economic benefits and values of wildlife, forests, and other features of Project Area biodiversity in conjunction with possible eco-tourism development, supporting infrastructure which might be included in the proposed ARIDP, and a related debt-for-nature swap.

- Old growth/virgin forest

In addition to the overall significance of forest-related concerns, Scoping results and subsequent field studies identified the status of old growth and virgin forests in the Project Area and the potential impacts of project-related development as a key issue requiring additional examination.

- Road improvements and increased access

Scoping Session comments and results identified "access" to forests and other natural resources potentially provided by the proposed ARIDP as a key issue for analysis. Client comments (CCSC, 7/31/91; CCSC, 8/8/91) directed the Consultant to examine and evaluate the contribution of ARIDP-enhanced access to both illegal logging and transport of forest products and to enforcement, forest protection, and improved natural resources management.

- DENR activities

Department of Environment and Natural Resources policies and programs in the Project Area were recognized (in Scoping results) as critical features influencing potential ARIDP impacts. Examination of existing and proposed DENR activities particularly in reforestation and watershed maintenance were recommended by the Client (CCSC, 7/31/91; CODA, 8/8/91) as was an evaluation of the potential relation of these activities to the mitigation of project impacts and the ARIDP Environmental Plan of Action to be contained in the ARIDP EA/EIS.

- effectiveness of natural resources management

  In addition to other related forest and environmental issues identified above, Scoping results and field studies indicated that the effectiveness of natural resources management was a critical analytic dimension of ARIDP impact assessment, the potential success of mitigations, and the environmental aspect of development potential in the Project Area.

- Role of environmental restoration

  Scoping session comments identified environmental rehabilitation, restoration, and reforestation needs as issues for further analysis in relation to both existing and proposed developments in the Project Area. Vulnerability of ARIDP investments to flooding and landslide natural hazards aggravated by environmental degradation of watersheds was identified for additional investigation. Reforestation and other conservation activities also recommended for additional consideration in preliminary feasibility analysis findings.

7.4.4 Socio-Cultural Concerns

Socio-cultural issues identified for additional examination in the Environmental Analysis phase of the ARIDP environmental assessment are a composite of concerns associated with potential social and cultural impacts of the project, the distribution of costs and benefits, and the consequences of both project implementation or inaction on insurgency and peace and order.

Three issues were identified for further analysis and evaluation:

- Tribal Filipino and Ancestral Land Claims

  The USAID IEE identified Tribal Filipino concerns, potential displacement of indigenous people, and project impacts on Ancestral Lands as significant issues. These concerns and considerations associated with overall insecurity of tenure of forest occupants generally were also a prominent feature of the Scoping Session/Consultations and submissions which emphasized the potentially extreme vulnerability of some groups. Review of existing information and initial field studies confirmed the possibility that some cultures might already be considered endangered, and that, given the small size of some indigenous populations, potential impacts could be severe.

  Recent Mt. Pinatubo impacts on other Luzon Aeta groups underscored the gravity of this issue and suggested additional analysis. The legal status of Ancestral Land claims, pending legislation, and other policy and procedural aspects associated

with the recognition, delineation and protection of Tribal Filipino land and resources rights was also identified for additional investigation.

- Project Beneficiaries

  In addition to the Tribal Filipino issues above, Scoping Session/Consultations identified the distribution of potential project benefits and costs as a significant issue. Section 118 concerns require attention to the extent of the proposed project's direct benefits to the rural poor and its relation to logging activities. Benefits of proposed road improvements to illegal and legal logging and the forest products industries were identified for evaluation in Client comments (CCSC, 7/31/91).

- Peace and Order

  Peace and order considerations were identified in the Scoping process related to the proposed project's impacts on insurgency, counter-insurgency, illegal activities, and the maintenance and enforcement of public order. Client comments (CCSC, 8/2/91) recommended analysis of existing and potential peace and order disbenefits and evaluation of relative costs and benefits of project implementation or inaction. Civil/military relations and the potential for inter-sectoral and NGO and other private/public sector partnership bears additional examination with respect to the potential effectiveness of mitigations and the Environmental Plan of Action under development in the ARIDP EA/EIS.

7.4.5 Bioregional considerations

Bioregional issues are those associated with the ecological context of the proposed ARIDP and the project's relation to and impacts upon the larger environmental region in which it occurs. Key issues identified for analysis include:

- Significance of Sierra Madre

  Review of existing information and Scoping Session comments spotlighted the Sierra Madre as a larger ecological unit with unique biological characteristics of national and planetary significance. Evaluation of project impacts in this context and examination of macro-level biodiversity concerns was recommended. TOR and EA/EIS directives to assess cumulative and growth-inducing effects of the project necessitate consideration of ARIDP in conjunction with other existing a proposed development activities and the designation of protected areas in the Sierra Madre system as a whole.

- Unusual significance of new road construction

  Scoping Session comments identified new road construction as an action of extreme ecological significance in the Sierra Madre context. The Sierra Madre range is currently crossed by only 4 roads along its entire length, and construction of additional crossings poses issues of potential ecological insularization and biodiversity loss which require examination as do potential impacts on regional natural resources management.

- ARIDP compatibility with regional and other plans

  The TOR and EA/EIS require consideration of impacts of the proposed project on present and proposed land uses and regional plans. Scoping Session comments identified potential planning conflicts for additional investigation and Client comments (CCSC, 8/2/91; CODA, 8/8/91) direct the Consultant to consider the project in relation to watershed protection, DENR plans, and an integrated area approach to development.

7.4.6 Project Design Factors

Project design issues relate to environmental implications of project organization, construction techniques, scheduling, labor, operation and other project factors; and the character of institutional and other linkages between the project and other agencies, including the coordination of mitigations and other measures included in the Environmental Plan of Action and the role of public participation in project design and implementation. Project design issues identified for examination in ARIDP environmental analysis include:

- Project construction variables

  The Consultant's pre-Scoping examination of potential ARIDP impacts identified choice of labor, type of construction, siting of construction camps and facilities as issues of potential significance. Scoping Session comments directed attention to both project and community benefits of employing local labor in project construction and review of existing information suggested that labor-intensive alternatives to the use of heavy equipment and blasting should be investigated for environmental and employment benefits. EA/EIS requirements, existing information, and field studies identified environmental compliance monitoring of construction as an issue warranting additional examination.

- Identification of Project Alternatives

  Scoping Session comments suggested additional consideration of potential alternatives to the Project. Client comments (CCSC, 8/2/91) identified improved boat service as an alternative to Segment 3 and encouraged Consultant analysis of other possibilities such as trail systems to enhance rural accessibility and realize development potentials.

- Project operation variables

  Review of existing information and field studies identified extent and effectiveness of maintenance as a key determinant of long-term ARIDP impacts on the environment. Effective monitoring of both operational mitigation and environmental conditions impinging on or jeopardizing project operation was also identified for consideration in Scoping results. Maintenance of existing roads vs. construction of new ones was identified as an issue in Scoping Session/Consultations. Localization of maintenance and the potential for community participation in maintenance contracts should be examined for environmental and other benefits.

- Mitigations and complementary investments

  TOR and EA/EIS requirements direct attention both to mitigation measures and to other complementary investments necessary to ensure project success. The relationship between these two components is an issue identified for evaluation as is their respective roles in the ARIDP Environmental Plan of Action and inclusion in project costs and budget allocations. The issue of costing of mitigations was identified in Client comments (CODA, 8/8/91) and DENR/EMB recommended examination of both mitigation costs and overall costs of the ARIDP Environmental Action Plan and their inclusion in project funds.

- Process-related concerns

  USAID pre-Scoping recommendations directed the Consultant to consider all available opportunities for NGO, community, and public participation in the ARIDP environmental assessment. USAID policy encourages NGO involvement in project development, implementation and operation. Scoping session comments suggest that the role of the public in subsequent ARIDP project decisions and design should be evaluated to maximize the potential contributions of NGO, community, and citizen involvement to minimizing impacts, enhancing effectiveness of mitigations, and increasing project acceptability and success. Client comments (CCSC, 8/2/91) recommending additional consultations to identify development potential suggest public participation aspects of ARIDP final design and implementation are important considerations in environment analysis

of the project. Scoping session comments also identified the source and nature of potential project funding, in particular whether grant or loan, as a significant issue to the public. Debt avoidance and reduction concerns additionally identify debt-for-nature swaps proposed for examination by the Client (CODA, 8/8/91) as an issue to be evaluated for both economic and environmental benefits.

7.5 TROPICAL FOREST AND BIODIVERSITY CONCERNS

7.5.1 US Foreign Assistance Act Section 118

In 1986, the US Foreign Assistance Act was amended by Congress to reflect increasing concern about the environment and natural resources. In particular the Congress recognized the importance of forests and tree cover to the developing countries and expressed concern for continuing and accelerating alteration, destruction, and loss of tropical forests and the threat thereby posed to the environment and sustainable development. These concerns were stated in a new section added to the FAA numbered 118 and entitled "Tropical Forest" which requires the President to place a high priority on conservation and sustainable management of tropical forests and the protection and preservation of biological diversity.

Section 118 recommends a number of positive actions in response to forest destruction in the developing countries that bear consideration in the proposed ARIDP. More significantly it also explicitly specifies in 118(c)(14)(B) that the President deny assistance to "actions which significantly degrade national parks or similar protected areas which contain tropical forest."

Further, Section 118(c)(15) requires the President to:

- "Deny assistance under this chapter for the following activities unless an environmental assessment indicates that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development:

  (a) Activities which would result in the conversion of forest lands to the rearing of livestock.

  (b) The construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands.

(c) The colonization of forest lands.

(d) The construction of dams or other water control structures which flood relatively undegraded forest lands.

Based on the identification of potential ARIDP impacts and preliminary environmental review of project Alternatives, the Consultant found a significant likelihood that Sections 118(c)(14)(B) and 118(c)(15)(B) and (C) may apply to proposed ARIDP actions. Field studies to assess ARIDP impacts and environmental analysis addressed these concerns.

Preliminary results confirm that proposed ARIDP activities currently include proposed actions for which US assistance must be denied. The Consultant has also detemined that Section 118c (14)A may be applicable to proposed the ARIDP and requires examination. This clause requires US assistance be denied for:

> "The procurment or use of logging equipment unless an environmental assessment indicated that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will produce positive economic benefits and sustainable forest management systems:
>
> Preliminary findings of impacts assessment and environmental analysis indcare that the ARIDP EA/EIS will not be able to demonstrate that conditions justifying waiver of either Section 118(c)(14) or 118(c)(15) are met by the ARIDP as currenlty proposed.

7.5.2 US Foreign Assistance Act Section 119

In 1983, Congress added Section 119, entitled "Endangered Species", to the Foreign Assistance Act. This section stated that the preservation of animal and plant species through the regulation of hunting and trade, limitations on pollution, and the protection of wildlife habitats should be an important objective of US development assistance. Protection of endangered species was also emphasized. In 1986, Section 119 was amended to encourage the participation of local people in all stages of project design and development relating to biodiversity. USAID is required to enter into long-term arrangements in which the recipient country agrees to protect ecosystems, support research, and deny assistance for actions which significantly degrade protected areas.

Section 119(g)(8) also requires the USAID Administrator to "deny any direct or indirect assistance under this Chapter for actions which significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas."

Based on the identification of potential ARIDP impacts and preliminary environmental review of project alternatives, the Consultant found a significant likelihood that Sections 119(g)(8) and (10) may apply to proposed ARIDP actions. Field studies to assess ARIDP impacts and segments environmental analysis addressed this concern.

Preliminary results of ARIDP impacts assessment and environmental analysis which would require denial of US assistance for the ARIDP as currently proposed.

7.6 REMAINING ENVIRONMENTAL STUDIES ACTIVITIES

7.6.1 Design and Development of Environmental Mitigation, Monitoring, and Management Plans

The Consultant will consider findings of the feasibility analysis and Client comments and recommendations on the ARIDP Draft/Final Feasibility Stidy Report to determine whether a second series of major consultations with affected or interested agencies, NGO's, communities and citizens is warranted. Potential consultations would explore mitigation, monotoring, and environmental management requirements and opportunities. Based either on the recommendations of these workshop/consultations or on existing findings as guided by Client comments the Consultant will prepare an Environmental Plan of Action specifying requirements and mitigation, monitoring and management activities. This phase of ARIDP Environmental Studies is expected to conclude in late October.

7.6.2 Draft EA/EIS

The Consultant will revise the Preliminary EA/AIS in response to comments received from its review and incorporate the Environmental Plan of Action to compose the Draft EA/EIS which will be submitted for Client review. This phase of ARIDP Environmental Studies is expected to conclude in late October 1991.

7.6.3 Final EA/EIS

The Consultant wiil respond to comments received from the review of the Draft EA/EIS and revise it as necessary to produce the ARIDP Final EA/EIS. Timing of this phase of ARIDP Environmental Studies will depend on the receipt of comments.

7.6.4 Environmental Compliance Certificate/Public Hearings

The Consultant will prepare documentation required for EMB/DENR Review Committee action and issuance of the Environmental Compliance Certificate (ECC). Public Hearings associated with the ARIDP ECC may be recommended by EMB/DENR.

FEASIBILITY STUDY
DRAFT FINAL REPORT

FOR

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
AND
COORDINATING COUNCIL OF THE PHILIPPINE ASSISTANCE PROGRAM

AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

VOLUME II - APPENDIX A TO E, G

Prepared by:

LOUIS BERGER INTERNATIONAL, INC.

in association with

LOCKWOOD GREENE INTERNATIONAL, INC.

GLOBETROTTERS ENGINEERING CORPORATION

TRANS-ASIA (PHILS.)INC.

CONSULTANT MANAGEMENT SERVICES,INC.

ERNST & YOUNG

Under
U.S. Agency for International Development
Contract No. 492-0452-C-00-00990
Philippine Assistance Program Support Project No. 492-0452

September 1991

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APPENDIX A

TRAFFIC

Table A-1
RAW TRAFFIC COUNTS

HOMOGENEOUS TRAFFIC SECTIONS	DAY	CAR, TAXI	JEEP PICKUP VAN	JEEPNEY	SMALL BUS	LARGE BUS	2-AXLE TRUCK	3-AXLE TRUCK	ARTICU-LATED TRUCK	OTHERS	TOTAL
BONGABON - SAN LUIS	1st	0	32	14	0	2	10	1	0	225	284
	2nd	0	16	18	0	2	15	3	0	219	273
	3rd	0	20	23	0	4	20	0	0	232	299
SAN LUIS - BONGABON	1st	0	41	24	0	1	23	1	0	242	332
	2nd	0	23	20	0	1	15	1	0	217	277
	3rd	0	19	25	0	1	14	2	0	261	322
BALER - SAN LUIS	1st	0	75	63	0	1	28	3	0	321	491
	2nd	1	37	40	0	0	8	3	0	244	333
	3rd	1	48	50	0	1	19	6	0	253	378
SAN LUIS - BALER	1st	0	63	44	0	2	20	4	0	300	433
	2nd	2	45	35	0	2	14	7	0	275	380
	3rd	0	67	44	0	7	35	6	1	271	431
BALER - MA. AURORA	1st	1	8	0	0	0	6	1	0	52	68
	2nd	0	3	1	0	0	2	0	0	54	60
	3rd	0	7	0	0	0	4	0	0	49	60
MA. AURORA - BALER	1st	1	8	0	0	0	5	2	0	58	74
	2nd	0	4	2	0	0	2	0	0	48	56
	3rd	0	1	0	0	0	3	0	0	44	48
BALER - DIPACULAO	1st	0	7	4	0	0	6	7	0	115	139
	2nd	0	10	5	0	0	4	4	0	119	142
	3rd	0	9	4	0	0	4	7	0	110	134
DIPACULAO - BALER	1st	0	8	10	0	0	4	4	0	121	147
	2nd	0	10	4	0	0	5	4	0	124	147
	3rd	0	10	5	0	0	4	11	0	106	136
MA. AURORA - SAN LUIS	1st	0	55	40	0	0	28	3	0	146	275
	2nd	0	38	47	0	0	24	3	0	171	283
	3rd	0	52	49	0	1	25	2	0	179	308
SAN LUIS - MA. AURORA	1st	0	64	29	0	0	13	0	0	121	227
	2nd	0	40	26	0	1	17	0	0	134	218
	3rd	0	43	36	0	0	20	0	0	154	253
MA. AURORA - DIPACULAO	1st	0	28	19	0	0	5	7	0	157	216
	2nd	0	24	18	0	0	5	4	0	157	208
	3rd	1	24	25	0	0	3	2	0	178	233
DIPACULAO - MA. AURORA	1st	0	14	33	1	0	8	6	0	205	267
	2nd	0	12	24	0	0	8	2	0	193	239
	3rd	1	22	28	0	0	1	5	0	183	240
MA. AURORA - CANILI	1st	0	27	14	0	0	15	10	0	147	213
	2nd	0	51	29	0	0	11	7	0	234	332
	3rd	0	54	37	0	1	25	14	0	327	458
CANILI - MA. AURORA	1st	0	33	17	0	1	9	17	0	149	226
	2nd	0	63	22	0	0	12	16	0	321	434
	3rd	0	55	27	0	2	7	14	0	344	449
BONGABON JCT. - GABALDON	1st	5	23	63	1	9	14	7	2	6	130
	2nd	0	32	94	0	6	12	22	4	9	179
	3rd	3	30	97	1	7	16	3	0	4	161
GABALDON - BONGABON JCT	1st	3	30	63	0	6	31	2	3	11	149
	2nd	0	30	81	0	5	25	5	0	13	159
	3rd	4	36	92	1	4	18	1	1	21	178
DINGALAN - GABALDON	1st	0	13	8	0	4	8	4	0	4	41
	2nd	0	16	12	0	6	7	7	0	8	56
	3rd	0	8	15	0	7	1	2	0	9	42
GABALDON - DINGALAN	1st	0	12	8	0	3	11	5	0	5	44
	2nd	0	14	10	0	4	6	3	0	4	41
	3rd	0	9	18	1	3	4	3	0	1	39

Source: Traffic counts made by the Consultant.

Table A-2
VEHICLE ORIGIN-DESTINATION MATRIX
Maria Aurora, July 5 and 6, 1991

DESTINATION

ORIGIN	DILASAG	DIPACULAO	BALER	MA. AURORA	RIZAL	BONGABON	CABANATUAN	MUÑOZ	TALUGTUG	GAPAN	CASTAÑEDA	SAN MIGUEL	BULACAN	MANILA	ANGELES	DAGUPAN	PANGASINAN	BENGUET	TOTAL
Dilasag																			0
Dipaculao							3			1			1	1		1	1		8
Baler					1							1							2
Ma. Aurora			1	46			12						1	1					61
Rizal																			0
Bongabon				1															1
Cabanatuan City		3		4															7
Muñoz		1																	1
Talugtug		1																	1
Gapan																			0
Castañeda				1															1
San Miguel																			0
Bulacan																			0
Manila				1															1
Angeles	1																		1
Dagupan City																			0
Pangasinan																			0
Benguet				1															1
TOTAL	1	5	1	54	1	0	15	0	0	1	0	1	2	2	0	1	1	0	85

Table A–3
VEHICLE ORIGIN–DESTINATION MATRIX
San Luis, July 5 and 6, 1991

DESTINATION

ORIGIN	CASIGURAN	DIPACULAO	BALER	MA. AURORA	SAN LUIS	BONGABON	CABANATUAN	SAN JOSE	NUEVA ECIJA	SAN MIGUEL	BALIWAG	BULACAN	MANILA	BALINTAWAK	QUEZON CITY	PANGASINAN	BATANGAS	TOTAL
Casiguran						1												1
Dipaculao					1													1
Baler					39		13		1		1	2	2					58
Ma. Aurora					3		4						1			1		9
San Luis		1	29		24		1											55
Bongabon			1		1													2
Cabanatuan City		1	23	2	2													28
San Jose City			1															1
Nueva Ecija																		0
San Miguel					1													1
Baliwag																		0
Bulacan																		0
Manila			6		1													7
Balintawak					1													1
Quezon City			1															1
Pangasinan																		0
Batangas			1															1
TOTAL	0	2	62	2	73	1	18	0	1	0	1	2	3	0	0	1	0	166

Table A-4
VEHICLE ORIGIN-DESTINATION MATRIX
Dingalan, July 12 and 13, 1991

DESTINATION

ORIGIN	DINGALAN	BALER	GABALDON	CABANATUAN	RIZAL	TALUGTUG	STA. ROSA	BALIWAG	PLARIDEL	BULACAN	MANILA	SAN FERNANDO	ANGELES	TARLAC	DAGUPAN	PANGASINAN	LA UNION	APARRI	TOTAL
Dingalan		2	24	27		1	1	1	1	1	4		1		1	1	1		66
Baler																			0
Gabaldon	32																		32
Cabanatuan City	13																		13
Rizal, N.E.	1																		1
Talugtug, N.E.																			0
Sta. Rosa																			0
Baliwag																			0
Plaridel, Bul.																			0
Bulacan																			0
Manila	5																		5
San Fernando, Pamp.	1																		1
Angeles City																			0
Tarlac	1																		1
Dagupan City																			0
Pangasinan																			0
La Union																			0
Aparri	2																		2
TOTAL	55	2	24	27	0	1	1	1	1	1	4	0	1	0	1	1	1	0	121

Table A-5
VEHICLE ORIGIN-DESTINATION MATRIX
Tablang Junction, July 12 and 13, 1991

DESTINATION

ORIGIN	DINGALAN	GABALDON	LAUR	PALAYAN	BONGABON	NATIVIDAD	CABANATUAN	TALAVERA	SAN JOSE	SAN LEONARDO	GAPAN	SAN MIGUEL	STA. MARIA	MEYCAUAYAN	BULACAN	MANILA	SAN FERNANDO	PAMPANGA	TARLAC	DAGUPAN	PANGASINAN	AGOO	TOTAL
Dingalan					1		25							1	1	4		1		2	1	1	37
Gabaldon			1	2			53				1					1	1		1				60
Laur		1		5	1	1	106	1	1	2	5				2	2					1		128
Palayan City			3		3		2																8
Bongabon			2	3																			5
Natividad			1																				1
Cabanatuan City	9	40	84	3																			136
Talavera			4																				4
San Jose City			1																				1
San Leonardo			2																				2
Gapan			3																				3
San Miguel			1																				1
Sta. Maria			1																				1
Meycauayan																							0
Bulacan																							0
Manila	3	2																					5
San Fernando, Pamp.																							0
Pampanga			1																				1
Tarlac	1																						1
Dagupan City																							0
Pangasinan																							0
Agoo																							0
TOTAL	13	43	104	13	5	1	186	1	1	2	6	0	0	1	3	7	1	1	1	2	2	1	394

AURORA ROAD PROJECT FEASIBILITY STUDY	VOLUME COUNT	
	Location:	Date:
	From:	Weather:
	To:	Surveyor:

Time	Car/ Taxi	Jeep/ Pickup/ Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Articu-lated Truck	Others	TOTAL

500

AURORA ROAD PROJECT FEASIBILITY STUDY	PASSENGER INTERVIEW SURVEY		
	Vehicle Type: ☐ Bus ☐ Minibus ☐ Jeepney	Route:	Date:
		Terminal Location:	Weather:
	Plate Number:	Departure Time:	Surveyor:

Passenger Information			ORIGIN		DESTINATION						
Sex	Age	Occ	Where did you start your trip?	How did you come to the terminal?	Where will you get off from this vehicle?	How will you go from the terminal to your final destination?	Where will you end your trip?	How much fare will you pay?	What is your purpose for this trip?	What time did you arrive at the terminal?	How often do you make this trip?

AURORA ROAD PROJECT FEASIBILITY STUDY	ORIGIN–DESTINATION SURVEY (LAITD)	
	Location:	
	From:	Date:
	To:	Weather:
	Time:	Surveyor:

FOR ALL VEHICLES:	VEHICLE TYPE:	☐ Car ☐ Taxi ☐ Jeep ☐ Pickup ☐ Van ☐ Jeepney ☐ Small Bus	☐ Large Bus ☐ 2-Axle Truck ☐ 3-Axle Truck ☐ Articulated Truck ☐ Tricycle ☐ Motorcycle ☐ Others
	TYPE OF FUEL:	☐ Gasoline ☐ Diesel	
	FUEL CONSUMPTION (Kilometers/liter):		
	LICENSE PLATE NUMBER:		
	NUMBER OF PASSENGERS (including driver):		
	ORIGIN:	Barrio:	
		City/Municipality:	
		Province:	
	DESTINATION:	Barrio:	
		City/Municipality:	
		Province:	
	TRAVEL TIME FROM ORIGIN TO DESTINATION:		
	NUMBER OF TRIPS PER DAY:		
FOR PRIVATE VEHICLES:	TRIP PURPOSE:	☐ To Home ☐ To Work ☐ At Work ☐ To School ☐ Shopping	☐ Medical/Dental ☐ Private Business ☐ Recreation ☐ Tourism ☐ Others
FOR PUBLIC VEHICLES:	SEATING CAPACITY:		
FOR TRUCKS:	TYPE OF BODY:	☐ Flat ☐ Open Low ☐ Open High ☐ Closed	☐ Tanker ☐ Container ☐ Others
	LOADING:	☐ 4/4 (full) ☐ 3/4	☐ 2/4 (half) ☐ 1/4
	COMMODITY:		
	NET LOAD CAPACITY:		
	GROSS VEHICLE WEIGHT:		

AURORA ROAD PROJECT FEASIBILITY STUDY	ORIGIN–DESTINATION SURVEY (WATER)	
	Location:	
	From:	Date:
	To:	Weather:
	Time:	Surveyor:

TYPE (MOTORIZED):	☐ Small Banca ☐ Medium Banca ☐ Large Banca ☐ Medium Launch ☐ Large Launch	☐ Inter-Island Ship ☐ Others
TYPE OF FUEL:	☐ Gasoline ☐ Diesel	
FUEL CONSUMPTION (kilometers/liter):		
SEATING CAPACITY:		
NUMBER OF PASSENGERS (including boatmen/crew):		
ORIGIN:	Port:	
	City/Municipality:	
	Province:	
DESTINATION:	Port:	
	City/Municipality:	
	Province:	
TRAVEL TIME FROM ORIGIN TO DESTINATION:		
NUMBER OF TRIPS PER DAY:		
TRIP PURPOSE:	☐ To Home ☐ To Work ☐ At Work ☐ To School ☐ Shopping	☐ Medical/Dental ☐ Private Business ☐ Recreation ☐ Tourism ☐ Others
LOADING:	☐ 4/4 (full) ☐ 3/4 ☐ 2/4 (half) ☐ 1/4	
COMMODITY:		
NET LOAD CAPACITY:		
DISPLACEMENT/SIZE:		

Table A-6

Parameters Used in Traffic Forecast
Baler-Dipaculao
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	20	11	0	0	7	6	0	44	282
1991 Diverted Traffic	0	19	11	0	3	3	0	0	36	0
1991 Generated Traffic	5	4	2	2	1	2	2	2	20	58
1991 Total Traffic (Normal+Diverted+Generated)	5	43	24	2	4	12	8	2	100	340
2004 Total Traffic	8	69	32	3	6	15	10	3	146	544
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-7

Summary of Traffic Forecast
Baler-Dipaculao
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	5	43	24	2	4	12	8	2	100	340	311		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	6	52	27	2	5	13	9	2	116	410	367	1	31,584
1996	6	54	28	2	5	14	9	2	121	430	383	2	63,996
1997	7	57	29	2	5	14	9	2	125	451	399	3	97,257
1998	7	60	30	3	5	14	10	2	130	472	416	4	131,391
1999	7	63	30	3	5	15	10	2	135	495	434	5	166,422
2000	8	66	31	3	6	15	10	2	140	519	452	6	202,372
2001	8	69	32	3	6	15	10	3	146	544	472	7	239,268
2002	8	72	33	3	6	16	10	3	151	570	492	8	277,133
2003	9	76	34	3	6	16	11	3	157	597	513	9	315,995
2004	9	79	35	3	6	17	11	3	163	626	535	10	355,881
2005	10	82	36	3	6	17	11	3	168	647	551	11	396,413
2006	10	85	37	3	7	17	11	3	172	669	568	12	437,602
2007	10	88	37	3	7	17	12	3	177	692	585	13	479,461
2008	11	91	38	4	7	18	12	3	182	716	603	14	522,000
2009	11	94	39	4	7	18	12	3	187	740	621	15	565,231
2010	11	97	40	4	7	18	12	3	192	765	640	16	609,166
2011	12	100	41	4	8	18	12	3	197	792	660	17	653,817
2012	12	104	42	4	8	19	12	3	203	819	680	18	699,196
2013	12	107	42	4	8	19	13	3	208	847	701	19	745,315
2014	13	111	43	4	8	19	13	3	214	875	722	20	792,188

Table A-8

Parameters Used in Traffic Forecast
Baler-Dipaculao
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	20	11	0	0	7	9	0	47	282
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	5	4	2	2	1	2	2	2	20	58
1991 Total Traffic (Normal+Diverted+Generated)	5	24	13	2	1	9	11	2	67	340
2004 Total Traffic	8	38	17	3	1	12	14	3	96	544
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

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Table A-9

Summary of Traffic Forecast
Baler-Dipaculao
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	5	24	13	2	1	9	11	2	67	340	270		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	6	29	15	2	1	10	12	2	77	410	319	1	33,883
1996	6	30	15	2	1	10	12	2	80	430	332	2	68,631
1997	7	32	16	2	1	10	13	2	83	451	347	3	104,267
1998	7	33	16	3	1	11	13	2	86	472	361	4	140,812
1999	7	35	16	3	1	11	13	2	89	495	377	5	178,292
2000	8	37	17	3	1	11	14	2	93	519	393	6	216,729
2001	8	38	17	3	1	12	14	3	96	544	410	7	256,149
2002	8	40	18	3	1	12	14	3	100	570	428	8	296,578
2003	9	42	19	3	2	12	15	3	104	597	447	9	338,041
2004	9	44	19	3	2	12	15	3	108	626	466	10	380,565
2005	10	46	19	3	2	13	15	3	110	647	481	11	423,749
2006	10	47	20	3	2	13	16	3	113	669	495	12	467,605
2007	10	49	20	3	2	13	16	3	116	692	510	13	512,143
2008	11	51	21	4	2	13	16	3	119	716	526	14	557,374
2009	11	52	21	4	2	13	16	3	122	740	542	15	603,308
2010	11	54	22	4	2	14	17	3	126	765	559	16	649,958
2011	12	56	22	4	2	14	17	3	129	792	576	17	697,334
2012	12	58	22	4	2	14	17	3	132	819	594	18	745,449
2013	12	60	23	4	2	14	17	3	136	847	612	19	794,314
2014	13	62	23	4	2	14	18	3	139	875	631	20	843,942

Table A-10

Parameters Used in Traffic Forecast
Dipaculao-Maria Aurora
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	2	44	50	1	0	9	10	0	116	397
1991 Diverted Traffic	0	22	10	0	3	7	1	0	43	0
1991 Generated Traffic	10	14	16	1	0	3	3	2	49	124
1991 Total Traffic (Normal+Diverted+Generated)	12	80	76	2	3	19	14	2	208	521
2004 Total Traffic	19	128	102	3	4	24	18	3	301	833
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-11

Summary of Traffic Forecast
Dipaculao-Maria Aurora
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	12	80	76	2	3	19	14	2	208	521	548		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	14	97	86	2	3	21	15	2	241	629	643	1	49,930
1996	15	101	88	2	4	21	16	2	250	659	670	2	101,148
1997	16	106	91	2	4	22	16	2	259	690	698	3	153,689
1998	17	111	94	3	4	23	17	2	269	724	727	4	207,588
1999	17	116	96	3	4	23	17	2	280	758	757	5	262,879
2000	18	122	99	3	4	24	17	2	290	795	789	6	319,600
2001	19	128	102	3	4	24	18	3	301	833	822	7	377,787
2002	20	134	105	3	4	25	18	3	313	873	856	8	437,481
2003	21	140	108	3	5	26	19	3	325	915	892	9	498,720
2004	22	147	112	3	5	26	19	3	337	959	930	10	561,545
2005	23	152	114	3	5	27	20	3	346	992	957	11	625,364
2006	24	157	116	3	5	27	20	3	355	1,026	986	12	690,194
2007	24	163	119	3	5	27	20	3	365	1,061	1,015	13	756,052
2008	25	168	121	4	5	28	20	3	375	1,097	1,045	14	822,954
2009	26	174	124	4	5	28	21	3	385	1,134	1,076	15	890,917
2010	27	180	126	4	6	29	21	3	395	1,173	1,108	16	959,960
2011	28	186	129	4	6	29	21	3	406	1,213	1,141	17	1,030,099
2012	29	193	131	4	6	30	22	3	417	1,254	1,175	18	1,101,353
2013	30	199	134	4	6	30	22	3	428	1,297	1,210	19	1,173,741
2014	31	206	137	4	6	30	22	3	440	1,341	1,247	20	1,247,281

Table A-12

Parameters Used in Traffic Forecast
Dipaculao-Maria Aurora
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	2	44	50	1	0	9	7	0	113	397
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	10	14	16	1	0	3	3	2	49	124
1991 Total Traffic (Normal+Diverted+Generated)	12	58	66	2	0	12	10	2	162	521
2004 Total Traffic	19	93	89	3	0	15	13	3	234	833
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-13

Summary of Traffic Forecast
Dipaculao-Maria Aurora
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	12	58	66	2	0	12	10	2	162	521	483		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	14	70	74	2	0	13	11	2	188	629	569	1	34,295
1996	15	73	77	2	0	14	11	2	195	659	593	2	69,468
1997	16	77	79	2	0	14	12	2	202	690	618	3	105,541
1998	17	81	81	3	0	14	12	2	210	724	644	4	142,537
1999	17	84	84	3	0	15	12	2	217	758	671	5	180,482
2000	18	88	86	3	0	15	12	2	226	795	700	6	219,398
2001	19	93	89	3	0	15	13	3	234	833	730	7	259,312
2002	20	97	91	3	0	16	13	3	243	873	761	8	300,250
2003	21	102	94	3	0	16	13	3	252	915	793	9	342,239
2004	22	107	97	3	0	17	14	3	262	959	827	10	385,305
2005	23	110	99	3	0	17	14	3	269	992	852	11	429,043
2006	24	114	101	3	0	17	14	3	276	1,026	878	12	473,465
2007	24	118	103	3	0	17	14	3	284	1,061	905	13	518,580
2008	25	122	105	4	0	18	15	3	291	1,097	932	14	564,401
2009	26	126	107	4	0	18	15	3	299	1,134	960	15	610,939
2010	27	131	110	4	0	18	15	3	307	1,173	989	16	658,205
2011	28	135	112	4	0	18	15	3	315	1,213	1,019	17	706,212
2012	29	140	114	4	0	19	16	3	324	1,254	1,050	18	754,970
2013	30	144	117	4	0	19	16	3	333	1,297	1,082	19	804,494
2014	31	149	119	4	0	19	16	3	342	1,341	1,115	20	854,794

Table A-14

Parameters Used in Traffic Forecast
Maria Aurora-San Luis
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	108	77	0	2	33	0	0	220	335
1991 Diverted Traffic	0	36	22	0	5	9	0	0	72	0
1991 Generated Traffic	12	38	27	1	1	12	2	2	95	118
1991 Total Traffic (Normal+Diverted+Generated)	12	182	126	1	8	54	2	2	387	453
2004 Total Traffic	19	291	169	1	11	69	3	3	567	724
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-15

Summary of Traffic Forecast
Maria Aurora-San Luis
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	12	182	126	1	8	54	2	2	387	453	745		
1992	Construction Year												
1993	Construction Year												
1994	14	210	138	1	9	58	2	2	434	521	837	1	52,460
1995	14	220	142	1	9	60	2	2	450	547	871	2	106,304
1996	15	230	146	1	10	61	2	2	468	573	905	3	161,571
1997	16	241	150	1	10	63	2	2	486	600	941	4	218,299
1998	17	253	155	1	10	64	2	2	505	629	979	5	276,527
1999	17	265	160	1	11	66	2	2	525	659	1,019	6	336,296
2000	18	278	164	1	11	67	2	2	545	691	1,060	7	397,648
2001	19	291	169	1	11	69	3	3	567	724	1,102	8	460,626
2002	20	305	175	1	12	71	3	3	589	759	1,147	9	525,274
2003	21	320	180	2	12	73	3	3	612	796	1,194	10	591,638
2004	22	331	183	2	13	74	3	3	629	823	1,227	11	659,091
2005	23	342	187	2	13	75	3	3	646	851	1,262	12	727,652
2006	23	353	191	2	13	76	3	3	664	880	1,298	13	797,342
2007	24	366	195	2	14	77	3	3	683	910	1,335	14	868,178
2008	25	378	199	2	14	78	3	3	702	941	1,373	15	940,182
2009	26	391	203	2	14	79	3	3	721	973	1,413	16	1,013,374
2010	27	404	207	2	15	81	3	3	741	1,006	1,453	17	1,087,774
2011	28	418	212	2	15	82	3	3	762	1,041	1,495	18	1,163,403
2012	29	432	216	2	15	83	3	3	783	1,076	1,538	19	1,240,283
2013	29	447	220	2	16	84	3	3	805	1,113	1,582	20	1,318,435
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A-16

Parameters Used in Traffic Forecast
Maria Aurora-San Luis
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	108	77	0	2	33	2	0	222	335
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	12	36	27	1	1	12	2	2	93	118
1991 Total Traffic (Normal+Diverted+Generated)	12	144	104	1	3	45	4	2	315	453
2004 Total Traffic	19	230	140	1	4	58	5	3	460	724
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-17

Summary of Traffic Forecast
Maria Aurora-San Luis
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	12	144	104	1	3	45	4	2	315	453	650		
1992	Construction Year												
1993	Construction Year												
1994	14	166	114	1	3	48	4	2	353	521	731	1	47,011
1995	14	174	117	1	3	50	4	2	366	547	761	2	95,237
1996	15	182	121	1	4	51	5	2	380	573	791	3	144,711
1997	16	191	124	1	4	52	5	2	395	600	823	4	195,466
1998	17	200	128	1	4	53	5	2	410	629	856	5	247,534
1999	17	210	132	1	4	55	5	2	426	659	891	6	300,952
2000	18	220	136	1	4	56	5	2	443	691	927	7	355,754
2001	19	230	140	1	4	58	5	3	460	724	965	8	411,977
2002	20	241	144	1	4	59	5	3	478	759	1,005	9	469,659
2003	21	253	148	2	5	61	5	3	497	796	1,046	10	528,838
2004	22	262	151	2	5	61	5	3	511	823	1,076	11	588,957
2005	23	270	155	2	5	62	6	3	525	851	1,106	12	650,032
2006	23	280	158	2	5	63	6	3	539	880	1,138	13	712,077
2007	24	289	161	2	5	64	6	3	554	910	1,171	14	775,111
2008	25	299	164	2	5	65	6	3	569	941	1,205	15	839,148
2009	26	309	168	2	5	66	6	3	585	973	1,239	16	904,205
2010	27	320	171	2	5	67	6	3	601	1,006	1,275	17	970,300
2011	28	331	175	2	6	68	6	3	618	1,041	1,312	18	1,037,449
2012	29	342	178	2	6	69	6	3	635	1,076	1,350	19	1,105,671
2013	29	354	182	2	6	70	6	3	653	1,113	1,390	20	1,174,983
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A-18

Parameters Used in Traffic Forecast
San Luis-Baler
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	2	99	84	0	3	29	7	1	225	582
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	4	3	2	1	0	2	2	2	16	15
1991 Total Traffic (Normal+Diverted+Generated)	6	102	86	1	3	31	9	3	241	597
2004 Total Traffic	10	163	116	1	4	40	12	4	349	955
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-19

Summary of Traffic Forecast
San Luis-Baler
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	6	102	86	1	3	31	9	3	241	597	632		
1992	Construction Year												
1993	Construction Year												
1994	7	117	94	1	3	33	10	3	269	687	713	1	48,217
1995	7	123	97	1	3	34	10	3	279	720	743	2	97,680
1996	8	129	100	1	4	35	10	3	290	755	773	3	148,422
1997	8	135	103	1	4	36	10	3	301	791	805	4	200,476
1998	8	142	106	1	4	37	11	4	312	829	839	5	253,876
1999	9	148	109	1	4	38	11	4	324	869	874	6	308,659
2000	9	156	112	1	4	39	11	4	336	911	910	7	364,860
2001	10	163	116	1	4	40	12	4	349	955	948	8	422,518
2002	10	171	119	1	4	41	12	4	362	1,000	988	9	481,670
2003	11	179	123	2	5	42	12	4	376	1,048	1,029	10	542,356
2004	11	185	125	2	5	42	12	4	386	1,084	1,059	11	604,005
2005	11	192	128	2	5	43	12	4	397	1,121	1,091	12	666,631
2006	12	198	130	2	5	44	13	4	407	1,160	1,123	13	730,252
2007	12	205	133	2	5	44	13	4	418	1,199	1,156	14	794,884
2008	12	212	136	2	5	45	13	4	429	1,240	1,190	15	860,543
2009	13	219	139	2	5	46	13	4	441	1,282	1,225	16	927,247
2010	13	227	142	2	5	46	13	4	453	1,326	1,262	17	995,013
2011	14	234	144	2	6	47	14	5	465	1,371	1,299	18	1,063,859
2012	14	242	147	2	6	48	14	5	478	1,418	1,338	19	1,133,802
2013	15	251	150	2	6	48	14	5	491	1,467	1,378	20	1,204,861
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Table A-20

Parameters Used in Traffic Forecast
San Luis-Baler
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	2	122	94	0	6	32	7	1	264	582
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	4	3	2	1	1	2	2	1	16	15
1991 Total Traffic (Normal+Diverted+Generated)	6	125	96	1	7	34	9	2	280	597
2004 Total Traffic	10	200	129	1	10	44	12	3	408	955
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-21

Summary of Traffic Forecast
San Luis-Baler
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	6	125	96	1	7	34	9	2	280	597	681		
1992	Construction Year												
1993	Construction Year												
1994	7	144	105	1	8	37	10	2	313	687	768	1	51,611
1995	7	151	108	1	8	38	10	2	325	720	800	2	104,579
1996	8	158	111	1	8	38	10	2	337	755	833	3	158,940
1997	8	166	115	1	9	39	10	2	350	791	867	4	214,731
1998	8	174	118	1	9	40	11	2	364	829	903	5	271,991
1999	9	182	122	1	9	41	11	2	378	869	940	6	330,759
2000	9	191	125	1	10	42	11	2	392	911	979	7	391,076
2001	10	200	129	1	10	44	12	3	408	955	1,020	8	452,984
2002	10	209	133	1	10	45	12	3	423	1,000	1,063	9	516,526
2003	11	220	137	2	11	46	12	3	440	1,048	1,107	10	581,746
2004	11	227	140	2	11	46	12	3	452	1,084	1,140	11	648,029
2005	11	235	143	2	11	47	12	3	464	1,121	1,173	12	715,393
2006	12	243	146	2	12	48	13	3	477	1,160	1,208	13	783,857
2007	12	251	149	2	12	49	13	3	489	1,199	1,243	14	853,439
2008	12	260	152	2	12	49	13	3	503	1,240	1,280	15	924,159
2009	13	269	155	2	12	50	13	3	517	1,282	1,318	16	996,037
2010	13	278	158	2	13	51	13	3	531	1,326	1,357	17	1,069,092
2011	14	287	161	2	13	52	14	3	545	1,371	1,397	18	1,143,344
2012	14	297	165	2	13	52	14	3	560	1,418	1,438	19	1,218,815
2013	15	307	168	2	14	53	14	3	576	1,467	1,481	20	1,295,526
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Table A-22

Parameters Used in Traffic Forecast
Tablang Jct.-Gabaldon

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	7	66	166	2	18	30	10	3	302	33
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	8	18	45	1	5	8	3	1	89	9
1991 Total Traffic (Normal+Diverted+Generated)	15	84	211	3	23	38	13	4	391	42
2004 Total Traffic	24	134	284	4	33	49	17	5	549	67
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-23

Summary of Traffic Forecast
Tablang Jct.-Gabaldon

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	15	84	211	3	23	38	13	4	391	42	601		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	Construction Year												
1996	19	106	245	4	27	43	15	5	463	53	708	1	79,137
1997	20	111	252	4	28	44	15	5	479	56	732	2	160,424
1998	21	117	260	4	29	45	15	5	496	58	756	3	243,922
1999	22	122	267	4	31	46	16	5	513	61	782	4	329,692
2000	23	128	275	4	32	47	16	5	531	64	808	5	417,798
2001	24	134	284	4	33	49	17	5	549	67	835	6	508,305
2002	25	141	292	4	34	50	17	5	569	70	864	7	601,281
2003	26	148	301	5	35	51	17	5	589	74	893	8	696,793
2004	28	155	310	5	36	52	18	6	609	77	923	9	794,914
2005	29	162	319	5	38	54	18	6	631	81	955	10	895,716
2006	30	168	326	5	39	54	19	6	646	84	977	11	998,250
2007	31	173	333	5	40	55	19	6	662	87	1,000	12	1,102,548
2008	32	179	340	5	41	56	19	6	678	90	1,023	13	1,208,641
2009	33	185	347	5	42	57	19	6	695	93	1,047	14	1,316,562
2010	34	192	354	6	43	58	20	6	712	96	1,072	15	1,426,345
2011	35	198	361	6	44	59	20	6	729	99	1,097	16	1,538,024
2012	37	205	368	6	45	60	20	6	747	102	1,123	17	1,651,633
2013	38	212	376	6	46	60	21	6	765	106	1,149	18	1,767,207
2014	39	219	384	6	47	61	21	6	784	110	1,177	19	1,884,783
2015	40	227	392	6	48	62	21	7	804	113	1,205	20	2,004,397

Table A-24

Parameters Used in Traffic Forecast
Gabaldon-Dingalan

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	35	28	1	15	9	6	0	94	13
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	16	13	1	7	4	3	1	47	6
1991 Total Traffic (Normal + Diverted + Generated)	2	51	41	2	22	13	9	1	141	19
2004 Total Traffic	3	82	55	3	31	17	12	1	204	30
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-25

Summary of Traffic Forecast
Gabaldon-Dingalan

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	51	41	2	22	13	9	1	141	19	218		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	Construction Year												
1996	3	64	48	2	26	15	10	1	169	24	260	1	44,694
1997	3	68	49	2	27	15	10	1	176	25	269	2	90,657
1998	3	71	50	3	28	15	11	1	182	26	279	3	137,926
1999	3	74	52	3	29	16	11	1	189	28	289	4	186,539
2000	3	78	54	3	30	16	11	1	196	29	299	5	236,535
2001	3	82	55	3	31	17	12	1	204	30	310	6	287,956
2002	3	85	57	3	32	17	12	[illegible]	211	32	321	7	340,842
2003	4	90	58	3	34	17	12	1	219	33	333	8	395,238
2004	4	94	60	3	35	18	12	1	228	35	345	9	451,188
2005	4	98	62	3	36	18	13	1	236	37	357	10	508,737
2006	4	102	63	3	37	19	13	1	242	38	366	11	567,341
2007	4	105	65	3	38	19	13	1	249	39	375	12	627,020
2008	4	109	66	4	39	19	13	1	255	41	385	13	687,795
2009	4	113	67	4	40	19	13	1	262	42	395	14	749,688
2010	5	116	69	4	41	20	14	2	269	43	405	15	812,721
2011	5	120	70	4	42	20	14	2	276	45	415	16	876,916
2012	5	124	72	4	43	20	14	2	284	46	425	17	942,296
2013	5	129	73	4	44	21	14	2	291	48	436	18	1,008,884
2014	5	133	75	4	45	21	15	2	299	50	447	19	1,076,705
2015	5	138	76	4	46	21	15	2	307	51	459	20	1,145,782

Table A-26

Parameters Used in Traffic Forecast
Rizal-Canili
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	39	103	0	2	7	8	5	164	30
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	22	58	1	1	4	3	3	94	17
1991 Total Traffic (Normal+Diverted+Generated)	2	61	161	1	3	11	11	8	258	47
2004 Total Traffic	3	98	216	1	4	14	14	10	361	75
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-27

Summary of Traffic Forecast
Rizal-Canili
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	61	161	1	3	11	11	8	258	47	404		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	2	74	181	1	3	12	12	9	295	57	460	1	45,030
1996	3	77	187	1	4	12	12	9	305	59	475	2	91,219
1997	3	81	192	1	4	13	13	9	316	62	491	3	138,598
1998	3	85	198	1	4	13	13	10	326	65	508	4	187,198
1999	3	89	204	1	4	13	13	10	338	68	525	5	237,050
2000	3	93	210	1	4	14	14	10	349	72	542	6	288,187
2001	3	98	216	1	4	14	14	10	361	75	561	7	340,643
2002	3	102	223	1	4	14	14	10	374	79	580	8	394,452
2003	4	107	230	2	5	15	15	11	387	83	599	9	449,649
2004	4	112	237	2	5	15	15	11	400	87	620	10	506,271
2005	4	116	241	2	5	15	15	11	410	89	634	11	563,786
2006	4	120	246	2	5	16	16	11	420	93	649	12	622,210
2007	4	124	252	2	5	16	16	12	430	96	664	13	681,557
2008	4	128	257	2	5	16	16	12	440	99	680	14	741,842
2009	4	133	262	2	5	16	16	12	451	102	696	15	803,080
2010	5	137	267	2	6	17	17	12	462	106	712	16	865,287
2011	5	142	273	2	6	17	17	12	473	109	729	17	928,479
2012	5	147	279	2	6	17	17	12	485	113	746	18	992,672
2013	5	152	284	2	6	17	17	13	496	117	764	19	1,057,881
2014	5	157	290	2	6	18	18	13	509	121	782	20	1,124,124

Table A-28

Parameters Used in Traffic Forecast
Rizal-Canili
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	82	140	0	7	8	8	6	251	30
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	46	78	1	4	4	4	3	142	0
1991 Total Traffic (Normal+Diverted+Generated)	2	128	218	1	11	12	12	9	393	30
2004 Total Traffic	3	205	293	1	16	15	15	12	560	48
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-29

Summary of Traffic Forecast
Rizal-Canili
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	128	218	1	11	12	12	9	393	30	571		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	2	154	245	1	13	13	13	10	453	36	653	1	54,433
1996	3	162	253	1	13	14	14	10	469	38	675	2	110,317
1997	3	170	260	1	14	14	14	10	486	40	699	3	167,691
1998	3	178	268	1	14	14	14	11	503	42	723	4	226,595
1999	3	186	276	1	15	15	15	11	522	44	748	5	287,072
2000	3	195	285	1	15	15	15	11	541	46	774	6	349,165
2001	3	205	293	1	16	15	15	12	560	48	801	7	412,917
2002	3	214	302	1	16	16	16	12	581	50	829	8	478,374
2003	4	225	311	2	17	16	16	12	602	53	858	9	545,583
2004	4	236	320	2	17	17	17	12	624	55	888	10	614,591
2005	4	244	327	2	18	17	17	13	640	57	910	11	684,750
2006	4	252	334	2	18	17	17	13	656	59	932	12	756,081
2007	4	261	341	2	19	17	17	13	673	61	954	13	828,603
2008	4	269	348	2	19	18	18	13	691	63	978	14	902,338
2009	4	279	355	2	20	18	18	13	708	65	1,001	15	977,307
2010	5	288	362	2	20	18	18	14	727	68	1,026	16	1,053,532
2011	5	298	370	2	21	18	18	14	745	70	1,051	17	1,131,035
2012	5	308	377	2	21	19	19	14	765	72	1,077	18	1,209,839
2013	5	319	385	2	22	19	19	14	784	75	1,103	19	1,289,966
2014	5	330	393	2	22	19	19	14	805	77	1,130	20	1,371,439

Table A-30

Parameters Used in Traffic Forecast
Canili-Km Post 38
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	69	23	0	1	8	15	0	116	15
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	23	8	1	0	3	5	1	43	10
1991 Total Traffic (Normal+Diverted+Generated)	2	92	31	1	1	11	20	1	159	25
2004 Total Traffic	3	147	42	1	1	14	26	1	236	40
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-31

Summary of Traffic Forecast
Canili-Km Post 38
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	92	31	1	1	11	20	1	159	25	222		
1992	Construction Year												
1993	Construction Year												
1994	2	106	34	1	1	12	22	1	179	29	247	1	52,057
1995	2	111	35	1	1	12	22	1	186	30	257	2	105,429
1996	3	116	36	1	1	12	23	1	193	32	266	3	160,150
1997	3	122	37	1	1	13	23	1	201	33	276	4	216,253
1998	3	128	38	1	1	13	24	1	209	35	287	5	273,773
1999	3	134	39	1	1	13	24	1	218	36	298	6	332,747
2000	3	140	40	1	1	14	25	1	227	38	309	7	393,211
2001	3	147	42	1	1	14	26	1	236	40	321	8	455,204
2002	3	154	43	1	1	14	26	1	245	42	333	9	518,764
2003	4	162	44	2	2	15	27	1	255	44	346	10	583,932
2004	4	167	45	2	2	15	27	1	263	45	355	11	650,094
2005	4	173	46	2	2	15	28	1	270	47	365	12	717,266
2006	4	179	47	2	2	15	28	1	278	49	375	13	785,464
2007	4	185	48	2	2	16	29	1	286	50	385	14	854,704
2008	4	191	49	2	2	16	29	1	294	52	395	15	925,001
2009	4	198	50	2	2	16	29	1	303	54	406	16	996,373
2010	4	204	51	2	2	16	30	1	311	56	416	17	1,068,836
2011	5	211	52	2	2	17	30	2	320	57	428	18	1,142,406
2012	5	219	53	2	2	17	31	2	329	59	439	19	1,217,101
2013	5	226	54	2	2	17	31	2	339	61	451	20	1,292,939
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A-32

Parameters Used in Traffic Forecast
Canili-Km Post 38
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	122	59	0	3	22	20	0	226	15
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	41	20	1	1	7	7	0	79	10
1991 Total Traffic (Normal+Diverted+Generated)	2	163	79	1	4	29	27	0	305	25
2004 Total Traffic	3	261	106	1	6	37	35	0	449	40
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-33

Summary of Traffic Forecast
Canili-Km Post 38
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	163	79	1	4	29	27	0	305	25	418		
1992	Construction Year												
1993	Construction Year												
1994	2	188	86	1	4	31	29	0	342	29	465	1	80,947
1995	2	197	89	1	5	32	30	0	356	30	482	2	163,954
1996	3	206	92	1	5	33	31	0	370	32	500	3	249,076
1997	3	216	94	1	5	34	31	0	384	33	518	4	336,365
1998	3	226	97	1	5	34	32	0	399	35	538	5	425,878
1999	3	237	100	1	5	35	33	0	415	36	558	6	517,672
2000	3	249	103	1	6	36	34	0	432	38	578	7	611,806
2001	3	261	106	1	6	37	35	0	449	40	600	8	708,340
2002	3	273	109	1	6	38	35	0	467	42	623	9	807,335
2003	4	286	113	2	6	39	36	0	485	44	646	10	908,855
2004	4	296	115	2	6	40	37	0	499	45	663	11	1,011,945
2005	4	306	117	2	6	40	37	0	513	47	680	12	1,116,631
2006	4	317	120	2	7	41	38	0	527	49	698	13	1,222,938
2007	4	327	122	2	7	41	39	0	542	50	716	14	1,330,891
2008	4	339	125	2	7	42	39	0	557	52	735	15	1,440,516
2009	4	350	127	2	7	43	40	0	573	54	754	16	1,551,841
2010	4	362	130	2	7	43	40	0	589	56	774	17	1,664,891
2011	5	374	133	2	7	44	41	0	606	57	794	18	1,779,694
2012	5	387	135	2	8	45	42	0	623	59	815	19	1,896,278
2013	5	400	138	2	8	45	42	0	641	61	837	20	2,014,672
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table A-34

Parameters Used in Traffic Forecast
Tablang Jct.-Bongabon-Km Post 170
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	55	41	0	5	26	3	0	130	15
1991 Diverted Traffic	0	53	36	0	5	19	3	0	116	0
1991 Generated Traffic	3	57	38	1	5	21	3	2	130	0
1991 Total Traffic (Normal+Diverted+Generated)	3	165	115	1	15	66	9	2	376	15
2004 Total Traffic	5	264	155	1	21	84	12	3	545	24
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-35

Summary of Traffic Forecast
Tablang Jct.-Bongabon-Km Post 170
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	3	165	115	1	15	66	9	2	376	15	536		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	4	199	129	1	17	73	10	2	436	18	614	1	81,170
1996	4	209	133	1	18	75	10	2	452	19	636	2	164,478
1997	4	219	137	1	19	77	10	2	469	20	658	3	249,983
1998	4	229	141	1	19	78	11	2	487	21	682	4	337,744
1999	4	240	146	1	20	80	11	2	505	22	706	5	427,821
2000	5	252	150	1	21	82	11	2	525	23	731	6	520,277
2001	5	264	155	1	21	84	12	3	545	24	757	7	615,175
2002	5	276	159	1	22	87	12	3	565	25	784	8	712,582
2003	5	290	164	2	23	89	12	3	587	26	812	9	812,565
2004	6	304	169	2	24	91	12	3	610	28	841	10	915,194
2005	6	314	172	2	24	92	13	3	626	29	862	11	1,019,502
2006	6	325	176	2	25	94	13	3	643	30	884	12	1,125,518
2007	6	336	180	2	26	95	13	3	660	31	905	13	1,233,272
2008	6	347	183	2	26	97	13	3	678	32	928	14	1,342,792
2009	7	359	187	2	27	98	13	3	696	33	951	15	1,454,111
2010	7	371	191	2	28	99	14	3	715	34	975	16	1,567,257
2011	7	384	195	2	28	101	14	3	734	35	999	17	1,682,264
2012	7	397	199	2	29	102	14	3	754	36	1,024	18	1,799,162
2013	7	411	203	2	30	104	14	3	774	37	1,050	19	1,917,985
2014	8	425	207	2	30	106	14	3	796	39	1,076	20	2,038,766

Table A-36

Parameters Used in Traffic Forecast
Tablang Jct.-Bongabon-Km Post 170
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	55	41	0	5	26	3	0	130	15
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	2	24	18	0	2	11	2	2	61	0
1991 Total Traffic (Normal+Diverted+Generated)	2	79	59	0	7	37	5	2	191	15
2004 Total Traffic	3	126	79	0	10	47	6	3	275	24
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-37

Summary of Traffic Forecast
Tablang Jct.-Bongabon-Km Post 170
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	2	79	59	0	7	37	5	2	191	15	281		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	2	95	66	0	8	41	6	2	221	18	322	1	45,478
1996	3	100	68	0	8	42	6	2	229	19	333	2	92,144
1997	3	105	70	0	9	43	6	2	237	20	345	3	140,030
1998	3	110	73	0	9	44	6	2	246	21	357	4	189,168
1999	3	115	75	0	9	45	6	2	256	22	369	5	239,591
2000	3	121	77	0	10	46	6	2	265	23	382	6	291,334
2001	3	126	79	0	10	47	6	3	275	24	396	7	344,432
2002	3	132	82	0	10	49	7	3	286	25	410	8	398,921
2003	4	139	84	0	11	50	7	3	296	26	424	9	454,838
2004	4	145	87	0	11	51	7	3	308	28	439	10	512,220
2005	4	150	88	0	11	52	7	3	316	29	450	11	570,529
2006	4	156	90	0	12	53	7	3	324	30	461	12	629,779
2007	4	161	92	0	12	53	7	3	332	31	472	13	689,987
2008	4	166	94	0	12	54	7	3	341	32	484	14	751,168
2009	4	172	96	0	13	55	7	3	350	33	495	15	813,339
2010	5	178	98	0	13	56	8	3	360	34	508	16	876,517
2011	5	184	100	0	13	57	8	3	369	35	520	17	940,718
2012	5	190	102	0	14	57	8	3	379	36	533	18	1,005,960
2013	5	197	104	0	14	58	8	3	389	37	546	19	1,072,261
2014	5	203	106	0	14	59	8	3	400	39	560	20	1,139,638

Table A-38

Parameters Used in Traffic Forecast
Km Post 170-Km Post 38
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	0	0	0	0	0	0	0	0	0
1991 Diverted Traffic	0	97	65	0	9	35	4	0	210	0
1991 Generated Traffic	3	57	38	1	5	21	3	2	130	0
1991 Total Traffic (Normal+Diverted+Generated)	3	154	103	1	14	56	7	2	340	0
2004 Total Traffic	5	246	138	1	20	72	9	3	494	0
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-39

Summary of Traffic Forecast
Km Post 170-Km Post 38
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	3	154	103	1	14	56	7	2	340	0	473		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	Construction Year												
1996	4	195	119	1	17	63	8	2	409	0	562	1	70,508
1997	4	204	123	1	17	65	8	2	425	0	582	2	142,884
1998	4	214	127	1	18	67	8	2	441	0	603	3	217,180
1999	4	224	131	1	19	68	9	2	458	0	624	4	293,446
2000	5	235	134	1	19	70	9	2	476	0	647	5	371,736
2001	5	246	138	1	20	72	9	3	494	0	670	6	452,106
2002	5	258	143	1	21	73	9	3	513	0	694	7	534,612
2003	5	270	147	2	21	75	9	3	533	0	719	8	619,311
2004	6	283	151	2	22	77	10	3	554	0	745	9	706,264
2005	6	297	156	2	23	79	10	3	575	0	772	10	795,531
2006	6	307	159	2	24	80	10	3	591	0	791	11	836,272
2007	6	318	162	2	24	82	10	3	607	0	811	12	978,512
2008	6	329	166	2	25	83	10	3	623	0	831	13	1,072,277
2009	7	340	169	2	25	84	10	3	640	0	852	14	1,167,594
2010	7	351	173	2	26	85	11	3	658	0	873	15	1,264,490
2011	7	363	176	2	27	87	11	3	676	0	895	16	1,362,992
2012	7	376	180	2	27	88	11	3	694	0	917	17	1,463,128
2013	8	389	184	2	28	89	11	3	713	0	941	18	1,564,926
2014	8	402	187	2	29	90	11	3	733	0	965	19	1,668,416
2015	8	416	191	2	29	92	11	3	753	0	989	20	1,773,627

Table A-40

Parameters Used in Traffic Forecast
Maria Aurora-Km Post 38
Full Road

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	122	59	0	3	22	20	0	226	682
1991 Diverted Traffic	0	44	29	0	7	21	1	0	102	0
1991 Generated Traffic	3	48	23	1	1	9	12	2	99	268
1991 Total Traffic (Normal+Diverted+Generated)	3	214	111	1	11	52	33	2	427	950
2004 Total Traffic	5	342	149	1	16	67	42	3	625	1,519
ESALs (8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs Per Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-41

Summary of Traffic Forecast
Maria Aurora-Km Post 38
Full Road

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	3	214	111	1	11	52	33	2	427	950	1,058		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	Construction Year												
1996	4	271	129	1	13	59	37	2	516	1,201	1,295	1	123,719
1997	4	284	133	1	14	60	38	2	536	1,259	1,349	2	250,641
1998	4	297	137	1	14	62	39	2	557	1,319	1,405	3	380,850
1999	4	312	141	1	15	63	40	2	578	1,383	1,464	4	514,432
2000	5	326	145	1	15	65	41	2	601	1,449	1,525	5	651,477
2001	5	342	149	1	16	67	42	3	625	1,519	1,589	6	792,075
2002	5	359	154	1	16	68	43	3	649	1,592	1,656	7	936,321
2003	5	376	158	2	17	70	44	3	675	1,668	1,725	8	1,084,311
2004	6	394	163	2	17	72	45	3	701	1,749	1,798	9	1,236,143
2005	6	413	168	2	18	73	47	3	729	1,833	1,874	10	1,391,920
2006	6	427	171	2	19	75	47	3	749	1,895	1,930	11	1,550,173
2007	6	441	175	2	19	76	48	3	770	1,960	1,987	12	1,710,944
2008	6	457	179	2	19	77	49	3	791	2,027	2,046	13	1,874,273
2009	7	472	182	2	20	78	49	3	813	2,096	2,107	14	2,040,204
2010	7	488	186	2	20	79	50	3	836	2,167	2,170	15	2,208,780
2011	7	505	190	2	21	80	51	3	859	2,241	2,234	16	2,380,043
2012	7	522	194	2	21	82	52	3	883	2,318	2,301	17	2,554,040
2013	8	540	198	2	22	83	53	3	908	2,397	2,370	18	2,730,815
2014	8	558	202	2	23	84	53	3	933	2,479	2,441	19	2,910,416
2015	8	577	206	2	23	85	54	3	960	2,563	2,514	20	3,092,888

Table A-42

Parameters Used in Traffic Forecast
Maria Aurora-Km Post 38
With Gap

Description	Vehicle Type								AADT	Other Vehicles
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck		
Base Year Normal Traffic 1991 AADT	0	122	59	0	3	22	20	0	226	682
1991 Diverted Traffic	0	0	0	0	0	0	0	0	0	0
1991 Generated Traffic	1	48	23	1	1	9	8	0	91	268
1991 Total Traffic (Normal+Diverted+Generated)	1	170	82	1	4	31	28	0	317	950
2004 Total Traffic	2	272	110	1	6	40	36	0	466	1,519
ESAL[illegible] 8.2 tons) Per Vehicle	0.002	0.004	0.030	0.300	1.350	1.850	5.300	2.900		0.002
PCUs [illegible] Vehicle	1.00	1.00	1.50	1.50	2.00	2.00	2.00	3.00		0.50
Traffic Growth Rate (1991 to 2003, percent p.a.)	4.8%	4.8%	3.0%	3.6%	3.6%	2.5%	2.5%	2.5%		4.8%
Traffic Growth Rate (2004 to 2014, percent p.a.)	3.4%	3.4%	2.1%	2.5%	2.5%	1.5%	1.5%	1.5%		3.4%

Table A-43

Summary of Traffic Forecast
Maria Aurora-Km Post 38
With Gap

Year	Vehicle Type										PCUs Per Day	Cumulative Two-Way ESALs	
	Car Taxi	Jeep Pickup Van	Jeepney	Small Bus	Large Bus	2-Axle Truck	3-Axle Truck	Artic Truck	AADT	Other			
1991	1	170	82	1	4	31	28	0	317	950	897		
1992	Construction Year												
1993	Construction Year												
1994	Construction Year												
1995	Construction Year												
1996	1	215	95	1	5	35	32	0	384	1,201	1,104	1	89,745
1997	1	225	98	1	5	36	32	0	399	1,259	1,152	2	181,794
1998	1	236	101	1	5	37	33	0	415	1,319	1,201	3	276,207
1999	1	247	104	1	5	38	34	0	431	1,383	1,253	4	373,045
2000	2	259	107	1	6	39	35	0	448	1,449	1,307	5	472,373
2001	2	272	110	1	6	40	36	0	466	1,519	1,363	6	574,254
2002	2	285	114	1	6	41	37	0	485	1,592	1,422	7	678,756
2003	2	299	117	2	6	42	38	0	504	1,668	1,483	8	785,947
2004	2	313	120	2	6	43	39	0	524	1,749	1,547	9	895,898
2005	2	328	124	2	7	44	40	0	546	1,833	1,615	10	1,008,680
2006	2	339	127	2	7	44	40	0	561	1,895	1,664	11	1,123,232
2007	2	351	129	2	7	45	41	0	577	1,960	1,715	12	1,239,581
2008	2	363	132	2	7	46	41	0	593	2,027	1,767	13	1,357,756
2009	2	375	135	2	7	46	42	0	609	2,096	1,821	14	1,477,789
2010	2	388	137	2	7	47	43	0	627	2,167	1,877	15	1,599,708
2011	2	401	140	2	8	48	43	0	644	2,241	1,935	16	1,723,545
2012	2	415	143	2	8	49	44	0	663	2,318	1,995	17	1,849,331
2013	3	429	146	2	8	49	45	0	682	2,397	2,056	18	1,977,098
2014	3	444	149	2	8	50	45	0	701	2,479	2,120	19	2,106,878
2015	3	459	152	2	8	51	46	0	721	2,563	2,185	20	2,238,705

APPENDIX B

DEVELOPMENT BENEFITS COMPUTATIONS

Appendix B
DEVELOPMENT BENEFITS COMPUTATION

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APPENDIX B-1

Appendix B-1

B.1.1 ASSESSMENT OF GROWTH POTENTIAL

In examining the growth potential of Aurora to determine development benefits of the proposed project roads, the Consultants have concluded that the province is approaching the limits of its sustainable growth. The following notes set out the reasons for this reservation.

- Maintaining existing production levels will depend on halting the destruction of the resource base and repairing the damage done by several decades of logging and erosion of steep slopes (Chapter II).

- Increased production would require increased areas of cultivable land. It appears from Bureau of Soils and AIADP surveys that surplus land capable of sustaining increased production is limited and almost fully occupied.

- The alluvial plains in the northern (Casiguran) zone were excluded from the present Aurora Integrated Area Development Project (AIADP) study. Table B-1-1 shows that the northern zone has a significant agricultural potential, in relation to the total provincial output. The Consultants consider that in a future program, an all-weather road should be included linking Casiguran, Baler and an inter-provincial road to Nueva Ecija. This will improve the feasibility of the central zone roads included in the present study.

- Land use areas were mapped by the Bureau of Soils in 1986 as shown in Table B-1-1 and Table B-1-2 as part of a general land suitability study. The figures shown in Table B-1-1 may be taken as the potential for maximum output. Areas actually cultivated as reported by provincial authorities are smaller. Table B-1-3 shows Agricultural Land Utilization (1989.)

Table B-1-1
LAND USE AREAS (ha) AURORA PROVINCE (Main Crops)

Zone	Paddy	% Total	Coconut	% Total	Peanut	% Total
North	7,813	57.0	23,692	72.6	1,042	94.0
Central	4,662	34.0	7,705	23.6	38	3.0
South	1,167	9.0	1,226	3.8	29	3.0
TOTAL	13,642		32,623		1,109	

Source: Bureau of Soils and Water Management (1986)

Any significant increase in crop production through higher yields is likely to come from the alluvial plains around Casiguran in the north, and from the central Ma. Aurora flood plain. It should be noted that the northern Casiguran zone has 57 percent of the provincial area of paddy (mainly irrigated), 73 percent of the total area planted with coconut, and has 94 percent of total peanut area, a cash crop with an assured market.

Past growth figures for crop production do not necessarily indicate future increased output. All land with a growth potential is fully occupied, and cultivation has expanded into less suitable and marginal land.

The potential for increased yields per hectare depends on land suitability, that is the physical and chemical qualities of the land.

Based on the FAO Framework for Land Evaluation (Rome 1977) three main sub-classes of suitability are recognized:

S_1 - highly suitable, where level of production is expected to be relatively high under commonly applied management practices.

S_2 - moderately suitable - significant qualities of the land pose limits to the productivity of the land,

S_3 - marginally suitable - strong limitations

N - not suitable

To determine the possibility of growth with increased yields of the three main crops, paddy-rice, coconut and corn, the above land suitability criteria were applied as shown in Table B-1-2.

Table B-1-2
LAND SUITABILITY OF MAIN CROPS

Land Mapping Units	Area (ha)	Paddy/ rice	Coconut	Corn	Peanut
Beach ridges/Swales	3,296	N	S_1	N	N
River Terraces	2,528	S_2	S_1	S_1	S_1/S_2
Alluvial plain, seasonally flooded	1,152	S_1	S_1/S_2	S_1	S_1/S_2
Alluvial plain, not seasonally flooded	2,176	S_1	S_1	S_2	S_1/S_2
Alluvial fan, seasonally flooded	3,808	S_1	S_1/S_2	S_1/S_2	S_1
Alluvial fan, not seasonally flooded	7,120	S_1	S_1/S_2	S_1	S_1/S_2
Alluvial fan, shallow soils	448	S_1	S_1	S_2	S_1
TOTAL LOWLAND	20,528				
River Wash	6,097 [1]	N	N	N	N
Low to medium foothills (50-150 m. AMSL)	25,024	N[2]	S_2	N[2]	N[2]
Medium to high foothills (150-500 m. AMSL)	35,792	N	S_2[2]	N	N
Mountains (< 500 m. AMSL)	210,522	N	N	N	N
TOTAL FOOTHILLS/MOUNTAIN	271,338				

Source: Bureau of Soils and Land Management (1986)

1. Area of river wash increasing annually
2. Small pockets of land may be in category S_2

- Tidal flats (720 ha) and inland swamps (800 ha) are excluded as they are unsuitable for any crops.

- Total areas are those of land mapping units (LMU) prepared by the Bureau of Soils in their survey using various techniques. Physiographic mapping based on 1:50,000 aerial photographs (1980) was eventually transferred to the 1:50,000 topographic map. Quantification of land use areas was made by dot grid on 1:100,000 map. A discrepancy of 7,274 ha appears between the LMU and built up areas and the total province area of 308,122 km. given by interpretation of SPOT sattelite imagery (1987).

The lowland area classified as highly suitable for all crops is 17,232 ha. to which is added 3,296 ha of beach ridges suitable only for coconuts, making a total land area of 20,528 ha.

Table B-1-3 listing land areas under cultivation shows that the major cropping areas in Aurora cover more than twice this area. They have spread well beyond the alluvial plains with a high potential into low to medium foothills and even higher. These foothills have pockets of good soil, but their slopes, which are also cultivated have mainly shallow unstable soils, subject to erosion. They are classified as unsuitable for any crop except coconuts. Coconuts will give a reduced yield on these soils. Foothills above 200 meter AMSL are likely to have shallow, leached soils. Rainfed paddy yields will not exceed 700 to 800 kg/ha. and may be as low as 300 kg/ha.

Table B-1-3
AGRICULTURAL LAND UTILIZATION (1989)

CROP	(ha)	Average Yield per ha. (MT)	Estimated Potential Production (MT)
Paddy rice (irrigated)	7,600	4.47 [1]	33,972
Paddy rice (rainfed)	2,600	1.7	4,420
Coconut	21,955	42 nuts per tree	87.6×10^6
Peanuts	1,108	1.20	1,330
Corn	250	1.20	300
Banana	2,000	3.50	7,000
Coffee	723	1.60	1,157
Citrus	153	3.40	520
Rootcrops/Vegetables	1,450	2.70	3,843
Total Cultivated Area	37,839		

Source: Department of Agriculture. National Irrigation Authority (NIA): AIADP
Philippine Coconut Authority: (all since 1989)

[1] Two crops per year.

Table B-1-3 shows that the cultivated area covers all available land classified as suitable (S_1/S_2) estimated at 20,528 ha. by the Bureau of Soils and has extended over 17,311 ha. of low/medium/high of foothills, classified as suitable only for coconuts, except for small pockets of soil.

As regards development potential, the NIA considers that irrigation could be extended to cover 4,900 ha (Aurora Provincial Irrigation profile). This would include 2,900 ha. of communal irrigation and 2,000 ha. of a "small water impounding project". Extension of the irrigated area requires the construction of flood control dikes to protect paddy fields against flooding and river wash, and retention dams upstream in the watershed. These will be rapidly filled with river wash and silt unless conservation work is carried out further up the watershed.

The AIADP has recommended that land use development areas be increased by 42,500 ha on steep Alienable and Disposable (A & D) Land, owing to the general unavailability of lowlands and of alternative employment. This recommendation assumes that sloping agricultural land techniques (SALT) and watershed protection will be carried out. But in the foothills and on the steep A & D land only limited pockets of more level land are available, on slopes between 18 and 30 percent. The landless migrants will therefore be forced to cultivate slopes in excess of 30 percent, or push up-stream in the watersheds into remaining forest reserves.

From the level lowlands the land rises to Low to Medium Foothills (25,024 ha) ranging in elevation from 50 to 150 meters AMSL with a dominant slope range of 18 to 30 percent. Soil depth is from 50 to 100 cm.

The problem of future land settlement is illustrated in Table B-1-4 showing the distribution of sloping land in Aurora province.

Table B-1-4
SLOPE DISTRIBUTION IN AURORA PROVINCE

Slope Classes	Total Area	
	(ha)	(%)
3-8% level to newly level	38,136	12.7
3-8% gently sloping to undulating	5,623	1.9
8-18% undulating to rolling	41,936	14.0
18-30% moderately steep	50,467	16.9
30-50% steep mountain slopes	68,315	22.8
> 50% very steep mountain slopes	95,026	31.7
TOTAL	299,503	100

Source: Agricultural Land Management Division. Department of Agriculture. Bureau of Soils and Water Management (1990)

By interpretation of Tables B-1-1through B-1-4, it appears that all the land up to 8 percent slope and 2,465 ha of land up to 18 percent are cultivated areas covering 46,224 ha. This is a main reason for the Consultant's hesitation in accepting optimistic growth rates for crop production.

Expansion of the total cultivated area as envisaged by the AIADP will therefore involve hill farm settlements on slopes up to and above 18 percent. Records established by the AIADP for 24 slope classes show that 44.1 percent of landslides and soil erosion occur on slopes of less than 30 percent. (Mass Movement and Erosion Report - 1990)

Controlled settlement of moderately steep slopes with shallow, unstable soils requires:

- conservation engineering in the 20 watersheds identified by the AIADP for settlement.
- establishment of control units to plan land use and assure the adoption of SALT and agro-forestry by the hill-farmers.
- orderly land division and allocation to hill-farmers.

There would thus be three phases in this expansion of the cultivated area:

- a planning phase involving the establishment of one or more control units, to undertake soil reconnaissance, site selection, lay out access roads, and prepare a financial plan. The continuation of the AIADP and the use of its data base would cover these operations.
- a construction phase involving contouring of slopes, installing check dams, building access roads and water supply systems, surveying and sub-dividing the settlement areas, establishing nurseries for forest trees and tree-crops.
- a settlement phase in which 250 families are settled on 1000 ha in a selected watershed each year (Table B-5-1). This phase would continue, if successful, at the same rate of settlement over 10 years on watersheds selected by AIADP.

The costs of these three phases have been estimated by the Consultant from:

- standard unit costs
- AIADP estimates
- the Consultant's own estimates

For the planning phase and administration, AIADP costs were used. For the construction and settlement phases, the Consultant has calculated a standard cost per hectare as used in plantation development and land settlement projects in Southeast Asia.

Table B-5-1
ESTIMATED LAND PREPARATION AND SETTLEMENT COSTS

		₱ (1991)
A.	Capital Costs	
	Control center for field operations	2,750,000
	Pilot project demonstration centers (5 units)	18,854,000
	Watershed conservation and settlement costs (1 unit)	
	Calculated Standard Cost per hectare ₱ 807 for 1000 ha (250 families)	807,000
	Total Capital Cost	22,411,000
B.	Annual Recurrent Costs	
	Pilot project demonstration centers (10% of capital costs)	1,885,400
	Control center for field operations (AIADP estimates)	5,552,111
	Total Recurrent Costs	7,437,511

Assumptions: 1 watershed is conserved and settled by 250 families each year, over a period of 10 years. Total capital costs are likely to increase by 10 per year for contingencies and equipment replacement. Recurrent costs for the Control center are estimated by the AIADP to increase by 49.59 percent to year 5 to ₱ 8,305,376 or by nearly 10 percent per year.

The Pilot Project Center costs increase by the same amount, to year 5 at ₱ 2,820,370 per year.

Total costs for the conservation of 10,000 ha in 10 watersheds and the settlement of 2,500 families on agro-forestry units are:

CAPITAL	₱ 58,128,322
RECURRENT	19,290,988
Total	₱ 77,419,350

Expenditure per family of hill-farmers: ₱ 30,967 in 1991 pesos.

Hill farmers would be settled on land up to 30 degree slopes at 300 meters AMSL and upwards to practice agro-forestry which involves tree planting. Yields of annual crops such as rain-fed mountain rice will not exceed 500 to 800 Kgs/ha. Tree crops will take 8 to 10 years to become fully established.

In 1990, there were 5,100 hill farmers in Aurora with an average claimed hill farm area of 3.23 ha. making a total claimed area of 16,470 ha. in 19 watersheds. Their average family income was estimated at ₱ 6,500 per year supplemented by carabao logging and forest gathering. The AIADP estimates that 10,900 hill-farmers will be settled on 35,190 ha by the year 2010. The Consultants consider that this figure is unlikely to be achieved in view of delays and problems involved in setting up a new organization, raising the capital, and implementing the programme. Although the AIADP aims to increase farm income to about ₱ 21,000 per year, by SALT and agro-forestry over 20 years, this is dependent on the implementation of the settlement program outlined above. It appears that lack of land or alternative employment may substantially increase the number of farmers on steep slopes.

B.1.2 CONCLUSION

It does not appear that any significant increase in provincial production and income levels will result from hill-farm settlements, even assuming that the capital and recurrent funds are made available for such settlements.

Lowland agriculture would have possibilities for yield increases, but they are limited by the restricted area of lowland at 20,528 ha and by environmental factors. The Consultants have hesitated to accept exponential growth figures by which production of paddy from lowland areas might be doubled during the project period. Marginal increases in paddy yields may be obtained, but present cultivation techniques and the use of improved International Rice Research Institute (IRRI) rice varieties would suggest that production is near the limit of the irrigable land area. Increased yields may be limited by the adverse effects of removal of forest cover from the surrounding mountains, by diminished water supplies, silting of irrigation systems and river wash deposits.

The World Bank (Review of Commodity Markets: Dec. 1990) forecasts a continuing decline in Philippine copra production, which is likely to continue as little new planting has taken place over the past decade. Yields were expected to be 6 percent below the 5-year average of Philippine copra yields in 1991.

Any increase in coconut production, the chief crop, would entail replanting of a trees over 50 years old over the estimated area of 32,623 ha and the introduction of improved copra drying ovens. This is a long-term option, and would have little effect within the project period.

It is outside the scope of the present report to speculate whether the GOP will carry out policies involving a complete change in present practices, and also mobilize substantial investments to benefit small numbers of hill-farmers or undertake the replanting of 30,000 ha of coconut. What appears to be certain is that logging and forest industries are diminishing, and with them employment and expenditures by the companies within the province. Increasing number of people will be forced to cultivate steep slopes for lack of alternative livelihood. Degradation of watersheds will severely limit any increased production of grain crops in the two main flood plains.

It is for these reasons that the Consultants have been unable to accept more optimistic projections which envisage a steady increase in agricultural production in Aurora province.

APPENDIX B-2

PRODUCTION DATA

Table B-2-1
PRODUCTION DATA

MUNICIPALITY: BALER PROVINCE: AURORA

TOTAL POPULATION: 26,689

NO. OF FAMILIES: 809 URBAN 3676 RURAL 82% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	1,367	3,458	20%	4.48	12,393,472
COCONUT (NUTS)	2,373	11,520	3%	1.67	18,661,248
MAIZE (CORN)	—	—	—	—	—
COFFEE	10	2	10%	18.62	25,137
BANANA	31	60	5%	2.97	169,290
OTHER CROPS (%)	237	812	7%	7.60	5,739,216
TOTAL CROPS	4,018	15,852			36,988,363
FISHERIES					
FISH CATCH		1278	5%	21.75	26,406,675

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	532	1%	2,230	27.10	60,433
CATTLE	523	20%	33,915	37.94	1,286,735
PIGS	1,198	59%	59,388	36.51	2,168,256
GOATS	546	10%	1,540	19.43	29,922
CHICKENS	8,463	40%	4,400	41.64	183,216
OTHER	856	10%	90	30.00	2,700
TOTAL LIVESTOCK	12,118		101,563		3,731,262
TOTAL RURAL INCOME					67,126,300

FAMILY INCOME

URBAN	P	34,141	P	27,620,069.00
RURAL	P	18,639		67,126,300.00
TOTAL INCOME			P	94,746,369.00

Source: Municipal Profile, Consultant's Estimates

Note: Urban income is estimated from provincial totals given by NCSO (1988).

Table B-2-2
PRODUCTION DATA

MUNICIPALITY: DINGALAN PROVINCE: AURORA

TOTAL POPULATION: 14,475

NO. OF FAMILIES: 861 URBAN 1902 RURAL 69% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	572	966	20%	4.48	3,462,144
COCONUT (NUTS)	120	120	3%	1.67	194,388
MAIZE (CORN)	110	198	20%	—	—
COFFEE	40	80	10%	18.62	1,340,640
BANANA	108	432	5%	2.97	1,218,888
OTHER CROPS (%)	270	924	7%	7.60	6,530,832
TOTAL CROPS	1,220	2,720			12,746,892
FISHERIES					
FISH CATCH		310	5%	21.75	6,570,675
LIVESTOCK	**POPULATION**	**ESTIMATED TAKE-OFF**	**LIVE WEIGHT (Kg)**	**UNIT PRICE (P/Kg)**	**VALUE (P)**
CARABAO	300	1%	1,338	27.10	36,260
CATTLE	420	20%	27,132	37.94	1,029,388
PIGS	500	59%	24,780	36.51	904,718
GOATS	N.D.	—	—	—	—
CHICKENS	5,000	40%	2,600	41.64	108,264
OTHER	300	10%	31	30.00	930
TOTAL LIVESTOCK	6,520		55,881		2,079,560
TOTAL RURAL INCOME					21,397,127

FAMILY INCOME

URBAN	P	34,141	P	29,395,401.00
RURAL	P	11,250		21,397,127.00
TOTAL INCOME			P	50,792,528.00

Source: Municipal Profile, Consultant's Estimates

Note: Urban income is estimated from provincial total given by NCSO (1988).

Table B-2-3
PRODUCTION DATA

MUNICIPALITY: DIPACULAO **PROVINCE:** AURORA

TOTAL POPULATION: 18,951

NO. OF FAMILIES: 713 URBAN 2953 RURAL 80% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	2,079	5,259	20%	4.48	18,848,256
COCONUT (NUTS)	3,225	6,869	3%	1.67	11,127,093
MAIZE (CORN)	20	22	0	3.58	63,008
COFFEE	717	86	10%	18.62	1,441,188
BANANA	246	3,806	5%	2.97	10,738,629
OTHER CROPS (%)	28	35	7%	7.60	247,380
TOTAL CROPS	6,315	16,077			42,465,554
FISHERIES					
FISH CATCH		507	5%	21.75	10,475,888

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	711	1%	3,122	27.10	84,606
CATTLE	857	20%	55,323	37.94	2,098,954
PIGS	2,344	59%	116,172	36.51	4,241,440
GOATS	1,724	10%	4,816	19.43	93,575
CHICKENS	4,765	40%	2,478	41.64	103,184
OTHER	563	10%	59	30.00	1,770
TOTAL LIVESTOCK	10,964		181,970		6,623,529
TOTAL RURAL INCOME					59,564,971

FAMILY INCOME

URBAN	P	34,141	P	24,342,533.00
RURAL	P	20,171		59,564,971.00
TOTAL INCOME			P	83,907,504.00

Source: Municipal Profile, Consultant's Estimates

Note: Urban income is estimated from provincial total given by NCSO (1988).

Table B-2-4
PRODUCTION DATA

MUNICIPALITY: MARIA AURORA PROVINCE: AURORA

TOTAL POPULATION: 28,378

NO. OF FAMILIES: 987 URBAN 4376 RURAL 82% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	3,714	9,396	20%	4.48	33,675,264
COCONUT (NUTS)	3,025	6,443	3%	1.67	10,437,016
MAIZE (CORN)	—	—	—	—	—
COFFEE	17	2	10%	18.62	33,516
BANANA	369	712	5%	2.97	2,008,908
OTHER CROPS (%)	192	655	7%	7.60	4,629,540
TOTAL CROPS	7,317	17,208			50,784,244

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	N.D.	—	—	—	—
CATTLE	955	20%	61,693	37.94	2,340,632
PIGS	693	59%	34,356	36.51	1,254,337
GOATS	956	10%	2,688	19.43	52,228
CHICKENS	1,290	40%	671	41.64	27,940
OTHER	955	10%	101	30.00	3,030
TOTAL LIVESTOCK	4,849		99,509		3,678,167
TOTAL RURAL INCOME					54,462,411

FAMILY INCOME

URBAN	P 34,141	P 33,697,167.00
RURAL	P 12,446	54,462,411.00
TOTAL INCOME		P 88,159,578.00

Source: Municipal Profile, Consultant's Estimates

Note: Urban income is estimated from provincial total given by NCSO (1988).

Table B-2-5
PRODUCTION DATA

MUNICIPALITY: SAN LUIS PROVINCE: AURORA

TOTAL POPULATION: 16,740

NO. OF FAMILIES: 385 URBAN 2621 RURAL 87% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	1,016	2,570	20%	4.48	9,210,880
COCONUT (NUTS)	4,602	9,802	3%	1.67	15,878,260
MAIZE (CORN)	N.D.	—	—	—	—
COFFEE	36	4	10%	18.62	67,032
BANANA	637	1,229	5%	2.97	3,467,263
OTHER CROPS (%)	86	316	7%	7.60	2,233,488
TOTAL CROPS	6,377	13,921			30,856,923

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	391	1%	1,784	27.10	48,346
CATTLE	622	20%	40,052	37.94	1,519,573
PIGS	910	59%	45,108	36.51	1,646,893
GOATS	618	10%	1,736	19.43	33,730
CHICKENS	1,965	40%	1,022	41.64	42,556
OTHER	N.D.	—	—	—	—
TOTAL LIVESTOCK	4,506		89,702		3,291,098
TOTAL RURAL INCOME					34,148,021

FAMILY INCOME

URBAN	₱ 34,141	₱ 13,144,285.00
RURAL	₱ 13,028	34,148,021.00
TOTAL INCOME		₱ 47,292,306.00

Source: Municipal Profile-AIADP 1989, Consultant's Estimates

Note: Urban income is estimated from provincial total given by NCSO (1988).

Table B-2-6
PRODUCTION DATA

MUNICIPALITY: BONGABON PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 39,616

NO. OF FAMILIES: 2736 URBAN 4787 RURAL 64% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	5,363	19,521	20%	4.98	77,771,664
COCONUT (NUTS)	3	4	3%	2.21	8,575
MAIZE (CORN)	181	147	20%	5.76	677,376
COFFEE	no data	no data	no data	no data	no data
BANANA	11	143	5%	5.10	692,835
OTHER CROPS (%)	2,767	28,821	7%	4.76	127,584,803
TOTAL CROPS	8,325	48,636			206,735,253

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	27	1%	—	—	—
CATTLE	1,200	1%	3,876	37.94	147,055
PIGS	2,365	61.5%	122,220	30.00	3,666,600
GOATS	45	10%	112	21.94	2,457
CHICKENS	10,354	40%	5,383	33.97	182,860
OTHER	1,350	10%	142	30.00	4,260
TOTAL LIVESTOCK	15,341		131,733		4,003,232
TOTAL RURAL INCOME					210,738,485

FAMILY INCOME

URBAN	₱ 30,795	₱ 84,255,120.00
RURAL	₱ 44,023	210,738,485.00
TOTAL INCOME		₱ 294,993,605.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Table B-2-7
PRODUCTION DATA

MUNICIPALITY: GABALDON **PROVINCE:** NUEVA ECIJA

TOTAL POPULATION: 21,744

NO. OF FAMILIES: 1053 URBAN 3188 RURAL 75% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	2,754	9,088	20%	4.98	36,206,592
COCONUT (NUTS)	11	12	3%	2.21	25,724
MAIZE (CORN)	25	20	20%	5.76	92,160
COFFEE	no data	no data	no data	no data	no data
BANANA	22	299	5%	5.10	1,448,655
OTHER CROPS (%)	462	3,399	7%	4.76	15,046,693
TOTAL CROPS	3,274	12,818			52,819,824

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	no data	no data	no data	no data	no data
CATTLE	571	5.6%	10,336	37.94	392,148
PIGS	1,396	67.50%	79,128	30.00	2,373,840
GOATS	17	10%	56	21.94	1,228
CHICKENS	8,651	40%	4,498	33.97	152,797
OTHER	1,919	10%	201	30.00	6,030
TOTAL LIVESTOCK	12,554		94,219		2,926,043
TOTAL RURAL INCOME					55,745,867

FAMILY INCOME

URBAN	P	30,795	P	32,427,135.00
RURAL	P	17,486		55,745,867.00
TOTAL INCOME			P	88,173,002.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Urban income is estimated from provincial total given by NCSO (1988).

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Table B-2-8
PRODUCTION DATA

MUNICIPALITY: LAUR PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 21,464

NO. OF FAMILIES: 1281 URBAN 2980 RURAL 70% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	3,691	13,435	20%	4.98	53,525,040
COCONUT (NUTS)	4	5	3%	2.21	10,718
MAIZE (CORN)	86	78	20%	5.76	359,424
COFFEE	no data	no data	no data	no data	no data
BANANA	12	171	5%	5.10	828,495
OTHER CROPS (%)	639	6,127	7%	4.76	27,123,004
TOTAL CROPS	4,432	19,816			81,846,681

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	52	1%	—	—	—
CATTLE	720	1.6%	3,876	37.94	147,055
PIGS	1,489	62.25%	77,868	30.00	2,336,040
GOATS	127	10%	364	21.94	7,986
CHICKENS	7,840	40%	4,077	33.97	138,495
OTHER	1,300	10%	137	30.00	4,110
TOTAL LIVESTOCK	11,528		86,322		2,633,686
TOTAL RURAL INCOME					84,480,367

FAMILY INCOME

URBAN	P 30,795	P 39,448,395.00
RURAL	P 28,349	84,480,367.00
TOTAL INCOME		P 123,928,762.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Urban income is estimated from provincial totals given by NCSO (1988).

Table B-2-9
PRODUCTION DATA

MUNICIPALITY: PALAYAN CITY PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 20,393

NO. OF FAMILIES: 171 URBAN 3620 RURAL 95% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	1,740	6,403	20%	4.98	25,509,552
COCONUT (NUTS)	no data	no data	no data	no data	no data
MAIZE (CORN)	195	158	20%	5.76	728,064
COFFEE	no data	no data	no data	no data	no data
BANANA	52	712	5%	5.10	3,449,640
OTHER CROPS (%)	258	2,914	7%	4.76	12,899,695
TOTAL CROPS	2,245	10,187			42,586,951

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	—	—	—	—	—
CATTLE	1,074	4%	13,889	37.94	526,948
PIGS	2,268	55%	104,748	30.00	3,142,440
GOATS	219	10%	616	21.94	13,515
CHICKENS	45,802	40%	23,817	33.97	809,063
OTHER	1,000	10%	105	30.00	3,150
TOTAL LIVESTOCK	50,363		143,175		4,495,116
TOTAL RURAL INCOME					47,082,067

FAMILY INCOME

URBAN	P	30,795	P	5,265,945.00
RURAL	P	12,746		47,082,067.00
TOTAL INCOME			P	52,348,012.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Urban income is estimated from provincial total given by NCSO (1988).

Table B–2–10
PRODUCTION DATA

MUNICIPALITY: PANTABANGAN PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 18,341

NO. OF FAMILIES: 837 URBAN 2580 RURAL 75% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	2,169	5,618	20%	4.98	22,382,112
COCONUT (NUTS)	no data	no data	no data	no data	no data
MAIZE (CORN)	147	119	20%	5.76	548,352
COFFEE	no data	no data	no data	no data	no data
BANANA	no data	no data	no data	no data	no data
OTHER CROPS (%)	260	2,451	7%	4.76	10,850,087
TOTAL CROPS	2,576	8,188			33,780,551

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	—	—	—	—	—
CATTLE	615	4%	8,075	37.94	306,365
PIGS	2,214	55%	102,312	30.00	3,069,360
GOATS	—	—	—	—	—
CHICKENS	9,432	40%	4,905	33.97	166,623
OTHER	—	—	—	—	—
TOTAL LIVESTOCK	12,261		115,292		3,542,348
TOTAL RURAL INCOME					37,322,899

FAMILY INCOME

URBAN	P 30,795	P 25,775,415.00
RURAL	P 14,466	37,322,899.00
TOTAL INCOME		P 63,098,314.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Urban income is estimated from the provincial total given by NCSO (1988).

Table B-2-11
PRODUCTION DATA

MUNICIPALITY: RIZAL PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 38,970

NO. OF FAMILIES: 1568 URBAN 5943 RURAL 79% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	13,550	55,149	20%	4.98	219,712,620
COCONUT (NUTS)	5.50	6	3%	2.21	12,862
MAIZE (CORN)	3,080	5,607	20%	5.76	25,837,056
COFFEE	no data	no data	no data	no data	no data
BANANA	2.25	30	5%	5.10	145,350
OTHER CROPS (%)	552	5,437	7%	4.76	24,068,512
TOTAL CROPS	17,189.75	66,229			269,776,400

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	2,553	—	—	—	—
CATTLE	1,457	0.75%	3,553	37.94	134,801
PIGS	8,129	56%	381,108	30.00	11,433,240
GOATS	931	10%	2,604	21.94	57,132
CHICKENS	26,864	40%	13,968	33.97	474,493
OTHER	—	—	—	—	—
TOTAL LIVESTOCK	39,934		401,233		12,099,666
TOTAL RURAL INCOME					281,876,066

FAMILY INCOME

URBAN	P 30,795	P 48,286,560.00
RURAL	P 47,430	281,876,066.00
TOTAL INCOME		P 330,162,626.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Consultant's Estimates based from the 1980 Census of Agricultural Statistics Data, Urban income is estimated from the provincial total given by NCSO (1988).

Table B-2-12
PRODUCTION DATA

MUNICIPALITY: A. CASTAÑEDA PROVINCE: NUEVA ECIJA

TOTAL POPULATION: 3,751

NO. OF FAMILIES: 335 URBAN 375 RURAL 46% RURAL

CROPS	AREA (Ha)	PRODUCTION (MT)	LESS % SPOILAGE	UNIT PRICE (P/Kg)	VALUE (P)
PADDY	255	638	20%	4.94	2,521,376
COCONUT (NUTS)	2	5	3%	1.68	8,148
MAIZE (CORN)	36	67	20%	4.07	218,152
COFFEE	no data	no data	no data	no data	no data
BANANA	6.50	32	5%	2.62	79,648
OTHER CROPS (%)	63	336	7%	4.96	1,549,901
TOTAL CROPS	362.50	1,078			4,377,225

LIVESTOCK	POPULATION	ESTIMATED TAKE-OFF	LIVE WEIGHT (Kg)	UNIT PRICE (P/Kg)	VALUE (P)
CARABAO	450	1%	2,230	27.10	60,433
CATTLE	66	20%	4,199	37.94	159,310
PIGS	308	50%	12,396	32.89	407,704
GOATS	12	no data	no data	—	—
CHICKENS	5,243	40%	2,726	33.38	90,994
OTHER	—	—	—	—	—
TOTAL LIVESTOCK	6,079		21,551		718,441
TOTAL RURAL INCOME					5,095,666

FAMILY INCOME

URBAN	P 42,477	P 14,229,795.00
RURAL	P 13,588	5,095,666.00
TOTAL INCOME		P 19,325,461.00

Source: Bureau of Agricultural Statistics
Provincial Agriculture Office
Consultants' Estimates

Note : Consultant's Estimates based from the 1980 Census of Agriculture and Bureau of Agricultural Statistics Data, Urban income is estimated from the provincial total given by NCSO (1988).

APPENDIX B-3

DEVELOPMENT BENEFITS COMPUTATION

Appendix B-3
DEVELOPMENT BENEFITS COMPUTATION

B.3.1 AGRICULTURAL BENEFITS

Estimation of agricultural development benefits was based on the producer surplus concept as discussed in the Main Report of the Rural Infrastructure Fund (RIF) Project. Development benefits from the producer surplus corresponds to increased production induced by a road improvement project, measured in terms of value added.

The supply response of the producers influence the increase in value added from a road improvement project. The supply response of the producers, however, depends on two key parameters; the change in price and the quantity elasticity of price. The price change include transport and storage cost, spoilage and the entrepreneurial overhead. These elements are dependent on the distance from the major market and the condition of the road leading to that market.

A key source of change in prices received by farmers is the "entrepreneurial overhead". A more inaccessible area is expected to provide a trader with less competition and thus, is better able to dictate prices to farmers. However, as access to the area improves, more traders are encouraged and able to go into the area, increasing trading competition and driving up farmgate prices.

Farmers respond to these price changes by increasing area planted, purchasing more inputs and adopting improved technology in accordance with the long term elasticity of supply of each farm product produced in the zone of influence. This is related to regional supply elasticities and local production potential which indicate the additional area that may be brought into production.

Estimation of development benefits in the zone of influence is presented below.

Production in the zone of influence was computed from the estimated 1990 Municipal Production Data. Production in the zone of influence is estimated as follows:

- The total agricultural zone of influence is measured in hectares and estimated as a percentage of total municipal land area reported in the municipal profiles. This percentage is applied to each major crop estimated in the Municipal Production Data (Appendix B-2) to estimate production in the zone of influence.

- Each crop is grown up to 1991 at the projected growth rate as shown in Table B-3-1. In the case of coconut, the Consultant assumed that it will continue with its

present negative growth rate, as evidenced by the current coconut situation in the country.

- May 1991 prices are assumed to prevail throughout the life of the project.

For livestock and poultry, the provincial slaughter/inventory ratios of the different animals were applied to the municipal production. To estimate the ZOI production, the ZOI percentage of total area against the municipal area was applied to the estimated municipal production.

Tables B-3-2 through B-3-8 present the benefits for each agricultural product for the Km 38 - Ma. Aurora road section. The summary of the agricultural benefits are presented in Table B-3-9. The benefits were computed based on the following:

- The production is projected "without the project" based on production forecast as shown in Table B-3-1. Growth projections were based on the estimated historical average growth rate of the provincial agriculture, giving due consideration to the estimated growth rates for population, traffic and income in the province. These projections are not expected to hold on up to the end of the life of the project, and considering the limited potential of the zone of influence a reduction in growth rate is applied after 10 years to continue towards the end of the project life.

- For the case "with the project", after a lag of from 0 to 5 years during which the farmers respond to higher prices, production increases are realized, according to annual adjustments shown in Table 6-3 for a three to five year period, until the impact of the road has been fully felt.

- Marketing charges are estimated as the difference between the wholesale prices and the farmgate prices obtained from the Bureau of Agricultural Statistics. The farmgate prices are increased in year 1 of the project by the estimated reduction in marketing charges. The components of the marketing costs of selected crops as shown in Table B-3-10 were based on interviews with traders and producers in the locality.

- Production costs are estimated for each crop based upon the proportions computed in Table B-3-11. This table shows the proportion of the gross value of production to the gross value added for each product based on the analysis of farm budgets carried out in the National Road Improvement Project (NRIP) for 1987. It is assumed that the change in these proportions from 1987 to present is not significant.

- Net benefits are computed as the difference between the increase in production value and the increase in cost of production.

- Economic prices of crops which the country either exported or imported in 1990 in significant volume were estimated based on the relation of the international market price of the crop to the local wholesale price. The international market prices of selected crops were taken from the 1990 foreign trade statistics from the Bureau of Agricultural Statistics and data from Central Bank.

B.3.2 TOURISM BENEFITS

Aurora Province is endowed with a vast area of forest and long stretch of scenic beaches. It is an integral part of the Sierra Madre mountain range in Luzon which is believed to be the center of species endemism in the whole archipelago and that of southeast Asia. Although a considerable proportion of its forest area had already been intruded by logging operation, a substantial area of wilderness remains untouched, its pristine beauty and natural scenic features still preserved.

The zone of influence of the proposed San Luis-Dingalan road boasts of a number of natural scenic features whose visual quality can attract tourists and other special-interest-groups. The remaining virgin forests in this area is an important habitat of some rare and endangered species of wildlife such as the Philippine Eagle as well as rare species of wildflowers. Similar situation occurs in the Aurora National Park where a section of the Palayan-Maria Aurora road will be passing nearby. The coastal areas on the other hand offer scenic geologic features that can impress nature lovers. These features include the Anyao and Egg islets which forms rugged promontories that have become important sanctuaries of shorebirds and gulls.

There are other areas away from the project road's zones of influence that have potential for tourism development. Diniog Bay in Dilasag has a fringing reef with a sheltered lagoon which offers good snorkelling opportunities. The beach area has white sand and demonstrate signs of good coral growth. However, the reef flat needs to be protected as it is now being exploited by coral gatherers.

Aside from Diniog Bay, a national park is proposed at the location on Casigurn Sound from which Cape San Ildefonso is visible across the water. The vegetation here is lush and extra-ordinary, the scenery superb and the area more or less remote. The beaches are splendid.

This description of the pristine environment could well suit the preference of special interest group of tourists. This include the naturalists and back-packers who enjoy this type of environment for sightseeing pleasure and, at times, for academic purposes.

Already, there are tourists of this sort who have visited the area. This type of tourists enjoy walking for hours along foot trails while sightseeing, camp in the woods at night, take pictures of interesting sights, go shopping for souvenir items and anything that interest them, and visit

Table B-3-1
AGRICULTURAL PRODUCTION FORECAST
IN THE ZONE OF INFLUENCE

PALAYAN - BONGABON - Ma. AURORA ROAD SECTOR
Km. POST 38 - Ma. AURORA SECTION

AGRICULTURAL ACTIVITIES	1990 ESTIMATED PRODUCTION IN THE ZOI (MT)	1992 PROJECTED PRODUCTION (MT)	PROJECTED ANNUAL GROWTH RATES	
			1992 - 2005	2006 - 2015
A. CROPS				
Paddy	2,954	3,104	2.50%	1.50%
Corn	-	0	2.50%	1.50%
Coconut	2,025	2,013	-0.29%	-0.29%
Banana	224	235	2.50%	1.50%
Coffee	0.63	0.66	2.50%	1.50%
Other Crops	206	216	2.50%	1.50%
SUB-TOTAL	5,410	5,569		
B. LIVESTOCK				
Carabao	n. d.	0	2.50%	1.50%
Cattle	19.40	20.38	2.50%	1.50%
Hogs	10.80	11.35	2.50%	1.50%
Goat	0.85	0.89	2.50%	1.50%
SUB-TOTAL	31.05	32.62		
C. POULTRY				
Chicken	0.21	0.22	2.50%	1.50%
Ducks	0.03	0.03	2.50%	1.50%
SUB-TOTAL	0.24	0.25		
GRAND TOTAL	5,440.71	5,601.90		

Table B-3-2

AGRICULTURAL DEVELOPMENT BENEFITS

Km. POST 38 - Ma. AURORA SECTION

PADDY

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	3,104	3,104	2,178			3,813		
1993	3,182	3,182	2,178			3,813		
1994	3,261	3,261	2,178			3,813		
1995	3,343	3,343	2,178			3,813		
1996	3,426	3,470	2,178	2,346	697,925	3,813	165,688	532,237
1997	3,512	3,602	2,178	2,346	818,546	3,813	341,815	476,731
1998	3,600	3,738	2,178	2,346	946,104	3,813	528,880	417,223
1999	3,690	3,832	2,178	2,346	969,756	3,813	542,102	427,654
2000	3,782	3,928	2,178	2,346	994,000	3,813	555,655	438,345
2001	3,876	4,026	2,178	2,346	1,018,850	3,813	569,546	449,304
2002	3,973	4,126	2,178	2,346	1,044,322	3,813	583,785	460,536
2003	4,073	4,230	2,178	2,346	1,070,430	3,813	598,380	472,050
2004	4,175	4,335	2,178	2,346	1,097,190	3,813	613,339	483,851
2005	4,279	4,444	2,178	2,346	1,124,620	3,813	628,673	495,947
2006	4,343	4,510	2,178	2,346	1,141,489	3,813	638,103	503,387
2007	4,408	4,578	2,178	2,346	1,158,612	3,813	647,674	510,937
2008	4,474	4,647	2,178	2,346	1,175,991	3,813	657,389	518,601
2009	4,541	4,716	2,178	2,346	1,193,631	3,813	667,250	526,380
2010	4,610	4,787	2,178	2,346	1,211,535	3,813	677,259	534,276
2011	4,679	4,859	2,178	2,346	1,229,708	3,813	687,418	542,290
2012	4,749	4,932	2,178	2,346	1,248,154	3,813	697,729	550,425
2013	4,820	5,006	2,178	2,346	1,266,876	3,813	708,195	558,681
2014	4,892	5,081	2,178	2,346	1,285,879	3,813	718,818	567,061
2015	4,966	5,157	2,178	2,346	1,305,167	3,813	729,600	575,567

Note: Losses without project 3.00%

Losses with project 2.50%

Table B-3-3
AGRICULTURAL DEVELOPMENT BENEFITS
Km. POST 38 - Ma. AURORA SECTION

COCONUT

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	2,013	2,013	3,078			330		
1993	2,007	2,007	3,078			330		
1994	2,001	2,001	3,078			330		
1995	1,996	1,996	3,078			330		
1996	1,990	1,990	3,078	3,365	587,404	330	0	587,404
1997	1,984	1,984	3,078	3,365	585,701	330	0	585,701
1998	1,978	1,978	3,078	3,365	584,002	330	0	584,002
1999	1,972	1,972	3,078	3,365	582,309	330	0	582,309
2000	1,967	1,967	3,0[illegible]	3,365	580,620	330	0	580,620
2001	1,961	1,985	3,078	3,365	656,369	330	7,790	648,579
2002	1,955	2,003	3,078	3,365	732,603	330	15,629	716,974
2003	1,950	2,021	3,078	3,365	809,327	330	23,516	785,810
2004	1,944	2,039	3,078	3,365	886,545	330	31,453	855,092
2005	1,938	2,033	3,078	3,365	883,974	330	31,362	852,613
2006	1,933	2,028	3,124	3,365	794,851	330	31,271	763,580
2007	1,927	2,022	3,078	3,365	878,855	330	31,180	847,675
2008	1,922	2,016	3,078	3,365	876,306	330	31,090	845,216
2009	1,916	2,010	3,078	3,365	873,765	330	31,000	842,765
2010	1,910	2,004	3,078	3,365	871,231	330	30,910	840,321
2011	1,905	1,998	3,078	3,365	868,704	330	30,820	837,884
2012	1,899	1,993	3,078	3,365	866,185	330	30,731	835,454
2013	1,894	1,987	3,078	3,365	863,673	330	30,642	833,032
2014	1,888	1,981	3.078	3,365	861,169	330	30,553	830,616
2015	1,883	1,975	3,078	3,365	858,671	330	30,464	828,207

Note: Losses without project 0.00%
Losses with project 0.00%

Table B-3-4
AGRICULTURAL DEVELOPMENT BENEFITS
Km. POST 38 - Ma. AURORA SECTION

BANANA

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	235	235	2,860			1,859		
1993	241	241	2,860			1,859		
1994	247	247	2,860			1,859		
1995	253	253	2,860			1,859		
1996	259	259	2,860	3,188	105,636	1,859	0	105,636
1997	266	270	2,860	3,188	119,623	1,859	6,751	112,872
1998	273	280	2,860	3,188	134,402	1,859	13,934	120,468
1999	279	291	2,860	3,188	150,010	1,859	21,570	128,440
2000	286	302	2,860	3,188	166,486	1,859	29,682	136,804
2001	293	310	2,860	3,188	170,648	1,859	30,424	140,224
2002	301	318	2,860	3,188	174,914	1,859	31,184	143,730
2003	308	326	2,860	3,188	179,287	1,859	31,964	147,323
2004	316	334	2,860	3,188	183,770	1,859	32,763	151,006
2005	324	342	2,860	3,188	188,364	1,859	33,582	154,782
2006	329	347	2,860	3,188	191,189	1,859	34,086	157,103
2007	334	352	2,860	3,188	194,057	1,859	34,597	159,460
2008	339	358	2,860	3,188	196,968	1,859	35,116	161,852
2009	344	363	2,860	3,188	199,922	1,859	35,643	164,280
2010	349	368	2,860	3,188	202,921	1,859	36,178	166,744
2011	354	374	2,860	3,188	205,965	1,859	36,720	169,245
2012	360	380	2,860	3,188	209,055	1,859	37,271	171,784
2013	365	385	2,860	3,188	212,190	1,859	37,830	174,360
2014	370	391	2,860	3,188	215,373	1,859	38,398	176,976
2015	376	397	2,860	3,188	218,604	1,859	38,974	179,630

Note: Losses without project 5.00%
Losses with project 2.00%

Table B-3-5

AGRICULTURAL DEVELOPMENT BENEFITS

Km. POST 38 - Ma. AURORA SECTION

COFFEE

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	0.66	0.66	21,480			7,518		
1993	0.68	0.68	21,480			7,518		
1994	0.69	0.69	21,480			7,518		
1995	0.71	0.71	21,480			7,518		
1996	0.73	0.73	21,480	22,320	675	7,518	0	675
1997	0.75	0.75	21,480	22,320	692	7,518	0	692
1998	0.77	0.77	21,480	22,320	709	7,518	0	709
1999	0.78	0.78	21,480	22,320	727	7,518	0	727
2000	0.80	0.80	21,480	22,320	745	7,518	0	745
2001	0.82	0.83	21,480	22,320	869	7,518	36	832
2002	0.84	0.85	21,480	22,320	999	7,518	75	924
2003	0.87	0.88	21,480	22,320	1,135	7,518	115	1,020
2004	0.89	0.91	21,480	22,320	1,279	7,518	158	1,121
2005	0.91	0.94	21,480	22,320	1,429	7,518	203	1,227
2006	0.92	0.95	21,480	22,320	1,451	7,518	206	1,245
2007	0.94	0.97	21,480	22,320	1,472	7,518	209	1,264
2008	0.95	0.98	21,480	22,320	1,494	7,518	212	1,283
2009	0.97	0.99	21,480	22,320	1,517	7,518	215	1,302
2010	0.98	1.01	21,480	22,320	1,540	7,518	218	1,321
2011	0.99	1.02	21,480	22,320	1,563	7,518	221	1,341
2012	1.01	1.04	21,480	22,320	1,586	7,518	225	1,361
2013	1.02	1.06	21,480	22,320	1,610	7,518	228	1,382
2014	1.04	1.07	21,480	22,320	1,634	7,518	232	1,403
2015	1.06	1.09	21,480	22,320	1,659	7,518	235	1,424

Note: Losses without project 3.00%

Losses with project 2.50%

Table B-3-6

AGRICULTURAL DEVELOPMENT BENEFITS

Km. POST 38 - Ma. AURORA SECTION

OTHER CROPS

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	216	216	6,830			4,098		
1993	221	221	6,830			4,098		
1994	227	227	6,830			4,098		
1995	233	233	6,830			4,098		
1996	238	238	6,830	7,304	157,345	4,098	0	157,345
1997	244	244	6,830	7,304	161,279	4,098	0	161,279
1998	250	255	6,830	7,304	197,869	4,098	19,028	178,841
1999	257	266	6,830	7,304	236,806	4,098	39,369	197,437
2000	263	278	6,830	7,304	278,213	4,098	61,093	217,119
2001	270	285	6,830	7,304	285,168	4,098	62,621	222,547
2002	276	292	6,830	7,304	292,297	4,098	64,186	228,111
2003	283	299	6,830	7,304	299,605	4,098	65,791	233,814
2004	290	307	6,830	7,304	307,095	4,098	67,435	239,659
2005	298	315	6,830	7,304	314,772	4,098	69,121	245,651
2006	302	319	6,830	7,304	319,494	4,098	70,158	249,335
2007	307	324	6,830	7,304	324,286	4,098	71,211	253,075
2008	311	329	6,830	7,304	329,150	4,098	72,279	256,872
2009	316	334	6,830	7,304	334,088	4,098	73,363	260,725
2010	321	339	6,830	7,304	339,099	4,098	74,463	264,636
2011	326	344	6,830	7,304	344,185	4,098	75,580	268,605
2012	330	349	6,830	7,304	349,348	4,098	76,714	272,634
2013	335	354	6,830	7,304	354,588	4,098	77,865	276,724
2014	340	360	6,830	7,304	359,907	4,098	79,033	280,875
2015	346	365	6,830	7,304	365,306	4,098	80,218	285,088

Note: Losses without project 7.00%

Losses with project 4.00%

Table B-3-7

AGRICULTURAL DEVELOPMENT BENEFITS

Km. POST 38 - Ma. AURORA SECTION

LIVESTOCK

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	32.62	32.62	31,450			23,588		
1993	33.44	33.44	31,450			23,588		
1994	34.27	34.27	31,450			23,588		
1995	35.13	35.13	31,450			23,588		
1996	36.01	36.01	31,450	33,530	84,719	23,588	0	84,719
1997	36.91	36.91	31,450	33,530	86,837	23,588	0	86,837
1998	37.83	38.27	31,450	33,530	103,561	23,588	10,446	93,115
1999	38.77	39.69	31,450	33,530	121,241	23,588	21,540	99,701
2000	39.74	41.16	31,450	33,530	139,922	23,588	33,313	106,609
2001	40.74	42.19	31,450	33,530	143,420	23,588	34,146	109,274
2002	41.76	43.24	31,450	33,530	147,005	23,588	34,999	112,006
2003	42.80	44.32	31,450	33,530	150,680	23,588	35,874	114,806
2004	43.87	45.43	31,450	33,530	154,448	23,588	36,771	117,677
2005	44.97	46.56	31,450	33,530	158,309	23,588	37,690	120,618
2006	45.64	47.26	31,450	33,530	160,683	23,588	38,256	122,428
2007	46.33	47.97	31,450	33,530	163,094	23,588	38,829	124,264
2008	47.02	48.69	31,450	33,530	165,540	23,588	39,412	126,128
2009	47.73	49.42	31,450	33,530	168,023	23,588	40,003	128,020
2010	48.44	50.16	31,450	33,530	170,543	23,588	40,603	129,940
2011	49.17	50.92	31,450	33,530	173,102	23,588	41,212	131,889
2012	49.91	51.68	31,450	33,530	175,698	23,588	41,830	133,868
2013	50.66	52.46	31,450	33,530	178,334	23,588	42,458	135,876
2014	51.41	53.24	31,450	33,530	181,009	23,588	43,095	137,914
2015	52.19	54.04	31,450	33,530	183,724	23,588	43,741	139,983

Note: Losses without project 3.00%

Losses with project 2.00%

Table B-3-8

AGRICULTURAL DEVELOPMENT BENEFITS

Km. POST 38 - Mn. AURORA SECTION

POULTRY

YEAR	PRODUCTION (metric tons)		PRICE (P/ton)		INCREASE IN PRODUCTION VALUE	PRODUCTION COST	INCREASE IN PRODUCTION COST	NET BENEFITS (Pesos)
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITH PROJECT	(P/ton)	WITH PROJECT	
1992	0.25	0.25	38,270			28,703		
1993	0.26	0.26	38,270			28,703		
1994	0.26	0.26	38,270			28,703		
1995	0.27	0.27	38,270			28,703		
1996	0.28	0.28	38,270	39,004	356	28,703	0	356
1997	0.28	0.28	38,270	39,004	365	28,703	0	365
1998	0.29	0.29	38,270	39,004	428	28,703	41	387
1999	0.30	0.30	38,270	39,004	494	28,703	83	410
2000	0.30	0.31	38,270	39,004	563	28,703	129	435
2001	0.31	0.32	38,270	39,004	636	28,703	176	460
2002	0.32	0.33	38,270	39,004	652	28,703	181	471
2003	0.33	0.33	38,270	39,004	668	28,703	185	483
2004	0.34	0.34	38,270	39,004	685	28,703	190	495
2005	0.34	0.35	38,270	39,004	702	28,703	194	508
2006	0.35	0.36	38,270	39,004	713	28,703	197	515
2007	0.36	0.36	38,270	39,004	723	28,703	200	523
2008	0.36	0.37	38,270	39,004	734	28,703	203	531
2009	0.37	0.37	38,270	39,004	745	28,703	206	539
2010	0.37	0.38	38,270	39,004	756	28,703	209	547
2011	0.38	0.38	38,270	39,004	768	28,703	213	555
2012	0.38	0.39	38,270	39,004	779	28,703	216	563
2013	0.39	0.40	38,270	39,004	791	28,703	219	572
2014	0.39	0.40	38,270	39,004	803	28,703	222	580
2015	0.40	0.41	38,270	39,004	815	28,703	226	589

Note: Losses without project 4.00%

Losses with project 2.50%

Table B-3-9

TOTAL AGRICULTURAL DEVELOPMENT BENEFITS

BONGABON - Ma. AURORA ROAD

Km. POST 38 - Ma. AURORA SECTION

NET DEVELOPMENT BENEFITS BY PRODUCT									
YEAR	PADDY	CORN	COCONUT	COFFEE	BANANA	OTHER CROPS	LIVESTOCK	POULTRY	TOTAL NET BENEFITS
1992	-	-	-	-	-	-	-	-	-
1993	-	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-	-
1995	-	-	-	-	-	-	-	-	-
1996	532,237	-	587,404	675	105,636	157,345	84,719	356	1,468,373
1997	476,731	-	585,701	692	112,872	161,279	86,837	365	1,424,477
1998	417,223	-	584,002	709	120,468	178,841	93,115	387	1,394,745
1999	427,654	-	582,309	727	128,440	197,437	99,701	410	1,436,677
2000	438,345	-	580,620	745	136,804	217,119	106,609	435	1,480,678
2001	449,304	-	648,579	832	140,224	222,547	109,274	460	1,571,221
2002	460,536	-	716,974	924	143,730	228,111	112,006	471	1,662,753
2003	472,050	-	785,810	1,020	147,323	233,814	114,806	483	1,755,307
2004	483,851	-	855,092	1,121	151,006	239,659	117,677	495	1,848,902
2005	495,947	-	852,613	1,227	154,782	245,651	120,618	508	1,871,345
2006	503,387	-	763,580	1,245	157,103	249,335	122,428	515	1,797,593
2007	510,937	-	847,675	1,264	159,460	253,075	124,264	523	1,897,198
2008	518,601	-	845,216	1,283	161,852	256,872	126,128	531	1,910,483
2009	526,380	-	842,765	1,302	164,280	260,725	128,020	539	1,924,011
2010	534,276	-	840,321	1,321	166,744	264,636	129,940	547	1,937,785
2011	542,290	-	837,884	1,341	169,245	268,605	131,889	555	1,951,810
2012	550,425	-	835,454	1,361	171,784	272,634	133,868	563	1,966,089
2013	558,681	-	833,032	1,382	174,360	276,724	135,876	572	1,980,626
2014	567,061	-	830,616	1,403	176,976	280,875	137,914	580	1,995,424
2015	575,567	-	828,207	1,424	179,630	285,088	139,983	589	2,010,487

Table B-3-10
IMPACT OF THE ROAD
ON COCONUT MARKETING CHARGES
(1991 Prices/1000 nuts)

	WITHOUT PROJECT	WITH PROJECT
Farm Price	1,650	1,870
Harvesting and collecting	80	80
Husking	70	70
Animal transport to road	100	100
Transport to market	350	280
Buyer margin	300	150
Wholesaler margin	250	250
Wholesale Price	2,800	2,800

Estimated number of husked nuts/ton = 1250 (PCA)
Wholesale price/ton = P 3,500

- Reduction due to lower cost and increased competition among transporters.
- ** Assumes part of production is sold directly to wholesalers, bypassing barangay buyers.

IMPACT OF THE ROAD
ON CITRUS MARKETING CHARGES
(1991 Prices per ton)

	WITHOUT PROJECT	WITH PROJECT
Farm Price	5,810	6,090
Harvesting/Sorting	2,075	2,075
Animal transport to road	210	210
Transport to market	450	400
Buyer margin	480	250
Wholesaler margin	300	300
Wholesale Price	9,325	9,325

- Reduction due to lower cost and increased competition among transporters.
- ** Assumes part of production is sold directly to wholesalers, bypassing barangay buyers.

Table B-3-11
VALUE ADDED AS A PROPORTION OF GROSS VALUE OF PRODUCTION BY AGRICULTURAL ACTIVITY
REGION IV

	YIELD (ton/ha.)	ECONOMIC PRICE (P/ton)	GROSS VALUE OF PRODUCTION (GVP)	NET VALUE OF PRODUCTION (NVP)	LABOR & PURCHASED INPUTS/ GVP (%)
PADDY	2.71	2,130	5,772	533	0.91
CORN (MAIZE)	2.02	2,780	5,616	1,710	0.70
BANANA	4.91	1,310	6,432		0.65 (2)
COCONUT	1.64	1,700	2,788	2,352	0.16 (2)
COFFEE	0.96	23,840	22,886	14,781	0.35
ROOTCROPS	5.58	1,190	6,640	3,662	0.45 (1)
VEGETABLE and OTHER CROPS	5.00	6,000	30,000		0.60 (2)
POULTRY/LIVESTOCK					0.75 (2)
FISHERIES					0.75 (2)
FORESTRY					0.40 (2)

Source: National Road Improvement Project

(1) Largely cassava (2) Consultants' estimates

ethnic tribes among others. Other tourists who have gone to Aurora were the "water-enthusiast" tourists who enjoyed surfing and swimming in the beach. However, no official record could show the number of tourists who had visited the area, and the particular activities they indulged in.

The attractiveness of an area is affected by the type of access leading to that area. Travel comforts offered by good roads as well as the amenities of high standard tourist facilities enhance the attractiveness of tourist areas. These at present, do not exist in Aurora Province.

The Palayan-Bongabon-Km. 38-Maria Aurora Road will provide a shorter road link between Nueva Ecija and Aurora, and will serve as an alternative to the existing Palayan-Baler National Road. The faster travel and greater comfort offered by the improved road will probably encourage more naturalists and back-packers as well as other types of tourists to visit the area.

The computation of tourism benefits is based on the following:

- Estimated number of tourists coming to Aurora

  In 1990, 893,763 foreign tourists visited the Philippines. Only a very small proportion of these tourists constitute the naturalists most of whom could have gone to Palawan, Banawe and other nature-laden areas. Travel comforts and the presence of tourist facilities could have attracted these tourists to these places. In the absence of tourist statistics, an arbitrary estimate of 30 tourists is assumed to have visited Aurora province in 1990.

- Growth Projection

  The annual growth of foreign tourist arrival for the period of 1985-89 is estimated at 9%. However, tourist arrival in 1990 dropped by 13.89% compared to previous year, with foreign tourist arrival declining by 16.94%. This could well have been the effect of the attempted coup d'etat in 1989 and the calamities that hit the country in 1990 (earthquake in Luzon and super typhoon in Visayas). Mount Pinatubo eruption could have further negative effect to tourism but after the danger of lahar and mudflows has gone, it could become an attraction to some types of tourist and cause higher tourist arrival.

  In the absence of official data for tourist arrival in Aurora, the Consultant assumed a conservative growth rate of 5% per annum. This figure is projected to increase to 7% each year "with the project" to continue up to the end of the project life. Table B-3-12 presents the tourist arrivals in the Philippines from 1981-90.

Table B-3-12

VISITOR ARRIVALS TO THE PHILIPPINES BY REGION OF RESIDENCE IN THE LAST TEN YEARS

ORIGIN	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ASEAN	88,509	80,171	64,641	57,190	49,454	46,884	46,528	59,671	64,806	47,758
East Asia	335,875	295,226	304,610	275,358	251,759	255,872	257,375	387,662	472,713	365,888
South Asia	10,309	10,831	11,162	11,555	9,957	6,908	6,344	5,781	6,348	6,474
North America	166,083	163,554	165,217	176,030	177,525	182,903	193,694	231,232	267,679	224,510
Oceania	67,679	66,879	56,739	52,900	50,836	47,110	45,915	48,698	54,143	50,978
Europe	105,704	98,742	96,882	85,556	79,096	80,251	80,865	99,930	109,339	112,083
Middle East	15,254	16,374	14,209	17,809	13,539	19,976	20,396	17,778	15,052	13,112
Others & Unspecified Residences	92,372	92,774	82,077	71,061	74,366	71,718	70,833	86,831	86,023	72,960
TOTAL	881,155	824,521	795,537	747,459	706,532	711,582	721,950	937,583	1,076,103	893,763
Overseas Filipinos	57,798	66,286	65,013	69,253	66,542	69,935	72,750	105,531	113,616	130,757
GRAND TOTAL	938,953	890,807	860,550	816,712	773,074	781,517	794,700	1,043,114	1,189,719	1,024,520
Percent Change		-5.13%	-3.40%	-5.09%	-5.43%	1.09%	1.69%	31.26%	14.05%	-13.89%

Source: Department of Tourism

Tourists get ideas of interesting places to see from advertisements and through relatives and friends who had earlier visited those places. Aurora is not commercially advertised as "naturalist paradise" and its beaches are less known. Information on the natural beauty of its wilderness spreads by word of mouth. The improved road, together with its proximity to Manila as compared to other similar tourist attractions will be an added factor to its attractiveness and thus will contribute to a higher growth rate in the case "with the project".

Only benefits from foreign tourists were considered in this study. The Consultants consider that while there may be local tourists and overseas Filipinos who are also interested in Mountain trekking, sightseeing, and beach surfing, their proportion is very small as compared to the foreign tourists. Besides, they are expected to visit the more popular areas for social reasons.

- Average Stay

The average stay of foreign tourists in 1990 is 10 nights. In 1989, foreign tourists spent an average of 9.8 nights of which 5.7 is in Metro-Manila and 4.2 at other locations. This duration is considered by the Consultants as applicable to the tourists who visited Aurora taking into account the activities of these tourists during their stay.

The Consultant also considers the decision by some tourists to stay longer as a result of shorter travel time and greater travel comfort.

- Average Daily Expenditure

Foreign tourists spent an average of US $113.69 in 1990. Expenses were associated to accommodation, entertainment, food and beverages, transportation and others. These were spent in areas where most of the amenities of high standard tourist facilities are present. For Aurora, expenses were estimated at US $36.54 per day, very much lower than the average expenditures of tourists in other places. This is due to lower chances of spending associated to their (naturalists) type of activity as well as lower spending opportunities due to the absence of tourism-oriented business in the area. Table B-3-13 presents the breakdown of tourist's daily expenditures.

As the number of tourists increase, more investments will probably be put to tourism-oriented business such as souvenir shops, better accomodations and entertainment. Daily expenditures are then expected to increase due to additional opportunities for spending. Increase in expenditures "with the project" is assumed to grow slightly higher than "without the project".

Table B-3-13
AVERAGE DAILY EXPENDITURES
1990

ITEMS	AMOUNT (IN US DOLLARS)	
	PHILIPPINES	AURORA
Accommodations	40.69	5.35
Food and Beverage	21.60	10.80
Shopping	23.63	4.63
Entertainment/Recreation	16.14	5.35
Miscellaneous	4.46	2.23
Local Transportation	4.61	4.61
Guided Tour	0.15	3.57
TOTAL	**113.69**	**36.54**

Source: Department of Tourism, Consultant Estimates

The net benefits is estimated as the net economic value of the difference in the total expenditures "with" and "without" the project. The net economic value is estimated as 20%, corresponding to one-third of the value-added to the investment cost in 1988 as studied by the Consultants in the RIF project. It is assumed that the general movement of the prices of commodities and factors of production for the past two years had not significantly changed this proportion.

The total tourism benefits is attributed to the whole stretch of the Tablang-Bongabon-Km 170-Km 38-Maria Aurora Road. These benefits are distributed to each road section in proportion to their length. Table B-3-15 presents the benefits corresponding to each road section.

B.3.3 TOTAL DEVELOPMENT BENEFITS

The total development benefits from the improved road consist of either agricultural or tourisn benefits, or combined, where applicable. Table B-3-16 presents the Total Development Benefits for Km. 38-Maria Aurora section.

Table B-3-14
TOURISM BENEFITS
PALAYAN–KM. 170–MA. AURORA ROAD

FOREIGN TOURISTS

YEAR	NUMBER OF TOURISTS		AVERAGE STAY		EXPENDITURES/DAY		TOTAL EXPENDITURES		BENEFITS	
	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	($)	(P)
1992	30		4		36.54		4,385			
1993	32		4		37.27		4,696			
1994	33		4		38.02		5,030			
1995	35		4		38.78		5,387			
1996	36	46	4	4.4	39.55	43.51	5,769	8,726	591	18,923
1997	38	49	4	4.4	40.34	45.68	6,179	9,803	725	23,198
1998	40	52	4	4.4	41.15	47.97	6,617	11,014	879	28,139
1999	42	56	4	4.4	41.97	50.37	7,087	12,374	1,057	33,838
2000	44	60	4	4.4	42.81	52.88	7,590	13,903	1,262	40,398
2001	47	64	4	4.4	43.67	55.53	8,129	15,620	1,498	47,937
2002	49	68	4	4.4	44.54	58.30	8,707	17,549	1,768	56,589
2003	51	73	4	4.4	45.43	61.22	9,325	19,716	2,078	66,503
2004	54	78	4	4.4	46.34	64.28	9,987	22,151	2,433	77,849
2005	57	84	4	4.4	47.27	67.49	10,696	24,886	2,838	90,819
2006	59	90	4	4.4	48.21	70.87	11,455	27,960	3,301	105,629
2007	62	96	4	4.4	49.18	74.41	12,269	31,413	3,829	122,524
2008	65	103	4	4.4	50.16	78.13	13,140	35,292	4,431	141,777
2009	69	110	4	4.4	51.16	82.04	14,072	39,651	5,116	163,702
2010	72	118	4	4.4	52.19	86.14	15,072	44,548	5,895	188,647
2011	76	126	4	4.4	53.23	90.45	16,142	50,049	6,782	217,009
2012	80	135	4	4.4	54.30	94.97	17,288	56,231	7,789	249,234
2013	84	144	4	4.4	55.38	99.72	18,515	63,175	8,932	285,823
2014	88	154	4	4.4	56.49	104.71	19,830	70,977	10,229	327,343
2015	92	165	4	4.4	57.62	109.94	21,238	79,743	11,701	374,433

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Table B-3-15
TOURISM BENEFITS
PALAYAN–KM. 170–MA. AURORA ROAD

FOREIGN TOURISTS

YEAR	TOURISM BENEFITS (IN PESOS)				
	SEGMENT 5C	SEGMENT 5B	SEGMENT 5A	KM. 38–MA. AURORA	TOTAL
1992					
1993					
1994					
1995					
1996	2,094	7,948	4,289	4,592	18,923
1997	2,567	9,743	5,258	5,629	23,198
1998	3,114	11,818	6,378	6,828	28,139
1999	3,745	14,212	7,670	8,211	33,838
2000	4,471	16,967	9,157	9,803	40,398
2001	5,305	20,134	10,866	11,633	47,937
2002	6,263	23,767	12,827	13,732	56,589
2003	7,360	27,931	15,027	16,138	66,503
2004	8,615	32,697	17,646	18,891	77,849
2005	10,051	38,144	20,586	22,039	90,819
2006	11,690	44,364	23,943	25,633	105,629
2007	13,559	51,460	27,772	29,732	122,524
2008	15,690	59,547	32,136	34,405	141,777
2009	18,116	68,755	37,106	39,725	163,702
2010	30,877	79,232	42,760	45,778	188,647
2011	24,016	91,144	49,189	52,661	217,009
2012	27,582	104,678	56,493	60,481	249,234
2013	31,631	120,046	64,786	69,360	285,823
2014	36,226	137,484	74,198	79,435	327,343
2015	41,437	157,262	84,871	90,862	374,433

Table B-3-16
SUMMARY OF DEVELOPMENT BENEFITS
BONGABON – MA. AURORA ROAD
KM POST 38 – MA. AURORA SECTION

YEAR	NET DEVELOPMENT BENEFITS (IN PESOS)		
	AGRICULTURAL	TOURISM	TOTAL
1992	–	–	–
1993	–	–	–
1994	–	–	–
1995	–	–	–
1996	1,468,373	4,592	1,472,965
1997	1,424,477	5,629	1,430,106
1998	1,394,745	6,828	1,401,573
1999	1,436,677	8,211	1,444,888
2000	1,480,678	9,803	1,490,481
2001	1,571,221	11,633	1,582,854
2002	1,662,753	13,732	1,676,485
2003	1,755,307	16,138	1,771,445
2004	1,848,902	18,891	1,867,793
2005	1,871,345	22,039	1,893,384
2006	1,797,593	25,633	1,823,226
2007	1,897,198	29,732	1,926,931
2008	1,910,483	34,405	1,944,887
2009	1,924,011	39,725	1,963,736
2010	1,937,785	45,778	1,983,564
2011	1,951,810	52,661	2,004,471
2012	1,966,089	60,481	2,026,570
2013	1,980,626	69,360	2,049,986
2014	1,995,424	79,435	2,074,859
2015	2,010,487	90,862	2,101,350

APPENDIX B-4

Table B-4-1

PROVINCE OF NUEVA ECIJA

DISTRIBUTION OF MANUFACTURING EMPLOYMENT BY INDUSTRY

(1988 Data and Peso Values)

PSIC Code	Type of Manufacturer	Number of Establishments by Employment: Total	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	500 to 999	1000 to 1999	2000 & Over	Total Full-time Employees	Value of Production P Millions
31	Food and Beverages	121	36	34	40	10	1	0	0	0	0	0	1203	230,796.2
311														
312	Food	121	36	34	40	10	1						1203	230,796.2
313	Beverages	0											0	0.0
314	Tobacco	0											0	0.0
32	Textile,Apparel,Leather	24	19	3	1	1	0	0	0	0	0	0	97	1,650.1
321	Textile	5	5										10	580.5
322	Wearing Apparel	14	9	3	1	1							71	708.9
323	Leather Products	1	1										1	44.8
324	Footwear	4	4										15	316.0
33	Wood Based Industries	30	16	6	5	3	0	0	0	0	0	0	259	22,166.8
331	Wood & Cork Products	20	11	3	3	3							198	18,790.8
332	Wood Furniture/Fixtures	10	5	3	2								61	3,376.0
34	Paper Based Industries	9	1	4	3	1	0	0	0	0	0	0	91	4,472.3
341	Paper	2	1	1									8	164.7
342	Printing & Publishing	7	0	3	3	1							83	4,307.7
35	Chemical and Rubber	6	4	2	0	0	0	0	0	0	0	0	20	285.3
351	Industrial Chemicals	0											0	0.0
352	Other Chemicals	3	3										7	88.2
353	Petroleum Refineries	0											0	0.0
354	Petroluem & Coal Prod	0											0	0.0
355	Rubber Products	3	1	2									13	197.0
356	Plastic Prod, nec	0											0	0.0
36	Non-Metallic Industry	18	9	4	4	0	0	1	0	0	0	0	222	8,677.5
361	Potter, China, etc.	4	4										10	81.3
362	Glass	0											0	0.0
363	Cement	0											0	0.0
369	Other Products	14	5	4	4			1					212	8,596.3
37	Basic Metal Industry	2	2	0	0	0	0	0	0	0	0	0	3	90.0
371	Ferrous Basic Industry	1	1										1	35.0
372	Non-Ferrous Basic Ind.	1	1										2	55.0
38	Metal Prod.& Machinery	28	21	6	1	0	0	0	0	0	0	0	109	5,640.9
381	Fabricated Metal Prod.	14	13	1									38	2,914.5
382	Non-Electric Machinery	9	3	5	1								58	2,542.2
383	Electrical Machinery	2	2										4	96.2
384	Transport Equipment	3	3										9	88.0
385	Other Equipment	0											0	0.0
386	Metal Furniture/Fixture	0											0	0.0
39	Other Manufacturers	7	6	1									24	1,095.9
	Total	245	114	60	54	15	1	1	0	0	0	0	2028	274,875.0

Source: National Statistics Office Printout

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Table B-4-2
PROVINCE OF NUEVA ECIJA
DISTRIBUTION OF ESTABLISHMENTS EXCLUDING AGRICULTURE, MANUFACTURING AND PUBLIC ADMINISTRATION

PSIC CODE	TYPE OF ESTABLISHMENT	TOTAL	NUMBER OF ESTABLISHMENTS BY EMPLOYMENT										TOTAL EMPLOYED FULL-TIME	VALUE OF PRODUCTION P.000s
			1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	500 to 999	1,000 1,999	2,000 & Over		
2	Mining & Quarrying	2	0	0	1	1	0	0	0	0	0	0	41	2,157.2
21	Metallic Ore Mining	0											0	0.0
22	Non-Metallic Mining	2	0	0	1	1							41	2,157.2
4	Electricity, Gas & Water	12	2	1	0	2	3	4	0	0	0	0	931	258,599.5
41	Electricity, Gas & Steam	6	0	0	0	0	3	3					729	240,329.8
43	Waterworks & Supply	6	2	1	0	2	0	1					202	18,269.7
5	Construction	10	1	4	1	3	1						243	28,878.2
6	Wholesale & Retail	251	134	79	21	16	1	0	0	0	0	0	1,695	607,282.3
61	Wholesale Trade	60	32	16	4	8							513	320,550.6
62	Retail Trade	191	102	63	17	8	1						1,182	286,731.7
7	Transportation, Storage & Warehousing	17	8	3	4	1	0	1	0	0	0	0	293	16,589.8
71	Transportation	14	7	2	3	1	0	1					268	13,456.5
72	Storage and Warehousing	3	1	1	1								25	3,133.4
73	Communications	0											0	0.0
8	Finance, Insurance, Real Estate & Business Services	84	28	14	31	11	0	0	0	0	0	0	946	141,280.7
81	Banking	54	3	13	29	9							796	128,567.0
82	Financial Intermediaries	5	4	0	1								24	2,337.7
83	Insurance	4	3	0	1								19	697.4
84	Real Estate	2	1	0	0	1							43	8,002.2
85	Business Services	19	17	1	0	1							64	1,676.5
9	Community, Social and Personal Services	156	72	27	27	15	11	1	3	0	0	0	2,844	126,367
93	Education	47	8	5	10	12	8	1	3				2,044	72,357.0
94	Health	13	10	1	0	0	2						164	12,980.2
96	Recreation & Culture	20	7	5	5	2	1						235	16,735.3
97	Personal & Household	39	32	5	2								122	4,570.0
98	Restuarants & Hotels	37	15	11	10	1							279	19,724.3
	Total	532	245	128	85	49	16	6	3	0	0	0	6,993	1,181,154.5

Source: National Statistics Office Printout

Table B-4-3

PROVINCE OF AURORA

DISTRIBUTION OF MANUFACTURING EMPLOYMENT BY INDUSTRY

(1988 Data and Peso Values)

PSIC Code	Type of Manufacturer	Number of Establishments by Employment: Total	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	500 to 999	1000 to 1999	2000 & Over	Total Full-time Employees	Value of Production (P 000s)
31	Food and Beverages	9	9	0	0	0	0	0	0	0	0	0	23	577.4
311														
312	Food	9	9										23	577.4
313	Beverages	0											0	0.0
314	Tobacco	0											0	0.0
32	Textile,Apparel,Leather	3	2	1	0	0	0	0	0	0	0	0	8	362.6
321	Textile	0											0	0.0
322	Wearing Apparel	3	2	1									8	362.6
323	Leather Products	0											0	0.0
324	Footwear	0											0	0.0
33	Wood Based Industries	21	7	3	4	2	3	1	1	0	0	0	904	75,183.7
331	Wood & Cork Products	18	4	3	4	2	3	1	1				892	74,903.5
332	Wood Furniture/Fixtures	3	3										12	280.2
34	Paper Based Industries	1	1	0	0	0	0	0	0	0	0	0	3	51.2
341	Paper	0											0	0.0
342	Printing & Publishing	1	1										3	51.2
35	Chemical and Rubber	0	0	0	0	0	0	0	0	0	0	0	0	0.0
351	Industrial Chemicals	0											0	0.0
352	Other Chemicals	0											0	0.0
353	Petroleum Refineries	0											0	0.0
354	Petroleum & Coal Prod	0											0	0.0
355	Rubber Products	0											0	0.0
356	Plastic Prod, nec	0											0	0.0
36	Non-Metallic Industry	2	2	0	0	0	0	0	0	0	0	0	2	140.8
361	Potter, China, etc.	0											0	0.0
362	Glass	0											0	0.0
363	Cement	0											0	0.0
369	Other Products	2	2										2	140.8
37	Basic Metal Industry	0	0	0	0	0	0	0	0	0	0	0	0	0.0
371	Ferrous Basic Industry	0											0	0.0
372	Non-Ferrous Basic Ind.	0											0	0.0
38	Metal Prod.& Machinery	8	8	0	0	0	0	0	0	0	0	0	18	197.2
381	Fabricated Metal Prod.	5	5										14	12.0
382	Non-Electric Machinery	0											0	0.0
383	Electrical Machinery	0											0	0.0
384	Transport Equipment	3	3										4	185.2
385	Other Equipment	0											0	0.0
386	Metal Furniture/Fixture	0											0	0.0
39	Other Manufacturers	0											0	0.0
	Total	44	29	4	4	2	3	1	1	0	0	0	958	76,512.9

Source: National Statistics Office Printout

Table B-4-4
PROVINCE OF AURORA
DISTRIBUTION OF ESTABLISHMENTS EXCLUDING AGRICULTURE, MANUFACTURING AND PUBLIC ADMINISTRATION
(1998 DATA AND PESO VALUES)

PSIC CODE	TYPE OF ESTABLISHMENT	TOTAL	NUMBER OF ESTABLISHMENTS BY EMPLOYMENT										TOTAL EMPLOYED FULL-TIME	VALUE OF PRODUCTION P 000s
			1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	500 to 999	1000 1999	2000 & Over		
2	Mining & Quarrying	1	0	0	1	0	0	0	0	0	0	0	13	NA
21	Metallic Ore Mining	1			1								13	NA
22	Non-Metallic Mining	0												0.0
4	Electricity, Gas & Water	1	0	0	0	0	1	0	0	0	0	0	66	8,785.4
41	Electricity, Gas & Steam	1					1						66	8,785.4
43	Waterworks & Supply	0												0.0
5	Construction	1			1								19	476.7
6	Wholesale & Retail	57	46	9	2	0	0	0	0	0	0	0	180	20,751.8
61	Wholesale Trade	12	9	2	1								44	6,106.2
62	Retail Trade	45	37	7	1								136	14,645.6
7	Transportation, Storage & Warehousing	29	9	15	2	3	0	0	0	0	0	0	261	5,283.0
71	Transportation	29	9	15	2	3							236	5,283.0
72	Storage and Warehousing	0											25	0.0
73	Communications	0											0	0.0
8	Finance, Insurance, Real Estate & Business Services	8	4	1	2	1	0	0	0	0	0	0	59	5,613.8
81	Banking	4		1	2	1							53	5,466.4
82	Financial Intermediaries	0											0	0.0
83	Insurance	0											0	0.0
84	Real Estate	0											0	0.0
85	Business Services	4	4										6	147.4
9	Community, Social and Personal Services	41	30	3	5	2	1	0	0	0	0	0	261	7,162.8
93	Education	7			4	2	1						174	5,057.5
94	Health	2	2										2	36.0
96	Recreation & Culture	5	4	1									17	335.0
97	Personal & Household	16	16										25	657.4
98	Restuarants & Hotels	11	8	2	1								43	1,076.9
	Total	138	89	28	13	6	2	0	0	0	0	0	859	48,073.4

Source: National Statistics Office Printout
(Total Production Value excludes the value of mining output.)

APPENDIX C

TRANSPORT ECONOMICS

APPENDIX C-1

PRICING OF INPUTS AND OUTPUTS

Appendix C-1
PRICING OF INPUTS AND OUTPUTS

A. INTRODUCTION

The determination of the financial costs and benefits for a project, whether it be a private or public initiated project, has been firmly established and is quite straightforward. On the other hand, the measurement of costs and benefits to the economy in general is quite difficult due to price distortions, i.e., the costs and benefits of a project may not reflect the economic or scarcity value of these costs and benefits. In this respect, adjustments to the actual or quoted prices to reflect their "true" economic values are necessary. The adjusted actual or quoted prices are called "shadow" or "accounting" prices.

Actual or quoted prices are the result of a complex of interworkings involving the market, society and government. In other words, actual prices are not determined by the marketplace alone, but are also determined by custom, decree and government regulation. This occurs in all countries. While most countries make use of the price mechanism, no country relies entirely on it.

Theoretically, the allocation of resources based on the price system alone would be most efficient and would maximize benefits for the economy as a whole. Thus, the impetus for shadow pricing -- to maximize output.

Under perfect competition, economic resources tend to move where they receive the highest prices and thereby produce the maximum economic value. Producers and sellers allocate resources where they can fetch the highest prices and thereby maximize their incomes at the same time minimize their costs, i.e., use the least amount of resources to produce a unit of output and thereby benefit the economy. In this regard, Nihal Amerasinghe states:

> The optimum degree of efficiency in resources allocation is attained when the output from a given quantity of resources is maximized, i.e., it cannot be increased by shifting resources from one use to another. Under these optimum conditions, equilibrium prices will prevail in all markets; costs would be minimized and profits maximized.[1]

On the other hand, inefficient resource allocation occurs when costs exceed receipts in a particular industry or production unit. It is a condition in which total output or economic value could be increased by shifting resources from one enterprise to another. This means that there are too many resources in an enterprise or industry, and a shift of resources (such as investment) would produce a net increase in economic value or output.

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[1]Nihal Amerasinghe, Elements of Financial and Economic Analysis of Project, Asian Development Bank, August 1985, p.49

Optimum allocation questions arise from the scarcity of resources in relation to human wants. The need to make choices rests on the fact that productive resources, land, labor, and capital, have alternative uses.

> Opportunity cost is a measurement of the real cost to the economy of uses and quantity of resources for a particular purpose. It measures costs in terms of alternative uses of these resources (i.e., opportunities foregone). The actual costs of a given quantity of resources to an individual purchaser may differ from the cost to the economy, e.g., if unemployed workers are hired their wages are the cost of their services to the employer. But if the alternative "use" of these workers is unemployment, the opportunity cost of employing them is close to zero. Though there will be some cost to the economy if they consume additional food or transport services as a result of being employed.[2]

Shadow pricing attempts to assist investment planners by estimating relative costs under conditions that are thought to be most efficient. This is a difficult task because deviations from the self-regulating market of many buyers and sellers exist for many reasons, e.g., embargos, boycotts, imperfect knowledge, oligopolies, barriers to entry and natural monopolies.

Estimating Shadow or Accounting Prices

To adjust for imperfections in the pricing of costs and benefits, the use of shadow or accounting prices is necessary. There are several methods of deriving shadow prices such as:

a. linear programming to solve maximization problems that show appropriate trade-offs on substitutes;

b. taking price relationships on observed markets for similar items on other countries' market for the same items;

c. by determining prices of other government choices; and

d. by the adjustment of market prices to allow for the factors not included in such market prices.

The best estimate of shadow prices is given by a well-specified, constrained input-output model of the economy. However, the computations of such shadow prices is in all cases quite problematic, and as a result, should be considered as approximations.

There are at least four studies of shadow prices in the Philippines, three of which were authorized or co-authored by Dr. Erlinda Medalla of the Philippine Institute for Development Studies. These are:

- Manalaysay, C.P., Estimating the Shadow Price of Capital for the Philippines, unpublished M.A. thesis, University of the Philippines, 1979.

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[2]Ibid., p. 47

- Medalla, E.M., Estimating the Shadow Exchange Rate Under Alternative Policy Assumptions, unpublished Ph. D. thesis, University of the Philippines, 1979.

- Medalla, E.M. and J.H. Power, Estimating the Shadow Exchange Rate, the Shadow Wage Rate and the Social Rate of Discount for the Philippines, PIDS Staff Paper Series No. 84-03, Makati, 1984.

- Medalla, E.M., et al, Reestimation of Shadow Prices for the Philippines, PIDS Working Paper Series No. 90-16, Makati, 1990.

The rest of this appendix summarizes the findings of the 1990 study.

B. THE SHADOW PRICE OF FOREIGN EXCHANGE

The foreign exchange rate in the computation of costs and benefits is very important in the realistic evaluation of any project. The official foreign exchange rate is generally used for converting all prices into the same foreign (or domestic) currency unit. However, adjustments are necessary if there is a significant and prolonged difference between the official and the free market or curb rate or when multiple foreign exchange rates exist.

Medalla, et al, state that:

> The shadow price of foreign exchange or the shadow exchange rate (SER) is an indication of the premium placed by the economy on foreign exchange. The wedge between the SER and the official exchange rate (OER) is attributed not only to balance of payments (BOP) disequilibrium but perhaps, even more importantly, to the existing protection system.
>
> The SER is primarily used as a general conversion factor for non-tradables to correct for price distortions in project evaluation. The need for shadow pricing in project evaluation arise from price distortions brought about by market imperfections due to genuine market failures and to government intervention or policies (in this case, the protection system).[3]

Medalla, et al, used two methodologies in the estimation of the shadow price of foreign exchange: the UNIDO method and the Bacha-Taylor method.

> The UNIDO method evaluates the SER as the marginal social value of foreign exchange. This measures the SER as the value of incremental consumption due to a marginal increase in foreign exchange. It assumes that the protection system will not change in the duration of the project evaluated.

[3]Erlinda M. Medalla, Cecille M. del Rosario, Virginia S. Pineda, Rosario G. Querubin and Elizabeth S. Tan, Reestimation of Shadow Prices for the Philippines - Working Paper Series No. 90-16, PIDS - NEDA/TDI Project, June 1990, p. 14

> The SER derived by the UNIDO method is appropriate when used in evaluating small projects in isolation and in the short-run. In the long-run, it is inadequate since project evaluation is aimed at identifying projects that have long-run comparative advantage such that continued protection is not necessary, implying that the protection system needs adjustment.[4]

The Bacha-Taylor method, which assumes that the economy will move to free-trade in the lifetime of the project and that free-trade is optimal, takes the "free-trade equilibrium" exchange rate as the shadow exchange rate.

Under both methods and using various sets of assumptions, two sets of estimates were made by Medalla, et al. These estimates all suggested that the shadow exchange rate was higher than the official exchange rate. The UNIDO method showed a range from 16.4 percent to 29.3 percent higher for the shadow rate compared to the official rate. The Bacha-Taylor method showed a range from 15.3 percent to 26.2 percent. There was also an additional 2.1 percent to 5.6 percent premium for the Balance of Payment constraint.

Medalla, et al, leave the choice of which shadow exchange rate to use with the project evaluator, although the choice should be consistent with the time frame, conditions and assumptions used in the evaluation.

> The estimates derived using the Bacha-Taylor method are recommend for long-run project evaluation because of the limitations set by the assumptions in the estimates using the UNIDO method. The estimates with the higher trade elasticities should be used when the longer run period is considered.[5]

NEDA in its appraisal and prioritization of projects uses 1.2 as the multiplier to the prevailing official exchange rate to compute the shadow exchange rate.

C. THE SHADOW PRICE OF LABOR

In a developing economy, prevailing wage rates (due perhaps to wage legislation) are usually higher than the real cost of the employment wage. The use of shadow wages are necessary to reflect the economic or social price of project wages.

Medalla, et al, concur that in a developing country, the price of labor is not necessarily equal to its value in alternative employment due to the prevalence of market imperfections and government intervention. They describe the situation as follows:

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[4]Ibid. p. 15

[5]Ibid. p.21

In the traditional or agricultural sector, there is excess supply of unskilled labor while in the modern or industrial sector, the wage for this type of labor is set by government legislation and influenced by labor union pressures. Inasmuch as it is not determined by market forces, the market wage does not reflect the true cost of labor to society. If it is used in social project evaluation, the resulting allocation of resources would likewise be distorted. Hence, in place of the market wage, the shadow wage rate (SWR) is estimated to indicate road economic cost and ensure efficiency despite the existence of distortions.[6]

Medalla, et al, used the traditional and non-traditional approaches in the estimation of the shadow wage rate for unskilled labor only, since it is in excess supply in developing countries.

The computations of the shadow wage rate use the estimates of the shadow exchange rate and the social discount rate. The traditional approach uses the marginal cost of labor as the direct opportunity cost. The non-traditional approach adds an adjustment for the value placed on additional consumption by the worker. Both approaches use a Cobb-Douglas production function from which the marginal product capital can be derived. The Cobb-Douglas formula for calculating output takes the following form:

$$Y = A L^{1-\alpha} K^{\alpha}$$

where Y = output, A = dimension less coefficient, L = labor, K = capital, α = share of capital in output, and $1-\alpha$ = share of labor in output.

The traditional approach gave a range of 64 percent to 75 percent of the prevailing wage of unskilled labor as the shadow wage rate. Because the additional consumption of the worker can be valued differently, the non-traditional approach gave a wide range for the shadow wage rate. The lowest showed a shadow wage rate of 43 percent of the prevailing wage; the highest showed a shadow wage rate of 183 percent of the prevailing wage rate.

NEDA uses sixty percent (60%) of the legislated wage rate as the shadow wage rate for unskilled labor while the existing wage rate for skilled labor is taken as the shadow wage rate.

D. THE OPPORTUNITY COST OF CAPITAL

The opportunity cost of capital, valued at the margin, is the marginal productivity of capital or the marginal productivity of investment. It is often estimated by return on physical capital (plant and equipment) or return on financial capital (international interest rates). Presumably, the two rates of return would be the same if there were perfect competition.

[6]Ibid. p. 30

Estimates of the marginal productivity of capita are made to shed some light on a more important rate -- the social discount rate used in project selection.[7] The UNIDO Manual for Evaluation of Industrial Projects defines the latter as

> the quantitative estimate of the value society places on future benefits and costs, or in other words, the rate at which the value placed by society on future benefits and costs declines over time. The need for such an estimate arises in compiling the present value of the social cost and benefits of a project spread over a long span of time. The social rate of discount provides the link between costs and benefits occurring at different times. The social rate of discount should, in principle, be uniform for the country.
>
> The essential economic role of the social rate of discount is to help allocate public investment funds to the socially most desirable uses. If the SRD is set too low, demand for public investment resources will exceed supply, since too many projects will have a positive present value added. If it is set too high, too few projects will pass the absolute efficiency test of a positive present value added and there will be an excess supply of public investment funds. In principle the SRD should be chosen so that the demand for public investment resources will more or less exhaust the available supply. The selection of a social rate for the purposes of project evaluation is a responsible exercise for, all other parameters of project being given, the soundness of the project may vary considerably with the variation of the social rate of discount.
>
> For practical reasons it is assumed that the social rate of discount is constant over time.[8]

This definition of the social discount rate seems to make the determination of the rate an easy matter. Given a known amount of investment funds and given a sufficient number of projects whose internal rate of returns (IRRs) are known, the investment planners simply set the rate so funds available equal funds needed. But, an incorrect social discount rate, even for a short time, could lead to costly mislocations of resources.

In the traditionalist approach, the marginal productivity of capital equals the social discount rate, so that any study of actual returns to investment is directly relevant to project planners. Even in the non-traditional approach, such estimates can be valuable if the relationship between the marginal productivity of capital and the social discount rate can be theorized.

Medalla, et al, made two estimates of the marginal productivity of capital. One was based on the Cobb-Douglas production function and the other was based on international borrowing rates. The former approach produced an estimate of 10.1 percent and the later produced an estimate of 12.3 percent. In 1984, Medalla and Power used average return on investment in manufacturing as a third method of estimating the marginal productivity of capital. That study showed a return of 14.0 percent.

All of these estimates are below the 15 percent social discount rate used by NEDA and the Consultant in this report. The higher rate can be explained as the investment-clearing rate or as the adjustment for a sub-optional savings rate.

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[7]This rate is also called the Social Rate of Discount (SRD)

[8]UNIDO, Manual for Evaluation of Industrial Project, 1984. p. 111

E. SPATIAL AND DISTRIBUTIONAL EFFECTS

While the determination and use of the shadow prices of foreign exchange, labor and capital assists in the measurement of the real costs and benefits to the economy of various projects, they are biased toward projects in areas with relatively large markets or areas with pre-existing robust economies. When the project under consideration is in an area considered "depressed", where the population, income levels and available resources for production are extremely low, then the proposed project tends to be of questionable economic feasibility, especially if the investment costs are high. Project benefits, in this respect, would be expectedly low.

Thus, "depressed" areas remain depressed because conventional analysis concludes that capital investments are better placed somewhere else where the alternative use would generate a higher IRR in excess of the social discount rate. Unless social factors such as poverty alleviation, access to healthcare, education, government and employment opportunities are given added weight in project evaluation in "special case" areas such as the most depressed provinces, then projects in "depressed" area will always be relegated to the lower ranks of the prospective investment projects of the national government. To a certain extent, the non-traditional approach to project selection addresses this difficulty by taking into account the income distribution in the project area.

In their 1984 study, Medalla and Powers examined the income distribution effects of an investment project. This was limited to the gains realized by agricultural workers hired in the project construction phase. The examination required the estimation of the income distribution parameter (d) defined as the ratio of the marginal utility of consumption of the newly-hired workers to the marginal utility of consumption for the average worker.

The range of values for h (1.0 to 2.0), the marginal utility parameter, led to a range in values for the social discount rate from 7.6 percent to 12.7 percent. Furthermore, a high (12.7 percent) social discount rate implied a very low shadow wage rate (₱ 4.4 in 1984) and a low social discount rate (7.6 percent) implied a very high shadow wage rate (₱ 41.8).

The trade off between current consumption and investment now to increase consumption later becomes more apparent when the income distribution of project benefits are examined using this approach. However, the appropriate combination of shadow rate adjustments (all interrelated) is indeterminate because the relevant value for h is not known nor is it observable.

The analysis implies that very high social discount rates favor current consumption (perhaps to the benefit of the current poor), but this also implies very low shadow wage rates and lower economic project costs. Low social discount rates encourage capital-intensive projects, lower current consumption, with very high shadow wage rates and higher economic project costs.

APPENDIX C-2

VEHICLE OPERATING COSTS

Appendix C-2
VEHICLE OPERATING COSTS

A. INTRODUCTION

The HDM-III model requires data of two types: financial data and physical characteristics data. The primary financial data required are the costs of the following: vehicle purchase price, fuel, oil, vehicle maintenance, tires and delay (passengers and cargo).

The physical characteristics required are for the roadway conditions and the vehicle specifications. Roadway conditions include average positive gradient, average negative gradient, degree of horizontal curvature and superelevation. The latter were estimated by the design engineer while vehicle specifications were the HDM-III default values for different vehicle types.

Once the financial and physical attributes were inputed into the model, the VOCs of each vehicle type were obtained for each roughness and operating speed combination by changing these model inputs and repeatedly running the model.

B. PRICES

The financial and economic costs used with the HDM-III Model are shown below. The economic cost of the items shown are net of taxes.

1. Tires

Table C-2-1 presents the financial and economic costs of tires based on price quotations of retailers and current tax rates. Prices are for one new tire for each vehicle category. Because tire prices are higher in Baler than Manila, an additional 20 percent has been added for transportation charge for delivery to the project area. (See Table C-2-4).

Table C-2-1
FINANCIAL AND ECONOMIC TIRE COSTS
(1991 pesos)

VEHICLE	TIRE	FINANCIAL COST	TAXES	ECONOMIC COST	TAXES AS PCT. OF FIN. COST
Tricycle	2.7 - 18	275	64	211	23.3%
Car/Jeep	165.0 - 13	1,045	254	791	24.3%
Pickup	175.0 - 14	1,436	327	1,109	22.8%
Jeepney	6.0 - 14 8 ply	1,476	346	1,130	23.4%
Bus	7.0 - 16 10 ply	6,266	1,450	4,816	23.1%
Truck	10.0 - 20 12 ply	2,391	554	1,837	23.2%

Source: Quoted prices. Taxes estimated by Consultant.

2. Vehicles

Table C-2-2 shows the prices of new vehicles. The prices are based on current customs duties (including the 9 percent import surcharge) on completely knocked down (CKD) units and the Consultant's estimates of local components. The prices shown do not include the cost of tires. The following models have been selected as representative of each vehicle type in the project area: tricycle, Kawasaki HD100 with Timbol sidecar; car, Toyota Corolla 1.3, pickup, Mazda B2200; jeepney, Transtar Jumbo; bus, Nissan RB31; medium truck, Mazda T3500.

Table C-2-2
FINANCIAL AND ECONOMIC VEHICLE COSTS
(1991 pesos)

VEHICLE	FINANCIAL COST	TAXES	ECONOMIC COST	TAXES AS PCT. OF FIN. COST
Tricycle	43,875	9,759	34,116	22.2%
Car	386,836	111,610	275,226	28.9%
Jeep	116,836	30,299	86,537	25.9%
Pickup	421,564	95,211	326,353	22.6%
Car/Jeep/Pickup	308,412	79,040	229,372	25.6%
Jeepney	352,980	47,987	304,993	13.6%
Bus	2,351,104	402,618	1,948,486	17.1%
Medium Truck	674,378	164,948	509,430	24.5%

Source: Quoted prices. Taxes estimated by Consultant.

Table C-2-3
VEHICLE USAGE

VEHICLE	SERVICE LIFE (yrs)	ANNUAL HOURS	ANNUAL KILOMETERS	SERVICE LIFE (km)
Tricycle	6	1,800	30,000	180,000
Car/Jeep	12.5	850	20,000	250,000
Jeepney	7	2,500	50,000	350,000
Bus	8	3,000	75,000	600,000
Truck	12	2,000	50,000	600,000

Source: Consultant's estimates.

Table C-2-3 presents estimated annual usage and service lifetimes for the different vehicle types.

3. Fuel and Lubricating Oil

Table C-2-4 illustrates how prices for fuel, oil and tires in or near the project area differ from prices in Manila. The percentage difference between Baler and Manila prices have been used in costing vehicle operating costs.

Table C-2-4
FUEL PRICES AT DIFFERENT LOCATIONS
(1991 pesos)

	MANILA	CABANATUAN	BONGABON	BALER
Regular	15.00	15.25	-----	15.80
Premium	15.95	16.24	17.32	16.75
Diesel	7.75	8.00	8.12	8.55
Kerosine	7.75	8.00	8.41	8.55
Lub. Oil_/1	35.00	-----	-----	42.00
Tires_/2	1,751.00	1,710.00	-----	2,100.00

	DIPACULAO	GABALDON	ADD'L COST_/3	ADD'L PCT. COST
Regular	16.00	16.00	0.80	5.3%
Premium	17.00	-----	0.80	5.0%
Diesel	8.75	8.75	0.80	10.3%
Kerosine	8.75	9.00	0.80	10.3%
Lub. Oil_/1	43.00	-----	7.00	20.0%
Tires_/2	2,110.00	-----	349.00	19.9%

/1 10-40W for diesel engines
/2 700-15 8 ply
/3 Baler compared to Manila

Table C-2-5 presents the estimated cost of fuels assuming crude oil costs $ 22 per barrel and a peso-dollar rate of ₱ 32 = $ 1. The fuel costs are an exception to the rule of using 1991 prices as the base year for costing benefits and project costs. The crude oil price and peso conversion rate shown in the table are thought to be more representative of fuel costs over the planning horizon.

Table C-2-5
ESTIMATED FUEL COSTS
(1991 pesos/liter)

FUEL	FINANCIAL COST		ECONOMIC COST	
	MANILA	BALER	MANILA	BALER
Premium	10.16	10.67	7.64	8.02
Regular	9.47	9.95	7.20	7.67
Diesel	9.47	10.41	9.02	9.96

Source: Consultant's estimates based on crude oil cost of $ 22 per barrel and peso-dollar rate of P 32 = $1. It is also assumed that the Oil Price Stabilization Fund charges are zero.

C. VALUE OF PASSENGER TIME

Some studies omit the time savings that passengers enjoy because of an improvement to a roadway that reduces commuting times. Other studies include passengers time savings in determining the feasibility of a proposed roadway. For the ARIDP roads, user benefits were calculated both with and without the value of passenger time savings.

The value of passenger time was based on the estimated 1991 per capita income of Aurora and Nueva Ecija provinces. The 1988 average family income levels found in the Family Income and Expenditure Survey were used to estimate 1991 per capita incomes in the two provinces by following the procedure described below.

In 1988, Aurora Province had 25,433 families with an average family income of 34,141 pesos.[1] Total family income was 868.308 million pesos. Similarly, Nueva Ecija Province had 224,698 families with an average family income of 30,795 pesos. Total family income was 6,919.575 million pesos. The growth in total income from 1988 to 1991 was proxied by the growth rate of Regional Gross Domestic Product (RGDP). The most recent estimates of RGDP growth are shown in Table C-2-6.

[1]This figure appears to be high. Nevertheless, it will serve as a starting point with adjustments to be applied later.

Table C-2-6
GROSS REGIONAL DOMESTIC PRODUCT
(BILLIONS OF CURRENT PESOS)

	REGION	1988	1989	1990	PERCENT GROWTH (1988-90)
NCR	Metro Manila	255.351	301.945	346.724	35.8%
I	Ilocos Region	34.733	39.298	43.910	26.4%
II	Cagayan Valley	19.214	22.152	25.539	32.9%
III	Central Luzon	70.232	77.362	94.843	35.0%
IV	Southern Tagalog	109.804	125.148	147.938	34.7%
V	Bicol Region	22.846	26.742	31.016	35.8%
VI	Western Visayas	57.576	64.961	75.707	31.5%
VII	Central Visayas	51.796	60.472	70.663	36.4%
VIII	Eastern Visayas	22.168	25.653	28.131	26.9%
IX	Western Mindanao	23.882	27.150	31.699	32.7%
X	Northern Mindanao	43.102	49.463	55.708	29.2%
XI	Southern Mindanao	62.526	68.581	78.569	25.7%
XII	Central Mindanao	29.282	33.633	39.960	36.5%

Source: National Statistical Coordination Board.

From 1988 to 1990, the percentage growth rates for the regions closest to the study area, Regions II, III and IV, are very similar, ranging from 32.9 percent to 35.0 percent. For 1990 to 1991, NEDA projects real growth for these regions to be between 1.0 percent and 3.5 percent. Inflation must be factored in, however, so that prevailing 1991 income levels are comparable to 1991 prices. Thus, the percentage growth rate from 1990 to 1991 is approximately 20 percent (with inflation at roughly 18 percent). Overall, the percentage growth rate in total income for the study area from 1988 to 1991 was close to 60 percent.

Using 60 percent as the percentage growth rate for income growth in current pesos for Aurora Province produced an estimated of 1991 provincial income of 1,389 million pesos. For Nueva Ecija, 1991 provincial income was estimated to be 11,071 million pesos.

The 1991 populations of Nueva Ecija and Aurora provinces can be estimated by simple extrapolation from the 1980 and 1990 census data. In 1980, Aurora Province had a population of 107,145. In 1990, Aurora's population had increased to 139,586, showing a growth rate of 2.7 percent per annum. Using this growth rate produced an estimated population for Aurora Province of 143,327 for 1991. Nueva Ecija Province had a population of 1,069,409 and 1,312,610 in 1980 and 1990, respectively. This translates to a 2.1 percent growth rate per

annum and produced an estimate of 1,339,784 for the province in 1991.

The total income and population figures for 1991 yield the following per capita income figures for 1991 for the two provinces: Aurora Province, 9,691 pesos; Nueva Ecija Province, 8,263 pesos. The simple average of per capita income for the two provinces is 8,977 pesos. Given that the 1988 average family income for Aurora appears to be high, a slightly lower figure of 8,800 pesos in income per capita for the study area in 1991 was taken as the basis for calculating the value of passenger time.

Following the procedures used by the Consultant in the Rural Infrastructure Fund (RIF) project, the per capita income figure was adjusted for the proportion of the population of working age and for the proportion of economically active trips taken during working hours. The latter figure was estimated to be 70.4 percent of daytime trips. In the case of the proportion of the population of working age, the projected age structure of Regions III na IV for the year 2005 was used. The population projection, done by Population Studies Division of the National Statistics Office, indicates that 65.3 percent of the study-area population in the year 2005 will be of working age. The year 2005 serves as the approximate mid-point of the lifetime of the proposed road upgrades.

These adjustments gave an estimated value of passenger time of 4.220 pesos per hour. The calculations were as follows:

The estimated capita annual income of 8,800 pesos is equivalent to 13,476 pesos per year per adult (₱ 8,800 divided by 65.3 percent). The number of work hours per year was estimated to be 2,248 hours (44 hours per week less five holidays per year). Thus, the unadjusted value of passenger time is 5.995 pesos per hour (₱ 13,476 divided by 2,248). Adjusting for the proportion of economic related trips taken during working hours gave a value of passenger time of 4.220 pesos per hour (₱ 5.995 times 70.4 percent).

D. RESULTS

Table C-2-7 presents vehicle operating costs for Aurora and Nueva Ecija Provinces (exclusive of passenger time savings). Table C-2-8 shows VOCs including passenger time savings. The occupancy rates by vehicle type for the study area were used in calculating the value of passenger time.

Table C-2-7

VEHICLE OPERATING COSTS -- HDM III RESULTS

W/O TIME VALUE OF USER COSTS (1991 PESOS/KM)

SPEED (km/h)	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Vehicle Type
10	3.401	3.427	3.456	3.489	3.525	3.567	3.615	3.669	3.729	3.789	3.848	3.907	3.965	4.023	4.080	2-3W Veh
20	1.869	1.895	1.924	1.957	1.994	2.036	2.084	2.139	2.200	2.260	2.320	2.380	2.441	2.501	2.560	2-3W Veh
30	1.364	1.390	1.419	1.452	1.489	1.532	1.581	1.637	1.699	1.762	1.824	1.887	1.951	2.015	2.079	2-3W Veh
40	1.118	1.144	1.174	1.207	1.245	1.288	1.338	1.396	1.461	1.526	1.592	1.660	1.728	1.798	1.869	2-3W Veh
50	0.978	1.005	1.034	1.068	1.107	1.151	1.203	1.263	1.331	1.399	1.470	1.541	1.615	1.690	1.767	2-3W Veh
60	0.893	0.919	0.949	0.983	1.023	1.069	1.123	1.185	1.255	1.327	1.401	1.477	1.555	1.635	1.716	2-3W Veh
70	0.895	0.921	0.952	0.987	1.027	1.074	1.129	1.193	1.265	1.339	1.415	1.494	1.575	1.658	1.741	2-3W Veh
80	0.906	0.932	0.963	0.998	1.039	1.087	1.143	1.208	1.280	1.357	1.436	1.517	1.600	1.686	1.772	2-3W Veh
90	0.926	0.952	0.982	1.016	1.059	1.108	1.165	1.230	1.300	1.381	1.464	1.546	1.630	1.719	1.809	2-3W Veh
100	0.955	0.981	1.009	1.041	1.087	1.137	1.195	1.259	1.325	1.411	1.499	1.581	1.665	1.757	1.852	2-3W Veh
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	7.078	7.193	7.327	7.484	7.668	7.885	8.140	8.442	8.780	9.120	9.459	9.798	10.136	10.490	10.826	Cars
20	4.292	4.407	4.542	4.699	4.883	5.100	5.356	5.658	5.998	6.339	6.680	7.021	7.363	7.721	8.061	Cars
30	3.375	3.490	3.624	3.782	3.967	4.185	4.442	4.746	5.089	5.433	5.779	6.125	6.473	6.838	7.187	Cars
40	2.929	3.044	3.179	3.337	3.523	3.743	4.003	4.310	4.657	5.006	5.358	5.712	6.069	6.444	6.804	Cars
50	2.676	2.792	2.927	3.086	3.273	3.495	3.757	4.069	4.420	4.776	5.135	5.498	5.864	6.249	6.619	Cars
60	2.522	2.637	2.773	2.933	3.122	3.346	3.611	3.927	4.284	4.645	5.011	5.381	5.755	6.148	6.526	Cars
70	2.528	2.643	2.781	2.943	3.135	3.362	3.632	3.954	4.317	4.686	5.061	5.442	5.828	6.233	6.623	Cars
80	2.559	2.675	2.813	2.977	3.171	3.402	3.675	4.002	4.371	4.749	5.136	5.527	5.923	6.339	6.739	Cars
90	2.615	2.733	2.869	3.035	3.230	3.466	3.740	4.071	4.446	4.834	5.236	5.636	6.040	6.466	6.874	Cars
100	2.696	2.817	2.949	3.117	3.312	3.554	3.827	4.161	4.542	4.941	5.361	5.769	6.179	6.614	7.028	Cars
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	9.531	9.710	9.916	10.157	10.437	10.765	11.149	11.602	12.110	12.619	13.128	13.637	14.146	14.654	15.158	Jeepneys
20	5.730	5.910	6.119	6.361	6.643	6.973	7.361	7.818	8.330	8.845	9.361	9.877	10.394	10.913	11.427	Jeepneys
30	4.544	4.726	4.936	5.180	5.466	5.800	6.192	6.655	7.174	7.696	8.221	8.748	9.277	9.809	10.339	Jeepneys
40	4.014	4.197	4.409	4.656	4.944	5.282	5.679	6.147	6.673	7.204	7.738	8.276	8.817	9.362	9.906	Jeepneys
50	3.739	3.923	4.136	4.385	4.675	5.017	5.418	5.892	6.424	6.962	7.504	8.051	8.601	9.156	9.710	Jeepneys
60	3.585	3.769	3.983	4.233	4.526	4.870	5.276	5.753	6.290	6.834	7.382	7.934	8.492	9.053	9.613	Jeepneys
70	3.643	3.828	4.044	4.297	4.595	4.944	5.356	5.840	6.386	6.940	7.497	8.060	8.629	9.202	9.774	Jeepneys
80	3.726	3.913	4.133	4.388	4.690	5.044	5.461	5.953	6.507	7.069	7.636	8.208	8.788	9.371	9.952	Jeepneys
90	3.834	4.024	4.250	4.506	4.811	5.170	5.591	6.092	6.653	7.221	7.799	8.378	8.969	9.560	10.147	Jeepneys
100	3.967	4.161	4.395	4.651	4.958	5.322	5.746	6.257	6.824	7.396	7.986	8.570	9.172	9.769	10.359	Jeepneys

(continued)

Table C-2-7 (continued)

VEHICLE OPERATING COSTS -- HDM III RESULTS

W/O TIME VALUE OF USER COSTS (1991 PESOS/KM)

SPEED (km/h)	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Vehicle Type
10	22.937	23.119	23.310	23.511	23.722	23.945	24.179	24.425	24.686	24.960	25.250	25.556	25.880	26.221	26.575	Buses
20	14.642	14.825	15.018	15.221	15.435	15.661	15.900	16.154	16.422	16.707	17.010	17.332	17.674	18.038	18.418	Buses
30	12.004	12.190	12.385	12.592	12.811	13.044	13.292	13.558	13.842	14.147	14.474	14.825	15.202	15.605	16.030	Buses
40	10.800	10.987	11.185	11.397	11.622	11.864	12.125	12.407	12.712	13.042	13.398	13.783	14.198	14.644	15.114	Buses
50	10.161	10.350	10.551	10.767	11.000	11.252	11.528	11.829	12.155	12.510	12.895	13.310	13.756	14.232	14.732	Buses
60	9.799	9.993	10.200	10.422	10.664	10.926	11.213	11.528	11.871	12.243	12.647	13.082	13.547	14.042	14.559	Buses
70	10.056	10.255	10.469	10.704	10.960	11.244	11.561	11.909	12.293	12.711	13.161	13.645	14.161	14.706	15.270	Buses
80	10.397	10.599	10.822	11.068	11.339	11.646	11.990	12.372	12.795	13.252	13.745	14.274	14.833	15.422	16.031	Buses
90	10.822	11.025	11.259	11.514	11.801	12.132	12.500	12.917	13.377	13.866	14.399	14.969	15.563	16.190	16.842	Buses
100	11.331	11.533	11.780	12.042	12.346	12.702	13.091	13.544	14.039	14.553	15.123	15.730	16.351	17.010	17.703	Buses
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	14.819	15.219	15.616	16.009	16.401	16.792	17.182	17.573	17.964	18.355	18.747	19.140	19.534	20.045	20.447	Trucks
20	8.620	9.022	9.420	9.817	10.214	10.612	11.012	11.415	11.821	12.232	12.647	13.067	13.493	14.040	14.483	Trucks
30	6.650	7.054	7.455	7.858	8.263	8.672	9.087	9.509	9.939	10.378	10.826	11.284	11.752	12.347	12.841	Trucks
40	5.758	6.164	6.571	6.981	7.397	7.820	8.253	8.696	9.151	9.617	10.096	10.587	11.090	11.719	12.248	Trucks
50	5.319	5.729	6.140	6.555	6.978	7.411	7.855	8.313	8.785	9.270	9.769	10.281	10.805	11.455	12.003	Trucks
60	5.095	5.506	5.919	6.337	6.764	7.202	7.654	8.120	8.602	9.099	9.609	10.133	10.669	11.330	11.889	Trucks
70	5.223	5.638	6.056	6.481	6.919	7.370	7.838	8.324	8.828	9.350	9.886	10.437	11.001	11.694	12.282	Trucks
80	5.381	5.800	6.224	6.657	7.104	7.569	8.054	8.558	9.084	9.628	10.188	10.765	11.355	12.079	12.694	Trucks
90	5.569	5.992	6.423	6.865	7.319	7.799	8.302	8.822	9.370	9.933	10.515	11.117	11.731	12.485	13.125	Trucks
100	5.787	6.214	6.653	7.105	7.564	8.060	8.582	9.116	9.686	10.265	10.867	11.493	12.129	12.912	13.575	Trucks

VEHICLE OPERATING COSTS -- HDM III RESULTS
WITH TIME VALUE OF USER COSTS (1991 PESOS/KM)

SPEED (km/h)	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Vehicle Type
10	5.021	5.047	5.076	5.109	5.145	5.187	5.235	5.289	5.349	5.409	5.468	5.527	5.585	5.643	5.700	2-3W Veh
20	2.679	2.705	2.734	2.767	2.804	2.846	2.894	2.949	3.010	3.070	3.130	3.190	3.251	3.311	3.370	2-3W Veh
30	1.904	1.930	1.959	1.992	2.029	2.072	2.121	2.177	2.239	2.302	2.364	2.427	2.491	2.555	2.619	2-3W Veh
40	1.523	1.549	1.579	1.612	1.650	1.693	1.743	1.801	1.866	1.931	1.997	2.065	2.133	2.203	2.274	2-3W Veh
50	1.302	1.329	1.358	1.392	1.431	1.475	1.527	1.587	1.655	1.723	1.794	1.865	1.939	2.014	2.091	2-3W Veh
60	1.163	1.189	1.219	1.253	1.293	1.339	1.393	1.455	1.525	1.597	1.671	1.747	1.825	1.905	1.986	2-3W Veh
70	1.126	1.152	1.183	1.218	1.258	1.305	1.360	1.424	1.496	1.570	1.646	1.725	1.806	1.889	1.972	2-3W Veh
80	1.109	1.135	1.166	1.201	1.242	1.290	1.346	1.411	1.483	1.560	1.639	1.720	1.803	1.889	1.975	2-3W Veh
90	1.106	1.132	1.162	1.196	1.239	1.288	1.345	1.410	1.480	1.561	1.644	1.726	1.810	1.899	1.989	2-3W Veh
100	1.117	1.143	1.171	1.203	1.249	1.299	1.357	1.421	1.487	1.573	1.661	1.743	1.827	1.919	2.014	2-3W Veh
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	8.985	9.100	9.234	9.391	9.575	9.792	10.047	10.349	10.687	11.027	11.366	11.705	12.043	12.397	12.733	Cars
20	5.246	5.361	5.496	5.653	5.837	6.054	6.310	6.612	6.952	7.293	7.634	7.975	8.317	8.675	9.015	Cars
30	4.011	4.126	4.260	4.418	4.603	4.821	5.078	5.382	5.725	6.069	6.415	6.761	7.109	7.474	7.823	Cars
40	3.406	3.521	3.656	3.814	4.000	4.220	4.480	4.787	5.134	5.483	5.335	6.189	6.546	6.921	7.281	Cars
50	3.057	3.173	3.308	3.467	3.654	3.876	4.138	4.450	4.801	5.157	5.516	5.879	6.245	6.630	7.000	Cars
60	2.840	2.955	3.091	3.251	3.440	3.664	3.929	4.245	4.602	4.963	5.329	5.699	6.073	6.466	6.844	Cars
70	2.800	2.915	3.053	3.215	3.407	3.634	3.904	4.226	4.589	4.958	5.333	5.714	6.100	6.505	6.895	Cars
80	2.797	2.913	3.051	3.215	3.409	3.640	3.913	4.240	4.609	4.987	5.374	5.765	6.161	6.577	6.977	Cars
90	2.827	2.945	3.081	3.247	3.442	3.678	3.952	4.283	4.658	5.046	5.448	5.848	6.252	6.678	7.086	Cars
100	2.887	3.008	3.140	3.308	3.503	3.745	4.018	4.352	4.733	5.132	5.552	5.960	6.370	6.805	7.219	Cars
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	15.726	15.905	16.111	16.352	16.632	16.960	17.344	17.797	18.305	18.814	19.323	19.832	20.341	20.849	21.353	Jeepneys
20	8.827	9.007	9.216	9.458	9.740	10.070	10.458	10.915	11.427	11.942	12.458	12.974	13.491	14.010	14.524	Jeepneys
30	6.609	6.791	7.001	7.245	7.531	7.865	8.257	8.720	9.239	9.761	10.286	10.813	11.342	11.874	12.404	Jeepneys
40	5.563	5.746	5.958	6.205	6.493	6.831	7.228	7.696	8.222	8.753	9.287	9.825	10.366	10.911	11.455	Jeepneys
50	4.978	5.162	5.375	5.624	5.914	6.256	6.657	7.131	7.663	8.201	8.743	9.290	9.840	10.395	10.949	Jeepneys
60	4.617	4.801	5.015	5.265	5.558	5.902	6.308	6.785	7.322	7.866	8.414	8.966	9.524	10.085	10.645	Jeepneys
70	4.528	4.713	4.929	5.182	5.480	5.829	6.241	6.725	7.271	7.825	8.382	8.945	9.514	10.087	10.659	Jeepneys
80	4.500	4.687	4.907	5.162	5.464	5.818	6.235	6.727	7.281	7.843	8.410	8.982	9.562	10.145	10.726	Jeepneys
90	4.522	4.712	4.938	5.194	5.499	5.858	6.279	6.780	7.341	7.909	8.487	9.066	9.657	10.248	10.835	Jeepneys
100	4.586	4.780	5.014	5.270	5.577	5.941	6.365	6.876	7.443	8.015	8.605	9.189	9.791	10.388	10.978	Jeepneys

(continued)

Table C-2-8 (continued)

VEHICLE OPERATING COSTS -- HDM III RESULTS

WITH TIME VALUE OF USER COSTS (1991 PESOS/KM)

SPEED (km/h)	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Vehicle Type
10	44.902	45.084	45.275	45.476	45.687	45.910	46.144	46.390	46.651	46.925	47.215	47.521	47.845	48.186	48.540	Buses
20	25.625	25.808	26.001	26.204	26.418	26.644	26.883	27.137	27.405	27.690	27.993	28.315	28.657	29.021	29.401	Buses
30	19.326	19.512	19.707	19.914	20.133	20.366	20.614	20.880	21.164	21.469	21.796	22.147	22.524	22.927	23.352	Buses
40	16.291	16.478	16.676	16.888	17.113	17.355	17.616	17.898	18.203	18.533	18.889	19.274	19.689	20.135	20.605	Buses
50	14.554	14.743	14.944	15.160	15.393	15.645	15.921	16.222	16.548	16.903	17.288	17.703	18.149	18.625	19.125	Buses
60	13.460	13.654	13.861	14.083	14.325	14.587	14.874	15.189	15.532	15.904	16.308	16.743	17.208	17.703	18.220	Buses
70	13.194	13.393	13.607	13.842	14.098	14.382	14.699	15.047	15.431	15.849	16.299	16.783	17.299	17.844	18.408	Buses
80	13.143	13.345	13.568	13.814	14.085	14.392	14.736	15.118	15.541	15.998	16.491	17.020	17.579	18.168	18.777	Buses
90	13.263	13.466	13.700	13.955	14.242	14.573	14.941	15.358	15.818	16.307	16.840	17.410	18.004	18.631	19.283	Buses
100	13.528	13.730	13.977	14.239	14.543	14.899	15.288	15.741	16.236	16.750	17.320	17.927	18.548	19.207	19.900	Buses
	ROUGHNESS (m/km) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
10	16.937	17.337	17.734	18.127	18.519	18.910	19.300	19.691	20.082	20.473	20.865	21.258	21.652	22.163	22.565	Trucks
20	9.679	10.081	10.479	10.876	11.273	11.671	12.071	12.474	12.880	13.291	13.706	14.126	14.552	15.099	15.542	Trucks
30	7.356	7.760	8.161	8.564	8.969	9.378	9.793	10.215	10.645	11.084	11.532	11.990	12.458	13.053	13.547	Trucks
40	6.288	6.694	7.101	7.511	7.927	8.350	8.783	9.226	9.681	10.147	10.626	11.117	11.620	12.249	12.778	Trucks
50	5.743	6.153	6.564	6.979	7.402	7.835	8.279	8.737	9.209	9.694	10.193	10.705	11.229	11.879	12.427	Trucks
60	5.448	5.859	6.272	6.690	7.117	7.555	8.007	8.473	8.955	9.452	9.962	10.486	11.022	11.683	12.242	Trucks
70	5.526	5.941	6.359	6.784	7.222	7.673	8.141	8.627	9.131	9.653	10.189	10.740	11.304	11.997	12.585	Trucks
80	5.646	6.065	6.489	6.922	7.369	7.834	8.319	8.823	9.349	9.893	10.453	11.030	11.620	12.344	12.959	Trucks
90	5.804	6.227	6.658	7.100	7.554	8.034	8.537	9.057	9.605	10.168	10.750	11.352	11.966	12.720	13.360	Trucks
100	5.999	6.426	6.865	7.317	7.776	8.272	8.794	9.328	9.898	10.477	11.079	11.705	12.341	13.124	13.787	Trucks

APPENDIX C-3

PAVEMENT DETERMINATION CURVES

Appendix C-3
PAVEMENT DETERIORATION CURVES

A. INTRODUCTION

Pavement deterioration curves estimate future values of an index related to pavement condition, such as pavement roughness, as a function of current values of that index and accumulated axle loads.

The Consultants have selected roughness as the primary indicator of pavement condition because:

- Several internationally-accepted studies have demonstrated the high degree of correlation between pavement condition (both user-defined as per AASHTO, and distress-defined as per US Corps of Engineers' PAVER) and roughness.
- There are readily available models for roughness progression prediction which are applicable in the Philippines.
- Roughness relates directly to vehicle operating costs and estimation of project benefits.

Estimates of road roughness with and without the proposed projects over the analysis period are required to estimate cost savings. The Consultants have projected roughness progression by means of appropriate roughness progression (pavement deterioration) curves for asphalt, concrete and unpaved roads which are presented in the following sections.

B. ASPHALT ROADS

Because of its recent development, extensive database and transferability among Third World Countries, the Consultants have selected the use of roughness progression curves derived by the World Bank in its "The Highway Design and Maintenance Standards Model", Washington, D.C., 1987 (HDM-III).

The HDM-III roughness model was developed mainly using data from a UNDP-funded transportation study in Brazil. The model is based on a relationship between initial roughness, modified structural number, cumulative traffic (in terms of ESALS) and the age of the pavement since construction or last overlay. The relationship is as follows:

$$(1) \quad R_t = [(R_i + 725\,(1+SN)^{-4.99} * N1)] * e^{(0.0153t)}$$

Where:

R_t	=	Roughness at time (t) on International Roughness Index (IRI) m/km
R_I	=	Initial roughness in IRI m/km
SN	=	Modified structural number = $0.0394 * \sum_{i=1}^{n} a_i * H_i + SNSG$
N1	=	Cumulative standard axles carried since construction or last overlay.
t	=	Age of pavement (years) since construction or last overlay
a_i	=	the strength coefficient of the ith layer from AASHTO Guidelines
H_i	=	the thickness of the ith layer from provided that the sum of thickness, H_i is not greater 700 mm, in mm.
n	=	the number of pavement layers
SNSG	=	the modified structural number contribution of the subgrade, given by: $3.51 \log_{10} CBR - 0.85 (\log_{10} CBR)^2 - 1.43$
CBR	=	the California Bearing Ratio of the subgrade at in situ conditions of moisture and density, in percent.

1. Effects Seal Coats on Roughness

Following guidelines presented in TRRL's LR1057, the Consultants have assumed that a seal coat does not reduce roughness. This is understandable since it is a very thin layer which follows the contour of the existing pavement. Indeed, if the seal coat is applied badly, roughness may well increase.

2. Effects of Overlay on Roughness

It is useful to know the effect of an AC overlay on road roughness so that the benefit of the overlay may be quantitatively assessed. Research based on data from the Brazil-UNDP study has related the roughness after overlay to the roughness of the road prior to overlay as follows:

(2) $QI_A = 19 + (QI_B - 19)/(0.602 * H + 1)$

Where:

QI_A = predicted roughness after overlay (Quarter-car index counts per km)[1]

QI_B = roughness immediately before overlay

H = thickness of the overlay

Also, an overlay changes a pavement's modified structural number used in equation (1) is as follows:

$$(3) \quad SN_A = 0.9 * SN_B + a_k * D_k$$

Where:

a_k = AASHTO overlay strength coefficient; and

D_k = overlay thickness in inches

C. CONCRETE PAVEMENTS

This study has followed the procedures developed by the RIF study based on the HDM-III roughness deterioration curve for asphalt roads as well as for PCC pavements. A very large structural number has been given to the PCC so that the increase in roughness over the life of the road is very small, as would be expected for a well-constructed, well-maintained road.

For example, inputting a modified structural number of 5 into the HDM-III model gives an increase in roughness from 2.0 m/km to 3.0 m/km over a 20-year period and the passing of 2.5 million ESALs. This corresponds to a condition rating bordering Good/Fair. If a modified structural number of 15 is used, the roughness increases to 2.72 m/km. It can be seen that here is little change in incremental roughness predicted for modified structural number of 15, the roughness after 40 years is 3.70; this is bordering on a Fair/Poor condition whereas, considering good construction and good maintenance practices which are being modelled here, one would expect the condition to be bordering on the Good/Fair, i.e. an IRI value close to 3.0 m/km.

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[1]Note: QI counts/km = 66 mm/km TRRI roughness units, and 13 QI count/km = 1 m/km IRI

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D. UNPAVED ROADS

1. Routine Grading

The purpose of routine grading is to improve surface roughness and minimize the loss of gravel material. It is reasonable to base the frequency of grading on the criteria of limiting roughness. If regrading is not carried out, the road condition will become very bad within the short period of time, even for a traffic level of 100 ADT. With such rapid changes in road roughness, it is not appropriate to determine annual roughness values as is done for paved roads. It is, however, viable to approximate average annual roughness values assuming good maintenance.

Annual average roughness increases between regravelling activities despite the regrading interventions. This is due to the gradual loss of gravel, which results in a weaker surface structure and also damages the subgrade level.

2. Regravelling Requirements

The model adopted by this study and the RIF study for determining regravelling requirements was developed in the Kenya Maintenance Study for Unpaved Roads by TRRL. The model relates gravel loss to traffic, rainfall, gravel type and average gradient as follows:

$$(4) \qquad GL_A = f(T_A^2/(T_A^2 + 50) * (4.2 + 0.92T_A + 3.5\ R_L^2 + 1.88VC)$$

Where:

GL_A = annual gravel loss in mm

T_A = annual traffic in thousands in both directions

R_L = annual rainfall in meters

VC = average percentage gradient

f = constant:

- 0.94 for lateritic gravel
- 1.51 for quartzitic gravel
- 0.96 for volcanic gravel
- 1.38 for sandstone gravel

Volcanic gravel is the predominant type of soil found in the Philippines and a value of f of 0.96 for calculating gravel loss has been assumed accordingly.

3. Roughness Progression Between Regravelling

Variations in gravel road roughness throughout the year are considerable and only an average annual roughness can be assumed. The annual increase in average roughness is linked to gravel loss. It is assumed that between regravellings the roughness increases as follows:

$$(5) \quad R_t = R_{(t-1)} + 2 * (GL_A/100)$$

Where:

R_t = Average roughness for year t (m/km)

R_{t-1} = Average roughness for year t-1 (m/km)

GL_A = Annual gravel loss (mm)

Appendix C-4
BALER-CASIGURAN BANCA TRAFFIC

There are approximately 15 bancas operating on the Baler-Casiguran route. Some of these bancas also service Dilasag north of Casiguran. This journey requires them to voyage south and then around Cape San Ildefonso, a distance comparable to, or greater, than the distance from Baler to Dingalan. Other destinations serviced by bancas operating in Baler include Polilio Island, Infanta, and Mauban, all in Quezon Province, and only on a chartered basis.

Goods shipped from Baler to Casiguran are principally retail goods, e.g., bottled beverages, biscuits, packaged food, and appliances. Dried fish was also observed to be shipped to Casiguran. (Dried fish in the Baler local markets is reputed to come from Manila. Apparently, all surplus fresh fish is sent inland, leaving little to be dried and sold for local consumption.)

Goods arriving at Baler from Casiguran are almost entirely agricultural products (but also empty bottles and scrap metal.) These goods are mostly copra, palay and onions.

Table C-4-1 illustrates the type of banca servicing the Baler-Casiguran-Dilasag route.

Table C-4-1
EXAMPLE BANCA SPECIFICATIONS
(1991 data)

Vessel Name	Myralene	Lyra Cris
Cargo Capacity	18 tons	20 tons
Passenger Capacity	10 - 15	10 - 15
Crew	6	7
Crew Pay	Commission	Commission
Motor	FUSO 6D10	Isuzu E110
Length	15 meters	18 meters
Draft	2 meters	2 meters
Estimated Cost	₱200,000 - ₱250,000	₱200,000 - ₱250,000
Fuel Used (trip)	200 liters of diesel	200 liters of diesel
Oil used (trip)	4 liters SAE40	4 liters SAE40

Source: Consultant's survey

A chartered voyage from Baler to Casiguran costs 3,000 pesos. A chartered voyage to Dingalan costs 6,000 pesos because the banca will likely return empty versus full or partially full from Casiguran. Larger bancas typical of the Myralene and Lyra Cris cost 15,000 pesos to travel to Casiguran (quoted price). Gross revenues on a regular round trip are said to average 12,000 pesos. Because ship waiting time is long, a charter could probably be arranged for less than the 12,000 pesos charged for a regular trip.

Crew remuneration is based on profits after fuel, oil and food costs and less 50 percent of the remaining for the banca owner. The captain or master receives twice the crew rate, and the engineman and chief mate 1.5 times the crew rate. The average crewman receives 700 pesos per round trip. Food is provided to all crew members out of gross revenues. Food costs are estimated to be 2,500 pesos per round trip.

Banca departures are based on the instructions of the owner's representative and seem to be made without any clearance from the Coast Guard.

According to the Rural Accessibility Planning in Aurora Province report by the Rural Transport Unit of the Department of Interior and Local Government, banca traffic is most common during February to September when the sea is calm and most limited during October to January. This report also states, contrary to the Consultant's findings, that there is regular banca service between Baler and Dingalan and irregular service (once or twice a week) between Baler and Dibut, and between Baler and Dibayabay.

APPENDIX D

HYDRAULICS/HYDROLOGY

APPENDIX D-1

TIME OF CONCENTRATION

Table D–1
COMPUTATION FOR TIME OF CONCENTRATION
ROAD SECTION: AURORA CIRCUMFERENTIAL ROAD

Name of River	D.A.	L	Hu	Hi	Lc	Tc
PODOK	0.50	2150	5	0	1500	72.30
AGUANG	562.76	45600	1675	5	19000	266.44
LIPIT	14.26	5000	5	3	2000	270.30
SALAY	23.95	9450	904	3	4250	55.13
PACUGAO	59.14	18250	1275	15	7250	103.45
MALUPA	106.68	19000	1180	20	9500	111.82
DIAMAN	224.84	36000	1675	20	14000	203.72
DIAMAN I(WITH NIA DAM @ U/S)	89.77	19500	700	20	9800	141.13
DITEKI	136.95	22000	1453	30	11250	122.46
SAN LUIS	1.58	225	146	50	1000	1.75
W.W. #1	8.45	4450	333	15	2200	34.44
W.W. #2	3.43	3100	196	16	1600	28.22
W.W. #3	0.79	1250	146	30	700	11.73
W.W. #4	2.11	225	146	50	150	1.75

LEGEND:
- D.A. – Drainage Area (Sq. km.)
- L – Length of longest watercourse from ridge of divide (m)
- Hu – Elevation at farthest point of the drainage divide (m)
- Hi – Elevation at point of interest (m)
- Lc – Length of watercourse from centroid of watershed to pt.of interest (m)
- Tc – Time of concentration (min.)

Table D–2
COMPUTATION FOR TIME OF CONCENTRATION
ROAD SECTION: BALER – DINGALAN

Name of River	D.A.	L	Hu	Hi	Lc	Tc
REAL	45.89	10850	1595	20	4500	52.26
W.W. #1	5.14	4850	915	30	2000	25.77
W.W. #2	0.50	1200	400	100	500	7.80
W.W. #3	2.93	2000	700	100	1000	10.79
W.W. #4	0.74	1250	887	280	500	6.26
W.W. #5	10.07	5350	1085	160	2000	28.37
W.W. #6	10.50	5500	1085	100	2000	28.60
W.W. #7	2.14	1750	300	100	1000	14.05
W.W. #8	1.42	1000	465	40	500	5.54
W.W. #9	6.59	2600	800	40	1500	13.33
DIKAPINISAN	39.74	12200	1100	20	5500	69.03
W.W. #10	2.87	1850	600	60	1000	10.27
W.W. #11	4.62	3200	1000	200	1500	16.60
W.W. #12	21.62	5750	1518	200	2500	26.95
W.W. #13	3.77	3000	1100	140	1250	14.38
W.W. #14	5.67	2700	1200	40	1750	11.86
W.W. #15	1.69	1300	571	240	600	8.24
W.W. #16	16.61	9000	1770	100	5000	41.23
W.W. #17	38.63	8550	1607	80	4000	40.21
W.W. #18	2.16	2250	695	100	1000	12.39
W.W. #19	6.07	3500	800	80	1900	19.16
DIKAPANIKIAN	30.72	6950	1762	60	3500	30.41
W.W. #20	2.00	1750	1049	640	850	10.70
W.W. #21	0.40	750	598	400	250	5.32
W.W. #22	0.60	1000	760	400	300	5.90
W.W. #23	0.21	750	700	336	350	4.22
W.W. #24	0.54	900	600	280	400	5.47
W.W. #25	0.18	600	400	300	300	5.34
W.W. #26	0.08	250	300	260	125	2.76
W.W. #27	0.08	250	220	170	125	2.54
W.W. #28	0.23	350	400	220	170	2.30

LEGEND:
D.A. – Drainage Area (Sq. km.)
L – Length of longest watercourse from ridge of divide (m)
Hu – Elevation at farthest point of the drainage divide (m)
Hi – Elevation at point of interest (m)
Lc – Length of watercourse from centroid of watershed to pt.of interest (m)
Tc – Time of concentration (min.)

Table D–3
COMPUTATION OF TIME OF CONCENTRATION
ROAD SECTION: PALAYAN – DINGALAN

Name of River	D.A.	L	Hu	Hi	Lc	Tc
SAGANA	2.24	1500	100	50	800	19.92
BILIK	1.77	2500	140	100	1250	39.02
W.W. #1	0.43	1250	110	80	417	19.61
W.W. #2	2.03	2500	200	60	1000	24.24
CULIAT	34.18	13000	300	60	6400	131.52
W.W. #3	3.48	3200	170	60	1700	35.29
W.W. #4	3.56	4000	170	60	1900	45.61
W.W. #5	2.63	4500	170	60	2300	52.23
W.W. #6	2.51	4000	170	60	2000	45.61
SAN JUAN #1	2.42	3500	200	70	2000	36.71
SAN JUAN #2	6.84	6200	300	80	2500	58.02
SAN JUAN #3	1.8	3200	200	80	1750	34.14
CORONEL	525.82	50500	600	100	15000	473.81
W.W. #7	0.64	1200	170	60	500	11.42
W.W. #8	0.64	1200	170	60	500	11.42
SEGUN CRK. #1	18.5	8450	1300	80	3500	43.20
SEGUN CRK. #2	8.48	6000	1380	180	3500	29.32
SEGUN MUNTI	2.8	4000	1100	100	2100	19.72
AMALUNGAN	4.88	4600	1200	130	2500	22.57
SALUSOY	1.52	1500	700	100	750	7.75
CALABASA	2.47	3200	1000	100	1800	15.88
W.W. #9	2.8	2600	800	100	1500	13.76
INASAN CRK.	26.71	14400	1700	100	7500	71.94
DUPINGA	139.64	18600	1400	100	8500	104.49
W.W. #10	1.79	1800	654	140	800	10.14
W.W. #11	1.34	2000	600	130	1100	11.84
W.W. #12	1.29	1200	400	130	1000	8.12
W.W. #13	1.65	1700	500	140	850	10.87
MALINAO	5.41	3200	900	140	1750	16.93
PANTOC	0.79	1250	400	130	500	8.51
ASAN	4.79	4500	800	110	2500	25.99
SAWMILL	11.36	5500	1083	100	3400	28.62
CUYAPA #1	3.57	4750	1400	130	2750	21.94
CUYAPA #2	2.71	3100	1200	200	1500	14.71
CUYAPA #3	1.78	2800	1100	380	1200	14.82
TANAUAN	1.5	3000	1100	280	1500	15.27
LANGAWAN	16.88	7300	1580	40	3750	33.42
SUBSOB	2.88	4100	1040	10	2650	20.06
W.W. #14	0.44	1400	300	10	500	9.44
VILLAPANDO	0.59	1250	1400	10	750	4.57
PALTIK	4.65	3500	1049	10	1750	16.66

LEGEND:
- D.A. – Drainage Area (Sq. km.)
- L – Length of longest watercourse from ridge of divide (m)
- Hu – Elevation at farthest point of the drainage divide (m)
- Hi – Elevation at point of interest (m)
- Lc – Length of watercourse from centroid of watershed to pt.of interest (m)
- Tc – Time of concentration (min)

Table D–4
COMPUTATION FOR TIME OF CONCENTRATION

ROAD SECTION: ALTERNATIVE ROUTE 5A

Name of River	D.A.	L	Hu	Hi	Lc	Tc
CABATANGAN 1	33.36	10000	1675	300	5000	50.10
WW #1	1.71	2300	400	240	1800	20.93
WW #2	1.05	1500	500	220	800	10.35
WW #3	3.03	2500	400	200	1500	21.17
CABATANGAN 2	85.31	17500	1675	160	9000	91.91

ROAD SECTION: ALTERNATIVE ROUTE $5A_1$

Name of River	D.A.	L	Hu	Hi	Lc	Tc
CABATANGAN 1	33.36	10000	1675	300	5000	50.10
WW 5b1	1.71	2300	400	240	1800	20.93
WW 5b2	1.05	1500	500	220	800	10.35
CABATANGAN 3	135.07	19700	1675	140	9000	104.80

LEGEND:
- D.A. – Drainage Area (Sq. km.)
- L – Length of longest watercourse from ridge of divide (m)
- Hu – Elevation at farthest point of the drainage divide (m)
- Hi – Elevation at point of interest (m)
- Lc – Length of watercourse from centroid of watershed to pt.of interest (m)
- Tc – Time of concentration (min.)

Table D–5
COMPUTATION FOR TIME OF CONCENTRATION

Name of River	D.A.	L	Hu	Hi	Lc	Tc
W.W. #1	0.75	1500	80	40	750	21.68
SAPANGBATO #1	0.58	1000	80	40	500	13.60
SAPANGBATO #2	0.77	1200	80	40	600	16.78
CORONEL RIVER #2	639.22	64500	600	40	29000	601.33
(BONGABON BR.)						
W.W. #2	0.42	1000	10	5	500	29.98
W.W. #3	5.80	6500	80	50	4000	130.61
LUSOK	1.84	2250	60	50	1250	58.54
CURVA	1.45	3800	80	60	1800	82.18
BONGABON	1.71	2800	80	60	1000	57.85
CALAANAN	7.62	4800	200	150	2800	75.90
W.W. #4	6.10	3200	400	200	1500	28.12
W.W. #5	3.03	2000	500	300	1100	16.38
W.W. #6	0.53	1200	580	300	400	8.01
W.W. #7	2.32	1500	580	260	500	9.84
W.W. #8	6.38	4200	680	60	1600	25.01
CALAANAN RIVER	54.31	15000	1600	360	6000	83.07
(LABI BRIDGE)						
W.W. #9	2.98	2200	1200	280	1500	10.23
W.W. #10	0.95	1000	800	360	350	5.47
SALABUSAB	2.16	2800	1200	360	1500	13.98
W.W. #11	1.32	1400	1300	540	650	6.54
W.W. #12	1.71	2200	1540	600	1000	10.15
W.W. #13	1.45	1200	1200	660	400	6.24
W.W. #14	0.71	1000	780	660	350	8.96
W.W. #15	1.05	1000	920	640	1000	6.49
W.W. #16	1.13	1400	1500	900	800	7.16
W.W. #17	0.52	900	700	580	900	7.94

LEGEND:
- D.A. – Drainage Area (Sq. km.)
- L – Length of longest watercourse from ridge of divide (m)
- Hu – Elevation at farthest point of the drainage divide (m)
- Hi – Elevation at point of interest (m)
- Lc – Length of watercourse from centroid of watershed to pt.of interest (m)
- Tc – Time of concentration (min.)

APPENDIX D-2

SYNTHETIC UNIT HYDROGRAPH METHODOLOGY

Appendix D

Unit Hydrography Computation

The procedure adopted followed the general methodology of the U.S. Soil Conservation Services. Lag time is computed using the formula:

$t_L = C_T (LL_C/\sqrt{S})^{0.38}$ where:

t_L	-	lag time, hrs.
C_T	-	lag time coefficient
L	-	length of watercourse from the divide to the bridge site, miles
L_c	-	centroidal length of the watercourse, miles
S	-	gross slope of the water course

The lag time coefficient used was based on the weighted values assigned to three types of drainage area: Generally for mountainous areas ($C_T = 1.2$), along foothill areas ($C_T = 0.72$), valleys ($C_T = 0.35$). The actual values and percentage weights were developed using the topographic maps and result of fields observation. The sum of the three weighted values constituted the final C_T value used in the lag time formula.

The following formulas were used for the succeeding computations:

Slope, $S = \frac{H}{L}$ where:

H	-	difference in elevation from divide to bridge site, m
L	-	length of water course, m

$T_R = T_L/5.5$

$T_L^* = T_L + 0.25 (T_R^* - T_R)$

$T_P = T_R^*/2 + T_L^*$

$T = 5\ Tp$

where:

T_L* = Adjusted Lag time

T_R = Rainfall duration

$T_{R\bullet}$ = Rounded value of Tr to nearest whole number

Tp = Time to peak

T = Time base

$$\text{Unit Peak Discharge, } Qp = \frac{0.54\ (DA)\ Q}{Tp}$$

where:

DA	-	Drainage Area, sq. m.
Q	-	Unit Run-off = 1.0 mm
Tp	-	Time to peak, hrs.
Qp	-	CMS/mm

The synthetic unit hydrograph was generated using the U.S. Soil Conservation Service (SCS) method of smoothing into a curvilenear graph the derived triangular hydrography using the tabulated ratios of T/Tp and q/qp. q/qp are interpolated values from the table prepared by SCS depending on different value of T/tp. Refer to Table D-__.

In the Synthetic Unit Hydrograph, time increment T is based on the computed and rounded-off value of the excess rainfall duration. The rounding-off of the computed value of excess rainfall duration was limited to within 10% and its value was made to be within 20% of the time to peak. (Reference: Design of Small dams - US Bureau of Reclamation).

Design Storm (Rainfall)

The design storm (rainfall) was generated using the Rainfall Intensity Duration Frequency (RIDF) data from the chosen PAGASA stations. The regression equation when this data is plotted in log-log scale, generally has the following forms:

$R = aT^b$ where:

a	-	the ordinate intercept of the rainfall data specified return period plotted in the log-log scale.
b	-	the slope of the straight line of the plotted rainfall data
T	-	time, hrs.
R	-	generated rainfall value corresponding to time T

Table D-6
TIME AND DISCHARGE RATIOS
AS PREPARED BY SOIL CONSERVATION SERVICE (SCS).

TIME RATIO	DISCHARGE RATIO	TIME RATIO	DISCHARGE RATIO
T/Tp	q/qp	T/Tp	q/qp
0	0	1.5	0.66
.1	0.015	1.6	0.56
.2	0.075	1.8	0.42
.3	0.16	2.0	0.32
.4	0.28	2.2	0.24
.5	0.43	2.4	0.18
.6	0.60	2.6	0.13
.7	0.77	2.8	0.098
.8	.89	3.0	0.075
.9	1.0	3.5	0.036
1.0	.98	4.0	0.018
1.2	.92	4.0	0.009
1.3	.84	5.0	0.004
1.4	.75	Infinity	0

Source: Design of Small Dams - U.S. Bureau of Reclamation.

Successive total rainfall values are generated at interval, T, successively increased by an increment corresponding to the computed excess rainfall duration in the unit hydrograph computations. Incremental rainfall data are taken from these total rainfall values, and rearranged to give the optimum value of flood discharge. This constitutes the design storm. Losses due to infiltration were computed using the method of estimating rainfall runoff from soil and cover data of the SCS on the assumption that the soil groupings, land-use and treatment and method of computation for runoff is applicable. Based on field condition of bed material and vegetation, a curve number (CN) of 85 and generally a minimum loss of 2.03 millimeters were chosen to get an optimum value for the flood discharge.

The procedure followed in the choice of curve number (CN) as per U.S. Soil Conservation Service, was first to consider the vegetation cover of the drainage area and the type of soil in the vicinity of the site as well as land use and treatment class.

It was decided to use soil Group C in the choice of minimum infiltration capacity since that is the generally observed soil type. Under Group C the infiltration loss of generally 2.03 millimeters was chosen to increase the net effective runoff.

Design Flood Discharge

The design flood discharge is arrived at by applying the generated synthetic unit hydrography to the design storm. The design flood hydrograph is actually the resulting curve of the convolution of several individual flood hydrographs corresponding to the successive increment of the design storm upon which the synthetic unit hydrography is applied.

Base Flow

The base flow computations for most project streams were made using the NWRC data on the gaged flow of selected rivers within the province or nearby areas where available. Using the mean monthly discharges and by the ratio's of the drainage area of the selected river and that of the stream under study, the computed base flow was obtained.

APPENDIX D-3

DISCHARGE COMPUTATION

Table D-7
DISCHARGE COMPUTATION
ROAD SECTION: AURORA CIRCUMFERENTIAL ROAD
(BALER – DIPACULAO – MA. AURORA – SN. LUIS – BALER)

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		Q50
	I 10	I 25	I50			Q 10	Q 25	
PODOK *	70	82	90	0.5	0.5	4.87	5.70	6.26
LIPIT *					14.28			
SALAY					23.95			
PACUGAO *					59.14			
MALUPA					106.68			
DIAMAN					224.84			
DIAMAN I(W/					89.77			
NIA DAM @ U/S)								
DITEKI					136.95			
SN. LUIS *	220	250	270	0.5	1.58	48.32	54.91	59.30
W.W. #1 *	95	110	115	0.5	8.47	111.85	129.51	135.39
W.W. #2 *	100	120	130	0.5	3.42	47.54	57.05	61.80
W.W. #3 *	145	165	180	0.5	0.79	15.92	18.12	19.77
W.W. #4 *	220	250	270	0.5	2.11	64.52	73.32	79.19

NOTE: Rivers with no computed discharge will be done separately using unit hydrograph i.e., rivers with more than 10 sq. km. of drainage areas.

Legend: I – Rainfall intensity, Q – Discharge
* – With existing permanent structure

Table D–8
DISCHARGE COMPUTATION
ROAD SECTION: BALER – DINGALAN

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		
	I 10	I 25	I50			Q 10	Q 25	Q50
REAL					45.89	0.00	0.00	0.00
W.W. #1	102	120	130	0.5	5.14	72.87	85.74	92.88
W.W. #2	185	205	220	0.5	0.50	12.86	14.25	15.29
W.W. #3	145	175	190	0.5	2.93	59.05	71.27	77.38
W.W. #4	210	235	250	0.5	0.74	21.60	24.17	25.72
W.W. #5					10.07	0.00	0.00	0.00
W.W. #6					10.50	0.00	0.00	0.00
W.W. #7	130	150	155	0.5	2.14	38.67	44.62	46.11
W.W. #8	220	245	260	0.5	1.42	43.42	48.36	51.32
W.W. #9	140	155	165	0.5	4.59	89.32	98.89	105.27
DIKAPINISAN					39.74	0.00	0.00	0.00
W.W. #10	160	180	198	0.5	2.87	63.83	71.81	78.99
W.W. #11	125	140	150	0.5	4.62	80.27	89.91	96.33
W.W. #12					21.62	0.00	0.00	0.00
W.W. #13	130	145	155	0.5	3.77	68.12	75.98	81.22
W.W. #14	145	165	175	0.5	4.67	94.12	107.11	113.60
W.W. #15	180	200	220	0.5	1.69	42.28	46.98	51.68
W.W. #16					16.61	0.00	0.00	0.00
W.W. #17					38.63	0.00	0.00	0.00
W.W. #18	145	165	175	0.5	2.16	43.53	49.54	52.54
W.W. #19	115	130	140	0.5	6.07	97.03	109.68	118.12
DIKAPANIKIAN					30.72	0.00	0.00	0.00
W.W. 20	220	250	270	0.5	2.00	61.16	69.50	75.06
W.W. 21	218	245	265	0.5	0.40	12.12	13.62	14.73
W.W. 22	210	235	250	0.5	0.60	17.51	19.60	20.85
W.W. 23	221	250	270	0.5	0.21	6.45	7.30	7.88
W.W. 24	221	250	270	0.5	0.54	16.59	18.77	20.27
W.W. 25	221	250	270	0.5	0.18	5.53	6.26	6.76
W.W. 26	221	250	270	0.5	0.08	2.46	2.78	3.00
W.W. 27	221	250	270	0.5	0.08	2.46	2.78	3.00
W.W. 28	221	250	270	0.5	0.23	7.07	7.99	8.63

NOTE: Rivers with no computed discharge will be done separately using unit hydrograph i.e., rivers with more than 10 sq. km. of drainage areas.

Legend: I – Rainfall Intensity , Q – discharge

Table D-9
DISCHARGE COMPUTATION
ROAD SECTION: PALAYAN – DINGALAN

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		Q50
	I 10	I 25	I 50			Q 10	Q 25	
SAGANA *	105	121	140	0.5	2.24	32.69	37.67	43.59
BILIK	80	94	110	0.5	1.77	19.68	23.13	27.06
W.W. #1	107	125	141	0.5	0.43	6.40	7.47	8.43
W.W. #2	99	115	130	0.5	2.03	27.98	32.50	36.74
CULIAT				0.5		0.00	0.00	0.00
W.W. #3	85	99	115	0.5	3.48	41.12	47.69	55.63
W.W. #4	80	90	110	0.5	3.56	39.59	44.54	54.43
W.W. #5	75	85	100	0.5	2.63	27.42	31.07	36.56
W.W. #6	80	90	110	0.5	2.51	27.91	31.40	38.38
SAN JUAN #1 *	85	95	115	0.5	2.42	28.59	31.96	38.68
SAN JUAN #2 *	68	80	95	0.5	6.84	64.65	76.06	90.32
SAN JUAN #3 *	85	100	115	0.5	1.80	21.27	25.02	28.77
CORONEL *					525.82			
W.W. #7	90	106	122	0.5	0.64	8.01	9.43	10.85
W.W. #8	90	106	122	0.5	0.64	8.01	9.43	10.85
SEGUN CRK. #1 *					18.50	0.00	0.00	0.00
SEGUN CRK. #2	85	100	115	0.5	8.48	100.19	117.87	135.55
SEGUN MUNTI	105	121	140	0.5	2.80	40.87	47.09	54.49
AMALUNGAN	100	119	135	0.5	4.88	67.83	80.72	91.57
SALUYSOY	160	187	206	0.5	1.52	33.80	39.51	43.52
CALABASA	112	130	150	0.5	2.47	38.45	44.63	51.50
W.W. #9	120	140	160	0.5	2.80	46.70	54.49	62.27
INASAN CRK.						0.00	0.00	0.00
DUPINGA *						0.00	0.00	0.00
W.W #10	140	165	185	0.5	1.79	34.83	41.05	46.03
W.W. #11	131	142	172	0.5	1.34	24.40	26.45	32.04
W.W. #12	150	172	190	0.5	1.29	26.90	30.84	34.07
W.W. #13	135	160	180	0.5	1.65	30.96	36.70	41.28
MALINAO	110	130	145	0.5	5.41	82.72	97.76	109.04
PANTOC	150	170	195	0.5	0.79	16.47	18.67	21.41
ASAN *	95	1.0	130	0.5	4.79	63.25	73.24	86.56
SAWMILL *					11.35	0.00	0.00	0.00
CUYAPA #1	101	120	139	0.5	3.57	50.12	59.55	68.48
CUYAPA #2	115	132	150	0.5	2.71	43.32	49.72	56.50
CUYAPA #3	115	132	150	0.5	1.78	28.45	32.66	37.11
TANAUAN *	114	130	150	0.5	1.50	23.77	27.11	31.28
LANGAWAN *					16.88	0.00	0.00	0.00
SUBSOB	105	121	140	0.5	2.88	42.03	48.44	56.04
W.W. #14	145	168	188	0.5	0.44	8.87	10.27	11.50
VILLAPANDO	157	183	203	0.5	0.59	12.88	15.01	16.65
PALTIK	110	130	148	0.5	4.65	71.10	84.03	95.66

NOTE: Rivers with no computed discharge will be done separately using unit hydrograph i.e., rivers with more than 10 sq. km. of drainage areas.

Legend: I – Rainfall intensity, Q – Discharge
* – With existing permanent structure

Table D – 10
DISCHARGE COMPUTATION

ROAD SECTION: ROUTE 5A

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		Q50
	I 10	I 25	I50			Q 10	Q 25	
CABATANGAN 1					33.36	0.00	0.00	0.00
WW #1	115	125	135	0.5	3.03	48.43	52.65	56.86
WW #2	115	125	135	0.5	1.71	27.33	29.71	32.09
WW #3	160	180	195	0.5	1.05	23.35	26.27	28.46
CABATANGAN 2					85 31			

ROAD SECTION: ROUTE $5A_1$

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		Q50
	I 10	I 25	I50			Q 10	Q 25	
CABATANGAN 1					33.36			
WW 5b1	115	125	135	0.5	1.71	27.33	29.71	32.09
WW 5b2	160	180	195	0.5	1.05	23.35	26.27	28.46
CABATANGAN 3					135.07			

NOTE: Rivers with no computed discharge will be done separately using unit hydrograph i.e., rivers with more than 10 sq. km. of drainage areas.

Legend: I – Rainfall intensity, Q – Discharge

Table D – 11
DISCHARGE COMPUTATION

ROAD SECTION: TABLANG – PROVINCIAL BOUNDARY (4B & 5C)

Name of River	RAINFALL INTENSITY (mm/hr.)			C	D.A.	DISCHARGE (cms.)		
	I 10	I 25	I50			Q 10	Q 25	Q50
W.W. #1	101	120	140	0.4	0.75	8.42	10.01	11.68
SAPANG BATO #1	120	140	160	0.4	0.58	7.74	9.03	10.32
SAPANG BATO #2	110	130	145	0.4	0.77	9.42	11.13	12.42
CORONEL R. #2					639.22			
(BONGABON BR.)								
W.W. #2	90	105	120	0.4	0.42	4.20	4.90	5.60
W.W. #3	45	55	70	0.4	5.80	29.02	35.47	45.15
LUSOK	70	80	95	0.4	1.84	14.32	16.37	19.44
CURVA	60	70	85	0.4	1.45	9.67	11.29	13.71
BONGABON	70	80	95	0.4	1.71	13.31	15.21	18.06
CALAANAN	60	71	84	0.4	7.62	50.84	60.16	71.18
W.W. #4	90	100	125	0.5	6.1	76.31	84.79	105.99
W.W. #5	101	130	148	0.5	3.03	42.54	54.75	62.33
W.W. #6	155	180	200	0.5	0.53	11.42	13.26	14.73
W.W. #7	140	165	185	0.5	2.32	45.15	53.21	59.66
W.W. #2	95	115	130	0.5	6.38	84.25	101.98	115.29
CALAANAN RIVER				0.5	54.31			
(LABI BRIDGE)								
W.W. #9	140	165	185	0.5	2.98	57.99	68.35	76.63
W.W. #10	170	200	220	0.5	0.95	22.45	26.41	29.05
SALABUSAB	120	140	160	0.5	2.16	36.03	42.03	48.04
W.W. #11	160	190	210	0.5	1.32	29.36	34.86	38.53
W.W. #12	140	165	185	0.5	1.71	33.28	39.22	43.97
W.W. #13	165	195	215	0.5	1.45	33.26	39.30	43.33
W.W. #14	150	170	190	0.5	0.71	14.80	16.78	18.75
W.W. #15	165	190	210	0.5	1.05	24.08	27.73	30.65
W.W. #16	160	185	205	0.5	1.13	25.13	29.06	32.20
W.W. #17	155	180	200	0.5	0.52	11.20	13.01	14.46

NOTE: Rivers with no computed discharge will be done separately using unit hydrograph i.e., rivers with more than 10 sq. km. of drainage areas.

Legend: I – Rainfall Intensity, Q – discharge

Table D-12
DISCHARGE COMPUTATION

ROAD SECTION: PALAYAN – DINGALAN

Name of River	D.A.	Q 50	Q 100
CULIAT	34.18	239.08	
INASAN	26.71	213.04	
SEGUN CRK. #1 *	18.50	187.14	
CORONEL *	525.82	4,253.97	4,767.50
DUPINGA *	139.64	980.19	
SAWMILL *	11.36	124.55	
LANGAWAN *	16.88	176.18	

ROAD SECTION: AURORA CIRCUMFERENTIAL ROAD

Name of River	D.A.	Q 50	Q 100
AGUANG	562.76	4,052.23	4,473.60
SALAY	23.95	185.21	
MALUPA	106.68	573.57	634.83
DIAMAN	224.84	1,021.77	1,135.32
DIAMAN W/ (NIA DAM @ U/S)	98.77	484.75	
DITEKI	136.95	741.04	818.53
LIPIT *	38.21	241.16	
PACUNGAO *	59.14	346.11	

ROAD SECTION: BALER – DINGALAN

Name of River	D.A.	Q 50	Q 100
REAL	45.89	355.13	
DIKAPINISAN	39.74	275.57	
W.W. #5	10.05	101.15	
W.W. #6	10.5	105.51	
W.W. #12	21.62	214.8	
DIKAPANIKIAN	30.72	260.08	
W.W. #16	16.51	134.15	
W.W. #17	38.63	327.9	

NOTE: Above are the results of discharge calculation using Synthetic Unit Hydrograph for drainage area greater than 10 sq. km.

* – With existing permanent structure

Table D–13
DISCHARGE COMPUTATION

ROAD SECTION: ROUTE 5A

Name of River	D.A.	Q 50	Q 100
CABATANGAN 1	33.36	257.17	
CABATANGAN 2	85.31	492.37	
CABATANGAN 3	135.07	744.37	

ROAD SECTION: TABLANG – BONGABON

Name of River	D.A.	Q 50	Q 100
CORONEL RIVER	639.22	4,316.79	4,842.96
(BONGABON BR.)			

ROAD SECTION: BONGABON – PROVINCIAL BOUNDARY

Name of River	D.A.	Q 50	Q 100
CALAANAN RIVER	54.31	436.77	
(LABI BR.)			

NOTE: Above are the results of discharge calculation using Synthetic Unit Hydrograph for drainage area greater than 10 sq. km.

* – With existing permanent structure

APPENDIX E

CONTRACT DOCUMENTS

APPENDIX E-1

DRAFT SCOPE OF WORK FOR DETAILED DESIGN SERVICES AND CONSTRUCTION SUPERVISION

Appendix E-1
DRAFT SCOPE OF WORK
FOR DETAILED DESIGN SERVICES AND CONSTRUCTION SUPERVISION

1.1 OBJECTIVE

The Scope of Work as outlined herein is intended to convey the general extent of consultant services required for the implementation of the selected schemes of activities for Aurora Roads Infrastructure Development Project, for the years 1992-95 as embodied in the 1991 ARIDP Feasibility Study Final Report.

1.2 THE PROJECT

The 1991 ARIDP Feasibility Study was conducted to identify and select a technically feasible, economically justified, socially sound and cost effective staged implementation plan for improving and upgrading the road facilities serving Aurora Province. The Final Report showed the need for construction/rehabilitation of the following:

- ____ Km. of roadway improvements
- ____ Single and multiple span bridges
- ____ Reinforced Concrete Box Culverts

1.3 SCOPE OF SERVICES

In the implementation of the activities outlined in Section 1.2 above, the Consultant for the detailed design and construction supervision, hereinafter referred to as "Consultant", would be responsible in the performance of the following activities:

1.3.1 Detailed Design Services

1.3.1.1 Review and Update of Feasibility Report

The Consultant shall review and, if necessary, revise the findings and recommendations embodied in the 1991 ARDIP Final Report. The Consultant shall be solely responsible for the analysis and interpretation of all data contained therein, and for its findings, conclusions and recommendations resulting therefrom. Design criteria for all roads and structures as established in the Final Report and/or as agreed between the Department of Public Works and Highways (DPWH) and the United States Agency for International Development (USAID), will be used. No deviation from such will be made without the prior approval of DPWH and USAID.

1.3.1.2 Land Ownership, Topographic and Hydrographic Surveys

Extensive hydrographic analyses were conducted in 1991, the result of which is included in the 1991 ARDIP Final Report. The data contained therein are to be used for the detailed engineering studies and updated as necessary by the Consultant. The Consultant is required to conduct a thorough survey and research on ownership and property lines of the private lands which will be affected by the proposed road construction. The boundaries of each privately-owned land shall be established and the land's technical descriptions defined. The Consultant shall establish the acquisition cost for such affected private lands. The Consultant will perform necesary field alignment and topographic surveys in order to establish lines, grades and construction materials quantities for each segment.

1.3.1.3 Soils Investigation and Testing

Several subsurface explorations and tests were conducted in the project and made part of the 1991 ARIDP Final Report. The Consultant, however, has to perform additional extensive subsurface exploration and soil testing due to the presence of layers of clay as can be seen in the profiles of previous explorations. The Consultant shall determine and take into consideration the effects of said clay in the design and its resulting cost implications.

1.3.1.4 Survey of Existing Structures

The Consultant shall conduct a detailed survey of the slabs, beams, pile caps, piles and other key elements on all existing structures. Damages to such structures shall be assessed by the Consultant and recommendations shall be made for appropriate rehabilitation/replacement measures to be instituted.

1.3.1.5 Detailed Engineering

- Designs

Upon completion of the review of available data and information relating to the design of the road facilities, the Consultant shall prepare and submit for USAID approval the preliminary design proposals before working on the detailed design of any of the road facilities. For this purpose, the Consultant shall submit a Preliminary Design Report which shall include findings of the Consultant based from field investigation, design criteria, layout plan for the facilities and alternative designs analyzed as well as the recommended designs and comparative cost estimates.

Once DPWH/USAID decides on the final scheme to be adopted, the Consultant shall perform detailed engineering designs and prepare contract plans in sufficient detail as to form a reasonable basis for competitive international bidding and actual construction of the road and structure facilities. This shall include, among others, preparation of detailed designs, cost estimates, plans and drawings for all proposed construction packages.

The Consultant, in coordination with the DPWH/USAID, shall prepare property acquisition plans showing the limits of the necessary right-of-way.

The design of the structures shall take into full account and provide adequate resistance against the likely seismic level in the project area.

- Technical Specifications

The Consultant shall prepare the complete technical specifications for the project. The specifications shall consider the most economical, effective and widely accepted engineering concepts and standards consistent with road design practice and DPWH practice. DPWH performance specifications as developed in the 1991 ARIDP shall be used as the principal basis for the technical specifications.

- Quantity and Cost Estimates

The Consultant shall prepare a detailed Bill of Quantities based from the final scheme approved by DPWH/USAID. The cost of construction, broken down into foreign exchange and local currency costs shall be prepared. The unit price for each item shall be established through a detailed analysis of the cost of equipment, materials, labor, overhead, etc. required to complete each work item.

The DPWH/USAID has the prerogative to review the Consultant's cost estimate for the improvements and to stop, totally or partially, any further work on the project if the costs are substantially above the cost indicated in the Feasibility Report.

The foreign currency component shall include the cost of:

(a) acquisition of imported materials, equipment and supplies
(b) identifiable foreign component of domestic materials to be used
(c) wages of expatriate personnel, and
(d) overhead and profit of foreign firms.

The local currency component shall include the cost of:

(a) right-of-way acquisition
(b) domestic materials and supplies
(c) taxes
(d) wages of domestic personnel, and
(e) overhead and profit of local firms.

The total foreign and local currency requirement for each year (broken down into quarterly expenditures) over the expected duration of the project shall be prepared by the Consultant.

- Schedules

The Consultant shall prepare a construction schedule for the project. Where items of work are divided into several contract packages, a detailed schedule for each contract package shall be prepared by the Consultant. The construction schedule shall include, among others, the ordering schedule for major materials and equipment.

The Consultant shall consider appropriate phased implementation of the project so as, to the extent possible, allow unhampered roadway operations during construction.

The phased implementation program will include a constructibility analysis. This constructibility analysis shall consider but not be limited to the following elements:

(a) Availability of bridge contractors and their capabilities.
(b) Availability and capabilities of road building contractors both within the project area and within the country.
(c) Probable staging of construction segments to minimize detours.

The Consultant shall take into account the climatic conditions in the project area in the preparation of construction schedules.

- Tender Documents

The Consultant, subject to the approval of DPWH and USAID, may divide the project into several contract packages.

The Consultant shall prepare all necessary tender drawings, including detailed drawings to illustrate all construction details for the road and structure facilities, and the required tender documents for the execution of the construction of such facilities as well as the procurement of necessary equipment and materials.

The tender documents shall include, among others, the following:

(a) Instruction to Bidders: general information, list of minimum equipment required, work schedule, form of guarantees;

(b) Tender form;

(c) General conditions of contract;

(d) Form of contract;

(e) Special conditions of contract, if any;

(f) Technical specifications for the execution of the works, and;

(g) Schedule of bid items including work and materials.

In addition to the preparation of necessary designs and tender documents for the execution of the project, the Consultant shall provide necessary services for the prequalification of contractors for each contract package, including the preparation of necessary documents for the invitation of applications and questionnaires for such prequalification, and the evaluation of such applications with recommendations regarding the capability of prospective bidders to undertake the construction of the required works for the project. A Draft Prequalification Document including the invitation and questionnaires shall be prepared and submitted by the Consultant to the DPWH/USAID for comments and approval. The Final Prequalification Document which appropriately incorporates the comments of DPWH/USAID shall be the one handed down by the Consultant to the prospective contractors. The final decision regarding the acceptability of each tenderer rests on the DPWH/USAID.

- Tendering

The Consultant, subsequent to the prequalification of contractors shall, upon receipt of the authorization to proceed from DPWH/USAID, provide necessary services for the invitation of tenders, evaluation of tenders and recommendations for the award of contract(s) to the most responsible bidder(s). The Consultant shall prepare and submit to the DPWH/USAID a detailed Tender Evaluation Report and the recommendation for the award of contract within one month of the closing date of tenders. The authorized representative of DPWH/USAID shall be present during the opening of bids. DPWH/USAID maintain the right of final decision in the acceptance of any tender.

The Consultant shall assist DPWH/USAID during contract negotiations and in coordination with DPWH/USAID, prepare and finalize all contracts relating to the carrying out of works for the project.

1.3.2 Construction Supervision

During the construction stage, the Consultant shall perform the following:

1.3.2.1 Provide necessary services for the supervision of the construction of the project(s) and the procurement and installation of equipment and materials to ensure completion of all works within the time allowed in each contract and to ensure that the conditions of the contracts are satisfactorily adhered too.

1.3.2.2 Check and/or approve as appropriate manufacturer's drawings and/or contractor's proposals relating to the construction of the project facilities and the procurement of equipment and materials.

1.3.2.3 Prepare all necessary work orders authorizing changes in the work, including altering plans and specifications, negotiating new or revised unit prices and other related activities, all for the approval by DPWH/USAID.

1.3.2.4 Review, evaluate and make recommendation to the DPWH/USAID on all proposals for changes by the Contractors.

1.3.2.5 Prepare any further designs and supply all necessary working drawings to the contractors for satisfactory execution of the works including those made necessary as a result of any modifications and/or alterations in the original tender documents.

1.3.2.6 Check as necessary, the location and alignment of all works as laid out by the Contractors and recommend acceptance or rejection of the works as constructed and equipment/materials procured.

1.3.2.7 Recommend acceptance or rejection of the materials to be used or incorporated in the works, to test such materials and to verify, if necessary, manufacturers certificates as presented by the contractors.

1.3.2.8 Issue interim payment certificates, certificates of completion, final payment certificates and maintenance certificates in accordance with the conditions of the contract.

1.3.2.9 Assist in settling disputes or differences in opinion which may arise between the client and the contractors, excepting litigation and arbitration.

1.3.2.10 Perform all other duties as necessary and incidental to the satisfactory execution of the Project.

1.3.2.11 Deliver to DPWH/USAID on the completion of the works all job records, reproducible record drawings and the instructions necessary for the satisfactory operation and maintenance of the works.

1.3.2.12 The Consultant shall provide any additional services related to the project upon request, to the approval of DPWH/USAID, on the basis of justifiable and mutually acceptable billing rates/costs. Such additional services shall also be subject to the prior approval of the USAID.

1.3.3 Other Related Activities

1.3.3.1 Monthly Progress Reports

The Consultant shall keep DPWH/USAID fully informed on all matters relating to the implementation of the project at all stages, including at the time of investigations, preparation of design and tender documents, construction supervision, etc., through Monthly Progress Reports and other special reports as necessary, Monthly Reports shall be submitted as early as possible and in no case later than the first week of the following month.

1.3.3.2 Contract Completion and Project Completion Reports

Within one month after the issuance of the completion certificates for each contract, the Consultant shall submit a Contract Completion Report. At the completion of the project, the Consultant shall prepare a Project Completion Report providing details of project implementation, costs, benefits and relevant information in a format acceptable to DPWH and the USAID. One year after project completion, the Consultant shall submit a Maintenance Analysis Report summarizing the conditions of the facilities and any remedial measures which need to be taken.

1.4 RESPONSIBILITY OF THE CONSULTANT

All engineering design shall be performed by or under the direct supervision of an engineer licensed in the Philippines to practice the engineering specialty in the specific area of design. All final design plans shall be signed by said licensed engineer.

The Consultant shall be responsible for all decisions relating to the suitability of the proposed designs, drawings and specifications of works for the project facilities, including supervision during construction of such works, and administrative and technical control of all relating contracts. DPWH/USAID however, reserves the right to override the decision of the Consultant in any matter relating to the execution of the Project; and for all such overriding decisions shall bear the related legal and/or financial responsibility.

APPENDIX E-2

MODEL STANDARD SPECIFICATIONS
FOR
PUBLIC WORKS CONSTRUCTION

FOREWORD

These specifications, representing a codification of documents from numerous city and county Public Works Departments, the Maricopa (Arizona) Association of Governments, the Colorado Contractor's Association and several other standards, were written to fulfill the need for uniform rules governing public works construction performed.

A uniform set of specifications, updated and embracing the most modern materials and construction techniques will redound to the benefit of the public and the private contracting industry. Uniform specifications will eliminate conflicts and confusion, lower construction costs, and encourage more competitive bidding by private contractors.

These Standard Specifications for Public Works Construction will be revised periodically and reprinted to reflect advanced thinking and the changing technology of the construction industry. To this end a Specifications Committee should be established as a permanent organization to continually study and recommend changes to the specifications.

Suggestions should be reviewed by the committee and appropriate segments of the industry and a cumulative annual supplement should be published each year. At approximately three-year intervals, the entire volume should be republished incorporating all current accepted revisions.

While in the interest of uniformity, it is hoped that all consulting engineers, developers and others will adopt these standards with as few changes as possible, it is recognized that because of various reasons some users will find it necessary to modify or supplement certain requirements. To accomodate such supplements, please utilize Section 205 Project Special Conditions and make necessary revisions.

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100 ABBREVIATIONS AND DEFINITIONS

101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, standard details or on the plans, they are to be construed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials
AAN	American Association of Nurserymen
AB	Aggregate Base
Aban	Abandon
ABC	Aggregate base course
AC	Asphalt cement or concrete
ACB	Asphalt concrete base
ACI	American Concrete Institute
ACP	Asbestos cement pipe
ACPA	American Concrete Pipe Association
ACWS	Asphalt concrete wearing surface
AGC	Associated General Contractors of America, Inc.
Agg	Aggregate
Ahd	Ahead
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
Approx	Approximate
APWA	American Public Works Association
AR	Aged residue
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
Asph	Asphalt
ASTM	American Society for Testing Materials
Ave	Avenue
AWPA	American Wood Preservers Association
AWSC	American Welding Society Code
AWWA	American Water Works Association
Bbl	Barrel
BC	Beginning of curve
BCR	Beginning of curb return
Beg	Beginning
Bk	Book or Back

Blvd	Boulevard
BM	Bench Mark of Board Measure
Brg	Bearing
BST	Bituminous Surface Treatment
BTB	Bituminous Treated Base
BTU	British Thermal Units
BVC	Beginning of vertical curve
C	Centigrade or Curb
CB	Catch Basin
CBF&C	Catch basin frame & cover
CC or C/C	Center to Center
CE	City or County Engineer
Cem	Cement
CF	Curb face
cfs	Cubic Feet per second
CIP	Cast Iron pipe
CIPP	Cast-in-place concrete pipe
CL or C	Centerline
Cm	Centimeter
CMP	Corrugated metal pipe
CO	Clean out
Col	Column
Conc	Concrete
Const	Construct
CP	Concrete pipe(non-reinforced)
CTB	Cement Treated Base
Cu	Cubic
CY	Cubic Yards
DBST	Double Bituminous Surface Treatment
Deg	Degree
DF	Douglas Fir
DG	Decomposed granite
Dia	Diameter
Dim	Dimension
DIP	Ductile Iron Pipe
Div	Division
DPW	McPherson County Department of Public Works
Dr	Drive
Drwg	Drawing
Dwy	Driveway
Ea	Each
Ease	Easement
E	East
EC	End of curve
ECR	End of curb return

El or Elv	Elevation
Equa or Eq	Equation
EVC	End of vertical curve
Ex or Exist	Existing
F	Fahrenheit
FB	Field Book
F & C	Frame & cover
FH	Fire hydrant
FL or F	Floor line or flow line
FlEl	Floor Elevation
Fnd	Found
fps	Feet per second
FS	Finished surface
FSS	Federal Specifications and Standards
Ft	Foot or feet
g	gram
G	Gutter
Ga	Gage
Galv	Galvanized
GL	Ground line
gpm	Gallons per minute
Gr	Grade
H	High or height
HC	House connection
Hdwl	Headwall
Horiz	Horizontal
Hwy	Highway
ID	Improvement District or inside diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronic Engineers
In	Inch
Inv	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
Irrig	Irrigation
Jt	Joint
JC	Junction Chamber
Jct	Junction
JS	Junction Structure
Ka	Kilogram
Km	Kilometer
L	Length
Lb	Pound

L&T	Lead and tack
LD	Local depression
LF	Linear Feet
LH	Lamp hole
Lin	Linear
Long	Longitudinal
Lt	Left
M	Map or maps
Max	Maximum
Meas	Measured
MH	Manhole
MHF&C	Manhole frame and cover
Min	Minutes or minimum
Misc	Miscellaneous
MLorM	Monument line
Mm	Millimeter
Mon	Monolithic or monument
MTD	Multiple tile duct
MUTCD	Manual of Uniform Traffic Control Devices
N	North
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NE	Northeast
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NP	Non-plastic
NPI	Non pay item
NSC	National Safety Council
NSF	National Sanitation Foundation
NW	Northwest
No	Number
OC	On center
OD	Outside diameter
Oz	Ounces
PC	Point of curvature
PCC	Point of compound curve or Portland Cement Concrete
PCCP	Portland Cement Concrete Pavement
PI	Point of intersection or plastic index
PL	Property line
POC	Point of Curve
POS	Point of Spiral
PP	Power pole

ppm	Parts per million
PRC	Point of reverse curve
Prod	Proposed or property
psi	Pounds per square inch
psf	Pounds per square foot
PTorPOT	Point of Tangent
P&TP	Power and telephone pole
Pvmt	Pavement
Q	Rate of flow
R	Radius
RC	Reinforced concrete
RCP	Reinforced concrete pipe
Rd	Road
Rdwy	Roadway
Reinf	Reinforced, Reinforcing
Ret Wall	Retaining Wall
RGRCP	Rubber Gasket Reinforced Concrete Pipe
rpm	Revolutions Per Minute
Rt	Right
R/W or ROW	Right-of-way
S	South or slope
SAE	Society of Automotive Engineers
San	Sanitary
SC	Spiral to Curve
SCCP	Steel cylinder concrete pipe
SD	Storm drain or Sewer District
SDDTC	Storm Drainage Design and Technical Criteria
Sdl	Saddle
Sec	Seconds
Sect	Section
SE	Southeast
SF	Square feet
Sht	Sheet
Spec	Specifications
SPR	Simplified Practice Recommendation
SpMH	Special manhole
Sq Ft/Yd	Square Foot, Yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
Str gr	Structural grade
Struct	Structure or structural

SW	Southwest
SY	Square Yard
T	Tangent Distance
Tel	Telephone
Temp	Temporary
TH	Test hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spirial
TSC	Traffic signal conduit
Typ	Typical
UL	Underwriters Laboratories
USC&GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
o	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

101.2 DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Addendum: A Supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

Advertisement: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

Agency: The government agency for which the construction is being done, either by permit or contract.

Agreement: The written agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are made a part thereof as provided therein.

Application for Payment: The form accepted by the ENGINEER which is to be used by CONTRACTOR in requesting progress or final payment and which is to include such supporting documentation as required by the Contract Documents.

Award: The formal action of the governing body is accepting a proposal.

Backfill: Material placed in an excavated space to fill such space. For trenches this space will be the area from 1 foot above the top of the pipe or conduit to the existing or proposed finished grade of pavement.

Base Course: The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

Bedding: Is the material placed in the area from the bottom of the trench to 1 foot above the top of the pipe or conduit.

Bid The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bidder: Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

Bond Issue Project: A project financed from bonds issued by the City or County pledging credit or a revenue resource.

Bridge: A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 12 m (13.12 ft) undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom or curbs or guard timbers or in the case of multiple height of curbs, between the bottom of the lower risers.

Budget Project: A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the governmental agency.

Building: Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

Building Code: A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specifications of materials and methods.

Calendar Day: Every day shown on the calendar.

Call for Bids: The standard forms inviting proposals or bids.

Change Order: A written order issued by the ENGINEER to the CONTRACTOR to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

Clerk: The duly authorized person who performs the duties of clerk for the Contracting Agency.

Completion Time: The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

Conflicting Utility Line: An existing utility line, shown or not shown on the plans, is conflicting line when any part falls within the trench pay widths as listed or within the dimensions, as shown on the plans, for appurtenant structures.

Construction Project: The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

Contingent Bid Item: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the ENGINEER determines that this work is required, the CONTRACTOR will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the ENGINEER may vary materially from this.

Contract: The written instrument executed by the CONTRACTOR and the Contracting Agency by which the CONTRACTOR is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the CONTRACTOR therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

Contract Documents: All the integral documents of the contract, including but not limited to, Call for Bids, Plans, Standard Specifications and Details, Special Provisions, Proposal Addenda, Performance Bond, Payment Bond, Certificates of Insurance, Ordinance, Contract, and Change Orders.

Contracting Agency: The legal entity that has contracted for the performance of the work or for whom the work is being performed.

CONTRACTOR: The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

Council: The Council which by law constitutes the Legislative Department of the governmental agency.

Culvert: Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

Days: Unless otherwise designated, days will be understood to mean calendar days.

Director: Director of Public Works.

DPW: Department of Public Works.

Emergency: Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection or work already done under the Contract Documents, or which endanger life or property and call for immediate action or remedy.

Engineer: The person, appointed as ENGINEER by the Council or the Board of Commissioners, acting directly or through his duly authorized representative.

Equipment: (Construction) - All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

Extra Work: An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

Field Order: A written set of emergency instructions to the CONTRACTOR issued only where the time required for preparation and execution of a formal Change Order would result in a delay or a stoppage of work, or would allow a hazardous condition to exist.

Flooding: Flooding will consist of the inundation of the entire lift with water, puddled with poles or bars to insure saturation of the entire lift.

Force Account Work: Extra work performed by the CONTRACTOR for which no bid price has been established and which is defined in Section 214.3.

Foundation: For buildings or structures, this will be the substructure. For pipe this will be the native material or prepared material on which the pipe rests; normally, this is the bottom grade line of the trench.

Full Depth Pavement: An asphalt concrete pavement structure in which the granular base and subbase are replaced by proportionate thickness of asphalt concrete.

Holiday: Holidays recognized are:

Additional legal holidays, when designated by the Governor or President, will also be recognized.

Inspector: The ENGINEER'S authorized representative assigned to make detailed inspections of contract performance.

Jetting: Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

Laboratory: The established materials testing laboratory of the Contracting Agency's, Engineering Department, or other laboratories acceptable to and/or authorized by the ENGINEER to test materials and work involved in the Contract.

Liquidated Damages: A daily charge made against the CONTRACTOR for each working day, including free time, that any work shall remain incompleted after elapse of Contract time.

Major Item: Any item of work and/or materials having an original contract value which exceeds ten percent of the amount of the original contract.

Materials: Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

Median: The portion of a divided highway separating the roadways used by traffic going in opposite directions.

Method of Measurement: The manner in which a "Pay Item" is measured to conform with the "Pay Unit".

Non Pay Item: An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

Notice of Award: A letter from the OWNER advising the CONTRACTOR that he is the successful Bidder and the OWNER has accepted his proposal.

Notice to Proceed: A directive issued by the Engineer, authorizing the CONTRACTOR to start the work or improvements required in the Contract.

Obligee: One to whom another is obligated.

Open Trench: The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

OWNER: The governmental agency, acting through its legally constituted officials, officers or employees.

Pavement: Any surface of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, portland cement or asphalt cement.

Pavement Structure: The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pay Item: A detail of work for which separate payments are to be made under the Contract, as specified in the proposal.

Payment Bond: The security provided by the CONTRACTOR solely for the protection of claimants, supplying labor and materials to the CONTRACTOR or his Subcontractors.

Performance Bond: The security by the CONTRACTOR solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

Permit: The license to do construction in public rights-of-way and/or easements; issued by an Agency to a CONTRACTOR working for another party.

Plans: All approved drawings or reproductions thereof pertaining to the work and details therefor, which are made a part of the Contract Documents.

Plant: The Contractors and/or subcontractors facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for preparation of materials and prosecution of work for the project.

Principal: The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

Profile Grade: The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Project: A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

Project Special Conditions: See definition for Special Conditions.

Proposal: The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

Proposal Form: The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

Proposal Guarantee: The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

Proposal Pamphlet: The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

Referred Documents: On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e.; Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

Resident Project Representative: The authorized representative of ENGINEER who may be assigned to the site or any part thereof. Also called the Inspector.

Reasonably Close Conformity: Compliance with reasonable and customary manufacturing and construction tolerances where working tolerances are not specified. Where working tolerances are specified, reasonably close conformity means compliance with such working tolerances.

Right-of-Way: A general term denoting, land, property or interest therein, usually in a strip, acquired for or devoted to a street, highway, or other public improvement.

Road: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Roadside: A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Development: Those items necessary to the complete roadway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

Roadway: The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

Salvageable Material: Material that can be saved or salvaged. Unless designated or directed by the ENGINEER or shown on the plans, all salvageable material shall remain the property of the Contractor.

Sewers: Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

Shop Drawings: Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data, which the CONTRACTOR is required to submit for approval.

Shoulder: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk: That portion of the roadway primarily constructed for the use of pedestrians.

Special Provisions: The special conditions, requirements, additions, and/or revisions to the Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration. Special provisions fall within one of the two following categories and take precedence as over the General Conditions in Section 210.

(a) Project Special Conditions. Special Conditions peculiar to the project and not otherwise thoroughly or appropriately set forth in the standard specifications or plans.

(b) Standard Special Conditions. Special directions or requirements not otherwise thoroughly or appropriately set forth in the standard specifications, and which are peculiar to a selected group of projects or which are intended for temporary use.

Specifications: The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

Standard Details: Uniform detail drawings of structures or devices adopted as Standard Details by the ENGINEER.

Standard Specifications: Uniform general specifications adopted as Standard Specifications by the ENGINEER.

Storm Drain: Any conduit and appurtenance intended for the reception and transfer of storm water.

Street: Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

Structures: Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, sewers, service pipes, underdrains, foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

Subbase: The lower course of the base of a roadway, immediately above the subgrade.

Subcontractors: Those having direct contracts with the CONTRACTOR and those who furnish material worked into a special design according to the Plans and Specifications for the work, but not those who merely furnish material not so worked.

Subgrade: The supporting structures on which the pavement and its special undercourses rest.

Substantial Completion: The work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, and Owner as evidenced by a definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to Substantial

Completion thereof. The work must meet the following criteria for Substantial Completion to apply:

- 90% of all pay items have been completed and are eligible for payment.
- The facility is ready for use.
- All traffic features have been completed.
- A "punch list" of remaining work has been prepared and accepted.

Substructure: All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

Superintendent: The Contractor's authorized representative in responsible charge of the work.

Superstructure: The entire structure or building except the substructure.

Supplemental Specifications: Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book.

Supplementary General Conditions: Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration.

Surety: The individual, firm or corporation, bound with and for the CONTRACTOR for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Surface Course: The finish or wearing course of an asphalt concrete pavement structure.

Title or Headings: The titles or headings or the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

Traveled Way: The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Utility: Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

Waterworks (Water Supply System): The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

Work: Any of all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

Working Day: A calendar day, exclusive of Saturdays, Sundays and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the CONTRACTOR will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

101.3 In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned, it shall be understood as if the expression were followed by the words by the ENGINEER or to the ENGINEER.

BIDDING REQUIREMENTS AND CONDITIONS

102 GENERAL PROVISIONS

102.1 NOTICE TO BIDDERS:

PUBLIC NOTICE is hereby given that there are on file with the (list location), plans, specifications, and form of contract for _____.

Sealed bids will be received at the office of (list location), until ____ local time on the _____ day of _____, 19_, for furnishing all labor, tools, materials, and equipment required to construct said public improvement per the plans and specifications now on file for public examination in the office of the _____, and available at the office of (consultant/Address). _____. Such bids as are received will be publicly opened and read aloud at _____ local time on the above stated day.

The work generally consists of [example--pavement rehabilitation of rural, suburban residential and suburban arterial roadways, including asphalt overlays of varying thicknesses, cold milling of existing pavement, patching, curb & gutter and crosspan reconstruction, placement of pavement fabric and minor shoulder and ditch work.]

Each bid shall be made on a form furnished by (consultant) _____ and no bidder may withdraw his bid for a period of thirty (30) days from and after the date set for opening of bids. Each bid must be accompanied, in a sealed envelope, separate from the one containing the bid, by a bid bond on an approved form in the amount equal to five percent (5%) of the bid price, made payable to _____, which shall be considered as liquidated damages and shall be forfeited to the OWNER if said bid is accepted and the bidder fails to execute the contract and file the required Performance Bond and Labor and Materials Payment Bond as required in the Contract Documents by one week after the acceptance of the contractor's bid by the OWNER which consideration for acceptance will occur on _____.

The work herein provided for shall be done under written contract with the contractor submitting the bid which the OWNER deems to be in the best interests of the OWNER.

The successful bidder will be required to furnish, as part of the contract documents, an insurance certificate in the amount of _____, a Performance Bond and Labor and Materials Payment Bond each in an amount equal to 100% of its contract price, said bonds to be issued by a responsible corporate surety approved by the OWNER and shall guarantee the faithful performance of the contract and the terms and conditions therein contained and shall guarantee the prompt payment of all materials and labor and protect and save harmless the OWNER from claims and damages of any kind caused by the operations of the Contractor.

Plans and Specifications and other Contract Documents may be obtained from the office of the Engineer, _____ at the address herein above given, upon payment of ___ _____ ($), which amount will not be refunded.

The OWNER reserves the right to waive informalities or irregularities and to reject any or all proposals.

Published upon order of the _____.
OWNER

By: _____
Title

ATTEST:

_____
Title

102.2 INSTRUCTIONS TO BIDDERS:

102.2.1 Owner:

The Owner of this project is the _____.

102.2.2 Engineer:

The Engineer of this Project _____
_____
_____.

102.2.3 Proposal Form:

Each bid must be submitted on the Proposal Form supplied by:
_____

102.2.4 Bid Security:

Each Proposal must be accompanied by a bid security of the type and in an amount equal to the sum set out in the Notice to Contractors. The bid security will be retained until a Contract is entered into by the successful low Bidder and the required Bonds and Insurance Certificates filed.

102.2.5 Preparation of Proposal

The Bidder shall submit his proposal upon the forms furnished by the Owner. The Bidder shall specify a unit price in words or figures, or both if required, for each pay item for which a quantity is given and shall also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose and the total amount of the proposal obtained by adding the amounts of the several items. All the words and figures shall be in ink or type. In case of a discrepancy between the prices written in words and those written in figures, when both are required, the prices written in words shall govern.

When an item in the proposal contains a choice to be made by the bidder, the bidder shall indicate his choice in accordance with the specifications for that particular item, and thereafter no further choice will be permitted.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by two officers of a corporation, or by an agent of the Contractor legally qualified and acceptable to the Owner. If the proposal is made by an individual, his name and post office address must be shown; by a

partnership, the name and post office address of each partnership member must be shown; as a joint venture, the name and post office address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate officials must be shown.

102.2.6 Submitting Proposals:

Each Proposal must be submitted in ink or typewritten in a sealed envelope with the following information on the outside: the Bidder's name, address, name of the project and the work "PROPOSAL". The bid security must be submitted in a separate sealed envelope with the following information on the outside: "BID SECURITY". If the Proposal is mailed, the two separate envelopes shall be placed in a mailing envelope, sealed and addressed to the Owner. The mailing envelope must have the following information on the outside: The Bidder's name, address, name of the project, and the words "PROPOSAL AND BID SECURITY".

102.2.7 Withdrawal Period:

No Bidder may withdraw a Proposal within _____ days after the date of opening of bids.

102.2.8 Informalities:

The Owner may waive any informalities or reject any or all bids.

102.2.9 Qualifications of Bidder:

The Owner may make such investigations as he deems necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein. Conditional bids will not be accepted.

102.2.10 Conditions of Work:

Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible the Contractor, in carrying out his work, must employ such methods or means as

will not cause any interruption of or interference with the work of any other Contractor.

Reference is made to the Special Conditions for the availability of surveys and investigations made for the Owner by Independent Testing Laboratories of subsurface or physical conditions at the site or otherwise affecting performance of the work which have been relied upon by: _____ in preparing the Drawings and Specifications. Before submitting his bid, each Bidder shall, at his own expense, make such additional surveys and investigations as he may deem necessary for the performance of the work at his bid price within the terms of the Contract documents.

102.2.11 Addenda and Interpretations:

No interpretation of the meaning of the Drawings, Specifications or other prebid documents will be made to any Bidder orally. Every request for such interpretation should be in writing addressed to: _____ _____ at the address hereinbefore given, and to be given consideration must be received at least eight days prior to the date fixed for the opening of bids. Any and all such interpretation and any supplemental instructions will be in the form of written Addenda which, if issued, will generally be mailed by certified mail with return receipt requested to all parties recorded as having received bidding documents (at the respective addresses furnished for such purposes), prior to the date fixed for the opening of bids, however, it will be the Bidder's responsibility to verify with the Architect-Engineer and/or Owner that all Addenda have been received prior to submitting a bid. All Addenda so issued shall become part of the Contract Documents.

102.2.12 Power of Attorney:

Attorneys-in-fact who sign Bid Bonds, Performance Bonds or Labor and Materials Payment Bonds must file with each bond a certified and effectively dated copy of their power of attorney.

Upon notice of award and prior to execution of the Contract, any successful bidder who is not a legal resident of the (list location, eg. County, province, etc.) shall appoint his process agent in accordance with the requisites of law within the jurisdiction where the project is located. The term of appointment of said process agent shall be for the full term of the surety bonds to be furnished by the Contractor as a part of these Contract Documents.

102.2.13 Laws and Regulations:

The Bidder's attention is directed to the fact that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though therein written out in full.

102.2.14 Obligation of Bidder:

At the time of the opening of bids each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Drawings, Specifications and other Contract Documents including all Addenda. The failure or omission of any Bidder to examine any form, instrument or document shall in no way relieve any Bidder from any obligation in respect of his bid.

102.2.15 Telegraphic Modification:

Bids received prior to the time of opening will be securely kept, unopened. The officer whose duty it is to open them will decide when the specified time has arrived, and no bid received thereafter will be considered. Modification by telegraph of bids already submitted will be considered if received prior to the time set for opening and written confirmation of such modification over the signature of the Bidder is placed in the mail and postmarked prior to the time set forbid opening; however, if written confirmation is not received within two days from the closing time, no consideration will be given to the telegraphic modification. Bidders are cautioned that, while telegraphic modifications of bids may be received as provided above, such modifications, if not explicit and if in any sense subject to misinterpretation, shall make the bid so modified or amended subject to rejection by the Owner. The telegraphic communication should not reveal the bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened.

102.2.16 Method of Award:

A. The Owner reserves the right to reject any or all bids and to pass upon the regularity or waive any irregularities of the bidders and to determine the acceptability of the surety offered.

B. If Bid Schedules are set forth in the Proposals, Contractors must bid on all Schedules. The contractor's bid considered for award shall be the sum of the bids on all schedules.

C. Portions of any project may have been termed "Alternates" and the Owner reserves the right to include or remove any or all of these Alternates from the Contract at his sole option or discretion.

D. Alternate bids, which are determined to in the best interest of the project will be considered in evaluating the bids.

E. Bids may be considered unresponsive if they do not include bids for all Alternates.

102.2.19 Permits:

The Contractor Shall be required to obtain permits to perform all construction activities associated with the project from the Owner. Such permits will be issued on a no-fee basis.

102.3 FORM OF PROPOSAL:

Bidder: _____

Project: _____

PROPOSAL

_____, 19__

The undersigned, having carefully examined the Drawings, Specifications, and all Addenda thereto and other Contract Documents prepared by _____ _____ for the construction of _____ _____ and having carefully examined the site of work and become familiar with all local conditions including labor affecting the cost thereof, and having familiarized himself with federal, state and local laws, ordinances, rules and regulations affecting performance of the work, do hereby propose to furnish all labor, mechanics, superintendence, tools, material, equipment, and all utilities and transportation services necessary to perform and complete said work and work incidental thereto, in a workmanlike manner, as described in said Drawings, Specifications, and other Contract Documents including Addenda No(s). _____ _____ issued thereto, for the base bid sum of:_____ _____ Dollars ($ _____).

The undersigned further certifies that he has personally inspected the actual location of the work, together with the local sources of supply and that he understands the conditions under which the work is to be performed, or that if he has not so inspected the site and conditions of the work, he waives all right to plead any misunderstanding regarding the work required or conditions peculiar to the same.

The undersigned understands that the quantities mentioned below are subject to increase or decrease, and hereby proposes to perform all quantities of work, as increased or decreased, in accordance with the provisions of the Contract Documents, and at the unit price bid.

The following is the itemized Bid Schedule:

PROJECT: _____

BID SCHEDULE

Item No.	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	_____			$	$ ____
2.	_____			$	$ ____
3.	_____			$	$ ____
4.	_____			$	$ ____
5.	_____			$	$ ____
6.	_____			$	$ ____
7.	_____			$	$ ____
8.	_____			$	$ ____
9.	_____			$	$
10.	_____			$	$ ____
11.	_____			$	$ ____

12.	_____	$	$____
13.	_____	$	$____
14.	_____	$	$____
16.	_____	$	$____
17.	_____	$	$____
18.	_____	$	$____
19.	_____	$	$____
20.	_____	$	$____
21.	_____	$	$____
22.	_____	$	$____
23.	_____	$	$____

TOTAL BASE BID
(Items 1 thru __, inclusive) $_____

The undersigned hereby agrees, if awarded the Contract to furnish a Performance Bond in an amount equal to One Hundred percent (100%) of the Contract Sum as security for the faithful performance of the Contract (including guarantee provisions) and also a Labor and Materials Payment Bond in an amount not less than One Hundred percent (100%) of the Contract Sum as security for the payment of all persons performing labor on the project under the Contract and furnishing materials in connection with this Contract.

Should the Owner elect to accept this proposal, the undersigned also agrees to furnish the required Bonds and Insurance Certificates and to execute the Contract on or before _____ and after the said acceptance and further agrees to begin and complete all work under Contract within the time limit set forth in the Supplementary Conditions.

Accompanying this Proposal, as a guaranty that the undersigned will execute the Contract and furnish satisfactory Bonds and Insurance Certificates in accordance with the terms and requirements of the Contract Documents, is a bid security of the type specified in the Notice to Contractors made payable to the _____ _____ in an amount of $_____.

It is hereby agreed that in case of failure of the undersigned either to execute the Contract or to furnish Bonds or Insurance Certificates which are satisfactory to the Owner within the time limitations stated herein after issuance of Notice to Award, the amount of this proposal guaranty shall be forfeited to the (list owner) as liquidated damages arising out of the failure of the undersigned either to execute the Contract or to furnish Bonds or Insurance Certificates as proposed. It is understood that in case the undersigned is not awarded the work, the proposal guaranty will be returned as provided in the Contract Documents.

If awarded the Contract, our Surety will be

_____ of _____
Name of Surety Company

FOR BIDDERS WHO ARE NOT LEGAL RESIDENTS OF _____ ONLY:

If awarded the Contract, our Process Agent will be

_____ of _____

It is expressly agreed that if portions of the work are subcontracted, that awards of such subcontracts will be made to the subcontractor stated below:

Work:	Subcontractor:
_____	_____ (Name)
	_____ (Address)

Work: Subcontractor:

_____ _____
(Name)

_____
(Address)

Work: Subcontractor:

_____ _____
(Name)

_____
(Address)

In the event of a discrepancy between unit price quoted in this Proposal and the extensions or totals, the unit prices shall control.

Respectfully Submitted,

Signature of Bidder:

(a) If an individual: _____
(Signature of Individual)

doing business as: _____
(Name of Firm)

(b) If a Partnership: _____
(Name of Partnership)

_____
(Signature of Partner)

_____
(Signature of Partner)

(c) If a Corporation: _____
(Name of Corporation)

ATTEST: _____
(Officer's Signature)

_____
(Title)

Business Address:

_____

_____

_____

Phone No. _____

"CERTIFICATE"

A Corporate Contractor, in submitting this Proposal hereby represents that the Corporation has complied with all _____ Statutory requirements, which are prerequisite to its being qualified to do business in _____ , or that it will take all steps necessary to so qualify, if the successful bidder.

_____
(Name of Corporation)

By _____
(Officer) (Title)

If Foreign Corporation: _____
_____ Resident Agent

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SYNOPSIS OF EXPERIENCE RECORD

(This synopsis must accompany Proposal Form)

Name of Bidder: _____

Business Address: _____

Individual ( ) Partnership ( ) Corporation ( ) (Check One)

Construction successfully completed within past five years similar in size, scope, and difficulty of construction to the work bid upon.

NAME OF COMPANY	NAME OF PROJECT	LOCATION OF PROJECT	AMOUNT OF CONTRACT
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____
5. _____	_____	_____	_____

NUMBER OF CONTRACT DAYS ALLOWED FOR ABOVE PROJECTS	ACTUAL NUMBER OF DAYS TO COMPLETE ABOVE PROJECT
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

(Signed) _____
(Name of Company)

(By) _____

(Title) _____

Date _____

102.4 FORM OF CONTRACT: (Sheet 1 of 3)

CONTRACT

THIS CONTRACT AND AGREEMENT, made and entered into in quadruplicate this ____ day of _____, 19___, (contract date) by and between _____.

Party of the First Part, and hereinafter called the Owner, and

_____

of _____

Party of the Second Part, and hereinafter called the Contractor.

WITNESSETH: That the Contractor, for and in consideration of the sum of

_____ Dollars ($ _____)
payable as set forth in the Contract Documents constituting a part of this Contract, hereby agrees to construct:

_____
complete in accordance with the Drawings, Specifications

Supplementary and General Conditions and Addenda Nos., therefore; the various items of work awarded said Contractor by the acceptance of the Proposal are as follows:

_____

_____

as shown in schedule of prices bid in the Proposal which is made a part of this Contract.

It is mutually understood and agreed by the parties hereto that (1) the Notice inviting Contractors to bid as published, (2) the Instructions to Bidders, (3) Supplementary and Special Conditions and all enclosures issued therewith, (4) the General Conditions, (5) the Form of Proposal, (6) the Bonds each in consideration of one hundred percent (100%) of the sum hereinafter mentioned, (7) all proceedings by the governing body of said Owner relating to this improvement, (8) the General and Detailed Drawings, (9) Specifications, and (10) all Addenda including their attachments, if any, are a part of this Contract the same as if each had been fully set out and attached hereto, and that no substitution or change in said Drawings and Specifications shall be made except upon written consent of the Owner and the Owner's Special Consultant: _____

and such allowance shall in no manner be construed to release either party from any specified or implied obligation of said Drawings and Specifications and other Contract Documents.

The Contractor herein also agrees to pay all just claims for material, supplies, tools, fuels, lubricants, equipment, equipment rental, machinery, insurance premiums, and services used or consumed in the construction of the work by him or any of his subcontractors, and for the payment of all laborers and mechanics for all labor performed in the work by him or any of his subcontractors, and for all other just claims filed against him or any of his subcontractors in carrying out the provisions of this Contract and further agrees that the Bonds shall be held to cover all such claims.

The Contractor shall not assign any moneys due or to become due without the prior written consent of the Owner. The Owner and the Contractor each binds himself, his partners, successors, assigns and legal representatives to the other party hereto in respect to all covenants, agreements and obligations contained in the Contract Documents.

In connection with the performance of the work under this Contract, the Contractor agrees not to refuse to hire, discharge, promote or demote, or discriminate in matters of compensation against any person otherwise qualified, solely because of race, creed, sex, color, national origin or ancestry; the Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

Local labor shall be employed to perform the work herein to the extend of not less than 80% of each type or class of labor in the several classifications of skilled and common labor employed on the project. The term "Local", shall mean any person who is a resident of the list country, province, municipalities,. Preference shall be given to labor and to supplies, materials, and provisions produced, manufactured, or grown in _____, quality being equal to articles offered by competitors outside the _____.

The Contract Documents constitute the entire agreement between the Owner and the Contractor and may only be altered, amended or repealed by a duly executed written instrument.

It is understood and agreed that the Contractor shall not do any work or furnish any material not covered and authorized by this Contract, except under an executed Change Order. Any such work which may be done or any such materials which may be furnished by the Contractor without such written order first being given, shall be at his own risk, cost and expense; and the Contractor hereby covenants and agrees that he shall make no claim for compensation for any work so done or any materials so furnished.

IN WITNESS WHEREOF, we, the contracting parties by our agents hereto affix our signatures and seals.

Attest:
Title

_____

OWNER - Party of the First Part

_____
(Title)

_____
(Title)

_____
(Title)

_____
Contractor-Party of the Second Party

By _____

_____
(Title)

Attest (Witness):

_____
(Title)

102.5 FORM OF BOND

102.5.1 Bid Bond

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

_____ as Principal, and
(Name and Address of Contractor)

_____ as Surety, are hereby
(Name and Address of Surety)

held and firmly bound unto _____
(Name of Owner)

as OWNER in the penal sum of _____

for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors, and assign.

Signed this _____ day of _____, 19 ____.

The Condition of the above obligation is such that whereas the Principal

has submitted to _____, a certain BID, attached hereto and hereby made a part hereof to enter a contract in writing, for the _____

_____

_____

NOW THEREFORE,

(a) If said BID shall be rejected, or

(b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (property completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being

expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by an extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____
(Principal, Contractor)

_____
(Surety)

BY: _____

IMPORTANT - - Surety companies executing BONDS must appear on the Treasury Department's most current list (_____) and be authorized to transact business in the (list country) where the project is located.

102.5.2 Performance Bond

KNOW ALL MEN BY THESE PRESENTS: that _____

_____

as Principal, hereinafter called Contractor, and, _____

_____

as Surety, hereinafter called Surety, are held and firmly bound unto _____

_____

_____

as Obligee, hereinafter called Owner, in the amount of _____

_____ Dollars ($ _____),

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 19 ___, entered into a contract with Owner for

_____

_____

_____

in accordance with Drawings and Specifications prepared by

_____

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration or extension of time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly

1) Complete the Contract in accordance with its terms and conditions, or

2) Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, or if the Owner elects, upon determination by the Owner and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as Work progresses (even though there should be a default or a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price", as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

Any suit under this bond must be instituted before the expiration of five (5) years from the date on which final payment under the Contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of the Owner.

_____

Principal (Seal)

_____

(Title)

_____

Surety (Seal)

_____

(Title)

_____

_____

(Resident Agent)

102.5.3 LABOR AND MATERIAL PAYMENT BOND

This Bond is issued simultaneously with Performance Bond if favor of the Owner conditioned on the full and faithful performance of the Contract)

_____

KNOW ALL MEN BY THESE PRESENTS: that _____

as Principal, hereinafter called Contractor, and, _____

_____

as Surety, hereinafter called Surety, are held and firmly bound unto

_____

_____

as Obligee, hereinafter call Owner, for the use and benefits of claimants

as hereinbelow defined, in the amount of _____

_____

_____ Dollars ($_____),

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 19___, entered into a contract with Owner for

_____

_____

_____

in accordance with Drawings and Specifications prepared by

_____

which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if Contractor shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonable required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Contractor or with a Subcontractor of the Contractor for labor, material, or both, used or reasonable required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental or equipment directly applicable to the Contract.

2. The above named Contractor and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgement for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant;

a) Unless claimant, other than one having a direct contract with the Contractor, shall have given written notice to any two of the following: The Contractor, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Contractor, Owner or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

b) After the expiration of one (1) year following the date on which Contractor ceased Work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

c) Other than in a court of competent jurisdiction in and for the political subdivision of the _____ in which the Project, or any part thereof, is situated, or in the _ _____ District court for the district in which the Project, or any part thereof, is situated, and not elsewhere.

4. The amount of this Bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this Bond.

_____

Contractor (Seal)

_____

(Title)

_____

Surety (Seal)

_____

(Title)

_____

_____

(Resident Agent)

CERTIFICATE AS TO CORPORATE CONTRACTOR

I, _____, certify that I am the (Assistant) Secretary of the corporation named as Contractor in the within bond; that _____, who signed the said bond on behalf of the Contractor was then _____ of said corporation; that I know his signature thereto is genuine; and that said bond was duly signed, sealed, and attested to for and in behalf of said corporation by authority of its governing body.

(Corporate Seal)

_____
Signature of Corporate Secretary or Assistant Secretary

* * * * * * * * * * * * * *

ACKNOWLEDGEMENT OF CONTRACTOR
(If not a Corporation)

STATE OF _____)
County of _____):ss

On this _____ day of _____ in the year 19 __, before me personally appeared _____ known to me to be the person who is described in, and who executed the within instrument, and acknowledged to me that he or they executed the same.

_____
Signature of Notary Public

My Commission Expires:

_____
(Seal)

* * * * * * * * * * * * * *

ACKNOWLEDGEMENT OF CONTRACTOR

STATE OF _____)
County of _____)

On this ___ day of _____,19___, before me, a Notary Public, personally appeared _____ known to me to be the _____ of the corporation that is described in and that executed the within instrument, and acknowledged to me that such corporation executed the same, that he is ____ _____ of the corporation described in and which executed the foregoing instrument; that he knew the seal of the corporation; that the seal affixed to said instrument was such corporate seal; that it was so affixed by order of the Board of Directors of said corporation; and that he signed his name thereto by like order.

_____
Signature of Notary Public

My Commission Expires:

_____
(Seal)

POWER OF ATTORNEY TO BE ATTACHED

103 AWARD AND EXECUTION OF CONTRACT

103.1 CONSIDERATION OF PROPOSALS:

After the proposals are opened and read, they will be compared on the basis of the summation of the products of the approximate quantities shown in the bid schedule by the unit bid prices. The results of such comparisons will be immediately available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if in the judgement of the awarding authority the best interests of the Owner will be promoted thereby.

The Owner reserves the right to settle bid discrepancies, as defined in this subsection and in subsection 102.2.5 that occur in the low bidders proposal at the time the contract is awarded. Bid discrepancies will be settled with the understanding that the low bidder waives any claims against the Owner because of the bidders mistakes in the bid proposal.

103.2 AWARD OF CONTRACT:

The award of contract, if it be awarded, will be made within 30 calendar days after the opening of proposals to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified, by letter mailed to the address shown on his proposal, that his bid has been accepted and that he has been awarded the contract.

103.3 CANCELLATION OF AWARD:

The Owner reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the Owner.

103.4 RETURN OF PROPOSAL GUARANTY:

All proposal guaranties consisting of bid bonds will be retained by the Owner.

All proposal guaranties consisting of certified checks or cashiers checks will be treated as follows:

(a) For the three lowest bidders, the proposal guaranty will be held until the Contract is awarded to the successful bidder. Proposal guaranty will then be returned immediately to the other two bidders. The proposal guaranty will not be returned to the successful bidder until a satisfactory performance bond has been furnished and the contract has been executed.

(b) For all other bidders, the proposal guaranty will be returned promptly after the opening of bids and verification of the proposals.

103.5 REQUIREMENT OF CONTRACT BOND:

At the time of the execution of the Contract, the successful bidder shall furnish a surety bond or bonds in a penal sum equal to the nearest integral one hundred dollars in excess of the estimated contract price. The form of the bonds and the security shall be acceptable to the Owner.

103.6 EXECUTION AND APPROVAL OF CONTRACT:

The Contract shall be signed by the successful bidder and returned, together with the Contract Bond, within 15 days after the date of award. If the signed Contract and Bond is returned by the successful bidder within 15 days after award and if the Contract is not executed by the Owner within 30 days from date of award, the bidder shall have the right to withdraw his bid without penalty. No Contract shall be considered effective until it has been fully executed by all of the parties thereto.

103.7 FAILURE TO EXECUTE CONTRACT:

Failure to execute the Contract and file acceptable bonds within 15 days after the date of award shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the Owner. The Owner may elect to waive forfeiture of the proposal guaranty only if it is determined that the bidder has made a good faith remedial error and that no damages were sustained by the Owner as a result of the failure by the successful bidder to execute the contract and file acceptable bonds within the time prescribed. Award may then be made to the next lowest responsible bidder, or the work may be re-advertised and constructed under contract or otherwise, as the Owner may decide.

104 THE CONTRACT: FOLLOWING EXECUTION

104.1 MATERIALS:

Unless otherwise stipulated, the CONTRACTOR shall provide and pay for all materials, labor, water, tools, equipment, light power, transportation, and other facilities necessary for the execution and completion of the work. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

104.2 PROGRESS SCHEDULE:

The CONTRACTOR shall submit, at such times as may reasonably be requested by the ENGINEER, schedules which shall show the order in which he proposes to carry on the work,

with dates at which the CONTRACTOR will start the several parts of the work, and estimated dates of completion of the several parts. The special provisions or Plans may require that certain phases or parts of the work be completed first or in a certain order. If the CONTRACTOR elects to use PERT or CPM charts, he shall furnish copies of them and all revisions thereto or amendments thereto as the work progresses to the ENGINEER upon request.

104.3 SCHEDULE OF UNIT PRICES:

104.3.1

Promptly following the execution of the contract documents for all lump sum contracts, the CONTRACTOR shall prepare and transmit to the ENGINEER two Copies of an itemized breakdown showing the unit quantities of each major construction item and the corresponding unit prices. Such unit prices shall contain all costs including profit of each item complete in place. The total cost of all items shall equal the contract price for the project. This breakdown when approved by the ENGINEER, will be used primarily in determining payment due the CONTRACTOR on periodical estimates. If, in the opinion of the ENGINEER, any unit price submitted by the CONTRACTOR is unbalanced, a detailed breakdown of the items contained in the unit will be required.

104.3.2

For contracts bid on a unit price basis, unit bid prices for completed work will be used in determining payment due the CONTRACTOR on periodical estimates. Partially completed units may be paid for in periodical estimates.

104.4 SURVEYS:

The Owner will furnish all site surveys, easements, pipeline licenses, etc. necessary to authorize construction of any permanent works required in the Specifications where such work is to be done on property other than the Owner's.

104.5 TAXATION:

The CONTRACTOR shall pay all fees and taxes including State and City sales and use taxes. (See Special Conditions Section 201.24.)

104.6 ASSIGNMENT OF CONTRACT:

No assignment by the CONTRACTOR of this contract or any part thereof or of the funds to be received thereunder by the CONTRACTOR will be recognized unless such assignment has had the written approval of the Owner and the surety has been given due notice of such assignment and has furnished written consent thereto. Such written

approval by the Owner shall not relieve the CONTRACTOR of the obligations incurred by him under the terms of this contract. In addition to the usual recitals in assignment contracts, the following language must be set forth:

> "It is agreed that the funds to be paid to the assignee under this assignment are subject to a prior lien for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms, or corporations rendering such services or supplying such materials."

104.7 SUBLETTING OF CONTRACT:

The CONTRACTOR shall as soon as practical after signing the contract, notify the ENGINEER in writing, giving the names and qualifications of all subcontractors proposed for work and shall not employ any that the ENGINEER may within a reasonable time object to. The CONTRACTOR will not be allowed to subcontract more than fifty percent (50%) of the total monetary value of the contract without prior approval of the owner. The CONTRACTOR shall notify the ENGINEER of each subcontract he awards, giving:

A. Name, address, and telephone number of the subcontractor

B. Branch of work covered

C. Total price of subcontract

D. Date of subcontract

Subcontractors, before commencing work, must file with the ENGINEER satisfactory certificates in duplicate showing insurance coverage. Failure of the subcontractor to provide such certificates shall not relieve the CONTRACTOR of his obligation to insure and to hold the Owner harmless. Subcontractors shall also file with the ENGINEER copies of applicable permits and licenses required to do the subcontracted work.

104.8 OTHER CONTRACTS:

The Owner may award other contracts for additional work, and the CONTRACTOR shall fully cooperate with such other contractors and carefully fit his own work to that provided under the other contracts as may be directed by the ENGINEER. The CONTRACTOR shall not commit or permit any act which will interfere with the performance of work by any other contractor.

105 CONTRACT FORMS

105.1	NOTICE OF AWARD	100-47
105.2	NOTICE TO PROCEED	100-48
105.3	SHOP DRAWING TRANSMITTAL FORM	100-50
105.4	FORM OF FIELD ORDER	100-52
105.5	FORM OF CHANGE ORDER	100-53
105.6	APPLICATION FOR PAYMENT	100-53
105.7	STATEMENT CONCERNING CLAIMS	100-55
105.8	FORM OF PARTIAL WAIVER OF LIEN	100-56
105.9	FORM OF FINAL WAIVER OF LIEN	100-58
105.10	NOTICE OF FINAL SETTLEMENT (Substantial Completion)	100-60
105.12	LETTER OF ACCEPTANCE (Final Completion)	100-61

This is for the Logo on all the various forms

To:

Description of Work:

The _____ (OWNER) has considered the BID submitted by you for the above described WORK in response to its Advertisement for BIDS dated _____,_____, and Information for Bidders. You are hereby notified that your BID has been accepted for items in the amount of $_____.

You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and certificates of insurance on or before

_____, _____ in accordance with the Contract Documents.

If you fail to execute said Agreement and to furnish said BONDS on or before above stated date, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, 19___.

_____
Title

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

by _____
this the _____ day of _____, 19___.
By _____.

To:

Description of Work:

You are hereby notified to commence WORK in accordance with the Agreement dated _____ _____,19___, on or before _____, 19___ and you are to complete the WORK within _____ consecutive calendar days after the date of this Notice to Proceed. The date of completion of all WORK is therefore _____, 19___.

Engineer

_____
Title

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

by _____

this the _____ day of _____, 19___.

(One Copy) Office _____ (One Copy) Owner _____ (One Copy) Field _____ (___ Copies) Contractor ___

PROJECT: _____

_____

DATE: _____

Shop Drawing Transmittal Form

JOB NO: _____

TO: _____

_____

_____

Transmittal Number _____ 1st Submittal _____ Resubmittal _____
(Previous Transmittal Number: _____)

Specification Section Number _____ Division No. _____

_____

Para No.	Drwg. or Description of Equipment	Manufacturer	Data No.	Action Taken

As stated in the Contract Documents, the undersigned CONTRACTOR'S submission of these Shop Drawings or samples shall constitute a representation to the OWNER and the ARCHITECT-ENGINEER that the CONTRACTOR has either determined and verified all quantities, dimensions, field construction criteria, materials, catalogue numbers and similar data or he assumes full responsibility for doing so, and that he has reviewed and coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents and he represents to the OWNER and the ARCHITECT-ENGINEER that item(s) described by these Shop Drawings do comply with the requirements of the Contract Documents. The undersigned Contractor certified that the equipment included in this submittal complies with the latest requirements of the Occupational Health and Safety Act including any standards or regulations established by the (list agency) in administration of said act.

NOTE: Please submit a minimum of four signed copies of this form with each submittal. All pages of this form on which equipment is listedX must be signed.

X ______________________
(Authorized Signature of Contractor)

X ______________________
(Firm Name)

X ______________________
(Mailing Address)

* *

(THIS SPACE FOR ARCHITECT-ENGINEER)

The above drawings are returned with action as designated above in accordance with the following legend:

A No Exception Taken
B Make Corrections Noted and Resubmit Corrected Copies
C Revise and Resubmit
D Rejected
E Submit Specified Item

By ______________________

Date: ______________________

FIELD ORDER

Order No. _____

Project Title _____

Project No. _____ Contract No. _____ Contract Date _____

Contractor _____

You are hereby authorized and instructed to effect the following modifications of the contract for the foregoing named project:

Maximum Cost $ _____

or Minimum Credit $ _____

This form shall be used only for the issuance of emergency instructions to the CONTRACTOR where the time required for preparation and execution of a formal Change Order would result in delay or stoppage of the work, or would allow a hazardous condition to exist. A duly authorized Change Order shall replace this Field Order as soon as possible and shall bear appropriate reference to this Field Order.

DISTRIBUTION:
1. Contractor
2. Proj. Mgr.
3. Field Office
4. Files
5. Owner

_____ _____
Date Resident Project Representative

_____ _____
Date Contractor's Authorized Representative

To:

Description of Original Work:

It is hereby mutually agreed that when this Change Order has been signed by the contracting parties, the following described changes shall be executed by the Contractor without changing the terms of the Contract, except as herein stipulated and agreed.

Description of change (use attachment if necessary) made to the Contract Documents:

The Contractor agrees to furnish all materials and labor and to perform all work required to complete the above described changes in accordance with the requirements for similar work covered by the Contract, except as otherwise stipulated herein, for the following considerations:

Change to CONTRACT PRICE

Original CONTRACT PRICE $_____
Current CONTRACT PRICE adjusted by Change Orders
_____ Thru ___ $_____
The CONTRACT PRICE due to this Change Order will be
(Increased)(Decreased)(Unchanged) by $_____
The new CONTRACT PRICE including this Change Order
will be $_____

Change to CONTRACT TIME

Current CONTRACT Completion Date _____
The CONTRACT TIME will be (Increased)(Decreased)
(Unchanged) by _____ Calendar Days.
The date for completion of all WORK will be _____
RECOMMENDED FOR ACCEPTANCE:

_____
Engineer

By: _____ By:_____

Date: _____ Date: _____
ACCEPTED:

_____ Owner
Contractor
By:_____ By: _____
Chairman

Date: _____ Date: _____

Contractor:

Description of Work:

Summary of Contract Account:

1)	Total accumulated work on original contract to date	$_____
2)	Extra work by Change Order to date	$_____
3)	Materials stored	$_____
4)	Total accumulated work to date (Items 1 thru 3)	$_____
5)	Less: Retainage @ ____% of total accumulated work to date	$_____
6)	Net amount earned to date	$_____
7)	Less: Amount of previous payments	$_____

BALANCE DUE THIS REQUEST $_____

The undersigned Contractor certifies to the best of his knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by him for Work for which previous Certificates for Payment were issued and payments received from the Owner; and that current payment shown herein is now due.

_____
Contractor

By: _____ Date: _____

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STATEMENT CONCERNING CLAIMS

TO BE PREPARE BY THE ENGINEER AND OWNER)

7/18

PARTIAL WAIVER OF LIEN

To All Whom it May Concern:

WHEREAS, the undersigned has been employed by (A) _____

_____

to furnish labor and materials for (B) _____

_____ work, under a contract (C)_____

_____

for the improvement of the premises described as (D) _____

_____

in the _____(_____) of_____

_____ of_____, _____ of _____

of which _____

_____is the Owner.

NOW, THEREFORE, this _____ day of _____, 19 ___, for and in

consideration of the sum of (E)_____

_____ Dollars

paid simultaneously herewith, the receipt whereof is hrerby acknowledged by the undersigned, the undersigned does hereby waive and release to the extent only of the aforesaid amount, any lien rigfhts to, or claim of lien with respect to and on said above-described premises, the the improvements thereon, and on the monies or other considerations due or to become due from the owner, by virtue of said contract, on account of labor, service, materials, fixtures, appartus or machinery furnished by the undersigned to or for the above-described premises, but only to the extent of the payment aforesaid.

(F) _____(SEAL)
(Name of sole ownership, corporation or partnership)

(Affix corporate seal here)

_____(SEAL)
(Signature of Authorized Representative)

Title: _____

INSTRUCTIONS FOR PARTIAL WAIVER

(A) Name person or firm with whom you agreed to furnish either labor, or services, or materials, or both.

(B) Fill in nature and extent of work;strike the word labor or the word materials if not in your contract.

(C) If you have more than one contract on the same premises, describe the contract by number if available, date and extent of work.

(D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.

(E) Amount shown should be the amount actually received on that date.

(F) If waiver is for a corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

FINAL WAIVER OF LIEN

To All Whom it May Concern:

WHEREAS, the undersigned has been employed by (A) _____

_____

to furnish labor and materials for (B) _____

_____ work, under a

contract (C)_____

for the improvement of the premises described as (D) _____

_____

in the _____(_____) of_____ of _____

_____, _____ of _____ of which _____

_____ is the Owner.

NOW, THEREFORE, this _____ day of _____, 19 ___,

for and in consideration of the sum of (E)_____ Dollars paid simultaneously herewith, the receipt whereof is hrerby acknowledged by the undersigned, the undersigned does hereby waive and release to the extent only of the aforesaid amount, any lien rigfhts to, or claim of lien with respect to and on said above-described premises, the the improvements thereon, and on the monies or other considerations due or to become due from the owner, by virtue of said contract, on account of labor, service, materials, fixtures, appartus or machinery furnished by the undersigned to or for the above-described premises, but only to the extent of the payment aforesaid.

(F) _____(SEAL)
(Name of sole ownership, corporation or partnership)

(Affix corporate seal here)

_____(SEAL)
(Signature of Authorized Representative)

Title: _____

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INSTRUCTIONS FOR FINAL WAIVER

(A) Name person or firm with whom you agreed to furnish either labor, or services, or materials, or both.

(B) Fill in nature and extent of work; strike the word labor or the word materials if not in your contract.

(C) If you have more than one contract on the same premises, describe the contract by number if available, date and extent of work.

(D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.

(E) Amount shown should be the amount actually received on that date.

(F) If waiver is for a corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

To: _____
Owner

And To: _____
Contractor

Date of Substantial Completion _____
(If Previously Provided)

The Work performed under this contract has been inspected by authorized representatives of the Owner, Contractor and/or Consulting Engineer, and the Project (or specified part of the Project, as indicated above) is hereby declared to be completed on the above date.

The date of Final Completion is the date upon which all guarantees and warranties begin, except as noted below. The responsibilities between the Owner and the Contractor or Engineer for maintenance, and utilities shall be as set forth below.

_____	_____	_____
Engineer	Authorized Representative	Date

_____
The Contractor accepts the above Certificate of Final Completion.

_____	_____	_____
Engineer	Authorized Representative	Date

_____

RESPONSIBILITIES: (For maintenance, utilities, etc.)

OWNER

CONTRACTOR/ENGINEER

_____

In accordance with the Contract Documents, based on on-site observation and the data comprising the above application, the Engineer certifies to the Owner that the Work has progressed to the point indicated; that to the best of his knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents; and that the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $_____

_____
Engineer

By:_____ Date: _____

CERTIFICATE OF FINAL COMPLETION

_____

Project No._____ Engineer's Project No._____

Project _____ Date: _____

_____

Contractor/Engineer _____ Contract Date _____

Contract For _____

_____

Project or Specified Part Shall Include _____

_____

_____

DEFINITION OF FINAL COMPLETION

The date of Final Completion of a Contract or specified part of a Contract is the date when the construction or services are complete, in accordance with the Contract Documents, so that the Project or specified part of the Project or Project Services can be utilized for the purposefor which it was intended.

Final Payment in accordance with ATTACHED VOUCHERS AND FINAL PAYMENT FORM IS HEREBY AUTHORIZED IN ACCORDANCE with approved McPherson County Procurement and Payment Procedures. Please return this copy to the Engineer for Final Payment Processing.

APPROVED FOR FINAL PAYMENT:

_____ Date _____
Engineer

ENCLOSURES (Identify and attach):

GENERAL REQUIREMENTS OF THE CONSTRUCTION CONTRACT

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201 STANDARD SPECIAL CONDITIONS

201.1 FORM OF TECHNICAL SPECIFICATIONS:

The detailed specifications may be of the abbreviated or outline type and the CONTRACTOR must supply omitted words or phrases by inference. "Omissions of words or phrases such as 'the CONTRACTOR shall,' 'in conformance with,' 'shall be,' 'as noted on the plans,' 'according to the plans,' 'a,' 'an,' 'the,' and 'all' are intentional."

The specifications are performance oriented and are intended to provide an end product of quality. They are not to be construed as establishing means, methods, or techniques to be used by the CONTRACTOR to obtain the expected results.

Whenever the context so admits or requires, all references herein in one number shall be deemed extended to and including the other number, whether singular or plural, and the use of any gender shall be applicable to all genders.

201.2 NOTICE TO PROCEED:

A written Notice to Proceed with Work will be issued by the Engineer and CONTRACTOR shall start the work within ten (10) calendar days of the date of that Notice to Proceed. Thereafter, CONTRACTOR shall prosecute the Work at such place or places as the Engineer directs and shall fully complete in every detail all the work to be done under the contract within the time limit set forth in the contract or any authorized extensions to the contract time.

201.3 COPIES OF PLANS AND SPECIFICATIONS:

After contract award, the successful bidder may obtain from the Engineer at no cost: ten sets of plans and special provisions; and if available for the project, one set of full size cross sections and one set of computer output data. If the CONTRACTOR has not picked up the plans and other available data within six weeks after bid opening, they will be sent to the Engineer in charge of the project. Additional sets of plans and other available data may be purchased on a cash sale basis from the Engineer at current reproduction prices.

Subcontractors and suppliers may obtain plans and other data from the successful bidder or they may purchase copies on a cash sale basis from the Reproduction Branch at current reproduction prices.

201.4 INSURANCE:

To assure OWNER that CONTRACTOR is always capable of fulfilling specified indemnification obligations, CONTRACTOR is required to purchase and maintain insurances of the kind and in amounts specified in the Contract Documents. However, insurance requirements contained in the Contract documents shall not be deemed to limit or define obligations of CONTRACTOR as provided elsewhere in the General Conditions. Should a CONTRACTOR find it difficult to locate insurance sources capable of satisfying the OWNER'S requirements, the CONTRACTOR is invited to contact the OWNER for information on insurance sources.

the OWNER may require that certified copies of the insurance policies be submitted and may refuse to recommend that the Contract be executed by the OWNER'S Representative until the applicable insurance policies are found to be acceptable.

201.4.1 Workmen's Compensation Insurance:

CONTRACTOR and all levels of subcontractors shall comply with requirements of the Workmen's Compensation Act and shall provide Workmen's Compensation Insurance to protect CONTRACTOR and all levels of subcontractors from and against any and all Workmen's Compensation claims arising from performance of Work under the contract. The OWNER will not execute the contract until the successful bidder has submitted evidence, acceptance to the OWNER, that such Workmen's Compensation Insurance is in effect and will remain in effect during the term of the contract.

201.4.2 Comprehensive General Liability Insurance:

CONTRACTOR must procure and maintain at his own expense, until final payment by the County for all work covered by the contract, Comprehensive General Liability Insurance covering all work to be performed under the contract. This insurance must pay on behalf of CONTRACTOR all sums which CONTRACTOR shall become legally obligated to pay as damages because of bodily injury or property damage caused by an occurrence up to the specified limits of liability for each occurrence. This coverage must include explosion hazard, collapse hazard, and underground property damage hazard. Blanket contractural liability coverage, as well as CONTRACTORs Protective Liability, must also be included. This insurance coverage must extend to all subcontractors and sub-subcontractors.

201.4.3 Comprehensive Automobile Liability Insurance:

CONTRACTOR must procure and maintain at his own expense, until final payment by the OWNER for all work covered by the contract, Comprehensive

Automobile Liability Insurance, which must cover CONTRACTOR for all sums which CONTRACTOR shall become legally obligated to pay as damages because of bodily injury or property damage caused by an occurrence up to the specified limits of liability for each occurrence. Blanket contractural liability must be included. This insurance coverage must extend to all subcontractors and sub-subcontractors.

Such coverage must include all automotive equipment used in the performance of the contract, both on and off the work site, and must include non-ownership and hired cars coverage.

201.4.4 Limits of Coverage:

The following minimum limits of coverage shall apply:

Workmen's Compensation	Statutory
Employers Liability	Each Occurrence
Bodily Injury & Property Damage with a Combined Single Limit of Liability of	Each Occurrence
or	
Bodily Injury	
General and AutomobilE	Each Person
General and Automobile	Each Occurrence
Property Damage	
General and Automobile	Each Occurrence
General	Aggregate

201.4.5

The insurance referred to in subparagraphs 201.4.2 and 201.4.3 above shall be written under the Comprehensive General and Comprehensive Automobile Liability policy forms, including coverage for all owned, hired, and non-owned automobiles. The CONTRACTOR may at his option provide the limits of liability as set out above by a combination of the above described policy forms and an Umbrella Excess Liability policy. The liability policy or policies shall have any exclusions for punitive and exemplary damages removed.

201.4.6

It is a condition of the Contract that the policy or policies afford coverage for damage to property of others arising out of the perils of Explosion, Collapse, and Damage to Underground Facilities, and it is a further condition that the policy or policies afford the same limits of liability as set out above for liability assumed under contract including CONTRACTUAL LIABILITY. It is a condition of the Contract that the policy or policies afford BROAD FORM PROPERTY DAMAGE LIABILITY COVERAGE for damage to property of others in the care, custody, or control of the insured, or as to which the insured is for any purpose exercising physical control.

201.4.7

All responsibility for payment of any sums resulting from any deductible provision, corridor, or self-insured retention conditions of the policy or policies shall remain with the CONTRACTOR.

201.4.8

It is a condition of the Contract that the policy or policies waive any and all Governmental Immunity as a defense in any action brought against the insured or any other party to the Contract.

201.5 PROGRESS SCHEDULE & SEQUENCE OF OPERATIONS:

201.5.1

Within ten days of the date of the Agreement, the CONTRACTOR shall submit for approval of the Engineer a chart, the form of which is included in the Contract Documents, showing the estimated progress schedule for the component divisions of the work, a balanced cost breakdown, together with a composite curve showing the estimated progress schedule for the entire project. The bar graph shall be completed showing the estimated percentage of each item in increments of 10% or 20%, depending on the value of the item. For purposes of comparison, the CONTRACTOR shall submit with each Application for Payment a chart in identical form showing the actual rate of progress to date for the component divisions and for the Project as a whole. The actual rate of progress shown on the chart shall only include work completed and shall not include stored materials.

201.5.2

Within ten days of the date of the Agreement award, the CONTRACTOR shall also submit for review by the Engineer a complete balanced cost breakdown approved by the CONTRACTOR's Surety Company of the various component divisions of work bid on a lump sum basis. All overhead items shall be prorated over the various items of actual work and no overhead items such as Insurance, Move In, Superintendence, General Conditions, falsework, scaffolding, temporary construction, etc., will be allowed to be listed separately for partial progress payment.

201.5.3

Also the CONTRACTOR shall submit for approval a planned sequence of construction indicating the approximate dates and time duration of street closings, utility interruptions, etc. if required.

201.5.4

In the event that the rate of actual progress of the work falls behind the estimated progress indicated on the approved chart, the CONTRACTOR shall accelerate the work by placing additional forces and equipment on the project so that the project will be completed within the Contract time.

201.5.5

The CONTRACTOR shall not begin construction of any work until he has notified the ENGINEER of his intention to do so, stating the time when work is to commence. Such notices shall be at least twenty-four (24) hours prior to the time when actual work is to commence. Two working days advance notice is required for surveying and staking.

201.5.6

In the event the CONTRACTOR temporarily leaves a job for more than three consecutive working days, he shall notify the ENGINEER upon his return to work. The CONTRACTOR shall keep the ENGINEER advised as to work schedule. Any work performed at times or places outside of the established work schedule shall be regarded as contrary to and outside of the terms of this Contract and the ENGINEER or his authorized representative may order such work removed and replaced without obligation on the part of the OWNER to pay for such removal and replacement.

201.6 INTERRUPTION WITH OWNER'S NORMAL OPERATIONS:

Portions of the work will be performed in or adjacent to areas in which the OWNER'S normal operation must proceed without interruption during the construction work. The CONTRACTOR shall conduct the work in these areas in such a manner as to create a minimum of disturbance and inconvenience to the OWNER and to the public. Road closing, if required, shall be scheduled with the governmental agency responsible for roads and with fire and police agencies.

201.7 UNEMPLOYMENT COMPENSATION:

Before final payment will be made by the OWNER, the CONTRACTOR must file with the OWNER a written clearance that all payment then due, including payment by subcontractors on the project, under the Statutes covering Unemployment Compensation have been made, all in full conformance with the Statutes in effect at the place or work.

201.8 DISCRIMINATION:

In connection with the performance of work under this contract, CONTRACTOR agrees not to discriminate against any employee or applicant for employment because of race, religion, color or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. CONTRACTOR agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause.

> CONTRACTOR further agrees to insert the foregoing provision in all subcontracts, except subcontracts for standard commercial supplies or raw materials.

201.9 INVESTIGATION OF THE SITE:

Bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of test hole, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty, expressed or implied, that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

201.10 SUBSTITUTIONS:

Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Such references shall be regarded as establishing a standard of quality, finish, appearance, performance or as indicating a selection based upon compatibility with existing equipment or materials. It shall not be construed as limiting the selection to a specified item or source.

The use of an alternate or substitute, item or source will be permitted, subject to the following:

(a) No consideration will be given a request for substitution prior to award of the contract.

(b) After the award and to permit consideration and approval without delaying the work CONTRACTOR shall submit a written request for substitution. The request shall include all information necessary for proof of equity and suitability for substitution. CONTRACTOR shall submit samples when required.

(c) ENGINEER will evaluate the information submitted, perform tests when necessary and make comparisons. ENGINEER will then make the final decision as to the acceptability of the proposed substitution.

201.11 COORDINATION WITH OTHER CONTRACTORS:

201.11.1:

Progress of the work may be affected by coordination of other work being performed by the OWNER or other CONTRACTOR, and the CONTRACTOR shall investigate such a possibility and make allowances therefor. Should the CONTRACTOR sustain any damage through any act or omission of any other CONTRACTOR having a contract with the OWNER, the CONTRACTOR shall have no claim against the OWNER for such damage, but shall have a right of action against the other CONTRACTOR to recover the damages sustained by reason of the acts or omissions of such CONTRACTOR.

201.11.2

If, through acts of neglect on the part of the CONTRACTOR, any other CONTRACTOR or any Subcontractor shall suffer loss or damage on their work, the CONTRACTOR agrees to settle with such other CONTRACTOR or Subcontractor by agreement or arbitration, if such other CONTRACTOR or Subcontractor will so settle. If such other CONTRACTOR or Subcontractor sues the OWNER and/or ENGINEER on account of any damage alleged to have been so sustained, the OWNER and/or ENGINEER shall notify the CONTRACTOR who shall defend and hold harmless the OWNER and the ENGINEER at such proceedings at the CONTRACTOR'S expense and if any judgement against the OWNER and/or ENGINEER arises therefrom the CONTRACTOR shall pay or satisfy it, including all attorney's fees and court costs which may accrue against the OWNER and/or the ENGINEER.

201.12 GUARANTEE AND WARRANTY PROVISIONS:

CONTRACTOR shall guarantee the work against defective workmanship or materials for a period of 1 year from the date of substantial completion under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of ENGINEER to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and CONTRACTOR will be required to correct defective work or materials at any time before substantial completion and within 1 year thereafter.

Should any defects develop within 1 year from the date of substantial completion due to faults in workmanship or materials CONTRACTOR shall, within 14 calendar days of receipt of written notice from Contracting Agency, begin making the necessary repairs to the satisfaction of the ENGINEER. Such work shall include the repair or replacement of other work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

In case of work, materials, or equipment for which written warranties are required by the special provision the CONTRACTOR shall provide or secure from the appropriate Subcontractor or supplier such warranties addressed to and in favor of the Contracting Agency and deliver same to the ENGINEER prior to final acceptance of the work. Delivery of such warranties shall not relieve the CONTRACTOR from any obligation assumed under any other provisions of the contract.

The warranties and guarantees provided in this subsection of the contract documents shall be in addition to and not in limitation of any other warranties, guarantees or remedies required by law.

201.13 APPLICABLE CODES AND STANDARDS:

All work and business activity conducted in the performance of the contract shall conform to the requirements of all National, provincial or local laws, ordinances, building codes or other regulations that are in effect at the place of work.

201.14 ASSIGNMENTS:

No assignment by the CONTRACTOR of this contract or any part thereof or of the funds to be received thereunder by the CONTRACTOR will be recognized unless such assignment has had the written approval of the OWNER and the surety has been given due notice of such assignment and has furnished written consent thereto. Such written approval by the OWNER shall not relieve the CONTRACTOR of the obligations incurred by him under the terms of this contract. In addition to the usual recitals in assignment contracts, the following language must be set forth.

> "It is agreed that the funds to be paid to the assignee under this assignment are subject to a prior lien for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms, or corporations rendering such services or supplying such materials."

201.15 SHOP DRAWINGS AND SAMPLES:

201.15.1:

The CONTRACTOR shall submit to the ENGINEER for review, in accordance with the accepted schedule of Shop Drawing submissions, copies of all Shop Drawings, as specified below. The data shown on the Shop Drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the ENGINEER to review the information as required. Within 14 days after Notice to Proceed has been issued, the CONTRACTOR shall submit to the ENGINEER, five (5) copies of a schedule of shop drawing submittals which shall indicate the date the ENGINEER can expect to receive the shop drawings on the various equipment and construction details. Scheduling to assure completion within contract period will be the sole responsibility of the CONTRACTOR, however, the CONTRACTOR shall submit shop drawings on an earlier date than indicated on the schedule if requested to do so by the ENGINEER.

201.15.2:

The CONTRACTOR shall check and verify all field measurements, all dimensions on shop setting drawings, and all schedules required for the work of all the various trades. All shop and setting drawings, certificates, concrete or asphalt mix designs, and required design computations approved by the CONTRACTOR shall be submitted in sufficient number of copies to provide the ENGINEER with three copies and up to three additional copies as may be desired by the CONTRACTOR, for himself, his subcontractors and/or suppliers (see also Paragraph 201.15.4 where special drawings are prepared). The shop drawings shall be neatly packaged by the CONTRACTOR into identical sets with a signed submittal form stapled to each set. Each submittal shall be accompanied by an equal number of copies of the submittal form bound in these Contract Documents for reproduction by the CONTRACTOR. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number will form a serial number for identifying each submittal. If initial submittal, indicate by check mark; if re-submittal, indicate by inserting the transmittal number of the previous submission of the same item.

201.15.3:

The review of Shop Drawings by the ENGINEER is for the purpose only of checking for general conformance with the design concept of the project and for general compliance with the information given in the Contract Documents. Any action taken on Shop Drawings by the ENGINEER does not relieve the CONTRACTOR of responsibility for proper dimensioning, for detailing of connections and incorporating into the work satisfactory materials and equipment meeting the requirements of the Contract Documents. If errors in Shop Drawings are not detected in the ENGINEER'S review, the CONTRACTOR is not relieved from the responsibility to comply with the Contract Documents and the ENGINEER'S review shall never be construed as permitting the CONTRACTOR to proceed in error. It is understood that where a Shop Drawing is submitted for review for compliance with a performance specification, it is impossible to determine with certainty whether the item or process covered by the Shop Drawing will conform to the requirements of the Contract Documents. Regardless of any information contained or not contained in the Shop Drawings, the requirements of the drawings and specifications and other Contract Documents must be followed and are not waived or superseded in any way by the Shop Drawing review.

201.15.4:

Shop Drawings shall be submitted covering all equipment and structural details proposed by the CONTRACTOR and for such other items required by the specifications or requested by the ENGINEER. Where Shop Drawings consist of special drawings prepared by the CONTRACTOR, his Subcontractor, or suppliers, one reproducible paper sepia copy and three prints thereof shall be submitted to the ENGINEER in lieu of the several copies specified above. The CONTRACTOR shall furnish additional copies of final corrected Shop Drawings upon request.

201.15.5:

Upon final review of shop drawings the CONTRACTOR shall furnish to the ENGINEER for use by the OWNER five (5) copies of operating and maintenance manuals, spare parts catalogs for each item of mechanical and electrical equipment, if any, and the source of procurement and unit price of spare parts. Also, there shall be submitted a list by the equipment manufacturer indicating the quantity of each spare part recommended for efficient operation for a one-year period. All submittals required by this paragraph shall be submitted with the Application for Payment in which the equipment is included.

201.15.6:

The CONTRACTOR will also submit to the ENGINEER for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples will have been checked by and deemed to have been approved by the CONTRACTOR, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.

201.15.7:

At the time of each submission, the CONTRACTOR shall in writing call the ENGINEER'S attention to any deviations that the Shop Drawing or sample may have from the requirements of the Contract Documents.

201.15.8:

Any action taken on a separate item as such will not indicate that the same action applies to the assembly in which the item functions. The CONTRACTOR shall make any corrections required by the ENGINEER and shall return the required number of corrected copies of Shop Drawings and resubmit new samples until the ENGINEER does not take exception to them. The CONTRACTOR shall direct specific attention in writing on resubmitted Shop Drawings to revisions other than

the corrections called for by the ENGINEER on previous submissions. The CONTRACTOR'S submission of any Shop Drawings or samples shall constitute a representation to the OWNER and the ENGINEER that the CONTRACTOR has either determined and verified all quantities, dimensions, measurements to fit adjacent work, field construction criteria, materials, catalogue numbers and similar data or he assumes full responsibility for doing so, and that he has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.

201.15.9:

No work requiring a Shop Drawing or sample submission shall be commenced until the submission has been reviewed by the ENGINEER. A copy of each reviewed Shop Drawing and each sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER or Project Representative.

201.15.10:

The ENGINEER'S review of Shop Drawings or samples shall not relieve the CONTRACTOR from his responsibility for any deviations from the requirements of the Contract Documents unless the CONTRACTOR has in writing by separate letter called the ENGINEER'S attention to such deviation at the time of submission and the ENGINEER has given written approval to the specific deviation, nor shall any action taken by the ENGINEER relieve the CONTRACTOR from responsibility for errors or omissions in the Shop Drawings.

201.16 MATERIALS TESTS AND CERTIFICATES:

All materials to be incorporated in the work may be subject to sampling, testing and approval, and samples furnished shall be representative of the material to be used. ENGINEER may select samples, or may require that samples be delivered by CONTRACTOR to a laboratory designated by ENGINEER.

The Contracting Agency will pay for the initial or normal test required by ENGINEER to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by CONTRACTOR. ENGINEER will designate the laboratory which will accomplish the additional test(s).

The procedure and methods used to sample and test materials will be determined by ENGINEER. Unless otherwise specified, samples and tests will be made in accordance with either the Materials Testing Manual of the Contracting Agency; the standard

methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least one copy of the test results to the Contracting Agency or his designated representative, to CONTRACTOR, and to the appropriate material supplier.

With respect to certain manufactured materials, ENGINEER may permit the use of some materials prior to sampling and testing provided they are delivered with either a certificate of compliance or analysis or both, stating that the materials comply in all respects with the requirements of the specifications. These certificates shall be furnished in triplicate and clearly identify each delivery of materials to the work area. The certificates shall be signed by a person having legal authority to bind the supplier or manufacturer.

201.17 FIELD TESTS:

201.17.1:

Department of Public Works and Highways Standard Specifications for Road and Bridge Construction dated 1988 most recent edition, special provisions thereto and as amended by the Roadway Design and Construction Standards contained in the Project Special Condition shall apply to roadway testing and inspection requirements.

201.17.2:

All test and inspection results performed by the testing firm in the employment of the owners/developers shall be submitted to the Engineer or his field representative at the time of testing or within fifteen working days after the testing or retesting date.

201.17.3:

Any work performed inside Public R.O.W. and associated easements shall be tested by an approved materials testing firm. Materials testing firms shall be approved by the Engineer on an annual basis and must employ a full time registered professional engineer who directly supervises work of the firm. The costs of testing and associated reporting are paid by the OWNER or the CONTRACTOR as specified in the Project Special Conditions.

201.17.4:

The testing of all materials and construction shall be in conformance with the appropriate AASHTO or ASTM specifications. A partial list of approved testing methods includes:

TEST PROCEDURES	AASHTO	ASTM
Atterberg Limits (LL & PL)	T 89 & T 90	D 4318
Gradation Analysis (except hydrometer)	T 27	D 422
CBR (as modified in Section 5.2.4)	T 193	--
R-value (subgrade & base)	T 190	D 2844
Marshall Stability	T 245	D 1559
R Value	T 246	D 1560
Compaction Curve (standard)	T 99	D 698
Compaction Curve (modified)	T 180	D 1557
Compaction Curve (CTAB)	T 134	--
Field Density Test (Sand Cone)	T 191	D 1556
Field Density Test (Nuclear)	T 238/T 239	D 2922/D 3017
Field Density Test (Balloon)	T 205	D 2167
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201.18 RECORD DRAWINGS:

201.18.1:

CONTRACTOR shall maintain at the construction site one complete set of drawings suitable marked to show all deviations from the original set of drawings and other information as specified. Supplementary sketches shall be included, if necessary, to clearly indicate all work as constructed.

201.18.2:

All work shall be clearly shown and the record drawings shall be satisfactory to OWNER. One complete set of the record drawings shall be furnished to ENGINEER for OWNER'S information prior to or with submittal of the final Application for Payment. Failure of CONTRACTOR to maintain an up to date set of record drawings on the project site shall be reason to withhold payments. All underground lines shall be referenced to surface landmarks so the exact location can be determined from the record drawings.

201.19 FIRST AID AND REPORTING OF ACCIDENTS:

CONTRACTOR shall be solely and exclusively responsible for the determining of requirements of first aid facilities and for providing such first aid facilities at the site, as are necessary to supply first aid service to anyone who may be injured in connection with the work. CONTRACTOR must promptly report in writing to ENGINEER and OWNER all accidents whatsoever arising out of, or in connection with, the performance of the work, whether on, or adjacent to the site, which causes death, personal injury, or property damages, giving full details and statements of witnesses. In addition, if death or serious injuries or damages are caused, the accident shall be reported immediately by telephone or messenger to both ENGINEER and OWNER. If any claim is made by anyone against CONTRACTOR or any subcontractor on account of any accident, CONTRACTOR shall promptly report the facts in writing to ENGINEER and OWNER, giving full details of the claim.

201.20 PROVISIONS REQUIRED BY LAW DEEMED INSERTED:

Each and every provision of law and clause required by law to be inserted in this contract shall be deemed to be inserted herein and the contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party the contract shall forthwith be physically amended to make such insertion or correction without change in the Contract Amount or Contract Time.

201.21 FIRE PROTECTION:

Adequate provisions shall be made throughout the construction of the project to ensure that fire fighting equipment can reach each property within the general area.

201.22 INTERRUPTION OF WATER SERVICE:

CONTRACTOR shall be obligated to give all affected water users adequate advanced warning before shutting off water service for any reason. CONTRACTOR shall not interrupt service to any user without prior written approval of the agency or department operating the water system.

201.23 PRICES:

In the event of discrepancy between unit prices quoted in the proposal and the extensions or totals, the unit prices shall control. The prices are to include the furnishing of all materials, plant, equipment, tools, and all other facilities and the performance of all labor, and services necessary or proper for the completion of the work.

201.24 TAX:

CONTRACTOR shall pay all Value Added, Use, Excise and similar Taxes required by law where the work is to be performed.

201.25 TEMPORARY SIGNS:

CONTRACTOR shall provide and install a temporary sign, located as approved by ENGINEER. CONTRACTOR shall provide all painting of sign and frame. The working and design of sign shall be as shown on the standard drawing bound in the specifications. No further job signs or advertisements will be allowed.

201.26 TEMPORARY UTILITIES:

CONTRACTOR shall pay for installation, use and disconnecting of all temporary utilities required for use in constructing the project.

201.27 PERMITS, LICENSES AND MISCELLANEOUS FEES:

CONTRACTOR shall be responsible for obtaining all the necessary permits and licenses required by law. All utility connection charges or other miscellaneous fees shall be paid by CONTRACTOR.

201.28 LIQUIDATED DAMAGES:

For each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or as adjusted by the ENGINEER, the sum per calendar day shown in the Project Special Conditions unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the CONTRACTOR, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the CONTRACTOR to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract.

LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day of Fixed Date
$ 0	$ 25,000	$ 85.00
25,000	50,000	140.00
50,000	100,000	205.00
100,000	500,00	280.00
500,000	1,000,000	420.00
1,000,000	2,000,000	560.00
2,000,000	4,000,000	840.00
4,000,000		1,120.00

201.29 ACCEPTANCE:

(a) Partial acceptance:

If at any time during the prosecution of the project CONTRACTOR substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the ENGINEER to make final inspection of that work. If ENGINEER finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and CONTRACTOR may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(b) Final Acceptance:

Upon due notice from CONTRACTOR of presumptive completion of the entire project, ENGINEER will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and ENGINEER will make the final acceptance. CONTRACTOR will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, ENGINEER will give the CONTRACTOR the necessary instructions for correction of same, and the CONTRACTOR shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, ENGINEER will make the final acceptance and notify CONTRACTOR in writing of this acceptance as of the date of the final inspection.

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205 PROJECT SPECIAL CONDITIONS:

The project Special Conditions document is provided to modify and expand the standard General Conditions and the standard Special Conditions. The design Engineer will use this section of the Contract Documents to provide for special requirements relating to the project.

The material attached is not written in specification form, or as a complete document, but rather as a discussion of items that the designer or specification writer may wish to consider. All of the items in the attached material may not be required on a specific project. In particular, the user will note the inclusion of many items which apply to specifications in which mechanical or electrical equipment is being provided. These items should not be included for a drainage or a paving project, but would be considered if a pumping station or some other electrical equipment were included in the project.

The sub-section numbers of attached material following section titles indicate reference paragraphs in the standard General Conditions to which the user should refer. Some item headings in the attached material are a duplication of items covered in the standard General Conditions. This duplication is intentional as it was believed that there are some conditions of the standardized General Copnditions which will not suit all users of the specifications. This guide document is prepared to point out some of these conditions and to suggest the possible modifications which the user may consider.

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205.1 WORK BY OTHERS: (sub-sections 213.17, 213.18)

This paragraph would be included in a Project Special Conditions section to indicate other activities in the area of construction and also work and equipment being furnished by others.

205.2 COORDINATION OF CONSTRUCTION: (sub-sections 213.17. 213.18, 213.22)

If it is necessary to set up any special conditions such as working hours, maintenance of existing utility operations, coordination with other contractors, hazardous operations or timing for special utility constructions, it should be covered in this paragraph. If a definite schedule is established by the owner, modify paragraph 213.22 in the General Conditions.

205.3 MAINTENANCE AND CONTROL OF TRAFFIC: (sub-sections 216.9, 216.10)

This paragraph is intended to allow the user to provide specific instructions if they are required in addition to the general provisions provided in General Conditions under paragraph 216.9. Maintenance of Traffic. This might include instructions such as

paving half the street width at a time or referring to the specific paving schedule to maintain a traffic flow and any other specific information on the Owner's requirements.

205.4 LOCATION OF WORK:

This paragraph defines the general location of the work with reference to its geographical site, rail, highway and port facilities to the site.

205.5 INVESTIGATION AND REPORTS: (sub-section 214.4)

Where soil borings or other investigative data have been obtained prior to the issuance of plans and specifications, the user may desire to include these documents in his bound specifications or on the plans for contractor reference. Transfer of soil boring information to plans is extremely hazardous because of the possibility of error. The user is cautioned not to make any soil boring information or other investigative data a part of the contract documents and to indicate that there is no expressed or implied agreement that depths or character of materials shown are correct or complete and that conditions affecting work may actually differ from those shown in the boring logs. It is suggested that the specification indicate that the bidders are expected to examine the site, interpret or disregard soil boring logs as they see fit and arrive at their own conclusions regarding the character and locations of materials to be encountered. The bidders may make their own investigation and this specification may indicate that the owner will assist in obtaining permission from the property owners if this is necessary.
If borings have not been taken prior to the issuance of the contract documents, and if the contractor is expected to obtain borings, this paragraph should so state. The ENGINEER should identify what work he will provide and what work the CONTRACTOR must provide.

205.6 LAYOUT OF WORK:

This paragraph should indicate who is responsible for furnishing and setting construction stakes and marks necessary for proper prosecution of the work in its final location. Provisions should be made for notifying the ENGINEER an adequate time prior to the need for construction staking so crews can be dispatched. Also, consideration should be given for the costs of re-staking and whether the CONTRACTOR shall be liable for those costs. The ENGINEER should identify what work he will provide and what work the CONTRACTOR must provide.

205.7 WORKING HOURS:

This paragraph should indicate whether or not there are hours of the day or days of the week when work must occur or when it cannot occur.

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205.8 RIGHT-OF-WAY: (sub-sections 213.10, 213.11)

The specification writer will use this paragraph to provide special instructions to the CONTRACTOR on available right-of-way widths of permanent and construction easements if applicable and any known conditions on the right-of-way use which are pertinent to the contractor's operations. The specification writer is advised to carefully read reference paragraphs in the General Conditions before preparing the specifications. The ENGINEER should identify what work he will provide and what work the CONTRACTOR must provide.

205.9 CONSTRUCTION FACILITIES: (sub-section 216.13)

This paragraph would indicate the availability of storage areas, the availability and conditions of use for utilities such as water and electrical energy, and also as to whether this is furnished at the OWNER'S expense or the CONTRACTOR'S expense and how the CONTRACTOR is to connect to these temporary utility facilties. It would also indicate whether the CONTRACTOR must provide all other services to meet his utility requirements. Any modifications to the conditions of Paragraph 216.13 of the General Conditions governing sanitary facilities for construction personnel should be indicated in this paragraph.

205.10 CONSTRUCTION WATER:

Construction water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required.

The CONTRACTOR shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

If the CONTRACTOR purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

The CONTRACTOR shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use.

The CONTRACTOR shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use.

205.11 SALVAGE: (sub-section 214.5)

If usable materials are to be removed by the CONTRACTOR, instructions should be given him as to their disposition.

205.12 WASTE SITES: (sub-sections 213.10, 213.11, 213.12)

Specific instructions should be given to the CONTRACTOR on his handling and disposition of excavation material either to sites within so many miles of the construction site or to waste sites shown on the plans. If any specific handling is required, or privilege of resale of a particular material is allowed, it should be covered under this specification. Special instruction on the maintenance of the waste site as to leveling and grading or finish dressing may be made in this paragraph.

205.13 INFORMATION FOR ENGINEER: (sub-sections 213.19, 213.22, 219.1)

This paragraph will provide instructions to the CONTRACTOR on his responsibility and the distribution of such items as construction schedules, copies of purchase orders and subcontracts, (normally without prices), performance certificates, test reports, shop drawings and manufacturer's information.

205.14 LANDS AVAILABLE FOR CONSTRUCTION: (sub-sections 213.10, 213.11, 216.2, 216.3)

If any restrictions exist which preclude the CONTRACTOR from having access to the project site, they should be noted here. Right-of-Way limitations, potentially available disposal sites, equipment storage sites, etc. should be addressed.

205.15 ANTI-KICKBACK STATUTE AND LABOR STANDARDS:

Projects wholly or in part financed by Federal grants will require Federal provisions for Anti-Kickback Regulations, Labor Standards and Wage Determinations. If is necessary that these documents be included as contract documents.

205.16 SERVICE ENGINEER:

Where mechanical equipment has been provided in the contract, the specifications may require a service engineer to be provided either within the contract costs or on an "extra" basis from the manufacturer of the equipment to properly check over the installation before operation. The service engineer shall instruction operating personnel on the operation ofthe equipment and also leave such data as he may secure, from testing of his equipment, with the ENGINEER. Service engineer's help might also be provided with equipment provided by OWNER, and division of responsibility should be established.

205.17 ERECTING SUPERINTENDENT:

While the services of an erecting superintendent are not common on most projects, it is possible that particular equipment might require the experience and expertness of a specialized service that can only be furnished by the manufacturer of the equipment. The CONTRACTOR must be advised in this paragraph that such service is required.

205.18 SHOP TESTS:

Unless otherwise specified, equipment will be delivered to the job with only the standard manufacturer's tests performed in advance of shipment. In some cases, these are minimal. In the case of pumps, the OWNER may desire to have certified test curves submitted for approval prior to the delivery of the equipment. Such tests may be generally covered in this section of the specifications, but preferably in the technical specifications where the equipment is specified.

205.19 MATERIAL TESTS AND CERTIFICATES: (sub-sections 213.1, 215.5)

This paragraph will indicate that certain tests are required in the standard and supplemental specifications which will either be paid for by the CONTRACTOR or by the OWNER. In the event the CONTRACTOR pays for the tests, the specification will indicate that the selection of a laboratory will be subject to the approval of the OWNER or ENGINEER.

In some instances, the ENGINEER may desire to have notarized certificates of compliance submitted by the CONTRACTOR from the manufacturer stating that certain materials have been subjected to tests or that certain work has been done in accordance with the specifications.

Such a testing paragraph will usually provide that the ENGINEER can require additional tests where he has a reasonable doubt that materials furnished comply with the specifications. In such a case, if the additional tests establish that materials comply with the specifications, all costs of such additional tests are borne by the OWNER, whereas if the additional tests establish that the materials do not comply with the specifications, all cost for such tests shall be borne by the CONTRACTOR.

205.20 FIELD TESTS: (sub-sections 213.1, 213.6, 215.5)

If detailed field tests are required for certain items of construction, the CONTRACTOR will notify the ENGINEER when he considers his work to be complete and ready for testing and the ENGINEER will perform such tests as are indicated to determine if performance has been obtained. The specifications should mention any scheduling requirements for test operations. If required performance is not indicated in the tests, the CONTRACTOR will be required to make the necessary corrections and upon completion to the corrections demonstrate that the required performance has been obtained.

205.21 PRELIMINARY OPERATION:

Where equipment or plant operation is included in the contract, the instructions should provide for the degree of CONTRACTOR'S responsibility to properly lubricate and place the equipment in operation. Further, the CONTRACTOR'S personnel or his service engineer should provide the OWNER'S operating personnel with information on operation of the equipment. CONTRACTOR should provide any construction labor required on a "stand-by" basis.

205.22 DEFECTIVE EQUIPMENT:

In the event that certain items of equipment, fail to conform to the specifications or to operate satisfactorily, the CONTRACTOR is obligated to correct such defects at no cost to the OWNER. Further, the OWNER should have the right to operate unsatisfactory equipment until it is replaced or corrected without cost for depreciation, use or wear. Any replacement of equipment should only be done at times approved by the OWNER.

205.23 SPECIAL TOOLS:

Where equipment is specified, any special tools, other than the normal maintenance tools, required for assembly or erection of the equipment shall be included by the CONTRACTOR. Any special tools or devices which are peculiar to the equipment furnished and are required for maintenance of the equipment shall be included and turned over to the OWNER upon completion of the work.

205.24 RESIDENT BID PREFERENCE:

205.24.1:

A resident bidder shall be allowed a preference against a nonresident bidder from a state or foreign country equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident.

Resident bidder means:

(a) A person, partnership, corporation, or joint venture which is authorized to transact business in Phillippines and which maintains its principai place of business in the Philippines; or

(b) A person, partnership, corporation, or joint venture which is authorized to transact business in the Philippines, which maintains a place of business in the Philippines, and which has paid Philippine taxes in at least seventy-five percent of the eight quarters immediately prior to bidding on a construction contract for a public project.

205.24.2:

To determine the residency bid preference status of a bidder, the bidder may be required to submit an affidavit certifying residency status with his proposal. Failure to submit the residency affidavit with the proposal may be justification for and may result in the rejection of the proposal and forfeiture of the proposal guaranty.

205.24.3:

The proposals will be treated as follows:

(a) All proposals will be checked for accuracy by the OWNER.

(b) The dollar amount of the checked proposal from nonresident bidders will be adjusted by a percentage equal to the preference percentage given or required by the state or foreign country of the bidder's residency. If the state or foreign country does not give or require a residency preference, no adjustment in the proposal dollar amount will be made.

(c) Adjusted proposals from nonresident bidders will then be compared to proposals from resident bidders, and the bidder with the lowest total will be considered the apparent low bidder.

(d) Should a nonresident bidder be the apparent low bidder, in accordance with paragraph (c) above, an award will be made on the basis of the original proposal, not the adjusted proposal.

(e) The OWNER will proceed with its normal award procedure.

205.25 PROJECT PLAQUE:

On major construction projects, a permanent plaque may be required to identify the work. The ENGINEER should ascertain the need for and type of plaque desired.

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211 DEFINITIONS:

211.1 GENERAL:

In the interpretation and construction of these Specifications and the Contract, or in any documents or instruments dealing with the construction operations governed by these Specifications, the following words, terms and abbreviations, or pronouns in place of them shall each be construed as defined in Section 101 and in the Special Conditions.

211.2 CONTRACT DOCUMENTS

211.3 OWNER

211.4 ENGINEER

211.5 WORK OR PROJECT

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212 PLANS, SPECIFICATIONS AND RELATED DATA:

212.1 INTENT OF PLANS AND SPECIFICATIONS:

The intent of the Plans and Specifications is that the Contractor furnish all labor and materials, equipment and transportation necessary for the proper execution of the work unless specifically noted otherwise. The Contractor shall do all the work shown on the Plans and described in the Specifications and all incidental work considered necessary to complete the project in an acceptable manner, and to fully complete the work or improvement, ready for use, occupancy and operation by the Owner.

It is further the intention of the Plans and Specifications to set forth requirements or performance, type of equipment and structures, and standards of materials and construction, to require new material and equipment unless otherwise indicated, and to require complete performance of the work without specific reference to any minor component part. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade of the Specifications shall be supplied unless distinctly so noted. Materials or work described in words, which so applied have a well-known technical or trade meaning, shall be held to refer to such recognized standards.

212.2 CONFLICT:

If there be conflicting variance between the Plans and the Specifications, or other Contract Documents, the provisions of the Contract Documents in the order listed in the Form of Contract shall control.

212.3 DISCREPANCIES IN PLANS:

Any discrepancies found between the Plans and Specifications and site conditions, or any errors, omissions or ambiguities in the Plans or Specifications shall be immediately reported to the Engineer.

Questions as to meaning of Plans and Specifications shall be interpreted by the Engineer, whose decision shall be final and binding on all parties concerned. See also Paragraph 213.1. The ENGINEER will provide the CONTRACTOR with such information as may

be required to show revised or additional details of construction. The CONTRACTOR will not be allowed to take advantage of any errors or omissions in the Plans and Specifications. The ENGINEER will provide full information when errors or omissions are discovered. Any work done by the CONTRACTOR, after his discovery of such discrepancies, errors or omissions and prior to a decision by the ENGINEER, shall be done at the CONTRACTOR'S risk.

212.4 ADEQUACY OF PLANS AND SPECIFICATIONS:

Responsibility for adequacy of the design and for sufficiency of the Plans and Specifications shall be borne by the OWNER. The complete requirements of the work to be performed under the Contract shall be set forth in Plans and Specifications to be supplied by the OWNER through the ENGINEER or by the ENGINEER as representative of the OWNER.

212.5 PLANS AND SPECIFICATIONS AT JOB SITE:

One complete set of all Plans and Specifications shall be maintained by the CONTRACTOR at the job site and shall be available to the ENGINEER at all times.

212.6 OWNERSHIP OF PLANS AND SPECIFICATIONS:

All original or duplicated drawings and Specifications and other data prepared by the ENGINEER shall remain the property of the ENGINEER, and they shall not be re-used on other work.

212.7 DIMENSIONS:

Figured dimensions on the Plans will be used in preference to scaling the drawings. Where the work of the CONTRACTOR is affected by finish dimensions or manufacturer's equipment, these shall be determined by the CONTRACTOR at the site, and he shall assume the responsibility therefor.

212.8 MODELS:

All models prepared for this work, in accordance with requirements of Plans or Specifications, shall become the property of the OWNER at the completion of the work.

213 ENGINEER-OWNER-CONTRACTOR RELATIONS

213.1 ENGINEER'S RESPONSIBILITY AND AUTHORITY:

The ENGINEER shall observe the work on behalf of the OWNER, and will provide general assistance during construction insofar as proper interpretation of the CONTRACTOR requirements is affected.

The ENGINEER shall not be responsible for the acts or omissions of the CONTRACTOR'S superintendent or other employees.

All materials used and all completed work by the CONTRACTOR shall be subject at all times to the observation, test, and approval of the ENGINEER. The CONTRACTOR shall furnish such samples of materials for examination and tests as may be requested by the ENGINEER and shall furnish any information required concerning the nature or source of any materials or equipment which he proposes to use.

The construction, fabrication, and manufacturer of any equipment or materials specified herein may be inspected by the ENGINEER at the plant or factory and the ENGINEER shall have free access to make such inspection.

Any materials, equipment, or work which do not satisfactorily meet the Specifications may be condemned by the ENGINEER by giving a written notice to the CONTRACTOR. All condemned materials, equipment, or work shall be promptly taken out and replaced.

Any defective material, equipment, or work may be rejected by the ENGINEER at any time prior to final acceptance by the OWNER even though said defective items may have been previously overlooked.

The ENGINEER shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, interpretation of Plans and Specifications and all questions as to the acceptable fulfillment of the Contract on the part of the CONTRACTOR. See also Paragraph 212.3. All decisions of the ENGINEER shall be final except in cases where time and/or financial considerations are involved, which decisions shall be subject to arbitration. See Paragraph 213.5 for arbitration provisions.

213.2 SUSPENSION OF WORK BY ENGINEER:

When, in judgement of the ENGINEER, unfavorable weather or any other condition makes it impractical to secure first-class results, or should the CONTRACTOR fail to carry out the provisions of the Contract or supply materials meeting the requirements of the Specifications, the ENGINEER may issue to the CONTRACTOR a written order to

suspend work on all or any part of the Contract work. When conditions are again favorable for prosecution of the work, the ENGINEER will issue to the CONTRACTOR a written order to resume the suspended work. Orders to suspend work will not be written for intermittent shutdowns due to weather conditions unless the suspension of work is to be for an extended period of time. The CONTRACTOR shall take every precaution to prevent any damage or unreasonable deterioration of the work during the time it is closed down.

Suspension of the work by the ENGINEER shall not furnish any grounds for claims by the CONTRACTOR for damages or extra compensation, but the period of such suspensions shall be allowed in determining the revised date for completion as hereinafter provided. The CONTRACTOR shall not suspend work under the Contract, except as permitted in Paragraph 213.4, without the written order of the ENGINEER as stated in the preceding paragraph. The CONTRACTOR will be required to work a sufficient number of hours per day in order to complete the project within the work days specified. The question as to the necessity of discontinuing any portion of the work by reason of unfavorable weather conditions shall be determined by the ENGINEER. See also Paragraph 213.9 for suspension of work by Inspectors.

213.3 SUSPENSION OF WORK BY OWNER:

The OWNER may at any time suspend the work, or any part thereof, by giving ten days' notice to the CONTRACTOR in writing. The work shall be resumed by the CONTRACTOR within ten days after the date fixed in the written notice from the OWNER to CONTRACTOR to do so.

If the work, or any part thereof, shall be stopped by the notice in writing aforesaid, and if the OWNER does not give notice in writing to the CONTRACTOR to resume work at a date within a year of the date fixed in the written notice to suspend, then the CONTRACTOR may abandon that portion of the work so suspended, and he will be entitled to the estimate and payments for all work done on the portions so abandoned, if any. See also Paragraph 217.10.

If suspension of all or part of the work causes additional expense not due to the fault or negligence of the CONTRACTOR, the OWNER shall reimburse the CONTRACTOR for the additional expense incurred due to suspension of the work. Claims for such compensation, with complete substantiating records, shall be filed with the ENGINEER within ten days after the date of order to resume work in order to receive consideration. This paragraph shall not be construed as entitling the CONTRACTOR to compensation for delays due to inclement weather, failure to furnish additional surety or sureties specified herein, for suspension made at the request of the CONTRACTOR, or for any other delay provided for in the Contract Documents.

213.4 SUSPENSION OF WORK BY CONTRACTOR:

The CONTRACTOR may suspend work upon ten (10) days' written notice to the OWNER and the ENGINEER, for any of the following reasons:

If an order of any court or other public authority caused the work to be stopped or suspended for a period of ninety (90) days through no act or fault of the CONTRACTOR or his employees.

If the ENGINEER should fail to act upon any Request for Payment, in the manner set forth in Paragraph 217.5, within ten (10) days after it is presented in accordance with the General Conditions.

If the OWNER should fail to act upon any Request for Payment, in the manner set forth in Paragraph 217.6, within thirty-one (31) days after its approval by the ENGINEER.

If the OWNER should fail to pay the CONTRACTOR any sum within thirty-one (31) days after its award by arbitrators.

213.5 ARBITRATION:

Should there by any question of the decision of the ENGINEER, which is subject to arbitration, it shall be promptly submitted to arbitration upon demand by either party to the Contract. See Paragraph 213.1 for ENGINEER'S decisions subject to arbitration. The CONTRACTOR shall not delay the work because arbitration proceedings are pending unless he shall have written permission from the ENGINEER so to do and such delay shall not extend beyond the time when the arbitrators shall have opportunity to determine whether the work shall continue or be suspended pending decision by the arbitrators of such a dispute. Any demand for arbitration shall be in writing and shall be delivered to the ENGINEER and any adverse party either by personal delivery or by registered mail addressed to the last known address of each within ten (10) days of receipt of the ENGINEER'S decision, and in no event after final payment has been made and accepted, subject, however, to any express stipulation to the contrary in the Contract Documents. Should the ENGINEER fail within a reasonable period to make a decision, a demand for arbitration may then be made as if the ENGINEER'S decision had been rendered against the party demanding arbitration.

No one shall be qualified to act as an arbitrator who has, directly or indirectly, any financial interest in the Contract or who has any business or family relationship with the OWNER, the CONTRACTOR, or the ENGINEER. Each arbitrator selected shall be qualified by experience and knowledge of the work involved in the matter to be submitted to arbitration.

Unless otherwise provided by controlling statutes, the parties may agree upon one arbitrator; otherwise there shall be three; one named in writing by each party to this Contract to the other party and to the ENGINEER, and the third chosen by these two arbitrators; or if they fail to select a third within fifteen days, then he shall be chosen by the presiding officer of the state or county bar association nearest to the location of the work. Should the party demanding arbitration fail to name an arbitrator within ten days of his demand, his right to arbitration shall lapse. Should the other party fail to choose an arbitrator within the said ten days, then such presiding officer shall appoint such arbitrator. Should either party refuse or neglect to supply the arbitrators with any papers or information demanded in writing, the arbitrators are empowered by both parties to proceed ex parte.

If there be one arbitrator, his decision shall be binding; if three, the decision of any two shall be biding. Such decision shall be a condition precedent to any right of legal action, and wherever permitted by law it may be filed in court to carry it into effect.

The arbitrators, if they deem that the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall deem proper for the time, expense and trouble incident to the arbitration and, if the arbitration was taken without reasonable cause, damages for delay. The arbitrators shall fix their own compensation, unless otherwise provided by agreement, and shall assess the costs of charges of the arbitration upon either or both parties.

The award of the arbitrators shall be in writing and it shall not be open to objection on account of the form of the proceeding or the award, unless otherwise provided by the controlling statutes.

In the event of such statutes providing on any matter covered by this article otherwise than as hereinbefore specified, the method of procedure throughout and the legal effect of the award shall be wholly in accordance with the said statutes, it being intended hereby to lay down a principle of action to be followed, leaving its local application to be adapted to the legal requirement of the jurisdiction having authority over the arbitration.

The invalidity of any provision of the Paragraph 213.5 shall not invalidate the remaining provisions of this Paragraph.

213.6 EXAMINATION OF COMPLETED WORK:

If the ENGINEER requests it, the CONTRACTOR at any time before acceptance of the work shall remove or uncover such portions of the finished work as may be directed. After examination, the CONTRACTOR shall restore said portions of the work to the standard required by the Specifications. Should the work thus exposed or examined prove acceptable, the uncovering or removing, and the replacing of the covering or

making good of the parts removed shall be paid for as Extra Work, in accordance with requirements of Paragraph 217.3; but should the work so exposed or examined provide unacceptable, the uncovering, removing and replacing shall be at the CONTRACTOR'S expense.

213.7 CONTRACTOR'S SUPERINTENDENCE:

A qualified superintendent, who is acceptable to the ENGINEER, shall be maintained on the work and give efficient supervision to the work until its completion. The superintendent shall have full authority to act in behalf of the CONTRACTOR, and all directions given to the superintendent shall be considered given to the CONTRACTOR. In general, the ENGINEER'S instructions shall be confirmed in writing and always upon written request from the CONTRACTOR.

213.8 CONTRACTOR'S EMPLOYEES:

Incompetent or incorrigible employees shall be dismissed from the project by the CONTRACTOR or his representative when request by the ENGINEER, and such persons shall not again be permitted to return to the project without the written consent of the ENGINEER.

No person whose age or physical condition is such as to make his employment dangerous to his health or safety, or to the health or safety of others, shall be employed in the development of the project.

There shall be no discrimination against any employee or applicant for employment because or race, creed or color. This provision shall be included in all subcontracts.

213.9 INSPECTORS:

Inspectors may be appointed by the ENGINEER or OWNER to see that the work is performed in accordance with the Plans and Specifications.

Inspectors shall have authority to suspend all or a portion of the work which is not being properly performed and, subject to the final decision of the ENGINEER, to condemn and reject defective work and materials.

Inspectors shall have no authority to permit deviation from the Plans and Specifications and the CONTRACTOR shall be liable for any deviations made without a written order from the ENGINEER. If requested by the CONTRACTOR, the suspension order will be given in writing. Inspectors shall not act as foremen or perform other duties for the CONTRACTOR.

213.10 LANDS BY OWNER:

The OWNER shall provide the lands, as specified, upon which the work under the CONTRACT is to be performed including rights-of-way for construction and access. Any delay in furnishing these lands by the OWNER shall be deemed proper cause for adjustment in the Contract amount, and/or the time of completion.

213.11 LANDS BY CONTRACTOR:

Any additional land and access thereto that may be required for temporary construction facilities or for storage of materials shall be provided by the CONTRACTOR with no liability to the OWNER. The CONTRACTOR shall confine his apparatus and storage of materials and operation of his workmen to those areas described in the Plans and Specifications and such additional areas which he may provide as approved by the Engineer.

213.12 PRIVATE PROPERTY:

The CONTRACTOR shall not enter upon private property for any purpose without obtaining permission, and he shall be responsible for the preservation of all property along and adjacent to the street and/or right-of-way, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits, and other underground structures, and shall protect carefully from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed.

213.13 REMOVAL OF CONSTRUCTION EQUIPMENT:

At the termination of this Contract, before acceptance of the work by the OWNER, the CONTRACTOR shall remove all of his equipment, tools and supplies from the property of the OWNER. Should the CONTRACTOR fail to remove such equipment, tools, and supplies, the OWNER shall have the right to remove them. See also Paragraph 217.11.

213.14 OWNER'S RIGHT TO CORRECT DEFICIENCIES:

If the CONTRACTOR should neglect to prosecute the work properly or fail to perform any provisions of this Contract, the OWNER after ten days' written notice to the CONTRACTOR may, without prejudice to any other remedy he may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the CONTRACTOR. See also Paragraph 217.11.

213.15 OWNER'S RIGHT TO TERMINATE CONTRACT AND COMPLETE THE WORK:

If the CONTRACTOR should be adjudged a bankrupt; or if he should make a general assignment for the benefit of his creditors; or if a receiver should be appointed on account of his insolvency; or if should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials; or if he should fail to make prompt payments to the subcontractors or for materials or labor; or persistently disregard laws, ordinances, or the instructions of the ENGINEER; or otherwise be guilty of a substantial violation of any provision of the Contract, then the OWNER, upon the certificate of the ENGINEER that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the CONTRACTOR seven days' written notice, terminate the employment of the CONTRACTOR and take possession of the premises and of all materials, tools, and appliances thereon and finish the work by whatever method he may deem expedient. In such case, the CONTRACTOR shall not be entitled to receive any further payment until the work is finished.

If the unpaid balance of the Contract price shall exceed the expense of finishing the work, including compensation for additional material, administrative services, and engineering fees, such excess shall be paid to the CONTRACTOR. If such expense shall exceed such unpaid balance, the CONTRACTOR shall pay the difference to the OWNER. The expense incurred by the OWNER as herein provided, and the damage incurred through the CONTRACTOR'S default, shall be certified by the ENGINEER.

See also Paragraph 217.12.

213.16 CONTRACTOR'S RIGHT TO TERMINATE CONTRACT:

The CONTRACTOR may terminate Contract upon ten (10) days' written notice to the OWNER and the ENGINEER, if an order of any court or other public authority caused the work to be stopped or suspended for a period of ninety (90) days through no act or fault of the CONTRACTOR or his employees. See also Paragraph 217.13.

213.17 RIGHTS OF VARIOUS INTERESTS:

Wherever work being done by the OWNER'S forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the ENGINEER, to secure the completion of the various portions of the work in general harmony.

213.18 SEPARATE CONTRACTS:

The OWNER may let other contracts in connection with the work of the CONTRACTOR. The CONTRACTOR shall cooperate with other contractors with regard to storage of materials and execution of their work. The CONTRACTOR shall report to the ENGINEER any irregularities which he may detect which will not permit him to complete his work in a satisfactory manner. The CONTRACTOR shall not be responsible for defects which develop due to the work of others after the work is completed. The CONTRACTOR shall report to the ENGINEER immediately any difference between completed work by others and the Plans.

213.19 SUBCONTRACTS:

At the time specified by the Contract Documents or when requested by the ENGINEER, the CONTRACTOR shall submit in writing to the OWNER for approval the names of the Subcontractors proposed for the work. Subcontractors may not be changed except at the request of and with the approval of the OWNER. The CONTRACTOR is responsible to the OWNER for the acts and omissions of his Subcontractors, and of their direct and indirect employees, to the same extent as he is responsible for the acts and omissions of his employees. The Contract Documents shall not be construed as creating any contractual relation between any Subcontractor and the OWNER.

The CONTRACTOR agrees to bind every Subcontractor and every Subcontractor agrees to be bound by the terms of the Contract, the Contract Documents, the Plans, the General Conditions or Contract, the Supplementary General Conditions, the Special Conditions and the Specifications as far as applicable to his work, including the following provisions of this Section, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the OWNER or ENGINEER.

The Subcontractor agrees to be bound to the CONTRACTOR by the terms of the Contract, the Contract Documents, the Plans, the General Conditions of Contract, the Supplementary General Conditions, the Special Conditions and the Specifications and to assume toward the CONTRACTOR all the obligations and responsibilities that the CONTRACTOR, by those documents, assumes toward the OWNER. The CONTRACTOR agrees to be bound to the Subcontractor by all the obligations that the OWNER assumes to the CONTRACTOR under the terms of said documents, and by all the provisions thereof affording remedies and redress to the CONTRACTOR from the OWNER.

The CONTRACTOR shall not assign, sublet, or transfer the whole or any part of the work herein specified without the written consent of the OWNER. Any such assignment, subletting, or transfer shall not in any manner relieve the CONTRACTOR from any of the responsibilities assumed herein.

For convenience of reference and to facilitate the letter of Contracts and subcontracts, the Specifications are separate into titled sections. Such separations shall not, however, operate to make the Engineer an arbiter to establish limits to the contracts between CONTRACTOR and Subcontractors.

213.20 WORK DURING AN EMERGENCY:

The CONTRACTOR shall perform any work and shall furnish and install any materials and equipment necessary during an emergency endangering life or property. In all cases he shall notify the ENGINEER of the emergency as soon as practicable, but he shall not wait for instructions before proceeding to properly protect both life and property. In cases where the CONTRACTOR cannot or does not meet the emergency, the OWNER may take action as outlined above. See also Paragraph 214.3.

213.21 ORAL AGREEMENTS:

No oral order, objection, claim or notice by any party to the others shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall be held to be waived or modified by reason of any act whatsoever, other than by a definitely agreed waiver or modification thereof in writing, signed by the parties to be bound, and no evidence shall be introduced in any proceeding of any other waiver or modification.

213.22 CONSTRUCTION SCHEDULE:

After being awarded the Contract, and if requested by the ENGINEER, the CONTRACTOR shall immediately prepare and submit to the ENGINEER for approval a progress schedule which will insure the completion of the project within the time specified. Adequate equipment and forces shall be made available by the CONTRACTOR to start work immediately upon order of the ENGINEER and to carry out the schedule to completion of the Contract within the time specified.

213.23 DELAYS AND EXTENSION OF CONTRACT TIME:

Delays caused by injunction or legal actions, "Acts of God", or other causes beyond the control of the CONTRACTOR shall entitle the CONTRACTOR to an extension of time within which to complete the work.

Application for such extension of time shall be made to the OWNER by the CONTRACTOR within ten days after the occurrence of such delay and shall state reasons for the request for the extension of time.

No extensions of time shall be valid unless it is given in writing by the OWNER.

214 SCOPE OF WORK:

214.1 ADDITIONAL INSTRUCTIONS:

If the instructions and Plans are not sufficiently clear to permit the CONTRACTOR to proceed with the work, the ENGINEER shall, either upon his own initiative or upon the request of the CONTRACTOR, furnish additional written instructions, together with additional drawings as may be necessary. When such request is made by the CONTRACTOR, it must be in ample time to permit the preparation of the instructions and drawings by the ENGINEER before the construction of the work covered by them is undertaken. Such additional instructions and drawings shall be consistent with the Contract Documents and shall have the same force and effect as if contained in the Contract Documents.

For the purpose of avoiding delays in the preparation of such additional instructions and drawings, the ENGINEER and the CONTRACTOR shall jointly prepare a schedule showing the time for the commencement of the work to be included in them and the time the CONTRACTOR shall furnish the necessary shop drawings which may be necessary for their preparation. The CONTRACTOR shall do no work without proper drawings or instructions and shall, at his own expense, replace and work wrongly executed.

214.2 INCREASE OR DECREASE OF WORK:

The OWNER reserves the right to make such alterations in the Plans or in the quantities of work to the extent authorized by law and as may be considered necessary. Such alterations shall be in writing by the ENGINEER and shall not be considered as a waiver of any conditions of the Contract nor to invalidate any of the provisions thereof; provided, however, that the execution of a supplemental agreement acceptable to both parties of the Contract will be necessary before any alteration is made which involves (1) an increase or decrease of more than 20% of the total cost of the work, calculated from the original proposal quantities and the unit Contract prices, or the original lump sum, as applicable, or (2) an increase or decrease of more than 20% in the quantity of any one major Contract item.

For condition (2) above, a major item is defined as any item, unless otherwise indicated on the Plans or designated in the Special Conditions, the Contract price for which amounts to 10% or more of the total Contract price as determined by either the original lump sum bid or by the original quantities and the unit Contract prices.

When an alteration requires the execution of a supplemental agreement, the agreement shall be fully executed before any work on the alteration is started. Alterations involving an increase of more than 20% in the net of any one minor Contract item may be the basis for either party to the Contract to require a supplemental agreement.

See Paragraph 217.3 for method of payment.

214.3 EXTRA WORK:

Any extra work made necessary by alteration of or additions to the Plans or by other reasons for which no price is provided in the Contract, shall be performed by the CONTRACTOR as directed by the ENGINEER and he shall be compensated therefor as provided under Paragraph 217.3.

Extra work which by reason of its character or extent is covered by a supplemental agreement between the OWNER and the CONTRACTOR, must have the written consent of the surety on the bond, but extra work and change orders not covered by a supplemental agreement will not require the consent of the surety. See also Paragraph 214.2.

214.4 CHANGED CONDITIONS:

Should the CONTRACTOR encounter subsurface or latent physical conditions at the site differing materially from those indicated in the Contract, or unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract, which changed or unusual conditions will be considered by the Contractor as the basis for a claim for extra compensation, the Contractor shall promptly and before any such conditions are disturbed, notify the ENGINEER of the alleged conditions in writing, with copies to the OWNER.

If the OWNER is not given written notice prior to the condition being disturbed, the CONTRACTOR will be deemed to have waived any claim or claims for extra compensation in any manner arising out of the changed or unusual conditions.

The OWNER shall instruct the ENGINEER to investigate and issue a decision on claim within a reasonable time. ENGINEER'S decision shall cover change, if any, in either or both time or money.

If the OWNER shall determine the conditions to be such as to justify a claim for additional compensation, he shall provide for additional payment for the particular phase of work in question by a negotiated agreement with the CONTRACTOR upon new unit Contract prices, by cost plus an agreed percentage, or by any other equitable arrangement mutually agreed upon by the OWNER and the CONTRACTOR and consented to in writing by the surety to the bond. In any event, the CONTRACTOR shall not be relieved, unless permitted to do so by the OWNER, from his obligation of resuming construction operations pending decision as to the validity of a claim, or pending the execution of a negotiated agreement to cover additional costs if a claim shall be recognized under the provisions of this Section of the specifications.

214.5 SALVAGE:

Unless otherwise indicated on the Plans or in the Special Conditions, all castings, pipe and any other material taken from the work shall be the property of the CONTRACTOR.

214.6 CLEANUP:

The CONTRACTOR shall at his own expense clean up and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within seventy-two (72) hours after request by the ENGINEER, the work may be done by the OWNER and the cost thereof be charged to the CONTRACTOR and deducted from his final estimate. See also Paragraph 217.11.

215 MATERIALS AND WORKMANSHIP:

215.1 QUALITY OF EQUIPMENT AND MATERIALS:

In order to establish standards of quality, the ENGINEER has, in the detailed Specifications, referred to certain products by name and catalog number. This procedure is not to be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable is design.

The CONTRACTOR shall furnish a complete list of proposed desired substitutions, together with such engineering and catalog data as the ENGINEER may require. List and information must be submitted prior to submittal of first progress payment estimate.

The CONTRACTOR shall abide by the ENGINEER'S judgement when proposed substitute materials or items of equipment are judged to be unacceptable and shall furnish the specified material or item of equipment in such case. All proposals for substitutions shall be submitted in writing by he CONTRACTOR and not by individual trades or material suppliers. The ENGINEER will approve or disapprove proposed substitutions in writing within a reasonable time. No substitute materials shall be used unless approved in writing.

215.2 MATERIALS FURNISHED BY THE OWNER:

Materials specifically indicated will be furnished by the OWNER. The fact that the OWNER is to furnish material is conclusive evidence of its acceptability for the purpose intended, and the CONTRACTOR may continue to use it until otherwise directed. If the CONTRACTOR discovers any defect in material furnished by the OWNER, he shall notify the ENGINEER. Materials furnished by the OWNER, which are not of local occurrence, will be provided at locations listed on Plans or in Specifications. The CONTRACTOR shall be responsible for material loss or damage, including that caused by third parties, after his receipt of material.

215.3 MATERIALS FURNISHED BY THE CONTRACTOR:

All materials used in the work shall meet the requirements of the respective Plans and Specifications. All materials not otherwise specifically indicated shall be furnished by the CONTRACTOR.

215.4 STORAGE OF MATERIALS:

Materials shall be so stored as to insure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground, and/or they shall be placed under cover. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without the written permission of the OWNER or lessee.

215.5 REJECTED WORK AND MATERIALS:

All materials which do not conform to the requirements of the Contract Documents, are not equal to samples approved by the ENGINEER, or are in any way unsatisfactory or unsuited to the purpose for which they are intended, shall be rejected.

Any defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause shall be removed and the work shall be re-executed by the CONTRACTOR.

Defective work or material may be condemned by the ENGINEER any time before the final acceptance of the work. Notice of such condemnation shall be given in writing by the ENGINEER. Such condemned work or material shall be removed or disposed of to the satisfaction of the ENGINEER within ten (10) days after written notice is given by the ENGINEER. Should the CONTRACTOR fail to remove rejected work or materials within ten (10) days after written notice to do so, the OWNER may remove them and store the materials. Failure or neglect on the part of the ENGINEER to condemn unsatisfactory material or reject inferior workmanship will in no way release the CONTRACTOR, nor shall it be construed to mean the acceptance of such work, nor shall the final acceptance bar the OWNER from recovering damages in case fraud was practiced, or for defective work resulting from the CONTRACTOR'S dishonesty. No compensation will be made for defective work or materials.

Work done contrary to or regardless of the instructions of the ENGINEER, work done without lines, grade and/or cross section stakes and grades shown on the Plans or as given by the ENGINEER, or any deviation made from the Plans and Specifications without written authority will be considered unauthorized and at the expense of the CONTRACTOR, and will not be measured or paid for by the OWNER. Any and all work so done may be ordered removed and replaced immediately at the CONTRACTOR'S expense.

See also Paragraph 217.9.

215.6 MANUFACTURER'S DIRECTIONS:

Manufactured articles, material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless herein specified to the contrary.

215.7 CUTTING AND PATCHING:

The CONTRACTOR shall do all necessary cutting and patching of the work that may be required to properly receive the work of the various trades or as required by the Plans and Specifications to complete the work. He shall restore all such cut or patched work as directed by the ENGINEER. Cutting of existing structures that will endanger the work, adjacent property, workmen or the public shall not be done unless approved by the ENGINEER and under his direction.

215.8 PATENTS:

All fees or royalties for patented inventions, equipment, or arrangements that may be used in any manner connected with the construction or erection of the work, or any part thereof, shall be included in the price mentioned in the Contract.

The CONTRACTOR shall protect and hold harmless the OWNER against any and all claims or litigation by reason of infringement of any patent rights on any materials, equipment, or construction furnished by the CONTRACTOR.

215.9 GUARANTEE:

The CONTRACTOR shall guarantee all work and material against all defects for the period specified in the Form of Bond or Special Conditions. The CONTRACTOR shall repair or replace any such defective work and/or material to conform to the provisions of this Contract and without expense to the OWNER, within ten (10) days after notification in writing by the OWNER of such defective work or material. If the CONTRACTOR shall not have made said repairs or replacements or have made arrangements for the correction thereof within the period specified above, the OWNER shall do so and shall charge the cost of same to the CONTRACTOR. The CONTRACTOR shall perform the work so as to cause the OWNER a minimum of inconvenience and interruption of services.

See also Paragraph 217.17.

215.10 BOND:

Prior to the signing of the Contract, the CONTRACTOR shall furnish a good and sufficient performance bond on the form provided in the full amount of the Contract.

Bond shall guarantee faithful performance of the provisions of the Contract, including the guarantee of all work and material against all defects for the period specified in the Form of Bond, and the payment of all bills and obligations arising from said Contract.

See also Paragraph 211.16.

216 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC:

216.1 CONTRACTOR'S RESPONSIBILITY:

The CONTRACTOR assumes full responsibility for the safekeeping of all materials and equipment and for all unfinished work until final acceptance by the OWNER, and if any of it be damaged or be destroyed from any cause, he shall replace it at his own expense.

The CONTRACTOR shall indemnify and save harmless the OWNER against any liens filed for nonpayment of his bills in connection with the Contract work. The CONTRACTOR shall furnish the OWNER satisfactory evidence that all persons who have done work or furnished materials, equipment, or service of any type under this Contract have been fully paid prior to the acceptance of the work by the OWNER. See also Paragraph 217.14.

The CONTRACTOR shall indemnify and hold harmless the OWNER, the OWNER'S employees, the ENGINEER, and the ENGINEER'S employees from any and all liability, loss, cost, damage, and expense (including reasonable attorney's fees and court costs) resulting from, arising out of, or incurred by reason of any claims, actions, or suits based upon or alleging bodily injury, including death, or property damage rising out of or resulting from the CONTRACTOR'S operations under this Contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by either of them. The CONTRACTOR shall obtain insurance for this purpose, which shall insure the interests of the OWNER and ENGINEER as the same may appear, and shall file with the OWNER and ENGINEER certificates of such insurance.

216.2 USE OF PREMISES:

The CONTRACTOR shall confine his equipment, storage of materials and operation of work to the limits indicated by law, ordinances, permits or direction of the ENGINEER, and shall not unreasonably encumber the premises with his materials.

216.3 CONFINE OPERATIONS WITHIN RIGHTS-OF-WAY AND EASEMENTS:

It shall be the CONTRACTOR'S responsibility to confine his construction activities within the limits of easements, property lines and limits of construction. Any damage to persons or property resulting from encroaching beyond these limits shall be the sole responsibility of the CONTRACTOR.

216.4 SAFETY:

Precautions shall be exercised at all times by the CONTRACTOR for the protection of persons, employees and property. The safety provisions of applicable laws and local building and construction codes shall be observed.

The operations of the CONTRACTOR for the protection of persons, and for guarding against hazards of machinery and equipment, shall meet the requirements of state law.

The CONTRACTOR shall provide and maintain, at his own expense and on a 24-hours basis, all necessary safeguards such as watchmen, warning signs or signals, barricades and night lights at all unsafe places at or near the work. Special care shall be exercised to prevent vehicles, pedestrians, and livestock from falling into open trenches or being otherwise harmed as a result of the work.

The CONTRACTOR shall in all cases maintain safe passageways at all road crossings, crosswalks and street intersections, and shall do all other things necessary to prevent accident or loss of any kind.

216.5 FAILURE TO PAY FOR LABOR AND MATERIALS:

If, at any item, the CONTRACTOR fails to pay the Subcontractor or the laborers employed upon the work, or fails to pay for the materials used therein, the OWNER may withhold from the money which may be due the CONTRACTOR under this agreement such amount or amounts as may be necessary for the payment of such Subcontractors, laborers, or materials, and may, acting as agent for the CONTRACTOR, apply the same to such payments and deduct the same from the final estimate of the CONTRACTOR.

216.6 MOVING OF PUBLIC AND PRIVATE UTILITIES:

Prior to awarding the Contract, the OWNER will notify all affected utilities to move such of their installations as would be within the confines of the finished improvement. It shall be the responsibility of the CONTRACTOR to coordinate his work with that of the utilities in such manner as to cause the least possible interference, and as may be further provided in the Special Conditions and Specifications.

It is provided that no utility, private or public, shall be moved to accommodate the Contractor's equipment or his method of operation when such utility does not conflict with the installation of the improvement under construction unless the costs of such removal shall be at the expense of the CONTRACTOR.

216.7 PROTECTION OF PUBLIC AND PRIVATE UTILITIES:

The CONTRACTOR shall support and protect by timbers or otherwise, all pipes, conduits, poles, wires or other apparatus which may be in any way affected by the work. If, through the CONTRACTOR'S operations, any of said pipes, conduits, poles, wires, or apparatus should be damaged, they shall be repaired by the authorities having control of same, and the expense of such repairs shall be charged to the CONTRACTOR.

The CONTRACTOR shall further be responsible for any damage done to any street or other public property, or to any private property by reason of breaking of any water pipe, sewer or gas pipe, electric conduit, or other utility by or through his negligence.

216.8 DAMAGE TO EXISTING IMPROVEMENTS AND UTILITIES:

Underground utilities to record will be shown on the construction plans insofar as it is possible to do so. These, however, are shown for convenience only and the Owner assumes no responsibility for improper locations or failure to show utility locations on the construction plans.

The CONTRACTOR shall take adequate precautions to protect existing lawns, trees and shrubs outside rights-of-way, sidewalk, curbs, pavements, utilities, adjoining property, and structures, and to avoid damage thereto. He shall at his own expense completely repair any damage thereto caused by his operations to the satisfaction of the ENGINEER, except as otherwise provided in other portions of these Specifications.

216.9 MAINTENANCE OF TRAFFIC:

216.9.1 Division of Responsibility:

The CONTRACTOR shall be responsible for maintenance, control, and the safeguarding of traffic within and immediately abutting the project as further outlined herein, and as may otherwise be provided in the Special Conditions. The Governmental Agency will be responsible for maintenance, control, and safeguarding of traffic on all detours which do not lie within the project limits, unless otherwise required in the Special Conditions.

216.9.2 Street Closures or Partial Closures:

Streets may be closed to through traffic but shall not be closed to traffic until such closure has been approved by the Governmental Agency. Street closures shall be made in such a manner as to provide for maximum public safety and public convenience. They shall be opened to through traffic at such time as the work has been completed, or as the Governmental Agency may direct.

216.9.3 Existing Traffic Signs and Facilities:

The Governmental Agency will make all necessary adjustments to traffic signals and traffic signal activators at no cost to the CONTRACTOR. Existing traffic and street name signs which will interfere with construction will be removed by the Governmental Agency as required by CONTRACTOR'S construction schedule. Upon completion of the project, the Governmental Agency will reset all such signs.

216.9.4 Detours:

Detours outside the limits of the project shall be the sole responsibility of the Governmental Agency unless otherwise provided in the Special Conditions. Detours within the limits of the project such as side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction area for maintenance of traffic, and such related facilities for the maintenance of traffic shall be the responsibility of the CONTRACTOR, the costs for which shall be included in the appropriate unit price or lump sum, as applicable.

216.9.5 Local and Emergency Traffic:

Local traffic shall be provided access to private properties at all times, except during some urgent stages of construction when it is impracticable to carry on the construction and maintain traffic simultaneously, such as for the placing of asphalt concrete pavement, placing and curing of portland cement concrete pavement, and deep sewer excavations which prohibit safe travel of vehicular traffic.

Emergency traffic such as police, fire, and disaster units shall be provided reasonable access at all times.

216.9.6 Protection of Pedestrian and Vehicular Traffic:

The CONTRACTOR shall take every precaution to protect pedestrian and vehicular traffic.

216.9.7 Restriction of Parking:

Where parking is a hazard to through traffic or to the construction work, it shall be restricted either entirely or during the time when it creates a hazard. Signs for this purpose will be initially furnished and placed by the Governmental Agency. The Contractor shall be responsible for and shall maintain the signs if they are used on any street which is directly involved in the construction work. If the parking signs are to be used beyond the confines of the work area, such as another street being used as a detour, the signs will be the responsibility of the Governmental Agency.

216.9.8 Flagmen:

The CONTRACTOR shall furnish at his own expense all flagmen who may be needed.

216.10 TRAFFIC CONTROL WITHIN AND ABUTTING THE PROJECT:

The CONTRACTOR shall place and maintain all signs, barricades and warning lights within the limits of the project on all streets, alleys and driveways entering the project so that approaching traffic will turn right or left on existing undisturbed street before reaching the warning signs and barriers immediately abutting the project. Signs which are required will be furnished by the Governmental Agency.

Barricades shall be furnished by the CONTRACTOR. The barricades shall conform to requirements of the Governmental Agency.

Unless otherwise provided in the Special Conditions, the Governmental Agency will assume responsibility for signs and traffic control devices beyond the limits hereinbefore described.

216.11 USE OF EXPLOSIVES:

Blasting will not be permitted in any case without specific authority of the OWNER, and then only under such restrictions as may be required by the proper authorities.

When the use of explosives is necessary for the prosecution of the work, the CONTRACTOR shall use the utmost care so as not to endanger life or property, cause slides or disturb the materials outside the neat lines of the cross section.

Blasting shall be completed in the vicinity of new structures before construction on such structures is undertaken. All explosives shall be stored in a secure manner and placed in compliance with local laws and ordinances and all such storage places shall be clearly marked "Dangerous - Explosives". No explosive shall be left in an unprotected manner along or adjacent to any existing highway or public place.

216.12 RAILROAD CROSSINGS:

Wherever a project is being constructed beneath, at grade or above railroad tracks, the permits for the construction will have previously been secured by the OWNER. It shall be the CONTRACTOR'S responsibility, however, to contact the railroad company prior to constructing such crossings and to proceed with the construction as directed by the railroad company. The CONTRACTOR shall comply with all construction and additional insurance requirements of the railroad company. The CONTRACTOR shall hold the OWNER harmless from any and all damages resulting from his operations in the construction at such crossings.

216.13 SANITARY PROVISIONS:

The CONTRACTOR shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Governmental Agency having jurisdiction thereover. He shall permit no public nuisance.

216.14 USE AND OCCUPANCY PRIOR TO COMPLETION OF CONTRACT:

The OWNER shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding that the timer for completing the entire work or such portions may not have expired; but such taking possession and use shall not be deemed an acceptance of any portion of the work not completed in accordance with the Contract Documents. Any claims which the OWNER may have against the CONTRACTOR shall not be deemed to have been waived by such occupancy.

If such prior use increases the cost of or delays the completion of uncompleted work or causes refinishing of completed work, the CONTRACTOR shall be entitled to such extra compensation, or extension of time or both, as the ENGINEER may determine.

216.15 PERSONAL LIABILITY OF PUBLIC OFFICIALS:

Neither the ENGINEER nor any of his assistants, nor any other officer of the OWNER shall be personally responsible for any liability arising under or growing out of the Contract. See also Paragraph 216.1.

216.16 NO WAIVER OF LEGAL RIGHTS:

Should an error be discovered in or payment of unauthorized work be made by the final estimate or should dishonesty on the part of the CONTRACTOR be discovered in the work, the OWNER reserves the right, after the final payment has been made, to claim and recover by process of law such sums as may be sufficient to correct the error, to recover the overpayment, or to make good the defects in the work resulting from the Contractor's dishonesty.

217 MEASUREMENT AND PAYMENT:

217.1 MEASUREMENT:

The determination of pay quantities of work performed under the Contract will be made by the ENGINEER based upon the lines, grades and cross sections given, or measurements made by him or his assistants. All items will be computed in the units in the Proposal.

217.2 SCOPE OF PAYMENT:

The CONTRACTOR shall accept the compensation, as provided in the Contract, in full payment for furnishing all materials, labor, tools and equipment necessary to the completed work and for performing all work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work until the final acceptance by the OWNER, and for all risks of every description connected with the prosecution of the work; also for all expenses incurred in consequence of the suspension or discontinuance of the work as herein specified; and for completing the work according to the Plans and Specifications. See also Paragraph 214.4.

Neither the payment of any estimate nor of any retained percentage shall relieve the CONTRACTOR or any obligation to make good any defective work or material. Payment will be made only for materials actually incorporated in the work. For payment of materials on site, see Paragraph 217.04.

The unit Contract prices for the various bid items of the Contract shall be full compensation for all labor, materials, supplies, equipment, tools and all things of whatsoever nature required for the complete incorporation of the item into the work the same as though the item were to read "In Place," unless the Plans and Special Conditions shall provide otherwise.

217.3 PAYMENT FOR EXTRA WORK:

Adjustments, if any, in the amounts to be paid the CONTRACTOR by reason of any change, addition, or deduction, shall be determined by one or more of the following methods:

By an acceptable lump-sum proposal from the CONTRACTOR.

By unit Contract prices contained in the Contract Proposal, or by unit prices mutually agreed upon by the CONTRACTOR and the OWNER.

Payroll cost of labor plus 15% for profit, overhead and small tools, plus the amount of social security tax imposed by law upon the CONTRACTOR, plus the cost of workmen's compensation, public liability insurance and employment security contributions.

Actual Cost of materials delivered to the work, including freight and hauling charges as shown by original receipted bills, plus 15%.

Equipment rental rates for machinery, tools and equipment, except small hand tools, as determined from current publications of the Association of Equipment Dealers.

It shall be the responsibility of the CONTRACTOR before proceeding with any change to satisfy himself that the change has been properly authorized in behalf of the OWNER. No charge for extra work or any other change in the Contract will be allowed unless the extra work or change has been authorized in writing by the Owner, and the compensation or method thereof is stated in such written authority.

See also Paragraph 214.2, 214.3 and 214.4.

217.04 PROGRESS PAYMENTS, RETAINED PERCENTAGE:

Partial payments will be made once each month as the work progresses, when the CONTRACTOR is performing satisfactorily under the contract. Said payments will be based upon progress estimates prepared by the ENGINEER of the value of work performed and materials placed in accordance with the contract and the value of the materials on hand in accordance with the Special Conditions. Request for partial payments shall be made on the forms specified in the Contract Documents and shall be submitted by the first Friday of the month for work completed in the previous month. The amount of the progress estimate to be paid to the CONTRACTOR will be subject to the following:

(a) Standard Retainment. The Engineer will make a deduction from the progress estimate in the amount considered necessary to protect the interests of the OWNER. That amount to be retained will be 10% of the value of the completed work, exclusive of mobilization and payments for materials on hand. No further retainment will be withheld if the CONTRACTOR makes satisfactory progress in the contract work. The amount retained will be in effect until such time as final payment is made, with the following exceptions, each of which required the CONTRACTOR'S written request and consent of the Surety:

1. When 97-1/2% of the work has been completed, the ENGINEER may, at his discretion, reduce the retained amount to twice the value of the remaining work.

2. Upon completion and acceptance of the project, the ENGINEER may reduce the retainage to 2% of the original contract amount.

3. Further subsequent reductions may be made with the approval of the OWNER.

(b) Securities in Lieu of Standard Retainment. When the original contract amount exceeds ₱ 20,000 (two million pesos), the CONTRACTOR may withdraw all or any portion of the standard retainment withheld to assure satisfactory performance of the contract, if the CONTRACTOR deposits and assigns acceptable securities to the County. Such securities so deposited shall at all times have a market value at least equal in value to the sums so withdrawn. If at any time the OWNER determines that the market value of the securities has fallen below the sums so withdrawn, it shall give notice thereof to the CONTRACTOR, who forthwith shall deposit additional acceptable securities in an amount sufficient to reestablish a total deposit of securities equal in value to the sums so withdrawn. This security substitution shall not apply if a part of the contract price is paid from federal, or other sources, and the federal or other source has requirements which are inconsistent with this subsection.

(c) Subcontractor and Supplier Claims. In addition to standard retainment, the OWNER may withhold funds for all claims against the CONTRACTOR filed by subcontractors and suppliers, pursuant to applicable Philippine Statutes.

(d) No Payment. A partial payment will not be made when the total value of the work done since the last estimate amounts to less than $500.

217.5 ENGINEER'S ACTION ON A REQUEST FOR PAYMENT:

Within ten (10) days of submission of any Request for Payment by the CONTRACTOR, the ENGINEER shall:

Approve the Request for Payment as submitted; or

Approve such other amount as he shall decide is due the CONTRACTOR, informing the CONTRACTOR in writing of his reasons for approving the amended amount; or

Withhold the Request for Payment, informing the CONTRACTOR in writing or his reasons for withholding it.

217.6 OWNER'S ACTION ON AN APPROVED REQUEST FOR PAYMENT:

Within thirty (30) days from the date of approval of a Request for Payment by the ENGINEER, the OWNER shall:

Pay the Request for Payment as approved; or

Pay such other amount as he shall decide is due the CONTRACTOR, informing the CONTRACTOR and the ENGINEER in writing of his reasons for paying the amended amount; or

Withhold payment informing the CONTRACTOR and the ENGINEER of his reasons for withholding payment.

217.7 INTEREST ON UNPAID REQUESTS FOR PAYMENT:

Should the OWNER fail to pay an approved Request for Payment within thirty (30) days from the date of approval by the ENGINEER, and should he fail to inform the ENGINEER and the CONTRACTOR in writing of his reasons for withholding payment, the OWNER shall pay the CONTRACTOR interest on the amount of the Request for Payment at the rate of five percent (5%) per annum, from a date thirty (30) days after approval by the ENGINEER of the Request for Payment, until payment is made.

217.8 PAYMENT FOR UNCORRECTED WORK:

Should the ENGINEER direct the CONTRACTOR not to correct work that has been damaged or that was not performed in accordance with the Contract Documents, an equitable deduction from the Contract amount shall be made to compensate the OWNER for the uncorrected work.

217.9 PAYMENT FOR REJECTED WORK AND MATERIALS:

The removal of work and materials rejected under Paragraph 215.5 and the re-execution of acceptable work by the CONTRACTOR shall be at expense of the CONTRACTOR, and he shall pay the cost of replacing the work of other CONTRACTORS destroyed or damaged by the removal of the rejected work or materials and the subsequent replacement of acceptable work.

Removal of rejected work or materials and storage of materials by the OWNER in accordance with Paragraph 215.5 shall be paid by the CONTRACTOR within thirty (30) days after written notice to pay is given by the OWNER. If the CONTRACTOR does not pay the expenses of such removal and after ten (10) days' written notice being given by the OWNER of his intent to sell the materials, the OWNER may sell the materials at auction or at private sale and shall pay to the CONTRACTOR the net proceeds therefrom

after deducting all the costs and expenses that should have been borne by the CONTRACTOR.

217.10 PAYMENT FOR WORK SUSPENDED BY THE OWNER:

If the work or any part thereof shall be suspended by the OWNER and abandoned by the CONTRACTOR as provided in Paragraph 213.3, the CONTRACTOR will then be entitled to payment for all work performed on the portions so abandoned, plus 15% of the value of the uncompleted portion of the abandoned work to compensate for overhead, plant expense, and anticipated profit, and which action shall terminate the Contract.

217.11 PAYMENT FOR WORK BY THE OWNER:

The cost of the work performed by the OWNER in removing construction equipment, tools and supplies in accordance with Paragraph 212.13, and correcting deficiencies in accordance with Paragraph 3-14 and Paragraph 214.6, shall be paid by the CONTRACTOR.

217.12 PAYMENT FOR WORK BY THE OWNER FOLLOWING HIS TERMINATION OF THE CONTRACT:

Upon termination of the Contract by the OWNER in accordance with Paragraph 213.15, no further payments shall be due the CONTRACTOR until the work is completed. If the unpaid balance of the Contract amount shall exceed the cost of completing the work including all overhead costs, the excess shall be paid to the CONTRACTOR. If the cost of completing the work shall exceed the unpaid balance, the CONTRACTOR shall pay the difference to the OWNER. The cost incurred by the OWNER, as herein provided, and the damage incurred through the CONTRACTOR'S default, shall be certified by the OWNER, and approved by the ENGINEER.

217.13 PAYMENT FOR WORK TERMINATED BY THE CONTRACTOR:

Upon termination of the Contract by the CONTRACTOR in accordance with Paragraph 213.16, the CONTRACTOR shall recover payment from the OWNER for the work performed, plus loss on plant and materials, plus established profit and damages, as approved by the ENGINEER.

217.14 RELEASE OF LIENS:

The CONTRACTOR shall deliver to the OWNER a complete release of all liens arising out of this Contract before the retained percentage or before the final Request for Payment is paid. If any lien remains unsatisfied after all payments are made, the Contractor shall refund to the OWNER such amounts as the OWNER may have been compelled to pay in discharging such liens including all costs and a reasonable attorney's fee.

217.15 ACCEPTANCE AND FINAL PAYMENT:

When the CONTRACTOR shall have completed the work in accordance with the terms of the Contract Documents, the ENGINEER shall certify his acceptance to the OWNER and his approval of the CONTRACTOR'S final Request for Payment, which shall be the Contract amount plus all approved additions less all approved deductions and less previous payments made. The CONTRACTOR shall furnish evidence that he has fully paid all debts for labor, materials, and equipment incurred in connection with the work, following which the OWNER shall accept the work and release the CONTRACTOR except as to the conditions of the Performance Bond, any legal rights of the OWNER, required guarantees, and Correction of Faulty Work after Final Payment, and shall authorize payment of the CONTRACTOR'S final Request for Payment. The CONTRACTOR must allow sufficient time between the time of completion of the work and approval of the final Request for Payment for the ENGINEER to assembly and check the necessary data.

217.16 TERMINATION OF CONTRACTOR'S RESPONSIBILITY:

The Contract will be considered complete when all work has been finished, the final inspection made by the ENGINEER, and the project accepted in writing by the OWNER. The CONTRACTOR'S responsibility shall then cease, except as set forth in his Performance Bond, as required by the Guarantee Period.

217.17 CORRECTION OF FAULTY WORK AFTER FINAL PAYMENT:

The approval of the final Request for Payment by the ENGINEER and the making of the final payment by the OWNER to the CONTRACTOR shall not relieve the CONTRACTOR of responsibility for faulty materials or workmanship. The OWNER shall promptly give notice of faulty materials or workmanship and the CONTRACTOR shall promptly replace any such defects. The ENGINEER shall decide all questions arising under this Paragraph, and all such decisions shall be subject to arbitration. See also Paragraph 215.9.

300 SITE PREPARATION

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301 CLEARING AND GRUBBING:

301.1 SCOPE:

Clearing and grubbing shall conform to the requirements specified herein. The work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the right-of-way and easement areas and from borrow pits and such other areas and pits as may be indicated on the Plans except such objects as are designated to remain or are to be removed in accordance with other sections of these specifications. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

301.2 EXECUTION OF WORK:

The ENGINEER will establish right-of-way lines and designate all trees, shrubs, plants and other objects to remain. The CONTRACTOR shall preserve all objects designated to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be an asphaltum base paint prepared especially for tree surgery.

All surface objects, all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared or grubbed. Undisturbed stumps and roots and non-perishable solid objects which will be a minimum of 0.6 m below subgrade or slope of embankments need not to be removed. When authorized by the ENGINEER, the CONTRACTOR may leave stumps and non-perishable solid objects, provided they do not extend more than 6 inches above the ground line or low water level. Stumps shall be cut off flush with or below the surface of the final slope line in the area to be rounded at the top of backslopes.

The clearing of growth shall not extend more than 2.5 m beyond the toes of the fills or the tops of cut slopes as treated. All trees within 8 m of the traveled way shall be removed as shown on the Plans or as directed.

All merchantable timber in the clearing area which has not been removed from the right-of-way prior to the beginning of construction, shall become the property of the CONTRACTOR, unless otherwise specified.

Branches of trees or shrubs shall be removed as directed. All trimming shall be done by skilled workmen and in accordance with good tree surgery practice.

The CONTRACTOR shall scalp areas where excavation or embankment is to be made, except that sod need not be removed where the embankment to be constructed is 1.3 m or more in height unless otherwise shown on the Plans or defined in the Special Conditions. Scalping shall include the removal of material, such as brush, roots, sod, grass, residue or agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

301.3 CLEAN UP:

Stump holes and other holes from which obstructions are removed, shall be backfilled with suitable material and compacted, except in areas to be excavated.

Perishable material that is to be burned shall be burned under the constant care of competent watchmen at such times and in such times and in such a manner that the surrounding vegetation, the other adjacent property or anything designated to remain on the right-of-way, will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

Materials and debris which cannot be burned and perishable materials shall be removed from the right-of-way and disposed of at locations off the project. The CONTRACTOR shall make all necessary arrangements with property owners for suitable disposal locations and the cost involved shall be included in the unit price bid.

301.4 METHOD OF MEASUREMENT:

An area measurement for clearing and grubbing shall not be made. The work to be paid for shall be the accepted clearing, grubbing and scalping within the limits shown on the Plans.

301.5 PAYMENT:

Unless otherwise provided for in the Special Conditions, clearing and grubbing shall be paid for at the Contract Lump Sum Price and shall be full compensation for clearing, grubbing and scalping the entire project.

302 EXISTING UTILITIES:

302.1:

No attempt is made to indicate or show accurate location of all existing utilities, in the line of or crossing the proposed work. In general, the approximate position of known utilities are shown on the plans. These are primarily for the purpose of indicating the approximate position of the utility lines with respect to the proposed work.

302.2:

Existing utility lines which are to be retained, that are shown on the drawings, or the locations of which are made known to the CONTRACTOR prior to the excavation, as well as utility lines constructed during excavation operations shall be protected from damage during all construction operations. Prior to construction, it shall be the responsibility of the CONTRACTOR to notify utility companies in an attempt to accurately locate utilities.

302.3:

In the event that the CONTRACTOR damages utility lines not shown on the drawings, or the location of which has not been known to him, report thereof shall be made immediately to the ENGINEER: the CONTRACTOR will be responsible for notifying the OWNER of the utility. If it is determined, in such case, that repairs are to be made by the CONTRACTOR, such repairs will be ordered under Article 214A entitled "Changed Conditions" of the general specifications. Utilities which the utility company is required to rebuild or relocate shall be rebuilt or relocated in advance of construction by others in accordance with the CONTRACTOR'S schedule. CONTRACTOR is advised to consult with the utility company regarding clearances past utility installations.

303 REMOVAL OF STRUCTURES AND OBSTRUCTION:

303.1 SCOPE:

The removal of structures and obstructions shall conform to requirements specified herein.

The work shall consist of the removal, in whole or in part, and satisfactory disposal of all buildings, foundations, fences, signs, structures, old pavements, traffic signal materials, abandoned pipelines, and any other obstructions which are not designated or permitted to remain. The work shall also include the salvaging of designated materials and backfilling any resulting trenches, holes and pits.

The work shall also include sawing concrete in reasonably close conformity with the dimensions and details on the Plans or to create planes of weakness in order to facilitate controlled breaking for removal.

303.2 EXECUTION OF WORK:

303.2.1 General:

The CONTRACTOR shall raze, remove and dispose of all buildings, foundations, signs, structures, fences, old pavements, abandoned pipelines, traffic signal materials and other obstructions to limits shown on the Plans or defined in the Special Conditions. All materials designated as salvageable on the Plans shall be carefully removed to avoid unnecessary damage. Savaged materials which may be readily transported shall be transported by the CONTRACTOR to the place designated on the Plans or defined in the Special Conditions.

Traffic signals and related materials shall include all attachment hardware and other incidental materials, such as, but not limited to, mast, arms and spanwire.

Concrete adhering to sign posts shall be removed.

Sign islands shall be considered part of the removal item and shall be removed to one foot below the surrounding ground.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with plan details, and in such manner that materials to be left in place shall be protected from damage. All damage to portions of structure to remain in place shall be repaired by the CONTRACTOR at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension. Dowels as required by plans are to be securely grouted with approved grout.

The ends of concrete or masonry culverts or sewers that are to be left in place shall be plugged with suitable material. The ends of CMP culverts shall be crushed. Culvert and sewer ends are to be sufficiently filled or crushed to prevent future settlement of embankments or backfill.

The sawing of concrete shall be done carefully. Concrete that is designed to remain in place that is damaged due to the CONTRACTOR'S operations shall be repaired or replaced at the CONTRACTOR'S expense.

303.3.2 Removal of Bridges, Culverts and Other Drainage Structures

Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

The substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream bed shall be removed to a point one foot below natural ground surface, unless otherwise shown on the Plans or detailed in the Special Conditions. Structures that lie wholly or in part within the limits of a new structure, shall be removed as necessary to accommodate the construction of the proposed structure.

Specified steel and wood bridges shall be carefully dismantled without unnecessary damage. Steel members to be salvaged shall be match marked with waterproof paint. All salvaged material shall be stored as specified in Subsection 303.2.1.

303.2.3 Removal of Pipe:

All pipe shall be carefully removed, cleaned and every precaution taken to avoid breaking or damaging the pipe. Pipes to be re-laid shall be removed and stored so that there will be no loss or damage before relaying. The CONTRACTOR will be required

to replace sections lost from storage or damaged by negligence or by use of improper methods.

Live sewers connected to removed manholes, catch basins and inlets shall be properly reconnected and satisfactory bypass service shall be maintained during such operations. Holes resulting from removal of manholes, catch basins and inlets shall be backfilled and compacted.

303.2.4 Removal of Pavements, Sidewalks, Curbs, Etc.

Pavements, sidewalks, curbs, gutters, etc., designated for removal, shall be broken into pieces and used for riprap on the project or:

(a) Broken into riprap sized pieces and stockpiled at designated locations.

(b) Disposed of as directed.

Old concrete construction that abuts new concrete construction, edges of pavement, sidewalks, curbs, etc., to be left in place shall be sawn to a true line with a vertical face. Concrete pavement to be broken and left in place, shall be broken in such a manner that the largest fragment shall not exceed one square yard in surface area.

303.3 Clean Up:

Materials and debris which cannot be burned and perishable materials shall be removed from the right-of-way and disposed of at locations off the project. The CONTRACTOR shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid.

303.4 Method of Measurement:

The work to be paid for shall include all stipulated structures and obstructions within the project limits in accordance with the provisions of the Specifications.

Concrete sawing designated on the Plans or required by the Specification shall not be measured.

303.5 Payment:

The accepted removal of structures and obstructions shall be paid for at the Contract Unit Price and shall be full compensation for removal, haul, disposal, excavation and subsequent backfill of all stipulated items. The price shall also include designated concrete sawing salvage of material removed, material custody and preservation and storage in accordance with the provisions of this Specification.

304 UNCLASSIFIED OR ROADWAY EXCAVATION:

304.1 SCOPE:

Unclassified or roadway excavation shall consist of excavation involved in the grading and construction of roadways or other excavation not specifically excluded. Structure excavation, trench excavation and any other separately designated excavation is excluded.

304.2 EXECUTION OF WORK:

304.2.1 Unsuitable Material:

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter in excess of 3%, soft spongy earth, or other matter of such nature that of 3%, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable.

Material that is unsuitable for the intended use, shall be excavated and removed from the site or otherwise disposed of as directed by the ENGINEER.

304.2.2 Slopes:

Excavation slopes shall be finished in conformance with the lines and grades shown on the Plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the Plans. Completed slopes shall not vary from the designated plane by more than 15 cm measured at right angles to the slope. Completed rock slopes shall not vary from the designated plane by more than 0.6 m measured at right angles to the slope. The slope shall not encroach on the roadbed.

Tops or excavation slopes and ends of excavations shall be rounded as shown on the Plans and these quantities will not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore.

Embankment slopes shall be finished in conformance with lines and grades shown on the Plans. When completed, the average plane of slopes shall conform to slopes indicated on the Plans and no point on the completed slopes shall vary from the designated plane by more than 15 cm measured at right angles to the slope.

304.2.3 Surplus Material:

The CONTRACTOR shall make all arrangements for disposal of surplus material at off-site locations and shall upon request file with the ENGINEER the written consent of the OWNER of the property upon which he intends to dispose of such material.

The CONTRACTOR shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any indicated surplus material. Shortage of material caused by premature disposal of surplus material by the CONTRACTOR shall be replaced by him and no compensation will be allowed the CONTRACTOR for such replacement.

304.3 METHOD OF MEASUREMENT:

The following earthwork operations will be measured as unclassified excavation for the quantities of material involved:

Excavating a roadway prism including public and private road approaches, connections and driveways; excavating and removal of unsuitable material when shown on the Plans, specified in the Special Conditions or designated by the ENGINEER; excavating slides and slipouts not resulting from overshooting; excavating surplus material; excavating selected material from within the limits of project and removing such materials from stockpiles when stockpiling is ordered; excavating ditches and excavating borrow.

The ENGINEER will compute the quantities of material excavated form its original position by a method which in his opinion is best suited to obtain an accurate determination.

Excavation in excess of the planned or authorized cross section will not be paid for, except as provided above. The CONTRACTOR shall backfill and compact unauthorized excavated areas to the original ground elevation of authorized section at no addition cost to the Contracting Agency.

Material resulting from excavating ditches or channels may be used to construct roadway embankments, dikes, or for other purposes, or disposed of, as directed by the ENGINEER.

Care shall be exercised to prevent excavating below the grade for the bottom of the ditch and areas excavated below grade shall be filled with suitable material and compacted by the CONTRACTOR at no additional cost to the Contracting Agency.

304.4 PAYMENT:

Quantities of unclassified excavation will be paid for at the Contract Unit Price per cubic yard. Such price shall include excavating, sloping, rounding tops and ends of excavations, loading, depositing, conditioning, spreading, and compacting the material complete in place and disposal of surplus material.

305 STRUCTURE EXCAVATION AND BACKFILL:

305.1 SCOPE:

Structure excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls, head walls, culverts, vaults, and other similar structures. Other excavation designated on the Plans or defined in the Special Conditions shall be considered to be structure excavation.

Structure backfill shall consist of furnishing material, if necessary, and placing and compacting backfill material around structures to the lines designated on the Plans or specified or directed by the ENGINEER.

305.2 EXECUTION OF WORK:

305.2.1 FOUNDATION MATERIAL TREATMENT:

When footing concrete or masonry is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. Seams in the rock shall be grouted under pressure or treated as the ENGINEER may direct and the cost thereof will be paid for as extra work.

When piles are not used and footing concrete or masonry is to rest on an excavated surface other than rock, care shall be taken, not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed. Excavation below grade shall be replaced at the CONTRACTOR'S expense with the same class of concrete specified for the structure and at the time the concrete for the structure is being placed, except when over-excavation is directed by the ENGINEER.

The excavation for structures shall be completed to the bottom of the footings before any piles are driven therin, and excess material remaining in the excavation after pile driving shall be removed to the elevation of the bottom of the footings.

When piles are used and ground displacement results from pile driving operations, the CONTRACTOR shall excavate or backfill the footing area to the grade of the bottom of the footing as shown on the Plans with structure backfill material, at no expense to the Contracting Agency.

When any structure excavation is completed, the CONTRACTOR shall notify the ENGINEER who will make an inspection of the excavation. Concrete or masonry shall not be placed until the excavation has been approved by the ENGINEER.

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305.2.2 Structure Backfill:

Backfilling operations shall conform to the following requirements: Structure backfill shall not be placed until the structure footings or other portions of the structure of facility have been inspected by the ENGINEER and approved for backfilling. Backfill material shall not be deposited against the back of concrete abutments, concrete retaining walls, or the outside walls of cast-in-place concrete until the concrete has developed a strength of not less than 2,500 psi in compression.

(a) Class 1 Structure Backfill shall meet the following requirements when tested with laboratory sieves:

SIEVE DESIGNATION	% BY WEIGHT PASSING LAB SIEVES
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

In addition this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T 89 and T 90 respectively.

(b) Class 2 Structure Backfill shall be composed of suitable materials developed on the project. To be suitable for use under this classification, backfill shall be free of frozen lumps, wood or other organic material. If the material contains rock fragments that, in the opinion of the Engineer, will be injurious to the structure, the native material shall not be used for backfilling and the CONTRACTOR shall be required to furnish "Class 1 Structure Backfill" material at the contract unit price. If contract unit price does not exist for "Class 2 Structure Backfill" if will be paid for as Extra Work as defined in the General Conditions.

All structural backfill within 0.6 m of any existing or proposed street or where any portion of the backfill is within 0.6 m of the above shall be compacted to the minimum density shown on the Plans or defined in the Special Conditions.

All structural backfill shall be compacted to the minimum density shown on the Plans or defined in the Special Conditions.

305.3 QUALITY CONTROL:

Compaction testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

305.4 METHOD OF MEASUREMENT:

A volumetric computation of structure excavation and structure backfill shall be made.

Quantities of structure excavation will be computed to encompass the area between the natural ground line or limit or other specified excavation and neat lines 18 inches outside and parallel to the outside profile of the structure. This area shall be multiplied by the width or length shown on the Plans to obtain the volume number of cubic yards of structure excavation.

Structure backfill will be the calculated volume of material lying within the prism defined above, less the volume occupied by the structure.

305.5 PAYMENT:

Payment for structure excavation and structure backfill shall be made at the Contract Unit Price per cubic yard and shall include the furnishing of all materials and equipment and providing other facilities which may be necessary to perform the excavation and to place and compact the backfill.

306 FILL CONSTRUCT:

306.1 SCOPE:

Fill construction shall consist of constructing embankments, including the preparation of the areas upon which they are to be placed; the construction of dikes; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of material in holes, pits, and other depressions. Fills or dikes intended to serve as water retention or long term storage facilities are excluded.

306.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply:

The testing of all materials and construction shall be in conformance with the appropriate AASHTO or ASTM specifications. A partial list of approved testing methods includes:

TEST PROCEDURES	AASHTO	ASTM
Atterberg Limits (LL & PL)	T 89 & T 90	D 4318
Gradation Analysis (except hydrometer)	T 27	D 422
CBR (as modified in Section 5.2.4.1)	T 193	---
R-value (subgrade & base)	T 190	D 2844
R-value	T 246	D 1560
Compaction Curve (standard)	T 99	D 698
Compaction Curve (modified)	T 180	D 1557
Field Density Test (Sand Cone)	T 191	D 1556
Field Density Test (Nuclear)	T 238/T 239	D 2922/D 3017
Field Density Test (Balloon)	T 205	D 2167
Strength of Soil-Lime Mixtures	T 220	---

306.3 EXECUTION OF WORK:

306.3.1 Placement:

Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right-of-way; the placing and compacting of approved materials within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the work area. Materials to be used in the construction of embankments and backfills shall be shown on the Plans.

Free running water shall be drained from the material before the material is placed on the roadway.

Rock, broken concrete, or other solid materials more than 15 cm in greatest dimension shall not be placed in embankment areas where piling is to be placed or driven.

Embankment that is to be placed and compacted on hillsides, or new embankments that are to be compacted against existing embankments, or embankments that are built 1/2 width at a time, the slopes that are steeper than 4:1 when measured longitudinally or at right angles to the roadway shall be continuously benched over those areas where it is required as the work is brought up in layers. Benching shall be well keyed and where practical, a minimum of 1.3 m wide. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus cut out shall be recompacted along with the new embankment material at the CONTRACTOR'S expense.

Fills that encroach on stream channels or lakes, shall be constructed with the largest available rock from the excavation placed along the toes of slopes to protect the fill against erosion from water action.

Fills of earth material shall be placed in horizontal layers not exceeding 20 m (loose measurement) and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be uniformly added or removed if necessary, in order to obtain the required density and optimum moisture.

Should the excavated material contain a predominance of rock too large to be placed in 20 cm layers, the ENGINEER may permit the material to be placed in thicknesses up to the average rock dimension, but not to exceed 1 m. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments or earth.

Embankments consisting predominantly of rock larger than 20 cm inches in greatest dimension, either placed in layers, cast, or end-dumped, shall not be constructed above an elevation 0.6 m below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 20 cm in loose thickness and compacted as specified.

Cross hauling or other action may be required when necessary to insure that the best available material is placed in critical areas of embankments, including the top 0.6 m of all embankments.

Frozen materials shall not be used in construction of embankments.

During the construction of the fill, the fill shall be maintained in such condition that it will be well drained at all times.

306.3.2 Compaction:

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified.

Where fills are to be constructed across low, swampy ground which will not support the weight of hauling equipment, the lower part of the embankment may be constructed by dumping successive loads of suitable material in a uniformly distributed layer of a thickness not greater than that necessary to support the equipment while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

The construction of dikes, the placing and compacting of approved material within the right-of-way where unsuitable material has been removed, and the filling of holes, pits and other depressions within the right-of-way, shall conform to all of the requirements herein specified for compacting fills. Trenches, holes, depressions and pits outside of areas where fills are to be constructed shall be graded to provide a presentable and well-drained area.

Areas upon which fills are to be placed shall be cleared and scarified to a depth of 15 cm inches to provide a bond between the existing ground and the material to be deposited thereon. Unless otherwise specified, the original ground area upon which fills are to be constructed shall be compacted to a uniform density of not less than 95 percent by Standard Proctor if clayey soils and Modified Proctor for granular soils.

The loose thickness of each layer of fill material before compacting shall not exceed 20 cm, except as provided in the following paragraph for rocky material. Each layer shall be compacted in accordance with the following Table. Except that where a new or widened roadway and appurtenances are required, density of the upper 0.6 m and when the fill is within 0.6 m of the above shall be not less than 95 percent (AASHTO T99).

SOIL CLASSIFICATION (Percent)	MINIMUM RELATIVE COMPACTION	
AASHTO M 145	AASHTO T 99	ASHTO T 180
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All Others	95	90

The fill below a plane 1.0 m below finished grade may be constructed in layers of a loose thickness before compaction not exceeding the maximum size of rock in the material, but not exceeding 1.0 m in thickness, provided the fill material contains more than 25 percent (by volume) of rock larger than 15 cm in greatest dimension.

The interstices around the rock in each layer shall be filled with earth or other fine material and compacted. Broken Portland Cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the fill with the following limitation:

(a) The maximum dimension of any piece used shall be 15 cm.

(b) Pieces larger than shall not be placed within 25 cm of any structure.

(c) Pieces larger than 6.5 cm shall not be placed within 25 cm of the subgrade for paving.

(d) Nesting of pieces will not t permitted.

At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill shall be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the CONTRACTOR price paid and no additional compensation will be allowed therefore.

Embankments shall be constructed so that each layer shall have a cross fall of at least 2 percent, but no more than 5 percent.

306.4 QUALITY CONTROL:

Compaction testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Provisions.

The fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T 99, Method A, T 191, or ASTM D 2922 and D 3017 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No. 4 sieve.

After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof rolled with a heavily loaded vehicle. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at lease 18,000 pounds and a tire pressure of 90 psi. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth stable, non-yielding base for subsequent paving courses. The ENGINEER shall be notified at least 24 hours before final proof rolling.

306.5 METHOD OF MEASUREMENT:

The quantity of fill construction used to construct embankments or dikes shall be measured in its final compacted position. Measurement will be upward from the original ground line without any allowance for subsidence due to compaction.

The ENGINEER will compute the quantities of fill by a method which in his opinion is best suited to obtain an accurate determination.

306.6 PAYMENT:

Quantities of fill construction will be paid for at the Contract Unit Price per cubic yard. Such price shall include placing and compaction and all related work as specified above.

Payment will not be made for fill construction to replace unsuitable material or for fill for holes, pits, and other depressions. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

307 EARTHWORK FOR OPEN CHANNELS:

307.1 SCOPE:

Earthwork for open channels shall consist of clearing, stripping, excavation, fill, backfill, grading and disposal or excavated and removed material.

Open channels are defined as open rectangular or trapezoidal concrete lined channels and unlined trapezoidal channels.

307.2 EXECUTION OF WORK:

307.2.1 Stripping:

Areas to be stripped shall be shown on the Plans or detailed in the Special Conditions. The CONTRACTOR shall strip the soil from the designated areas to the depths shown or as directed by the ENGINEER.

Soil loosened below the stripping depth specified shall be compacted. Soil removed below stripping depth shall be replaced with approved material and compacted up to the designated grade. All such filling and compacting shall be done by the CONTRACTOR at no additional cost to the Contracting Agency.

307.2.2 Excavation:

Open cut excavation for lined channels may be made so that concrete lining can be placed directly against the excavated surfaces, providing: (a) faces of the excavation are firm and unyielding and will stand without sloughing, and (b) are at all points outside the concrete lines shown on the Plans.

Excavation to provide a subgrade or subdrainage material for lined channels shall be to the lines shown on the Plans. Over-excavation shall be backfilled and compacted in accordance with Section 306 or filled with concrete of the same mix as used in the

channel lining. No payment shall be made for over-excavation or material used for backfill.

Material unsuitable for channel construction may be encountered during excavation. Suitability of subgrade material shall be determined by the ENGINEER based upon the ability of the subgrade to withstand the load of the proposed channel, and not construction equipment loads. The ENGINEER may direct the CONTRACTOR to excavate beyond the pay lines shown on the Plans.

Excavation beyond the lines shown on the Plans may be required to remove boulders or other interfering objects. Removal of such objects shall be accomplished with approval of the ENGINEER. Voids below the concrete channel subgrade or in the side of the excavation shall be backfilled and compacted in accordance with Section 306, or filled with concrete of the same mix as used in the channel lining.

307.2.3 Fill and Backfill:

Fill and backfill material shall conform to the requirements of Sections 901 and 902 or be material obtained from project excavations and approved by the ENGINEER. Stone, broken concrete or broken bituminous pavement obtained from within the project limits may be used as fill or backfill in conformance with the requirements of Section 900.

Density of all fills and backfills shall be not less than 90% per AASHTO T 99 as defined in Section 306.

307.2.4 Grading:

Grading tolerances for unlined channels, dikes, levees and access roads shall be as follows:

(a) A vertical tolerance of +0.0 cm, -6.0 cm from specified grade is allowable for:

1. Channel invert,
2. Channel side slopes in cut or fill conditions,
3. Dike, levee and access road side slopes in cut conditions.

(b) A vertical tolerance of +0.6 cm, -0.0 cm from specified grade is allowable for:

1. Top surface of dikes, levees and access road in cut and fill conditions,
2. Dike, levee and access road side slopes in fill conditions.

Grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks, regardless of construction tolerances specified.

307.3 QUALITY CONTROL:

Compaction testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

The fill shall be thoroughly compacted to not less than the stated densities when tested and determined by AASHTO T 99, Method A, T 191, or ASTM D 2922 and D 3017 with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, standard detail, to compensate for the rock content larger than that which will pass a No. 4 sieve.

307.4 CLEAN UP:

Material obtained from stripping operations shall be removed from the right-of-way and disposed of at locations off the project. The CONTRACTOR shall make all necessary arrangements with property owners for suitable disposal locations and the cost involved shall be included in the unit price bid.

307.5 METHOD OF MEASUREMENT:

Earthwork for open channels shall be measured in its original position by cross-sectioning the area excavated. Volume will be computed from the cross-section measurements by the average end area method.

Over-excavation ordered by the ENGINEER to remove unsuitable material, boulders or other interfering objects shall be included in the total volume measured.

307.6 PAYMENT:

Earthwork for open channels will be paid for at the Contract Price per cubic yard. Such price shall include stripping, excavation, fill, backfill, compaction, grading, hauling and removal and disposal of excess excavated material and debris.

308 RIPRAP CONSTRUCTION:

308.1 SCOPE:

The work shall consist of the construction of riprap in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Plans or established by the ENGINEER.

308.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in Effect at the time of bid shall apply:

AASHTO T 98 : Fineness of Portland Cement by the Turbidimeter.

ASTM C 131 : Test Method for resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

308.3 MATERIALS:

308.3.1:

Rock used for riprap or wire enclosed riprap shall be hard, durable, angular in shape, and be free from cracks, overburden, shale and organic matter. Neither breadth nor thickness os a single stone shall be less than 1/3 its length and rounded stone shall not be used. The rock shall sustain a loss of not more than 40% after 500 revolutions in an abrasion test (Los Angeles machine - ASTM C-535) and shall sustain a loss of not more than 10% after 12 cycles of freezing and thawing (AASHTO test 103 for ledge rock procedure A). Rock having a minimum specific gravity of 2.65 is preferred; however, in no case should rock have a specific gravity less than 2.50. Classification and gradation for riprap are shown in the following Table and Figure and are based on miminum specific gravity of 2.50 for the rock. Because of its relatively small size and weight, riprap types VL and L must be buried with native soil and revegetated to protect the rock from vandalism.

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

RIPRAP DESIGNATON	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d50*
Type VL	70-100 50-70 35-50 2-10	12 9 6 2	6**
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9**
Type M	70-100 50-70 35-50 2-10	21 18 12 4	12

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Type H	100 50-70 35-50 2-10	30 24 18 6	18
Type VH	100 50-70 35-50 2-10	42 33 24 9	24

* d50 = Mean particle size

** Bury types VL and L with native top soil and revegetate to protect form vandalism.

308.3.2:

Sacks for sacked concrete riprap shall be made of burlap. Sound reclaimed sacks may be used. All sacks shall be the same size with a capacity of at least 1.25 cubic feet.

308.3.3:

Water shall conform to the requirements of Section 309.

308.4 EXECUTION OF WORK:

The bed of the riprap shall be shaped and trimmed to provide even surfaces. Excavation for toe or cut-off walls shall be made to the neat lines of the wall. Allowance will not be made for work outside the neat lines.

308.4.1 Plain Riprap:

Riprap shall be placed to conform to the plan details. The larger size stones shall be placed first and roughly arranged in clos contact. The toe trench and foundation course shall be closed first. The spaces between the larger stones shall then be filled with smaller stone of suitable size, so placed as to leave the surface evenly stepped, conforming to the contour required. The finished surface shall be even and tight and shall not vary from the planned surface by more than 7.5 cm per 30 cm of depth.

The material may be machine-placed with sufficient hand work to accomplish requirements of this Specification.

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308.4.2 Grouted Riprap:

Stones shall be laid as specified in Subsection 308.4.1. Stone shall be laid with care to prevent earth and sand filling the joints. Joints shall be filled with grout and the surfaces swept with a stiff broom. Grouting shall not be done in freezing weather. The work shall be protected and kept moist during hot weather for at least 3 days after grouting, or coated with a clear membrane curing compound.

Grout shall consist of one part cement and three parts aggregate, by volume. The Portland Cement shall by Type II and aggregate shall be two parts sand and one part gravel passing a 3/8 inch square mesh screen.

The amount of water in the mix shall be such as to permit gravity flow into the interstices with limited spading and brooming.

308.4.3 Sacked Concrete Riprap:

Each burlap sack shall be loosely filled with one cubic foot (to .1 cubic foot) of dry mix concrete. Dry mix concrete shall contain not less than 375 pounds cement per cubic yard of aggregate. Aggregate shall conform to Section 925, unless otherwise defined in the Special Conditions. Tops of sacks shall be folded or loosely tied so the concrete will be retained when the filled sack is placed. Sacks shall be placed immediately after filling and lightly trampled to cause conformation to the ground surface and with adjacent sacks.

The first course shall be a double row of stretchers, laid in the toe trench. The second course shall be a single row of headers. The remaining courses shall be alternating double stretchers and headers unless otherwise shown on the Plans. Joints between courses shall be staggered. Not more than 4 vertical courses shall be placed in any tier until the initial set has taken place in the first course. Dirt and debris shall be removed from upper surfaces before the next course is laid.

Delays in laying successive course due to storm, mud or other courses may prevent proper bond or bearing. The ENGINEER shall direct remedial actions in such circumstances.

Sacked concrete riprap shall be cured by sprinkling with a fine water spray every 2 hours during daylight for not less than 3 days.

308.5 CLEAN UP:

The surface of the riprap shall be cleaned of construction debris upon completion of the work. Adjacent areas used for storage of rock, sacks, dry concrete or grout ingredients shall be restored to its original condition or as directed by the ENGINEER.

308.6 METHOD OF MEASUREMENT:

Riprap will be measured by the cubic yard by the average end area method based on the dimensions shown on the Plans or specifically ordered by the ENGINEER.

308.7 BASIS OF PAYMENT:

Payment for riprap shall be made for the number of cubic yards in place at the Contract Unit Price. Payment shall include preparation of ground surfaces, trenching and all materials incorporated into the finished riprap. Water used in curing grouted riprap or sacked concrete riprap shall not be paid for separately, but shall be included in the Contract Unit Price bid.

309 WATERING:

309.1 SCOPE:

Watering for wetting, compacting embankments, constructing subgrade, landscaping or application of dust palliative to soils or aggregates shall be accomplished in accordance with these Specifications. Amounts applied and locations of application shall conform to the Plans or as directed by the ENGINEER.

309.2 MATERIALS:

The CONTRACTOR shall provide a water supply sufficient for the needs of the project. The CONTRACTOR may arrange to purchase water from a water utility. Other sources of water may be used provided the water is free from mineral salts or contaminating materials, injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances.

The CONTRACTOR shall make all arrangements for the water supply and be responsible for payment directly to the supplier. The CONTRACTOR shall provide an appropriate meter if water is to be metered at the source.

Tank trucks and water dispensing equipment shall meet all safety and licensing regulations. Equipment shall be equipped with suitable devices to uniformly control water distribution.

309.3 EXECUTION OF WORK:

309.3.1 Prewetting:

Materials in excavation areas may be prewetted prior to removal and placement in embankments. Prewetting done with a sprinkler system shall be measured with a meter located near the point of discharge. Excessive runoff should be avoided to minimize waste of water. Payment will not be allowed for wasted water or water lost through the carelessness of the CONTRACTOR. Prewetting shall be supplemented by truck

watering where necessary to assure the proper amount of moisture in the material at time of compaction. Any required drying of prewetted embankment soils shall be done at the CONTRACTOR'S expense.

The CONTRACTOR shall provide adequate equipment to check penetration of prewetting for the full depth of the excavation.

309.3.2 Wetting:

Sprinkling equipment shall be of a type which insures uniform and controlled distribution without ponding or washing. Water shall be uniformly applied by spraying across the full width of the spray equipment by means of controlled pressures and spray bars or nozzles.

309.3.3 Dust Palliative:

The CONTRACTOR will be required to furnish and apply a dust palliative on portions of work site, roadway and haul roads at the locations shown on the Plans or defined in the Special Conditions.

Dust palliative shall consist of water unless an emulsified asphalt and water mixture is shown on the Plans or defined in the Special Conditions. Spreading of water or water mixture shall be done with equipment conforming to the requirements of Subsection 309.2.

309.3.4 Landscaping:

The CONTRACTOR will be required to furnish water for seeding, mulching, planting, transplanting, sodding, soil sterilization and any other landscaping shown on the Plans or defined in the Special Conditions.

309.4 QUALITY CONTROL:

Water testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

309.5 METHOD OF MEASUREMENT:

The quantity of water to be measured shall be the number of thousand gallons used (rounded to the nearest even thousand) and accepted in accordance with the preceding requirements. Water measurement may be made in the vehicle, at point of delivery or by meter measurement.

The quantity of water will not be measured when the proposal does not include a pay item for watering.

309.6 BASIS OF PAYMENT:

The measured quantities of water will be paid for at the Contract Unit Price per thousand (M) gallon, measured to the nearest hundred gallons. Such price shall include the cost of the water as well as transportation and distribution of the water and all other costs incidental thereto.

Water used for wetting or as a dust palliative for the benefit or safety of the public will be measured and paid for.

When the Proposal does not include a pay item for watering, the cost thereof shall be considered as being included in the price bid for the construction of installation of items to which the watering is incidental or appurtenant.

310 DEWATERING:

310.1 SCOPE:

The CONTRACTOR shall furnish, install and operate all necessary machinery, appliances and equipment to keep excavations free from water during construction, and shall dewater and dispose of the water so as to not cause injury to public or private property or to cause a nuisance or a menace to the public.

310.2 EXECUTION OF WORK:

He shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage, and shall have available at all times competent workmen for the operation of the pumping equipment.

The control of ground water shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils" during excavation shall be prevented. Dewatering systems shall be designed and operated so as to prevent removal of the natural soils.

During excavating, construction of structures, installing of pipelines and sewers, placing of structure and trench backfill and the placing and setting of concrete, excavations shall be kept free of water except as specified. The CONTRACTOR shall control surface run-off so as to prevent entry or collection of water in excavations. The static water level shall be drawn down a minimum of one foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow the placement of any fill or backfill to the required density. The dewatering system shall be installed and operated so that the ground

water level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

Before dewatering is started, the CONTRACTOR shall submit to the ENGINEER a statement of the method, installation and details of the dewatering system he proposes to use. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 1.0 m below the static water table.

The release of ground water to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines and sewers.

310.3 MEASUREMENT AND PAYMENT:

Dewatering of the trench shall be considered as incidental to the construction and all costs thereof shall be included in various unit contract prices in the proposal, unless otherwise provided in the Special Conditions.

STORM DRAINAGE

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401 GRAVITY FLOW STORM SEWER PIPE AND PRECAST BOX INSTALLATION:

400.1 SCOPE

The work covered by this Specification consists of constructing gravity flow storm sewer, including appurtenances normally installed as a part of this system. Construction may include surface preparation; trench excavation; shoring; dewatering; lay, align and join pipe installation of appurtenances; bedding and backfilling; surface restoration and other related work.

401.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO T 99:	Moisture-Density Relations of Soils, using a 5.5 lb. (2.5 KG) Rammer and a 12 inch (305MM) Drop.
AASHTO T 180:	Moisture-Density Relations of soils, using a 10 lb. (4.54 KG) Rammer and a 18 inch (457 MM) Drop.
ACPA :	Concrete Pipe Installation Manual (Published by American Concrete Pipe Association)
NCSPA Install. Manual	Installation Manual for Corrugated Steel Drainage Structures (published by National Corrugated Steel Pipe Association)
DP 103 Edition 5 :	Aluminum Storm Water Control (published by Kaiser Aluminum and Chemical Sales, Inc.)

401.3 SUBMITTALS:

Any submittals required shall be defined in the Special Conditions.

401.4 MATERIALS:

The CONTRACTOR shall install storm sewer pipe of the type, diameter, load class, wall thickness and protective coating that is shown on the Plans, defined in the Special Conditions or designated in the Bid Schedule. All pipe and appurtenances used shall conform to the requirements of Sub-sections 935 through 965.

One or more acceptable types of pipe may be shown on the Plans, defined in the Special Conditions or designated in the Bid Schedule. As such, the CONTRACTOR shall have the option of installing any of the acceptable types, provided only one type is used throughout any single size designation or run of pipe.

401.5 EXECUTION OF WORK:

401.5.1 Surface Preparation:

(a) Within easements, cultivated or agricultural area. All vegetation, such as brush, sod, heavy growth of grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trenchside storage shall be stripped and disposed of in accordance with the requirements of Section 301.

Topsoil shall be removed from the area to be excavated and stockpiled, or, the CONTRACTOR may elect to import topsoil to replace that lost during excavation. Topsoil shall be removed to a depth of 20 cm or the full depth of the topsoil, whichever is less.

(b) Within Unpaved Roadway Areas. The CONTRACTOR shall strip the cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable and useable for restoration purposes.

(c) Within Paved Areas. The removal of pavement, sidewalks, driveways or curb and gutter shall be performed in a neat and workmanlike manner. The width of the cut shall exceed with width of the trench at the subgrade by at least "W" inches on each side of the trench as shown in the following Figure.

Concrete pavement, sidewalks, driveways or curb and gutter shall be cut with a power saw to a depth of 5 cm prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.

Bituminous pavement, sidewalks, driveways or curb and gutter shall be cut with a power saw, pavement breaker or other approved method of scoring the mat prior to breaking or excavation. The bituminous mat shall be cut vertically, in straight lines and avoiding acute angles.

Any overbreak, separation or other damage to the existing bituminous or concrete outside the designated cut lines shall be replaced at the CONTRACTOR'S expense. Excavated paving materials shall be removed from the jobsite and shall not be used as fill or backfill.

Crossings under sidewalks, curbs and gutters or other utility lines may be made by tunneling only if approved by the ENGINEER.

401.5.2 Trench Excavation:

The CONTRACTOR shall excavate as necessary to attain the lines and grades at the locations shown on the Plans or as staked in the field. All trench excavation shall be open cut, unless otherwise shown on the Plans or approved by the Engineer.

The CONTRACTOR shall protect adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures and fences. Disturbed or damaged facilities or property shall be suitably restored or replaced at the CONTRACTOR'S expense.

Excavated materials unsuitable for backfill or not required for backfill shall be disposed of in accordance with Sub-section 304.2.3.

The CONTRACTOR shall prevent surface water from flowing into excavations. Water shall not be permitted to rise in trenches that have not been backfilled. Any pipe having its alignment or grade changed as a result of a flooded trench shall be relaid at the CONTRACTOR'S expense.

Repose of excavation and use of shoring, sheathing or trenching boxes shall conform to current Federal regulations and local safety requirements.

(a) Trench Dimensions:

1. Width. The width of the trench shall provide adequate working room for installation, joining and proper compaction along both sides of the pipe. Trenches shall conform to the following dimensions, unless otherwise shown on the Plans or defined in the Special Conditions.

NOMINAL SIZE OF PIPE	MAXIMUM TRENCH WIDTH AT TOP OF PIPE	MINIMUM TRENCH WIDTH AT PIPE SPRINGLINE
Less than 18" (46 cm)	Pipe O.D. + 18" (46 cm)	Pipe O.D. + 12" (30 cm)
18" thru 48" (46 cm-12.2 cm)	Pipe O.D. + 24" (60 cm)	Pipe O.D. + 18" (46 cm)
49" thru 96" (125 cm-244 cm)	Pipe O.D. + 30" (75 cm)	Pipe O.D. + 24" (60 cm)
Larger than 96"	See Special Provisions	See Special Provisions

The width of the trench above the top of the pipe may be as wide as necessary for shoring, bracing or proper installation of the pipe. Excavation in paved areas shall be confined to a minimum practical width.

The CONTRACTOR may be required to take remedial actions defined by the ENGINEER if the maximum trench width exceeds that shown in the table or as shown on the construction plans. The specified remedy shall be at the expense of the CONTRACTOR.

2. Depth. Trench depth shall be shown on the Plans as depth of bury or invert grade. Pipe trenches shall be excavated to provide a trench bottom that is firm for its full length and width. Care shall be taken to prevent excavation below the required depth.

   Spongy material, vegetable matter or fill material containing concrete, asphalt or debris that is encountered during trenching shall be excavated to the depth designated by the ENGINEER.

   Areas over-excavated for the CONTRACTOR'S convenience shall be backfilled with suitable material and compacted to the density of the adjacent soil, or backfilled with approved bedding material at the CONTRACTOR'S expense.

   Over-excavation directed by the ENGINEER and any subsequent backfill and compaction shall be considered to be an alteration to the Work and a Change Order shall be issued in accordance with Sub-section 214.4.

(b) Trench Grade and Fine Grading.
The bottom of the trenches shall be accurately graded to the line and grade shown on the Plans. Bedding material shall provide uniform bearing and support for each section of pipe at every point along its entire length. Bell holes or depressions for joints shall be dug after the trench bedding has been graded. Bell holes shall be of the minimum length, depth and width as required for proper assembly of the joint.

(c) Excavation for Structures and Appurtenances.
Excavation for manholes, structures and other appurtenances shall be sufficient to provide clearances adequate for proper backfill and compaction on all sides. The depth of excavation, provisions for dewatering, shoring, and other applicable portions of these Specifications shall apply to excavation for structures and appurtenances.

401.5.3 Dewatering:

All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying and other related work. The method of dewatering shall provide for a dry foundation at the final grades of excavation in accordance with Sub-section 310. Water shall be disposed of in a manner that does not inconvenience the public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as it is safe to allow the water to rise in the excavation.

401.5.4 Laying, Aligning and Joining Pipe:

Storm sewer pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used, unless otherwise shown on the Plans or defined in the Special Conditions.

Proper equipment, implements, tools and facilities shall be provided and used by the CONTRACTOR for safe and convenient installation of the type of pipe being installed.

(a) Responsibility for Material.
The CONTRACTOR shall be responsible for all materials intended for the Work that are delivered to the construction site and accepted by him. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at the CONTRACTOR'S expense.

The CONTRACTOR shall be responsible for the safe and proper storage of such materials, until incorporated into the Work.

(b) Handling.
Pipe and accessories furnished by the CONTRACTOR shall be delivered to, unloaded and distributed at the site by the CONTRACTOR. Pipe and accessories furnished by the Contracting Agency shall be unloaded and distributed at the site by the CONTRACTOR. Each pipe shall be unloaded adjacent to or near the intended laying location.

Pipe fittings, specials, valves and appurtenances shall be unloaded and stored in a manner that precludes shock or damage. Such materials shall not be dropped.

Pipe shall be handled so as to prevent damage to the pipe ends or to any coating or lining. Pipe shall not be skidded or rolled against adjacent pipe. Damaged coatings or linings shall be repaired by the CONTRACTOR, at his expense in accordance with the recommendations of the manufacturer and in a manner satisfactory to the ENGINEER. Physical damage to the pipe or accessory shall be repaired by the CONTRACTOR at his expense, and in a manner satisfactory to the ENGINEER.

(c) Laying Pipe.

The pipe and pipe coatings shall be inspected for damage or defects before being placed in the trench. Damaged or defective pipe shall not be installed. Damage to the coatings, linings or pipe may be repaired in accordance with Sections 935 through 965.

Pipe lines shall be laid to the grades and alignment shown on the Plans or staked by the ENGINEER. Variation from the prescribed grade and alignment shall not exceed 3 cm, and the rate of departure from, or return to, the established grade or alignment shall be not more than 25 mm in 3 m, unless approved by the ENGINEER. No. deviation from grade shall cause a depression in the sewer invert that could retain fluids or solids.

Pipe shall be laid so as to form a close concentric joint with the adjoining pipe to avoid sudden off-sets of the flowline. Pipe sections shall be joined together in accordance with the joining procedure for the type of pipe and joint being used as defined in Sections 935 through 965.

Pipe fittings and appurtenances shall be carefully lowered into the trench with suitable tools or equipment to prevent damage to the pipe and protective coatings and linings; pipe and accessory materials shall not be dropped or dumped into the trench.

Obstructions not shown on the Plans may be encountered during the progress of the Work. Should such an obstruction require an alteration to the pipe alignment or grade, the ENGINEER shall have authority to order a deviation from the Plan. Or the ENGINEER may arrange for the removal, relocation or reconstruction of any structures which obstruct the pipeline. If the change in Plans results in a change in the amount of work or in the time of completion, such altered work shall be done in accordance with the provisions of Section 214.

Precautions shall be taken to prevent foreign material from entering the pipe before or while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. The open ends of pipe shall be closed with a watertight plug, or with other devices approved by the ENGINEER, at times when pipe laying is not in progress.

Joint protective coating shall be applied to corrugated aluminum and corrugated steel pipe according to the manufacturer's recommendations and to Section 946.

Joints of precast concrete boxes and precast concrete pipe shall be grouted in accordance with the manufacturer's recommendations and with Sections 935 and 936.

401.5.5 Bedding and Backfilling:

Select bedding and backfill material may be required and shall be so shown on the Plans or defined in the Special Conditions. Select bedding materials shall conform to the designated gradation requirements shown below.

GRADATION FOR PIPE BEDDING

Percentage Passing Designated Sieves and Nominal Size Designation

SIEVE SIZE	AASHTO M 43 OR ASTM C 33 OR ASTM D 448						SQUEEGEE OR CRUSHER FINES
	No. 4	No. 6	No. 7	No. 8	No. 57	No. 67	
2"	100	--	--	--	--	--	--
1½"	90-100	--	--	--	100	--	--
1"	20-55	100	--	--	95-100	100	--
¾"	0-15	90-100	100	--	--	90-100	--
½"	--	20-55	90-100	100	25-60	--	--
⅜"	0-5	0-15	40-70	85-100	--	20-55	100
No. 4	--	0-15	0-15	10-30	0-10	0-10	30-100
No. 8	--	--	0-15	0-10	--	0-5	--
No. 16	--	--	--	0-15	--	--	0-10

Unless select bedding materials are required, bedding material shall be uniformly graded granular material with no particle larger than 5 cm in its maximum dimension and less than 50% of material passing the No. 200 sieve. Bedding material may be imported or developed from material excavated at the site.

Bedding material shall be placed under and around all pipe as shown on the Plans or in the Standard Details. Bedding shall be placed in a manner that will minimize separation or change in its uniform gradation. Bedding shall be distributed in 15 cm maximum layers over the full width of the trench and simultaneously on both sides of the pipe. Special care shall be taken to assure full compaction under the haunches and joints of the pipe. The bedding material shall be tamped or otherwise compacted to attain 90% of the maximum density at optimum moisture content as determined by AASHTO T 99.

Unless select backfill materials are required, suitable backfill material may be imported or developed from material excavated at the site. The ENGINEER shall determine suitability of backfill material. Backfill material shall be free from rubbish, stones or pieces of asphalt or concrete larger than 15 cm in diameter, or wet, soft or frozen materials. Backfill material larger than 5 cm in its maximum dimension shall not be allowed to intrude into an area within 15 cm of the pipe surface. Backfilling shall be conducted in an manner that prevents damage to the pipe, pipe coating or appurtenances. Backfilling operations shall follow pipe laying and bedding operations as closely as practical.

Backfill compaction shall not be attained by inundation or jetting unless approved in writing by the ENGINEER. Backfill material shall be uniformly compacted the full depth of the trench.

(a) For Trenching Outside the Roadway: The subgrade shall conform to the lines, grades and cross-sections as shown on the approved plans. The subgrade shall be compacted in successive layers not to exceed 30 cm thick to 90% standard proctor density and shall be finished and maintained in a smooth compacted condition. Rutting or other objectionable irregularities shall be corrected prior to placement of subbase.

(b) For Trenching Within the Roadway, or Under Curb, Gutter or Side walk: Within the roadway area, trench compaction shall be in accordance with AASHTO T 99 or T 180 results as required in Sub-section 306.3.2.

401.5.6 Surface Restoration:

All streets, alleys, driveways, sidewalks, curbs or other surfaces broken, cut or damaged by the CONTRACTOR shall be resurfaced in kind or as shown on the Plans or detailed in the Special Conditions.

401.6 QUALITY CONTROL:

Inspection, testing, approval and acceptance shall conform to the requirements of Section 801 and 820.

Pipe not inspected by the ENGINEER or damaged by an action of the CONTRACTOR may be subsequently rejected and replaced at the CONTRACTOR'S expense.

Pipe inspection by the ENGINEER, installed by the CONTRACTOR and found to be damaged through no fault of the CONTRACTOR shall be repaired or re- jected and replaced. Cost of the repairs or replacement shall be covered by a Change Order in accordance with the provisions of Sub-section 214.4.

401.7 CLEAN UP:

All rubbish, unused materials and other non-native materials shall be removed from the jobsite. All excess excavation shall be disposed of as specified, and the right-of-way shall be left in a state of order and cleanliness.

401.8 METHOD OF MEASUREMENT:

Measurement for precast concrete pipe shall be made in lineal feet along the centerline of the completed structure, from end to end through all joints, fittings, manholes, boxes, inlets and other appurtenances.

401.9 BASIS OF PAYMENT:

Payment for precast concrete pipe shall be made at the Contract Unit Price per lineal foot of the various sizes specified. The Unit Price shall include furnishing and installing pipe sections, joint sealant, cleaning and testing and all other work necessary or incidental to completion of the pay item. Trench excavation, bedding, backfill and related work defined under Section 731 shall be included in this pay item.

402 MANHOLE AND INLET CONSTRUCTION:

402.1 SCOPE:

The work covered by this Specification consists of constructing precast; pre-assembled or field assembled manholes and inlets for storm sewer or surface drainage construction. Construction consists of excavation; shoring; dewatering; subgrade preparation; construction of base; placement and assembly of risers, cone, or tops; installation of ring, cover and adjusting rings; backfilling; surface restoration and other related work.

402.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of Bid shall apply.

ASTM C 891: Installation of Underground Precast Concrete Utility Structures

402.3 SUBMITTALS:

Any submittals required shall be defined in the Special Conditions.

402.4 MATERIALS:

The CONTRACTOR shall install manholes of the dimensions shown on the Plans, defined in the Special Conditions or designated in the Bid Schedule. All materials used shall conform to the requirements of Section 930.

402.5 EXECUTION OF WORK:

402.5.1 Surface Preparation:

Surface preparation shall conform to the requirements of sub-section 401.5.1 for storm sewer construction.

402.5.2 Excavation:

Excavation shall conform to the requirements of Section 401.5.2 except that sub-paragraphs (a)1 and (b) shall not apply. Subgrade preparation shall conform to the requirements of Section 701.

402.5.3 Dewatering:

Dewatering of manhole and/or inlet excavation shall conform to the requirements of Section 401.5.3.

402.5.4 Manhole and Inlet Base:

Field poured concrete bases shall be at least 3.0 cm thick and not less than (one) foot greater diameter than the outside diameter of the manhole riser section. Concrete shall be Class A, B or P concrete in accordance with Section 925. Concrete placement shall conform to the requirements of Section 701. Concrete shall be consolidated and struck-off to a horizontal surface within the forms or pouring rings.

Field poured concrete bases shall be reinforced as detailed on the Plans or as shown in the Standard Details.

Precast reinforced concrete bases shall be of the size and shape detailed on the Plans or as shown in the Standard Details.

402.5.5 Manhole Barrels:

Manhole barrels shall be assembled of precast riser sections. Riser sections shall be placed vertically with tongues and grooves properly keyed. Ladder rungs shall be vertically aligned in the finished manhole.

Intermediate platforms shall be assembled into the manhole where required.

Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half-pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one inch per foot, nor more than two inches per foot.

Free drop inside the manhole shall not exceed two feet measured from the invert of the inlet pipe to the invert of the outlet pipe. Where the drop exceeds two feet, drop manholes shall be constructed as detailed on the Plans or as shown in the Standard Details.

All connections between the riser or base sections and the sewer pipe shall be joined in such a manner as to make the manhole watertight. Preformed rubber waterstop gaskets cast into the riser or base section or banded to the pipe and grouted in place are acceptable joining methods. Preformed flexible plastic sealing compound similar or equal to "Ramnek" or "Kent Seal" are also acceptable, provided acceptable watertightness is achieved.

402.5.6 Inlets and Miscellaneous Structures:

Inlets shall be constructed of reinforced concrete and shall conform to the dimensions indicated in the Standard Details. Miscellaneous structures shall conform to the requirements of the construction drawings or as otherwise designated by the ENGINEER.

(a) Bases: All inlets shall be constructed with a field poured concrete base. The base shall have a smooth top surface and shall slope toward the outlet pipe at not less than one 25 mm per 30 cm nor more than two 5 cm per 30 cm.

(b) Pipe Connections: Shall be constructed without projections or voids.

(c) Concrete: All exposed concrete surfaces shall be given a steel trowel and brush finish in a manner satisfactory to the ENGINEER.

402.5.7 Precast Inlets and Structures:

Precast inlets and structures shall be placed on the field poured concrete base only after sufficient compressive strength has been attained. No modifications of precast inlets or structure will be permitted on the job site.

All such fabrication shall be accomplished at the point of manufacture. The field poured base shall be thoroughly cleaned and wetted with water. While the base is still moist, a full mortar bed of at least one 25 mm in thickness shall be applied on the bearing surfaces. The precast section will be carefully placed on the base in a manner to assure a joint free of voids. The joints shall be smoothed inside and out to provide a good finished product.

402.5.8 Field Poured Inlets and Structures:

The materials, forming, pouring and curing shall conform to Section 700, Concrete Structures of these Specifications.

402.5.9 Top or Cone Sections:

Flat top sections may be used on shallow lines where standard cone sections will not conform to specified elevations.

Cone shaped top sections shall be assembled on top of the manhole barrel with tongues and grooves properly keyed. Ladder rungs shall be vertically aligned in the finished manhole.

Adjusting rings or brick may be used for adjusting the top elevation, except that the total height of the adjusting rings or brick shall not exceed 30 cm at any manhole.

Rings shall be set to the elevations shown on the Plans or established by the ENGINEER. Concrete shall be placed around and under the ring to provide a seal and properly seat the ring at the required elevation. Concrete shall be rounded-off in accordance with the Standard Details.

402.5.10 Watertightness:

The finished manhole is expected to be as watertight as the pipe system it is incorporated into.

All connections between riser sections, bases and tops shall be sealed with preformed flexible plastic joint sealing compound. Application of primer and sealing compound shall be accomplished in conformance with the manufacturer's recommendations. Grade of materials, quantity of materials and application temperatures recommended by the manufacturer shall govern. Sealing compound similar or equal to "Ramnek" or "Kent Seal" shall be used.

402.5.11 Backfilling:

Backfilling around manholes and inlets shall conform to the requirements of Section 401.5.5. Bedding material shall be placed up to a point equal to that required for the adjacent pipe.

402.5.12 Surface Restoration:

Surface restoration shall conform to the requirements of Section 402.5.6.

402.6 QUALITY CONTROL:

Inspection, testing, approval and acceptance shall conform to the requirements of Sections 801 and 840.

Materials not inspected by the ENGINEER or damaged by an action of the CONTRACTOR may be subsequently rejected and replaced at the CONTRACTOR'S expense.

Materials inspected by the ENGINEER, installed by the CONTRACTOR and found to be damaged through no fault of the CONTRACTOR shall be repaired or rejected and replaced. Cost of repairs or replacement shall be covered by a Change Order in accordance with the provisions of Sub-section 214.4.

402.7 CLEAN UP:

All rubbish, unused materials and other non-native materials shall be removed from the jobsite. All excess excavation shall be disposed of as specified, and the right-of-way shall be left in a state of order and cleanliness.

402.8 METHOD OF MEASUREMENT.:

Manholes will be measured by numerical count of the various sizes, depths and type identified in the Bid Schedule.

402.9 BASIS OF PAYMENT:

Payment for manholes and inlets shall be made at the Contract Unit Price for each size, depth and type specified. The Unit Price paid shall include excavation, concrete, reinforcement, precast sections, steps, rings and covers, backfilling, labor and equipment necessary and incidental to completion of the pay item. Related work defined under Section 402 shall be included in this pay item.

STREETS AND RELATED WORK

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501 SUBGRADE PREPARATION

501.1 SCOPE:

All subgrade preparation shall conform to the requirements specified herein. The work in this section shall govern the preparation of natural or excavated areas prior to the placement of: sub-base material, pavement, curb and gutters, driveways, sidewalks or structures.

501.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 145:	The Classification of Soils and Soil-Aggregate Mixture for Highway Construction Purposes.
AASHTO T 99:	The Moisture-Density Relations of Soils Using a 5.5 Lb. (2.5KG) Rammer and a 12 inch (305MM) Drop.
AASHTO T 180:	The Moisture-Density Relations of Soils Using a 10 Lb. (4.54KG) Rammer and a 18 inch (457MM) Drop.
AASHTO T 191:	Density of Soil In-Place by Sand Cone Method.
AASHTO T 205:	Density of Soil In-Place by Rubber-Balloon Method.
AASHTO T 224:	Correction for Coarse Particles in the Soil Compaction Test.
ASTM D 2487:	Classification of Soils for Engineering Purposes.
ASTM D 2922:	Tests for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
ASTM D 3017:	Test for Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).

501.3 EXECUTION OF WORK:

Subgrade preparation shall include stripping all unsuitable material from the area being prepared. All stripping and disposal of unsuitable material shall conform to the requirements of Section 301.

501.3.1 Preparation of Subgrade:

The moisture content of the subgrade shall be brought to the required moisture content and compacted as specified below. The proper moisture content may be achieved through addition of water, drying of existing material or blending of suitable imported material.

The subgrade shall be scarified and loosened to a depth of 0.5 foot.

The subgrade in both cut and fill areas shall be compacted to achieve uniform density when tested in accordance with one of the Quality Standards listed in Subsection 501.2. The percent of density shall be adjusted in accordance with the rock correction procedures for maximum density determination, standard detail, to compensate for content of rock larger than passing No. 4 sieve.

Compaction density shall be the density shown on the Plans, Standard Details or defined in the Special Conditions or to the minimum shown in Subsection 306.3.2.

501.3.2 Subgrade Tolerances:

The subgrade shall not vary more than 0.1 foot from the specified grade and cross section for areas that are to have pavements, sidewalks, curb and gutters, driveway and structure placed directly on the subgrade.

The subgrade shall not vary more than 0.08 ft. from the specified grade and cross section for areas that are to have sub-base or base material placed directly on the subgrade.

The Plans may define areas to be graded, but without paving or structures. The subgrade in these areas shall not vary more than 0.08 foot from the specified grade and cross section.

Variations within the above tolerances may be compensating so that the average grade and cross section specifications are accomplished.

501.4 QUALITY CONTROL:

Existing facilities shall be protected during subgrade preparation operations. Manholes, drop inlets or other structures shall be cleaned promptly in the event debris or subgrade materials enter the structures during subgrade preparation operations.

501.5 METHOD OF MEASUREMENT:

Measurement for subgrade preparation will be by the square yard to the extremities shown on the Plans.

501.6 BASIS OF PAYMENT:

Payment will be made at the Contract Unit Price. Payment shall be full compensation for the completed work including stripping excavation, hauling, filling, compacting and disposal of unsuitable materials, together with all costs incidental thereto.

502 LIME TREATED SUBGRADE:

502.1 SCOPE:

Lime treated base shall consist of a mixture of soil, hydrated or quick lime and water, compacted at optimum moisture content. Construction shall conform to these Specifications and be in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the Plans or in the Standard Details.

502.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 52: Tar for use in Road Construction

AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

AASHTO M 140: Emulsified Asphalt

AASHTO M 141: Slow-Curing Liquid Asphaltic Road Material

AASHTO M 208: Cationic Emulsified Asphalt

AASHTO T 99: Moisture-Density Relations of Soils, using a 5.5 lb Rammer and a 12 inch Drop

ASTM C 207: Specification for Hydrated Lime for Masonry Purposes

502.3 SUBMITTALS:

The Contractor shall provide manufacturer's certification of hydrated lime when required by the Special Provisions.

The Contractor shall submit design curves as defined in the Special Conditions.

502.4 MATERIALS:

Hydrated or quick lime, tar, liquid asphalt or emulsified asphalt shall conform to the requirements of one or more of the Quality Standards listed in Paragraph 502.2.

Water shall conform to the requirements of Section 309.

502.5 EXECUTION OF WORK:

502.5.1 Preparation:

The surface of the area to be treated shall be bladed to the lines, grades and cross section shown on the Plans.

The bladed area shall be scarified to the depth shown on the Plans. The material thus obtained shall be pulverized. The depth of scarification shall be carefully controlled and blading operations conducted in a manner to insure that the surface of the subgrade below the scarified material shall remain undisturbed and shall conform to the required cross section.

502.5.2 Application of Hydrated Lime:

The rate of application of lime shall be as shown on the Plans or defined in the Special Conditions. Lime may be applied dry or as a slurry. Spreading equipment shall uniformly distribute the lime without excessive loss. Spreading shall be halted if winds cause a loss of lime and prompt action shall be taken to avoid further losses. Spread lime that has been lost shall be replaced without additional compensation before mixing is started.

Only equipment used for spreading and water trucks shall be permitted to pass over the spread lime until it is mixed.

502.5.3 Mixing:

Water may be added to the mixture of lime and scarified material by means of pressure water distributors or by a traveling plant. Water shall be added during mixing operations to provide a moisture content not less than optimum nor more than 5 percentage points above optimum as determined by ASSHTO T 99.

Lime and water shall be thoroughly mixed throughout the scarified material. The mixture shall then be aged by one of the following processes:

(a) Mixed material shall be placed in a windrow and aged for not less than 48 hours.

(b) Mixed material shall be spread over the area to be treated and the surface sealed with a steel wheel or pneumatic roller and aged for not less than 48 hours.

After aging, water shall be added if necessary for the final mixing. The resulting mixture shall have a moisture content not less than optimum nor more than 5 percentage points above optimum as determined by AASHTO T 99.

502.5.4 Compaction and Finishing:

The thoroughly mixed lime treated subgrade shall be spread and compacted to a density of not less than 95 percent of maximum density determined in accordance with ASHTO T 99. Light sprinkling may be required during laying operations to maintain the specified moisture content. Compaction shall be accompanied by sufficient blading to eliminate irregularities.

502.5.5 Curing and Protection:

After compaction and finishing only sprinkling equipment will be permitted on the treated subgrade for a period of 7 days. The treated subgrade shall be lightly sprinkled with water at frequent intervals during the 7 day curing period.

A bituminous curing film may be used in lieu of the water cure. Bituminous curing material shall be applied to provide a protective film over the lime treated base. The protective film shall be applied immediately after the lime treated base has been finished. The protective film shall be maintained until the treated base is protected by a subsequent course.

Any damage to the treated base course due to other phases of construction shall be repaired.

502.5.6 Weather Limitations:

Mixing will not be permitted when the scarified material or the subgrade is frozen. The air temperature shall be at least 40 degrees F. in the shade and rising.

502.6 QUALITY CONTROL:

Lime treated subgrade and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

The lime treated subgrade surface will be tested with a 10 foot straight edge. The surface shall be tested prior to application of any curing film, pavement or surfacing. The variation above or below the testing edge between any two contact points shall not exceed 0.08 foot. Any area not complying with these tolerances shall be reworked to obtain conformity.

502.7 METHOD OF MEASUREMENT:

Processing of lime treated subgrade shall be measured by the number of square yards constructed in conformity to these Specifications and to the dimensions and limits shown on the Plans.

Measurement of hydrated or quick lime will be the number of tons mixed with the scarified materials. The net weight printed by the manufacturer on the sacks shall be used for measurement if sacked lime is used.

Water used in the preparation of scarified materials, in the lime-material mix and for curing shall be measured.

502.8 BASIS OF PAYMENT:

Payment for processing lime treated subgrade shall be at the Contract Unit Price per square yard and shall constitute full payment for furnishing all processing equipment, labor, materials, tools and incidentals necessary to complete the work.

Payment for hydrated or quick lime shall be at the Contract Unit Price per ton.

Water will be measured and paid for in accordance with Section 309.

No payment will be made for bituminous curing materials.

503 AGGREGATE BASE COURSE:

503.1 SCOPE:

Aggregate base course shall consist of furnishing and placing one or more courses of aggregate base on a prepared surface in accordance with these Specifications and in reasonably close conformity with the lines, grades and typical cross sections shown on the Plans or in the Standard Details.

503.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 6: Fine Aggregate for Portland Cement Concrete.

AASHTO M 43: Standard Size of Coarse Aggregate for Highway Construction.

AASHTO M 80: Coarse Aggregate for Portland Cement Concrete.

AASHTO M 145: The Classification of Soils and Soil-Aggregate Mixture for Highway Construction Purposes.

AASHTO M 147: Materials for Aggregate and Soil-Aggregate Sub-Base, Base and Surface Coarses.

AASHTO T 11: Amount of Material Finer than 0.075 mm Sieve in Aggregate.

AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine.

AASHTO T 99: The Moisture-Density Relations of Soils Using a 5.5 Lb. (2.5KG) Rammer and a 12 inch (305MM) Drop.

AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.

AASHTO T 180: The Moisture-Density Relations of Soils Using a 10 Lb. (4.54KG) Rammer and a 18 inch (457MM) Drop.

AASHTO T 191: Density of Soil In-Place by Sand Cone Method.

AASHTO T 205: Density of Soil In-Place by Rubber-Balloon Method.

AASHTO T 224: Correction for Coarse Particles in the Soil Compaction Test.

ASTM D 2487: Classification of Soils for Engineering Purposes.

503.3 SUBMITTALS:

The CONTRACTOR shall provide the ENGINEER a list of approved aggregate suppliers and a schedule of anticipated deliveries to the jobsite. Approved aggregates shall meet the requirements of Section 801 and 901.

503.4 MATERIALS:

The aggregates for aggregate base course shall conform to the requirements of Section 901 and shall conform to the grade or sieve analysis shown on the Plans, Standard Details or defined in the Special Conditions. The aggregates shall be composed of hard durable fragments of stone or gravel and a filler of sand or other finely divided mineral matter.

Aggregate base course mixed in a stationary plant may be placed immediately following mixing. Road mixed aggregate shall not be placed until blended and approved by the ENGINEER. Approval may be based upon samples taken from the combined windrow for each course.

Water shall conform to the requirements of Section 309.

503.5 EXECUTION OF WORK:

503.5.1 Placing:

Aggregate base courses of not more than 6 inch compacted thickness may be placed in a single layer. Base courses of more than 6 inch compacted thickness shall be constructed in successive layers. The maximum compacted thickness of any one layer shall not exceed 6 inches.

The compacted thickness of a single layer may be increased to 8 inches provided vibratory compacting equipment is used on each layer.

503.5.2 Mixing:

The CONTRACTOR shall mix the aggregate by either of the following methods:

(a) Stationary Plant Method: Untreated base course material and water shall be mixed in a stationary plant mixer. The mixed aggregate shall be

transported to the job site while it contains the proper moisture content.

The ENGINEER reserves the right to inspect and approve the mixing plant if the plant is not normally used for production of aggregates and base course materials.

(b) Road Mix Method: Materials shall be mixed at the job site. Materials shall be mixed while at optimum moisture content by means of motor grader or other equipment approved by the ENGINEER until the mixture is uniform throughout.

503.5.3 Shaping and Compacting:

Loose base course material shall be placed by an aggregate spreader or by blading. The material shall be spread to a uniform thickness throughout the area to be compacted.

Compaction of each layer shall continue until a density of 95 percent (-0%) of the maximum density determined in accordance with AASHTO T 99 has been achieved. The surface of each layer shall be maintained during compacting operations in a manner that will produce firmly keyed aggregates and a uniform texture.

Water shall be uniformly applied during compaction only in the amount necessary for proper consolidation. Care shall be exercised to avoid detrimental wetting of subgrade or any lower base course.

503.6 QUALITY CONTROL:

Aggregate base course testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

The final base course surface will be tested with a 10 foot straight edge. The surface shall be tested prior to application of any primer, pavement or surfacing. The variation above or below the testing edge between any two contact points with the surface shall not exceed 0.04 foot. Any area not complying with these tolerances shall be reworked to obtain conformity.

503.7 METHOD OF MEASUREMENT:

Aggregate base course shall be measured by the ton.

Water used at the mixing plant will not be paid for nor will weight of water be deducted from the scale weight of the base course material as it leaves the plant.

Water used in the road mix method and used during compaction shall not be measured.

503.8 BASIS OF PAYMENT:

Aggregate base course shall be paid for at the Contract Unit Price per ton and shall include all equipment, labor and incidental costs thereto. Commercial mineral fillers, when used or specified, will not be measured or paid for separately, but shall be included in the Contract Unit Price per ton.

504 CEMENT TREATED AGGREGATE BASE:

504.1 SCOPE:

Cement treated aggregate base shall consist of a mixture of aggregate and cement placed in one or more courses on a prepared surface. Placement shall conform to these Specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the Plans or in the Standard Details.

504.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 52: Tar for Use in Road Construction

AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

AASHTO M 85: Portland Cement, Magnesium Oxide

AASHTO M 140: Emulsified Asphalt

AASHTO M 141: Slow-Curing Liquid Asphaltic Road Material

AASHTO M 208: Cationic Emulsified Asphalt

AASHTO M 240: Blended Hydraulic Cement

AASHTO T 99: Moisture-Density Relations of Soils, Using a 5.5 lb. Rammer and a 12 inch Drop

AASHTO T 134: Moisture-Density Relations of Soil-Cement Mixtures

ASTM C 150: Portland Cement, Magnesium Oxide

ASTM C 595: Blended Hydraulic Cement

504.3 SUBMITTALS:

The CONTRACTOR shall submit trip tickets for each load of cement treated base mixed in a central plant outside the construction site. Tickets shall show weight of each material and additive used in each batch.

The CONTRACTOR shall submit design curves as defined in Division 800.

504.4 MATERIALS:

Portland Cement, tar, liquid asphalt and emulsified asphalt shall comply with the requirements of one or more of the Quality Standards listed in Paragraph 504.2.

Water shall conform to the requirements of Section 309.

Aggregates for cement treated aggregate base shall conform to the requirements of Section 901 and shall also conform to the grade or sieve analysis shown on the Plans, Standard Details, or defined in the Special Conditions. The aggregates shall be composed of hard durable fragments of stone or gravel and a filler of sand or other finely divided mineral matter.

The CONTRACTOR may prepare the cement treated aggregate base by using either the travel plant or central plant method described in Paragraph 504.5.

504.5 EXECUTION OF WORK:

504.5.1 Travel Plant Method:

The aggregate obtained from scarifying the existing roadway, or from other sources, shall be pulverized until 75 percent of all material other than stone or gravel will pass a No. 4 sieve. This determination may be made visually by the ENGINEER or by dry separation over a No. 4 sieve. Any material retained on a 3-inch sieve and other unsuitable material, shall be removed, additional material specified on the Plans shall be blended with the existing material. All butt joints at existing pavement or structures shall be cleaned prior to mixing.

Unsuitable material in the subgrade shall be excavated, backfilled and compacted in accordance with Subsection 305.2.1.

The aggregate to be treated shall be placed in a uniform windrow or spread to a uniform thickness to the width required. The specified quantity of Portland Cement shall be applied uniformly in a trench along the top of the windrow or spread uniformly over the aggregate. Spreading shall be halted if winds cause a loss of cement and prompt action shall be taken to avoid further losses. Spread cement that has been lost shall be replaced without additional compensation before mixing is started.

Mixing shall be accomplished by means of a mixer that will thoroughly blend the aggregate and the cement. The mixer shall be equipped with a water metering device that will introduce the required quantity of water during the mixing cycle. At least one pass of the mixer shall be made before water is added if more than one pass of the mixer is required.

504.5.2 Central Plant Method:

The aggregate shall be proportioned and mixed with cement and water in a central mixing plant. The plant shall be equipped with feeding and metering devices which will introduce cement, aggregate and water into mixer in the quantities specified. Mixing shall continue until a uniform mixture of aggregate, water and cement has been attained.

Mixed material shall be transported to the roadway in suitable vehicles and spread over a moistened subgrade or base in a uniform layer by a self propelled or other approved spreader. Not more than one hour shall elapse between the start of mixing and time of starting compaction of the cement treated base on the prepared subgrade or base.

504.5.3 Compaction and Finishing:

Cement treated aggregate base courses not more than 6 inches compacted thickness may be placed in a single layer. Courses more than 6 inches compacted thickness shall be constructed in successive layers. The maximum compacted thickness of any one layer shall not exceed 6 inches or be less than 4 inches.

The cement treated aggregate base shall be compacted after being spread. Any mixture of aggregate, water and cement that has not been compacted shall not be left undisturbed for more than 30 minutes.

The spread mixture shall be compacted to at least 95 percent of the maximum density determined in accordance with AASHTO T 134. The percentage of moisture in the completed mixture shall not be less than optimum nor more than 5 percentage points above optimum as determined by AASHTO T 134.

504.5.4 Curing and Protection:

Bituminous curing material shall be applied to provide a protective film over the cement treated aggregate base. The protective film shall be applied immediately after the cement treated aggregate base has been finished. The protective film shall be maintained until the cement treated aggregate base is protected by a subsequent course.

504.5.5 Weather Limitations:

Mixing will not be permitted when the aggregate or subgrade is frozen. The air temperature shall be at least 40 degrees F. in the shade and rising.

504.6 QUALITY CONTROL:

Cement treated aggregate base testing and testing laboratory services required shall conform to the applicable portions of Division 800 unless otherwise defined in the Special Conditions.

The cement treated aggregate base course surface will be tested with a 10 foot straight edge. The surface shall be tested prior to application of any curing film, pavement or surfacing. The variation above or below the testing edge between any two contact points shall not exceed 0.08 foot. Any area not complying with these tolerances shall be reworked to obtain conformity.

504.7 METHOD OF MEASUREMENT:

Processing of cement treated aggregate base shall be measured by the number of square yards constructed in conformity to these Specifications and to the dimensions and limits shown on the Plans.

Measurement of Portland Cement will be the number of tons mixed with the aggregate.

Measurement of imported aggregate will be the number of tons delivered to the construction site and incorporated into the cement treated base.

504.8 BASIS OF PAYMENT:

Payment for processing cement treated aggregate base shall be at the Contract Unit Price per square yard, and shall constitute full payment for furnishing all processing equipment, labor, materials, tools and incidentals necessary to complete the work.

Payment for Portland Cement shall be at the Contract Unit Price per ton.

Water will be measured and paid for in accordance with Section 309.

Imported aggregate will be measured and paid for in accordance with Section 503.

No payment will be made for bituminous curing materials.

505 BITUMINOUS PRIME COAT:

505.1 SCOPE:

All bituminous prime coats shall conform to the requirements specified herein.

505.2 QUALITY STANDARDS:

AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

AASHTO M 208: Cationic Emulsified Asphalt

ASTM D 2026: Cut-Back Asphalt (Slow-Curing Type)

ASTM D 2027: Cut-Back Asphalt (Medium-Curing Type)

ASTM D 2028: Cut-Back Asphalt (Rapid-Curing Type)

ASTM D 2397: Cationic Emulsified Asphalt

505.3 SUBMITTALS:

The CONTRACTOR shall provide the ENGINEER a list of suppliers. Any other submittals shall be defined in the Special Conditions.

505.4 MATERIALS:

Materials of the type and grade shown on the Plans or defined in the Special Conditions shall conform to the requirements of the applicable Quality Standards listed in Paragraph 505.2.

505.5 EXECUTION OF THE WORK:

Application rates will be shown on the Plans or defined in the Special Conditions. Prior to application, the surface should be allowed to dry to 80% of optimum moisture. Application shall be made with an approved type of self-propelled pressure distributor capable of uniform distribution at the rate specified. Application temperature shall be in accordance with the manufacturer's recommendations and shall not be applied when the ambient air temperature is below 50 degrees F., unless otherwise designated by the ENGINEER. The prime coat shall be permitted to cure until proper and thorough penetration has been obtained.

505.6 QUALITY CONTROL:

Bituminous prime coat testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise detailed in the Special Conditions.

Refineries or distributors shall provide a one-quart test sample for each shipment conveyed to the project. Weight tickets will accompany each load of material.

505.7 CLEAN UP:

Application methods which result in discoloration of concrete curbs and concrete gutters will not be permitted. Spills will be blotted immediately and the blotter material shall be disposed of in a satisfactory manner.

505.8 METHOD OF MEASUREMENT:

Bituminous material will be measured by the gallon, corrected to 60 degrees F. Emulsified material will be measured by the gallon prior to dilution with water.

505.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to apply the bituminous prime coat in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

506 BITUMINOUS TACK COAT AND REJUVENATING AGENT:

506.1 SCOPE:

All bituminous tack coats and rejuvenating agent shall conform to the requirements specified herein.

506.2 QUALITY STANDARDS:

The latest published revisions of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 6: Fine Aggregates for Highway Construction

AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

AASHTO M 208: Cationic Emulsified Asphalt

ASTM D 2026: Cut-Back Asphalt (Slow-Curing Type)

ASTM D 2027: Cut-Back Asphalt (Medium-Curing Type)

ASTM D 2028: Cut-Back Asphalt (Rapid-Curing Type)

ASTM D 2397: Cationic Emulsified Asphalt

506.3 SUBMITTALS:

The CONTRACTOR shall provide the ENGINEER a list of suppliers. Any other submittals shall be defined in the Special Conditions.

506.4 MATERIALS:

(a) Materials of the type and grade shown on the Plans or defined in the Special Conditions for tack coats shall conform to the requirements of the applicable Quality Standards listed in Paragraph 506.2.

(b) Rejuvenating agent materials shall conform to the requirements shown on the Plans or defined in the Special Conditions.

(c) Blotter material for rejuvenating agent shall consist of dry, gritty sand or crushed fines conforming to the requirements of the applicable Quality Standards listed in Paragraph 506.2.

506.5 EXECUTION OF THE WORK:

Application rates will be as shown on the Plans or defined in the Special Conditions. Prior to application, the surface to receive the tack coat or rejuvenating agent shall be clean and dry. Sweeping or other approved method shall be used to remove all dust, debris and foreign matter.

Application shall be made with an approved type of self-propelled pressure distributor capable of uniform distribution at the rate and temperature

specified. Application temperature shall be in accordance with the manufacturer's recommendations and shall not be applied when the ambient air temperature is below 50 degrees F., unless otherwise designated by the ENGINEER. The rejuvenating agent shall be permitted to cure until proper and thorough penetration has been obtained. If the rejuvenating agent fails to penetrate and the roadway must be used by traffic, blotter material shall be spread in amount required to absorb any excess bituminous material. The CONTRACTOR shall provide the necessary equipment to apply the blotter material when required. The CONTRACTOR shall remove all excess blotter material within 72 hours after application unless otherwise directed by the ENGINEER.

506.6 QUALITY CONTROL:

Bituminous tack coat and rejuvenating agent testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

Refineries or distributors shall provide a one-quart sample for each shipment conveyed to the project. Weight tickets will accompany each load of material.

506.7 CLEAN UP:

Application methods which result in discoloration of concrete curbs and concrete gutters will not be permitted. Spills will be blotted immediately and the blotter material shall be disposed of in a satisfactory manner.

506.8 METHOD OF MEASUREMENT:

Bituminous material will be measured by the gallon, corrected to 60 degrees F. Emulsified material will be measured by the gallon prior to dilution with water.

506.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to apply the bituminous tack coat and rejuvenating agent in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

507 EMULSIFIED ASPHALT TREATED BASE:

507.1 SCOPE:

This work shall consist of aggregate and emulsified asphalt mixed in a central plant, spread and compacted on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades and typical cross section shown on the plans or established.

507.2 MATERIALS:

The treated base shall be composed of a mixture of aggregate, water if required, and emulsified asphalt. The percentage of emulsified asphalt in the produced mixture shall be within + or - .03 percent of that specified, by weight of dry aggregate, on a daily yield basis.

Emulsified asphalt shall meet the applicable requirements of Section 913 for the type specified. The material may be conditionally accepted at the source. Cationic emulsified asphalt shall not be diluted prior to introduction into the pugmill.

Aggregates shall meet the requirements of Section 901 for the class specified. The aggregate will be accepted immediately preceding addition of emulsified asphalt to the mix.

Other materials shall conform to the requirements of Section 900 - Materials.

Filler	901
Hydrated Lime	909

507.3 CONSTRUCTION REQUIREMENTS:

507.3.1 Weather Limitations:

Emulsified asphalt treated base shall be placed only on accepted subgrade or subbase. Aggregate and air temperature shall be at least 50 degrees F. unless

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otherwise permitted. Ice or frozen lumps of aggregate will not be permitted in the mixing operations.

507.3.2 Mixing and Placing:

Central mixing plants shall be of the twin pugmill or other approved type. Central mixing plants shall be equipped with suitable pumps, proportioning devices, metering, or weighing devices and spray-bars for adding the required amount of emulsified asphalt and water to the aggregate. The plant shall be provided with a reliable mechanical means for feeding and proportioning the aggregates.

Water shall be added to the aggregate as directed, sufficiently in advance of the introduction of emulsified asphalt to insure uniform dispersion of the water.

Aggregates with moisture contents in excess of that necessary for proper mixing and compaction shall be allowed to drain before use. Stockpiling or other approved methods of reducing the moisture content of the aggregate will be permitted.

The prepared aggregates and emulsified asphalt shall be combined in the mixing plant in the specified proportions. The various materials shall be mixed until all particles are uniformly coated. The resulting mixture shall have a uniform color and an even distribution of coarse and fine particles.

The mixture shall not be stockpiled but shall be delivered direct to the roadbed, placed and spread by approved spreading devices capable of achieving specified surface tolerance. Blade placement will not be permitted for the initial spreading.

If the required compacted depth of the emulsified asphalt treated base exceeds 6 inches, it shall be constructed in two or more layers or approximately equal thickness. When 2 or more layers are required the maximum compacted thickness of any one layer shall not exceed 4 inches.

507.3.3 Shaping and Compaction:

Compaction of the treated base shall commence immediately after it has been placed on the roadway, unless otherwise directed in order to be completed before the emulsion has broken. Moisture content at the beginning of compaction shall not deviate from optimum moisture on the dry side by more than 2 percentage points as determined by AASHTO T 180.

Compaction of each layer shall continue until a density of not less than 95 Percent of the maximum density determined in accordance with AASHTO T 180 has been achieved. Upon completion of shaping and compacting to finish grade, the treated base shall not be disturbed by manipulation or surface blading unless directed. The CONTRACTOR shall be responsible for any damage to the treated base resulting from his operation.

The prepared surface upon which the surface course is to be placed will be tested with a 10 foot straight edge, or other approved device. The surface shall be tested prior to the application of any primer or pavement. The variation above or below the testing edge of the straight edge between any two contacts with the surface shall not exceed 1/4 inch. Any areas not complying with these tolerances shall be reworked to obtain conformity.

Emulsified asphalt necessary for compaction, maintenance or as a tack coat between layers shall be added in the form of one-to-one dilution with water.

The CONTRACTOR shall protect the prepared surface immediately with a bituminous coating of the type and grade shown on the plans, or as directed, prior to placement of surface course.

507.4 METHOD OF MEASUREMENT:

Emulsified asphalt treated base will be measured by the ton.

Weight of water and asphalt will not be deducted from the scale weight of the mixture as it leaves the plant.

Water will not be measured and paid for separately but shall be included in the work.

507.5 BASIS OF PAYMENT:

The accepted quantities of Emulsified Asphalt Treated Base, or the class specified, will be paid for at the contract price per ton.

Payment will be made under:

Pay Item	Pay Unit
Emulsified Asphalt Treated Base (Class.....)	Ton
Hydrated Lime	Ton

Processing Lime Treated Subgrade Sq. Yard

Water will be measured and paid for in accordance with Section 309

508 BITUMINOUS PLANT MIX PAVEMENTS AND BASE COURSE:

508.1 SCOPE:

All bituminous pavements of the plant mix type shall conform to the requirements specified herein, irrespective of aggregate gradation, kind or amount of bituminous material, or pavement use.

Pavement work shall consist of one or more courses of bituminous mixtures constructed on a prepared subgrade in accordance with these Specifications. The completed work shall conform to the thickness and typical sections shown on the Plans. The completed work shall conform to the lines and grades shown on the Plans or to those established by the ENGINEER at the job site.

Bituminous base course work shall consist of one or more courses of bituminous mixtures constructed in accordance with these Specifications. The completed work shall conform to the thickness and typical sections shown on the Plans. The completed work shall conform to the lines and grades shown on the Plans or to those established by the ENGINEER at the job site.

508.2 QUALITY STANDARDS:

AASHTO M 17: Mineral Filler for Bituminous Paving Mixtures

AASHTO M 29: Fine Aggregate for Bituminous Mixtures

AASHTO M 43: Standard Sizes of Coarse Aggregate for Highway Construction

AASHTO T 96: Percent Wear

AASHTO M 226: Viscosity Graded Asphalt Cement

AASHTO T 245: Marshall Test

AASHTO T 246: Hveem Test

ASTM C 207: Hydrated Lime, Type N, for Bituminous Paving Mixtures

ASTM D 242: Mineral Filler for Bituminous Paving Mixtures

ASTM D 448: Standard Sizes of Coarse Aggregates for Highway Construction

ASTM D 692: Coarse Aggregate for Bituminous Paving Mixtures

ASTM D 1073: Fine Aggregate for Bituminous Paving Mixtures

ASTM D 1075: Index of Retained Strengths

508.3 SUBMITTALS:

The CONTRACTOR shall provide the ENGINEER a list of suppliers. Mix designs shall be submitted prior to the start of any Work.

The job-mix formula shall be established by the Contracting Agency and will be shown in the Special Conditions. The job-mix formula including the allowable tolerances shall be within the master range set forth in the table for hot Mix Bituminous Pavement shown below.

MIX TOLERANCES	
Max. Size	+ or - 0 percentage points
Passing No. 8 and larger	+ or - 8 percentage points
No. 8 to No. 100	+ or - 6 percentage points
Passing No. 200	+ or - 3 percentage points
Asphalt Content	+ or - .5 percentage points
Discharged Mix Temperature	+ 20 degrees F.

508.4 MATERIALS:

508.4.1 Composition of Mixtures:

The bituminous plant mix shall be composed of a mixture of aggregate, filler as required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.

Tests for cleanliness, abrasion loss and percent of fractures faces will be made on representative samples of aggregate taken during production or from the stockpiles.

The plant mixed material will be accepted at the discharge point of the plant or it may be accepted at or behind the laydown machine.

The job-mix formula for each mixture shall remain in effect until modified in writing by the ENGINEER. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and a single temperature for the mixture at the discharge point of the plant in accordance with subsection 508.5.9.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

* Passing No. 8 and larger sieves	+ or - 8 percent
Passing sieves smaller than No. 8 to larger than No. 200	+ or - 6 percent
Passing No. 200 sieve	+ or - 3 percent
Bitumen	+ or - .5 percent
Temperature of mixture when emptied from mixer	+ or - 20 degrees F.

* Exclusive of the maximum size designated in the Special Conditions.

Approval of sources of aggregate will be contingent on the job-mix formula mixture, using aggregate from the proposed source, having a minimum index of retained strength of 75 percent when testing in accordance with AASHTO Standard Methods of Sampling and Testing T 165 "Effect of Water on Cohesion of Compacted Bituminous Mixtures".

The CONTRACTOR will be permitted to use an additive in order to meet the requirement for index or retained strength. The acceptable additives and minimum amounts are as follows:

(a) Hydrated lime - 1.0% on a dry aggregate, weight basis, or

(b) Portland Cement Type 1 - 2.0% on a dry aggregate, weight basis, or

(c) Anti-stripping additives, heat stable concentrated, refinery grade: Required concentrations shall be as per manufacturers recommendations.

Payment will not be allowed for hydrated lime, Portland Cement or anti-stripping additive needed to meet the requirement for index of retained strength.

After the project is under contract, requests made in writing by the CONTRACTOR for changes in the job-mix formula will be considered. The job-mix formula may be changed by the ENGINEER for either of the following reasons:

(a) Change in job-mix formula will produce material of equal or better quality and will permit better utilization of available material.

(b) Change in job-mix formula will produce material of equal or better quality and will result in a saving in cost to the Contracting Agency through an adjustment in unit price.

508.4.2 Aggregates:

All aggregates shall conform to the requirements of the applicable Quality Standards listed in Paragraph 508.2.

508.4.3 Mineral Filler:

Mineral filler shall conform to the requirements of the applicable Quality Standards listed in Paragraph 508.2.

508.4.4 Hydrated Lime:

Hydrated lime shall conform to the requirements of the applicable Quality Standards listed in Paragraph 508.2.

508.4.5 Bituminous Material:

Bituminous material of the type and grade specified in the Special Conditions shall conform to the requirements of the applicable Quality Standards listed in Paragraph 508.2.

508.5 EXECUTION OF THE WORK:

508.5.1 Weather Limitations:

Placement weather limitations shall conform to the requirements of Section 508.5.10.

508.5.2 Bituminous Mixing Plant:

The storage yard shall be maintained neat and orderly and the aggregates shall be readily accessible for sampling. Accommodations for storing of required filler or binder shall be provided.

Plants used for the preparation of bituminous mixtures shall conform to all requirements under (a), except that scale requirements shall apply only where weight proportioning is used. In addition, batch mixing plants shall conform to the requirements under (b), continuous mixing plants shall conform to the requirements under (c), and dryer-drum mixing plants shall conform to the requirements under (d).

(a) Requirements for all plants. Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed bituminous construction.

1. Plant Scales. Material shall be weighed on accurate, approved scales. In lieu of plant and truck scales, the CONTRACTOR may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weigh ticket for each load.

2. Equipment for preparation of bituminous material. Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that the flame shall not be in contact with the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provision shall be made for measuring and sampling storage tanks.

3. Feeder for Dryer. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the dryer so that uniform production and uniform temperature will be obtained.

4. Dryer. The plant shall include a dryer or dryers which continuously agitate the aggregate during the heating and drying process.

5. Aggregate Gradation Control. Aggregate gradation control shall be provided either with plant screens or screenless plants in accordance with the following methods described respectively:

   Method (a): Plant screens shall screen the hot aggregate to the specified sizes and proportions and have normal capacities in excess of the full capacity of the mixer.

Method (b): screenless plants with cold feed control shall be as follows: The cold aggregate shall be separated and stored in coarse aggregate and fine aggregate stock piles. Coarse aggregate is defined as that material retained on the No. 4 sieve. Fine aggregate is defined as that material passing the No. 4 sieve. Both the coarse and fine aggregates may be further separated and stored in as many individual piles as desired. Aggregates from the various piles shall be combined in the proportions necessary to conform to the job-mix formula. Only total aggregate combinations with a job-mix formula of 20% or more retained on the No. 4 sieve need be separated into more than one stockpile.

The total coarse aggregate fraction from the cold stockpiles as used in the combination shall not contain more than 12 percent passing the No. 4 sieve. The total fine aggregate fraction from the cold stockpiles as used in the combination shall not contain more than 15 percent retained on the No. 4 sieve. Screens with any size or shape of aperture or of any length or type may be used for separating the aggregates, provided the other requirements of this provision are met.

6. Hot Aggregate Bins. Pugmill plants shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the hot mineral aggregates. Separate dry storage shall be provided for filler or hydrated lime when used and the plant shall be equipped to accurately feed such material into the mixer. Each bin shall be provided with overflow pipes of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed, there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that representative samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

7. Bituminous Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

8. Thermometric Equipment. An armored thermometer of adequate range or an approved temperature measuring apparatus shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with an approved temperature measuring apparatus placed at the discharge chute of the dryer.

9. Emission Control. Dust, smoke or other contaminants shall be controlled to meet all air pollution requirements.

10. Handling and Storage of Hot mixtures. The hot mixtures shall not be emptied directly from conveyor belts, drag chains, or other conveying devices into hauling conveyances, storage bins or into surge hoppers with capacities of over 2 percent of the tons per hour output. Conveying devices shall discharge directly into batches with capacities under 2 percent of plant tons/hr. output; the entire batch quantity shall then be simultaneously dropped into storage or hauling units. Apparatus other than batchers may be approved for use upon demonstration of satisfactory results. Hauling units shall not be loaded by any means that cause segregation of the mixture.

11. Storage Time. Hot mixtures shall not be stored longer than shown below:

Maximum

Storage Times

Untreated Asphalt Cement,
air in bin . . . . . 9 hours

Treated* Asphalt Cement
air in bin; or Untreated . . . . . .24 hours

Treated* Asphalt Cement,
inert gas in bin . . . . . 72 hours

*Treated with liquid silicone (Dow Corning Fluid DC-200 or approved equal) at the rate of approximately 1 oz. per 5,000 gallons of asphalt cement.

12. Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the CONTRACTOR or on public scales at the CONTRACTOR'S option and expense.

13. Safety Requirements. Adequate and safe stairways to the mixer platform and sampling points shall be provided. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies and discharge gate

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shall be provided by a platform or other suitable device to enable the ENGINEER to obtain sampling and mixture temperature data. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment from the ground to the mixer platform and return. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

14. Commercial Binders or Fillers. When commercial binders or fillers are required to be mixed with the aggregate, a central mixing plant of the twin-pugmill type will be required. Other methods that assure a thorough and homogenous mixture will be permitted on written approval.

(b) Requirements for Batching Plants:

1. Weigh Box or Hopper. The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that material is not allowed to leak into the mixer while the batch is being weighed.

2. Bituminous Control. The equipment used to measure the bituminous material shall be accurate to + or - 0.5 percent. The bituminous material bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than 3/4 the length of the mixer and it shall be adequately heated. Steam jackets, if used, shall be efficiently drained and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least 15 percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

   The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of bituminous material used in a batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be controlled so that it will begin when the dry mixing period is over. All of the bituminous material required for one batch shall be discharged in not more than 15 seconds after the flow has started. The size and spacing

of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve the the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material bucket.

3. Mixer. The batch mixer shall be capable of producing a uniform mixture within the job-mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

   The clearance of blades from all fixed and moving parts shall not exceed one inch, unless the maximum diameter of the aggregate in the mix exceed 1 1/4 inches, in which case the clearance shall not exceed 1 1/2 inches.

(c) Requirements for Continuous Mixing Plants.

1. Aggregate Proportioning. The plant shall include means for accurately proportioning each size of aggregate.

   The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for measuring the volume of material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive mechanical means provided with a lock.

   Indicators shall be provided for each gate to show the respective gate opening in inches.

2. Weight Calibration of Aggregate Feed. The plant shall include a revolution counter in good working order and a means for calibration of gate openings by weighing samples. Provision shall be made so that materials fed out of individual orifices may be bypassed to individual boxes.

   The plant shall be equipped to conveniently handle individual samples weighing not less than 200 pounds. Accurate scales shall be provided by the CONTRACTOR to weigh such samples.

3. Synchronization of Aggregate Feed and Bituminous Material Feed. Satisfactory means shall be provided to control the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by another positive method satisfactory to the ENGINEER.

4. Mixer. The plant shall include a continuous mixer adequately heated and capable of producing a uniform mixture within the job-mix tolerances. It shall be equipped with a discharge hopper with dumpgates which will permit rapid and complete discharge of the mixture. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of feed of aggregate per minute for the aggregate being used.

(d) Requirements for Dryer-drum Mixer Plants

1. Aggregate proportioning. Aggregates shall be proportioned at the cold feed control in accordance with Subsection 508.5.2 (a).5, Method (b).

2. Weight measurement of Aggregate. The system shall provide positive weight measurement of the combined cold aggregate feed by use of belt scales or other devices which will allow regulation of the feed gate and permit correction for variations in load.

3. Synchronization of Aggregate Feed and Bituminous Material Feed. The bituminous feed control shall be coupled with the total aggregate weight measurement device in such manner as to automatically vary the bitumen feed rate as required to maintain the required proportion.

4. Dryer-drum Mixer. The dryer-drum mixer shall be of an approved type, capable of adequately heating, drying and mixing the bitumen-aggregate mixture.

508.5.3 Hauling Equipment:

Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of an approved release agent.

508.5.4 Bituminous Pavers:

Bituminous Pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in width applicable to the specified typical section and thickness shown on the Plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The paving machine shall be equipped with an automatic control system which will control the elevation of the screed and which is automatically actuated by a system of sensor-operated devices which sense and follow reference lines or surfaces on one or both sides of the machine as required.

The screed shall be maintained at the proper elevation at each end by controlling the elevation of one end and automatically controlling the transverse slope or by controlling the elevation of each end independently, as directed.

The automatic control system shall be capable of working with the following devices:

(a) Ski-type device at least 30 feet in length

(b) Short ski or short shoe

(c) At least 5,000 feet of control line and stakes.

The type or types of devices to be furnished shall be as called for on the Plans.

When the control line is to be used, it shall be installed by the CONTRACTOR and shall be maintained taut and to the grade and alignment established.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

508.5.5 Rollers:

Rollers shall be of the steel wheel, vibratory, pneumatic tire type, or combination and shall be in good condition, capable of reversing without backlash.

508.5.6 Conditioning of Existing Surface:

When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross section as directed.

When shown on the Plans or defined in the Special Conditions, all longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before spreading the mixture upon a Portland Cement concrete surface. All excess bituminous material shall be removed from joints and cracks prior to spreading the mixture.

Contact surfaces of curbing, gutter, manholes, and other structures shall be painted with a thin, uniform coating of bituminous material prior to the bituminous mixture being placed against them.

508.5.7 Preparation of Bituminous Material:

The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

508.5.8 Preparation of Aggregates

Aggregates for pugmill mixtures shall be dried and heated to the required temperature. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.

Untreated aggregates for dryer-drum mixtures will not require prior preparation other than gradation control, except that those containing free water shall be stockpiled and allowed to drain prior to mixing.

When hydrated lime is to be added to the plant mix material, the plans will indicate which of the following methods, (a) or (b), shall be used.

(a) Hydrated lime shall be added to the aggregate at the plant in accordance with the following:

1. When pugmill mixers are used, the CONTRACTOR will be required to add 1 percent (by dry weight of total aggregate) hydrated lime to the hot aggregate for bituminous pavement.

2. When dryer-drum mixers are used, hydrated lime shall be added in accordance with Subsection 508.5.8 (b), unless adequate hydrated lime dust control facilities are provided.

(b) Hydrated lime shall be added and the mixture stockpiled to undergo an aging process in accordance with the following:

1. The requirements in Paragraph (a) and (b) below shall apply to all hot Bituminous Pavement (except Grading F).

(a) When gradation is controlled in accordance with Subsection 508.5.2(a)5, Method (a) (Hot Screens), 1 percent hydrated lime (by dry weight of total aggregate) shall be added to the total aggregate. Hydrated lime, water and aggregate shall be thoroughly mixed in an approved mechanical mixer and shall then be stockpiled. The mixture shall contain between 4 percent and 7 percent moisture at the time it is stockpiled. (Note: It is to be expected that normally water will have to be added at the mixing machine in order to meet the above moisture requirements). The mixed material shall remain in the stockpile for a minimum of 5 days before being processed with asphalt cement to produce hot bituminous pavement.

(b) When gradation is controlled in accordance with Sub-section 508.5.2(a)5, Method (b) (Cold feed control), 2 percent hydrated lime (by dry weight of fine aggregate) shall be added to the fine aggregate. Hydrated lime, water and fine aggregate shall be thoroughly mixed in an approved mixer and shall then be stockpiled. The fine aggregate mixture shall contain between 6 percent and 10 percent moisture at the time it is stockpiled. (Note: It is to be expected that, normally, water will have to be added at the mixing machine in order to meet the above moisture requirements). The mixed material shall remain in the stockpile for a minimum of 5 days before being processed with the coarse aggregate and asphalt cement to produce hot bituminous pavement.

2. One percent hydrated lime (by dry weight of total aggregate for Hot Bituminous Pavement, Grading F, Hydrated Lime) water and aggregate shall be thoroughly mixed in an approved mixer and shall then be stockpiled. The mixture shall contain between 5 percent and 8 percent moisture at the time it is stockpiled. (Note: It is to be expected that, normally, water will have to be added at the mixing machine in order to meet the above moisture requirements). The mixed material shall remain in the stockpile for a minimum of 5 days before being processed with asphalt cement to produce hot bituminous pavement.

3. If the pit materials contain excess moisture, the excess shall be removed before adding the hydrated lime.

508.5.9 Mixing:

The aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles is secure.

The recommended mixture job-mix temperature at the mixer discharge (for pugmill or dryer-drum) shall be as shown in Column 1 for the grade asphalt being used, except as otherwise provided in this Subsection:

ASPHALT GRADE	COLUMN 1 JOB-MIX TEMP.	COLUMN 2 MINIMUM JOB-MIX TEMP.
AC 20	290 degrees F	255 degrees F.
AC 20	280 degrees F	245 degrees F.
AC 5	275 degrees F	240 degrees F.
AC 2.5	265 degrees F	230 degrees F.
AC 20 (rubberized)	320 degrees F	285 degrees F.

Upon approval, the CONTRACTOR may select a job-mix temperature below that shown in Column 1, but no lower than that shown in Column 2, provided he demonstrates adequate mixing at the discharge point and achieves specified compaction on the roadway. For a lower mixing temperature to be approved, at least 95% of the aggregate particles must be coated when tested in accordance with AASHTO T 195. Adequacy of mixing will be determined visually for mixtures containing less than 20 percent plus No. 4 sieve size particles and the job-mix temperature established accordingly. Regardless of job-mix temperature the mixture shall not be delivered for use on the roadway at the temperature lower than 30 degrees F. below the temperature shown in Column 2 for the grade of asphalt being used, unless otherwise approved.

508.5.10 Placement Temperature Limitations:

Bituminous plant mix shall be placed only on properly constructed and accepted layers that are free from water, ice or snow. Bituminous mixtures shall not be placed on frozen surfaces, unless approved in writing by the ENGINEER. The Bituminous mixtures shall be placed within the air temperature limitations of the following table and only when weather conditions otherwise permit the pavement to be properly placed and finished.

When it is in the public interest, the ENGINEER may waive minimum ambient air temperature requirements for placing prime coats and layers of bituminous mixtures below the top of the completed pavement.

PLACEMENT TEMPERATURE LIMITATIONS					
TOP LAYER OF THE COMPLETED PAVEMENT			LAYERS BELOW THE TOP LAYER OF COMPLETED PAVEMENT		
COMPACTED THICKNESS	MINIMUM PLACEMENT AIR TEMPERATURE		COMPACTED THICKNESS	MINIMUM PLACEMENT AIR TEMPERATURE	
	MIX TEMPERATURE > 234°	MIX TEMPERATURE 200°-234°		MIX TEMPERATURE > 234°	MIX TEMPERATURE 200°-234°
< 1"	60°F	70°F	< 2"	40°F	50°F
1" - 2½"	50°F	55°F	2" - 3"	30°F	40°F
> 2 ½"	40°F	45°F	3 ½	25°F	30°F

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508.5.11 Spreading and Finishing:

The mixture shall be laid upon an approved surface, spread and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches. The joints in any pavement layer shall not fall in a wheel track. The joints in the top layer shall be located as follows:

(a) For 2-lane roadways, at the center line of the pavement and at the outside edge of travel lanes.

(b) For roadways of more than 2 lanes, at the lane lines and at the outside edge of the travel lanes.

Where paving operations are on the present traveled roadway and where the thickness of pavement course being placed is greater than one inch, the CONTRACTOR shall arrange his paving operations so that there will be no exposed longitudinal joint between adjacent travel lanes at the end of a day's run. In lieu of this requirement, with approval of the ENGINEER, the CONTRACTOR will be permitted to use a modified 6 inch tapered shoe having not less than 1/2 inch of vertical shoulder at the top.

On areas where irregularities of unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas, the mixture shall be dumped, spread and screeded to give the required compacted thickness.

When production of the mixture can be maintained and when practical pavers may be used in echelon to place the wearing course in adjacent lanes.

The bituminous mixture shall be transported and placed on the roadway in such manner as to minimize segregation. All segregated areas behind the paver shall be removed immediately at the time of discovery. It is the intent of this Specification that the segregated material shall be replaced with specification material before the initial rolling has taken place. If more than 50 square feet of segregated pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, paving operations with the paving machine involved shall be discontinued until the source of the segregation has been found and corrected.

508.5.12 Compaction:

After the bituminous mixture has been spread, struck off and the surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

The number, weight and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping on-half the roller width, gradually progressing to the crown of the road. When paving in echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. On super-elevated curves the rolling shall begin at the low side and progress to high side by overlapping of longitudinal strips parallel to the centerline.

Rolling shall be continued until all roller marks are eliminated and a minimum density of 95 percent of a laboratory specimen made in the proportions of the job-mix formula has been obtained. A minimum density of 90 percent of the laboratory specimen will be required when mixtures are to be made from specified aggregates having 65 percent or more passing the No. 3 sieve.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and an addition of fresh mixture when required. Care should be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, wall and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hand tampers or with mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area.

508.5.13 Joints:

Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the ENGINEER.

Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by the ENGINEER, a coat of bituminous material shall be used on contact surfaces of all joints just before additional mixture is placed against the previously rolled material.

508.5.14 Pavement Samples:

The ENGINEER may take samples, or direct the CONTRACTOR'S testing laboratory to take samples of the compacted pavement at random locations on the project for testing. Where samples have been taken, new material shall be placed and compacted by the CONTRACTOR to conform with the surrounding area.

508.5.15 Surface Tolerances:

(a) All manholes, water valves, range boxes, etc. shall be 1/2 inch to 3/4 inch below the final paved grade. The finish grade of pavement shall be 1/4 inch above the rim elevation with a two foot transition provided.

(b) Any humps and depressions greater than 1/4 inch in 5 feet as measured with a 10 foot straight edge shall be cause for corrective measures.

(c) Additional asphalt thickness of up to 1/2 inch will be permitted at the joint of the roadway and gutter pan and will be included in the actual asphalt thickness. Corrective action may be required for additional asphalt in excess of 1/2 inch. In no case will asphalt in excess of 1/2 inch above the gutter pan be included in the asphalt thickness for acceptance purposes.

508.6 QUALITY CONTROL:

Bituminous plant mix paving and base course testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined by the Special Conditions.

Certificates of compliance shall be provided to the ENGINEER for each shipment of asphalt cement, mineral filler and hydrated lime. Refineries or distributors shall provide a one-quart test sample for each shipment of bituminous material conveyed to the project.

508.7 CLEAN UP:

The surface of the pavement shall be thoroughly cleaned upon completion of the work. The area of the plant site shall be restored to its original condition or as directed by the ENGINEER.

508.8 METHOD OF MEASUREMENT:

Plant mix bituminous pavement will be measured by the ton. The tonnage shall be the weight used in the accepted pavement. Deduction will not be made for the weight of bituminous material in the mixture.

508.9 BASIS OF PAVEMENT:

Payment for bituminous plant mix pavement shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to construct bituminous pavement in accordance with the project plans and Specifications and shall be full compensation for the item complete in place.

Payment for bituminous base course shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to construct the bituminous base course in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

509 BITUMINOUS PLANT MIX:

509.1 SCOPE:

Asphalt concrete overlay consists of the placing and compaction of plant mix asphalt concrete over existing asphalt concrete paving. The thickness of the overlay shall be as shown on the plans or as specified in the Special Conditions. Preliminary preparation of existing surfaces will be required except when accomplished by the Contracting Agency, and it is so stipulated in the Special Conditions. With the exception of those which have been preheated and remixed only, existing surfaces shall receive a tack coat. Geotextile fabrics may be used between the existing surface and the overlay.

509.2 MATERIALS:

The tack coat, asphalt concrete mix and transportation of the mix shall be as specified in Section 505, except for the maximum size of aggregate and percentage of binder which shall be as specified in the following paragraph. Geotextile materials shall be specified by the ENGINEER in the Project Special Conditions.

509.3 BITUMINOUS MIX:

The aggregate gradation and percentage of asphalt binder shall be as specified in the Special Conditions.

509.4 PREPARATION OF SURFACES:

Except when they have been preheated and remixed, surfaces shall be prepared as follows:

Before placing bituminous overlay, severely raveled areas or cracked areas that are depressed more than 3/4 inch from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted areas or rough high spots shall be removed by blading or rotomilling. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the ENGINEER. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above are incidental, and the cost thereof shall be included in the bid items.

After surfaces have been prepared to the satisfaction of the ENGINEER, they shall receive a tack coat as specified. Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto the concrete gutter, the gutter shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

509.5 CONSTRUCTION METHODS:

Placing and rolling of the asphalt concrete and the smoothness of the surface shall be as specified in Section 508. Installation of geotextile fabrics shall be in accordance with the Special Conditions.

509.6 MANHOLES:

Manholes shall be built up and the frames set flush with the finished surface of the new paving, and tops of valve boxes, clean-outs and other existing structures shall be adjusted to finish grade. In the event the base course and original paving have been removed or disturbed in order to build up the manhole, they shall be replaced with approved materials which shall be thoroughly compacted. The Bituminous mix around the manhole frame shall be completed and made flush with the adjacent overlay.

509.7 MEASUREMENT AND PAYMENT:

Measurement and payment for tack coat and bituminous plant mix will be as specified in Section 508 except as noted above. Payment for hot bituminous pavement patching materials shall be measured and paid by the ton.

510 HEATER REMIS RESURFACING:

510.1 SCOPE:

Heater remix resurfacing consists of heating and remixing existing asphalt concrete paved surfaces, and unless otherwise specified in the Special Conditions, followed by the application of a rejuvenating agent and bituminous plant mix overlay.

510.2 COORDINATION:

There shall be close coordination between those performing the heating and remixing operation and those placing the bituminous plant mix overlay.

510.3 WEATHER CONDITIONS:

Heater remix resurfacing shall not be done when it is raining or there is a threat of rain. The ambient temperature shall be at least 50 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling.

510.4 SURFACE PREPARATION:

The pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

510.5 HEATER REMIX EQUIPMENT:

The heater remixer shall consist of an insulated 8-12 foot minimum adjustable width heating furnace chamber with ports to inject fuel and air for satisfactory combustion without excessive smoke. The use of highly volatile fuels for heating, such as gasoline, will not be permitted within the boundaries of any incorporated City. Use of said highly volatile fuels for heating may be permitted in un-incorporated areas only if authorized in writing by the ENGINEER prior to such use. The burners shall be rated at 10,000,000 BTU per hour minimum. The hourly production shall be not less than 1100 square yards of heated and remixed surface. Movable exhaust ducts shall be provided and equipped with shields to protect trees and adjacent shrubbery. The heating chamber and scarifier shall be positively controlled by side shifting and rear wheel steering to heat areas divergent from the central axis of the machine at intersections and along existing structures. The scarifier shall be sectioned and spring tensioned to insure continuous and undiminished pavement contact. It shall be equipped with automatic release mechanism to protect manholes and valve boxes from damage.

510.6 HEATING AND REMIXING:

Prior to heating and remixing, all manholes in the path of the heater shall be checked for presence of explosive gases and ventilated, if necessary. The existing surface shall be evenly heated and remixed to a depth of from 0.05 to 0.08 foot by a continuously moving surface heater remixer machine. The remixed surface shall be left in an evenly spread condition and aggregate shall not be pulverized, spalled or broken. Atleast 80 percent of the aggregate shall be remixed by spinning or tumbling and heated t o a minimum temperature of not less than 250 degrees F. measured within 3 minutes following heating. The asphalt binder shall not be charred in excess of 0.10 of 1 percent. No uncontrolled heating causing differential softening of the upper surfaces without affecting the underlying structure will be permitted. The remixed layer shall be uniformly and evenly heated throughout. Following the mixing operation, an asphalt rejuvenating agent, or emulsion, if required, of the type designated in the contract, shall be applied at the rate hereinafter specified, by a pressure distributor while the remixed material is still hot.

510.7 ASPHALT REJUVENATING AGENTS:

Where the contract requires the use of an asphalt rejuvenating agent, or emulsion, it will designate one of the following types:

(a) Type I asphalt rejuvenating agent, a cationic oil and resin emulsion, shall comply with Section 918 and shall be applied at the rate of 0.0 to 0.15 gallons of undiluted concentrate per square yard. However, the exact quantity shall be as directed by the ENGINEER.

The CONTRACTOR shall furnish the ENGINEER with the brand name and name of the manufacturer of the Type I asphalt rejuvenating agent he proposes to use and the material shall be approved by the ENGINEER before it is used. The CONTRACTOR shall also furnish the ENGINEER with a manufacturer's certificate of compliance indicating quality and specification control.

(b) Type II asphalt emulsion shall be SS-1 or SS-1h emulsified asphalt as specified in Section 913 and shall be applied at the rate of 0.10 or 0.20 gallons per square yard undiluted. However, the exact quantity shall be as directed by the ENGINEER.

510.8 ASPHALT CONCRETE OVERLAY:

Bituminous plant mix overlay shall be in accordance with applicable requirements specified in Section 508.

The bituminous plant mix overlay shall be placed within 48 hours after the heating and remixing operation, unless otherwise specified in the Special Conditions.

The overlay shall cover existing pavement over areas not accessible to the heater remixer. Such areas including edges of adjoining concrete, shall receive a tack coat and joints shall be finished as specified in Section 508.

510.9 MEASUREMENT AND PAYMENT:

Payment for heater remix surfacing will be made on the basis shown below:

(a)	Heater Remix Only	Square Yard
(b)	Type I Asphalt Rejuvenating Agent	Ton (Undiluted)
(c)	Type II Asphalt Emulsion	Ton (Undiluted)
(d)	Asphalt Concrete Overlay	Ton or Square Yard
(e)	Tack Coat	Ton (Undiluted)

511 CHIP SEAL COAT:

511.1 SCOPE:

All bituminous material and cover coat material shall conform to the requirements specified herein.

511.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

AASHTO M 82: Cut-Back Asphalt (Medium-Curing Type)

AASHTO M 208: Cationic Emulsified Asphalt

ASTM D 1139: Crushed Stone, Crushed Slag and Gravel for Single or Multiple Bituminous Surface Treatments.

ASTM D 2026: Cut-Back Asphalt (Slow-Curing Type)

ASTM D 2027: Cut-Back Asphalt (Medium-Curing Type)

ASTM D 2028: Cut-Back Asphalt (Rapid-Curing Type)

ASTM D 2397: Cationic Emulsified Asphalt

511.3 SUBMITTALS:

The CONTRACTOR shall provide the ENGINEER a list of suppliers. Any other submittals shall be defined in the Special Conditions.

511.4 MATERIALS:

The type and grade of bituminous material will be shown on the Plans or defined in the Special Conditions and shall conform to the requirements of the applicable Quality Standards listed in Paragraph 511.2.

Aggregate for cover coat material shall conform to the requirements of Subsection 901.4.4.

511.5 EXECUTION OF THE WORK:

Prior to commencing seal coat operations, all vegetation shall be removed and the surface shall be swept where necessary.

Bituminous material shall not be applied on a damp surface or when the ambient air temperature is below 60 degrees F., unless otherwise specified.

Bituminous material shall be applied by means of a self propelled pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used per square yard shall be shown on the Plans or defined in the Special Conditions. If the texture of the surface is such that bituminous material penetrates too rapidly, a preliminary application of from 0.05 to 0.10 gallon per square yard of surface may be required. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas of deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface.

The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover coat material can immediately cover.

The spread of bituminous material shall not be more than 6 inches wider than the width covered by the cover coat material from the self propelled, mechanical spreading device.

Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

Immediately following the application of the bituminous material, cover coat material shall be spread in quantities as designated. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

If directed, the cover coat material shall be moistened with water to eliminate or reduce the dust coating of the aggregate.

Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Initial rolling shall begin immediately behind the spreader and shall consist of one complete coverage with a roller Pneumatic tire rolling shall begin immediately after completion of the initial rolling and shall be continued until 3 complete coverages are obtained. Pneumatic tire rolling shall be completed the same day the bituminous material and cover coat materials are applied.

511.6 QUALITY CONTROL:

Bituminous seal coat testing and testing laboratory services required shall conform to the applicable portions or Section 800 unless otherwise detailed in the Special Conditions.

Refineries or distributors shall provide a one-quart test sample for each shipment conveyed to the project. Weight tickets will accompany each load of bituminous material and each load of cover coat material.

511.7 CLEAN UP:

Application methods which result in discoloration of concrete curbs and concrete gutters will not be permitted. Spills will be blotted immediately and the blotter material shall be disposed of in a satisfactory manner.

After the application of the cover coat material, the surface where specified shall be lightly broomed or otherwise maintained as directed for a period of 4 days. Maintenance of the surface shall include the distribution of cover coat material and cover of any area deficient of cover coat material. The maintenance shall be conducted so as not to

displace imbedded material. Excess material shall be swept from the entire surface by means of approved brooms or street sweepers at the time determined.

511.8 METHOD OF MEASUREMENT:

Seal coat will be measured by the number of square yards complete in place.

511.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price per square yard. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to apply the bituminous material and cover coat material in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

513 SLURRY SEAL COAT:

513.1 SCOPE:

Slurry seal shall be a mixture of asphalt emulsion, mineral aggregate, mineral fillers, and water properly proportioned, mixed and spread on the pavement surface in accordance with this specification or as directed by the ENGINEER.

513.2 MATERIALS:

The bituminous material and mineral aggregates shall be as specified in Section 915.

(a) Type I - This is the recommended type for thin applications and for airfield usage.

(b) Type II - This is the recommended type when surfaces contain shallow voids and when it is desired to provide a minimum wearing surface.

(c) Type III - This is the recommended type for use on roads where it is intended to provide a moderate wearing surface.

Care shall be exercised to prevent segragation of aggregate in storage and handling; if segragation occurs, the material shall be rehandled, prior to mixing, in a manner to correct the segregation.

513.3 DETERMINATION OF JOB MIX:

Trial mixes shall be prepared to determine proportions. Measured wear on accepted trial mix shall not exceed 25 percent when tested by California Test Method No. 355A. Surface texture, tackiness and mix segragation shall be acceptable to the ENGINEER. Samples of materials to be used on the job shall be used to determine job mix and shall be available in sufficient quantity to produce not less than 30 pounds of emulsified asphalt slurry mixture. The mixture shall have the following characteristic: the dehydrated slurry tested shall not pick up on the roller.

513.3.1 Fluidity:

The mixture shall be sufficiently free flowing to fill cracks in the pavement. This shall be accomplished by the addition of water as required.

513.3.2 Non-Segregation:

The mixture shall not segregate during or after laydown.

513.3.3 Surface Texture:

The mixture shall have a non-skid texture.

To extablish a starting point for the amount of bituminous material to be added in the trial mix, the percent of residual asphalt may be established by use of the following formula in lieu of the C.K.E. procedure. California Test Method No. 303.

$$P = .03a + .06b + .5c$$

Where P = Percentage of residual asphalt by weight

a = Percentage aggregate retained on No. 8 sieve

b = Percentage aggregate passing No. 8 sieve and retained on No. 200 sieve.

c = Percent of aggregate passing No. 200 sieve

513.3.4 Trial Applications:

The CONTRACTOR shall place a test strip of 60 square yards in the area designated by the ENGINEER. The test sections shall be placed using the same equipment and methods as will be used on the job. Slurry mixtures placed in test

strips shall conform to design mix with minor variations to obtain crack filling, bond to pavement and desired skid resistant texture. In the event that the materials do not meet the requirements for fluidity, non-segregation, or surface texture, a new job mix shall be formulated and tested. Work shall not proceed before approval of a design mix and acceptance following the placing of a test strip.

513.4 EQUIPMENT:

Equipment used in the performance of the work shall be subject to approval by the ENGINEER and shall be maintained in satisfactory working condition at all times.

Descriptive information on the slurry mixing and applying equipment to be used shall be submitted for approval not less than 7 days before the work starts.

513.4.1 Mixer:

The slurry mixing machine shall be a continuous flow mixing unit and be capable of delivering accurately a predetermined proportion of aggregate, water, and asphalt emulsion to the mixing chamber and to discharge the thoroughly mixed product on a continuous basis. The aggregate shall be prewetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No excessive mixing shall be permitted.

The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed. The fines feeder shall be used whenever added mineral filler is a part of the aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog type spray bar adequate for complete water fogging of the surface preceding spreading equipment with an application of 0.05 to 0.10 gallon per square yard.

Sufficient machine storage capacity to mix properly and apply a minimum of 5 tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing slurry seal.

513.4.2 Self-contained Slurry Machine:

The machine shall be capable of rapid discharge of the mixed materials into a spreader having suitable controls to allow adjustment for variations in pavement grades and slope. The spreader shall be similar to the spreader box specified

below. The spreader box may be either an integral part of self contained slurry machine or a separate towed unit.

The self-contained slurry unit shall be mounted on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout the operation so that the slurry is spread evenly and all cracks are filled.

513.4.3 Slurry Spreading Equipment:

Attached to the mixer machine shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments and baffles to assure uniform spread. There shall be a lateral control device and a flexible strike off. The spreader box shall have an adjustable width. The box shall be kept clean, and built-up asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags may be approved by the ENGINEER.

513.4.4 Rollers:

Rollers shall be smooth pneumatic-tired, self-propelled or towed type. Rollers shall have a weight of not less than 2,000 pounds per wheel and shall have not less than 7 wheels, so spaced that the gap between adjacent tires will be covered by the tread of the following tire. Tires shall be inflated to a minimum of 50 psi. The rollers shall be equipped with water tanks and sprinkler apparatus which shall be used to keep the wheels damp and prevent adherence of the bituminous materials to the wheels. Steel wheeled rollers may be used in supplementary capacity if required by the Special Conditions.

513.4.5 Cleaning Equipment:

Power brooms, power blowers, air compressors, water flushing equipment, and hand brooms shall be suitable for cleaning the surface and cracks of the old surface.

513.4.6 Hand Tools:

Hand Squeegees, shovels, and other equipment shall be provided as necessary to perform the work.

513.5 CONSTRUCTION METHODS:

513.5.1 General Requirements:

The slurry seal shall be applied only when the existing surface is free from puddles of water. Slurry seal shall not be applied when the pavement is wet and shall be applied only when the atmospheric temperature is at least 70 degrees F. and rising, unless otherwise directed. The slurry seal surface shall consist of a mixture of emulsified asphalt, mineral aggregate, mineral filler if required, and water, properly proportioned, mixed, and spread evenly on the surface as specified and as directed. The cured slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the surface and have skid resistant texture.

513.5.2 Preparation of Surface:

Immediately prior to applying the slurry, the surface shall be cleaned of all loose material, including dust, vegetation, and any objectionable material. Any standard cleaning method used to clean pavements will be acceptable, except water flushing will not be permitted in areas where a considerable number of cracks are present in the pavement surface. The ENGINEER shall give final approval of the acceptability of the surface.

All surfaces shall be cleaned of dirt, clay, or other objectionable material by means of power brooms or blowers, or other approved equipment supplemented with hand brooms. Surface cracks shall be cleaned and blown out with compressed air, 90 psi at the nozzle, immediately before sweeping or vacuum operations.

513.5.3 Tack Coat Application:

Following the preparation for sealing and 2 to 24 hours prior to the application of slurry seal, a tack coat application conforming to Section 506, shall be applied with a distributor at the rate of 0.05 to 0.10 gallon diluted, per square yard of surface.

513.5.4 Mixing of Slurry:

The mixing shall be sufficient to produce a uniform mixture, but is shall not continue for more than 4 minutes. If breaking, hardening, segregation, balling, or lumping occurs during the mixing process, the batch shall be discarded.

Suitable methods such as barricades, flagmen, pilot cars, etc., shall be used to protect the uncured slurry surface from all types of traffic. The ENGINEER

shall have final approval of the method used. Any damage to the uncured slurry shall be the responsibility of the CONTRACTOR.

513.5.5 Application of Slurry Seal:

No mix shall be spread if there is a possibility of rain before the mix has dried, or during periods of abnormally high humidity.

The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface and no additional elements shall be added. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that complete coverage is obtained.

No segregation of the emulsion and aggregates fines from the coarse aggregate will be permitted. No streaks such as caused by oversized aggregate will be left in the finished pavement. No excessive build-up nor unsightly appearance shall be permitted on lonitudinal or transverse joints. Approved squeegees shall be used to spread slurry in areas inaccessable to the slurry mixer. Care shall be exercised in leaving no unsightly appearance from hand work. Treated areas will be allowed to cure until such time as the inspector in charge permits their opening to traffic.

Burlap bags, jute mats, or carpeting suitable to smooth longitudinal joints or laps of adjacent lanes of slurry application shall be provided and shall be used if ordered by the ENGINEER.

As soon as the asphalt slurry has set sufficiently to prevent any material being picked up, it shall be rolled by a minimum of 4 complete coverages, as directed. Rolling shall continue until all ridges have been ironed out and a uniformly smooth surface is obtained. The slurry seal shall be protected from traffic by barricades and markers for at least 4 hours and longer when the weather condition and thickness of the slurry seal require additional time for proper drying.

513.6 METHOD OF MEASUREMENT:

Quantities of materials for this work wili be paid for at the contract price per unit of measurement for each of the following pay items, as indicated in the proposal:

(a)	Bituminous Tack Coat	Ton (Undiluted)
(b)	Emulsified Asphalt for Slurry	Ton (Undiluted)

(c) Fine Aggregate Ton

(d) Specified Mineral Filler Ton

513.7 BASIS OF PAYMENT:

Payment shall be full compensation for furnishing, mixing and placing all materials specified in the proposal, with no allowance for waste, and shall include all labor, equipment, tools, water for dampening the pavement, and incidentals necessary to complete the work as prescribed and as directed by the ENGINEER.

Any slurry placed in the absence of the ENGINEER, or any slurry rejected due to improper placing, improper proportion of materials, or materials found to be defective, will not be paid for.

Payment for all measures necessary to direct and escort traffic through the area being sealed will be made as specified under Section 601, and the Special Conditions where required.

514 FOG SEAL COATS:

514.1 SCOPE:

Fog seal coats on bituminous paved surfaces shall consist of the application of emulsified asphalt, grade SS-1h, and a sand blotter when necessary, or when directed by the ENGINEER.

514.2 TIME OF APPLICATION AND WEATHER CONDITIONS:

Fog seal coats on new pavements shall be applied the same day the bituminous paving is completed or as soon thereafter as possible.

Emulsified asphalt shall be applied when the surface is dry or damp, but not wet and when there is no threat of rain. The ambient temperature shall be at least 50 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling.

514.3 MATERIALS:

514.3.1 Emulsified Asphalt:

Unless otherwise specified in the Special Conditions, emulsified asphalt shall be grade SS-1h as specified in Section 913, diluted with a minimum of 1 part of water to 1 part of emulsified asphalt.

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514.3.2 Sand Blotter:

The sand or crusher fines shall be as specified in Section 901 and shall be graded in accordance with the following sieve analysis:

SIEVE SIZE	PERCENTAGE PASSING (BY WEIGHT)
3/8"	100%
No. 4	90 - 100%
No. 200	0 - 12%

514.4 TESTS, TEST REPORTS AND CERTIFICATES:

Asphalt emulsion shall be tested as specified in Section 913.

Test reports and certificates shall be as specified in Section 911.

514.5 PREPARATION OF SURFACES:

Immediately before applying the emulsion, the area to be surfaced shall be cleaned of dirt and loose material by means of power brooms, supplemented by hand brooms if necessary, except that when the fog seal is applied within 24 hours from the time a bituminous paving is completed, the brooming may be omitted provided the condition of the surface is approved by the ENGINEER. In any case, the seal coat shall not be applied until an inspection of the surfaces has been made by the ENGINEER and he has determined that the surfaces are suitable for application of the emulsion.

514.6 APPLICATION OF ASPHALT EMULSION:

The diluted material shall be well mixed before applying. It shall be applied by a distributor truck equipped with fog nozzles, at the approximate rate of 0.10 gallon per square yard. The exact rate shall be as directed by the ENGINEER. The distributor truck shall be as specified in Section 912.

514.7 SAND BLOTTER:

After the asphalt emulsion has cured to such extent that the emulsion will not be picked up by traffic, a sand blotter shall be applied as directed or required by the ENGINEER where there is an excess of asphalt. After the treated area has been opened to traffic, any excess asphalt emulsion that comes to the surface shall be immediately covered with

additional sand. The CONTRACTOR shall remove all excess blotter material within 72 hours after application unless otherwise directed by the ENGINEER.

514.8 PROTECTION TO ADJACENT PROPERTY:

Care shall be taken to prevent the spraying of asphalt emulsion on adjacent pavements and that portion of the pavement being used for traffic, on structures, guard rails, guide posts, markers, trees, shrubs, and adjacent property, improvements and facilities of all kinds.

514.9 PROTECTION TO SEAL COAT:

The seal coat shall be protected by barricades until the ENGINEER directs that the pavement is to be opened to traffic.

514.10 BASIS OF PAYMENT:

Payment for asphalt emulsion in place will be by the ton, undiluted.

Payment for furnishing and applying sand blotter in place will be paid for as an extra work item.

517 PORTLAND CEMENT:

517.1 SCOPE:

Concrete pavement work shall consist of Portland Cement concrete placed on a prepared subgrade in accordance with these Standards. The completed work shall conform to the thicknesses and typical cross sections shown on the Plans. The completed work shall conform to the lines and grades shown on the Plans or to those established by the ENGINEER at the jobsite.

517.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 6: Fine Aggregates for Portland Cement Concrete

AASHTO M 33: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

AASHTO M 43: Standard Sizes of Coarse Aggregates for Highway Construction

AASHTO M 80: Coarse Aggregates for Portland Cement Concrete

AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO M 173: Concrete Joint Sealer Hot Poured Elastic Type

AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO T 11: Deleterious Material

AASHTO T 23: Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field.

AASHTO Y 176: Sand Equivalent

ASTM 448: Standard Sizes of Coarse Aggregates for Highway Construction

ASTM D 994: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

ASTM D 1190: Concrete Joint Sealer Hot Poured Elastic Type

ASTM D 1751: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 1752: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 1850: Concrete Joint Sealer Cold Application Type

517.3 SUBMITTALS:

The CONTRACTOR shall submit trip tickets for each load of concrete. Tickets shall show weight of all materials and additives used in each batch. The CONTRACTOR shall submit a list of material suppliers prior to commencing work. All other submittals shall be defined in the Special Conditions.

517.4 MATERIALS:

Pavement concrete shall conform to the requirements for Class A, Class B or Class P as shown in Section 925.

The Class of concrete will be set forth in the Special Conditions. Based on a satisfactory trial mix, and the ENGINEER'S approval, the CONTRACTOR shall have the option of substituting approved fly ash for Portland Cement in any class concrete shown in this Subsection up to a maximum of 20% by weight. The total weight of cement plus fly ash shall not be less than the minimum weight for cement content as shown in the Concrete Table for any given class. Where the voluntary use of fly ash by the CONTRACTOR results in delays, necessary changes in admixture quantities or admixture source or unsatisfactory work, the costs of such delays, changes or corrective actions shall be borne by the CONTRACTOR. In the event the finished concrete is unsuitable for its intended purpose, the use of fly ash will be discontinued.

Joint Fillers shall conform to the requirements of the applicable Quality Standards listed in 517.2. The type will be specified in the Special Conditions.

517.5 EXECUTION OF THE WORK:

517.5.1 Equipment:

(a) Batching plant and equipment

1. General. The batching plant shall include bins, weighing, hoppers and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper and separate scale for cement shall be included. Cement weighing hoppers shall be properly sealed and vented to preclude dusting during operation. A single weighing hopper with an accumulative scale will be permitted, provided a separate scale is used for weighing cement.

2. Bins and hoppers. Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.

3. Scales. The scales for weighing aggregates and cement shall be of either the beam-type or the springless dial type, and shall be approved by the ENGINEER.

(b) Mixers

1. General. Each mixer shall have a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. Manufacturer's plate shall be attached to a prominent place.

2. Mixers at site of construction. Mixers shall be capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging and distributing the mixture without segregation of the prepared grade.

3. Nonagitator trucks. Bodies of nonagitating hauling equipment for concrete shall be smooth, mortartight, metal containers and shall be capable of discharging the concrete without segregation.

(c) Consolidating and Finishing Equipment. Concrete shall be spread, struck-off and finished by mechanical equipment, unless otherwise permitted.

Consolidation shall be accomplished by vibrators for the full width of concrete paving slabs. They may be either the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer device, subgrade or side forms.

(d) Concrete saw. When sawing joints, the CONTRACTOR shall provide sawing equipment and adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. The CONTRACTOR shall provide adequate artificial lighting facilities for night sawing.

(e) Forms. Straight side forms shall be made of a metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to or greater than the prescribed edge thickness of the concrete, and a base width equal to or greater than the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Forms shall be provided with adequate devices for secure setting, so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the work.

Built-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 2,000 square yards. The top face of the form shall not vary from a true plane more than 1/8

inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly and for secure setting.

Forms for bridge approach slabs or for pavement areas with irregular dimensions shall be made of metal or straight, sound timber. Forms shall be free from warp and of sufficient strength to resist springing out of shape.

517.5.2 Preparation of Grade:

After the roadbed has been graded and compacted, the grade shall be trimmed approximately to correct elevation extending the work at least 2 feet beyond each edge of the proposed concrete pavement. Any work required beyond the planned roadbed necessary to support the CONTRACTOR'S paving equipment will not be paid for separately, but will be included in the cost of the work.

517.5.3 Setting Forms:

(a) Base support. The foundation under the forms shall be hard and true to grade, so that the form, when set, will be firmly in contact for its whole length and at the specified grade.

(b) Form setting. Forms shall be set in advance of the point where concrete is being placed, so as to not interfere with concrete placement. Forms shall be staked into place with not less than 3 pins for each 10-foot section. Form sections shall be tightly locked, free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any point. No excessive settlement or springing of forms under the finishing machine will be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

(c) Grade and alignment. The alignment and grade elevations of the forms shall be checked and corrections made by the CONTRACTOR immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

517.5.4 Conditioning of Subgrade or Base Course:

When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross section. High areas shall be trimmed to proper elevation. Low areas in untreated subbase may be filled and compacted to a condition similar to that of the surrounding grade, or filled with concrete integral

with the pavement. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed.

Unless water-proof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

517.5.5 Limitations of Mixing:

Concrete shall be mixed, placed, and finished only during periods of sufficient natural light, unless an adequate and approved artificial lighting system is provided.

Mixing and concreting operations shall be discontinued when a descending ambient air temperature in the shade and away from artificial heat reaches 40 degrees F. and not resumed until an ascending ambient air temperature in the shade and away from artificial heat reaches 35 degrees F., unless authorized in writing by the ENGINEER.

When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged, as to preclude the possible occurrence of overheated areas which might injure the materials. The temperature of the mixed concrete shall be not less than 50 degrees F. and not more than 80 degrees F. at the time of placing it in the forms, unless otherwise authorized.

If the air temperature is 35 degrees F. or less at the time of placing concrete, the ENGINEER may require the water and/or the aggregates to be heated to not less than 70 degrees F. and not more than 150 degrees F. Concrete shall not be placed on frozen subgrade, nor shall frozen aggregates be used in the concrete. Maximum temperature of the mixed concrete shall not exceed 90 degrees F. in concreting operations during the summer months.

517.5.6 Placing Concrete:

Concrete pavement may be placed using slip form methods or fixed forms.

The concrete shall be deposited on the prepared subgrade or base course in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or nonagitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be

unloaded into an approved spreading device and mechanically spread on the grade in such manner as to prevent segregation of the materials. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical finishing equipment will be operated upon the existing lane of pavement, that lane shall have attained a minimum compressive strength of 2,000 psi.

Concrete shall be thoroughly consolidated against and along faces of all forms and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper into a joint assembly unless the hopper is well centered on the joint assembly.

517.5.7 Strike-off of Concrete and Placement of Reinforcement:

Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans or established. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer, shall be removed and replaced with freshly mixed concrete at the CONTRACTOR'S expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete, after spreading by mechanical or vibration means.

Reinforcing steel shall be free from dirt, oil, paint, grease, loose mill scale, or loose or thick rust which could impair bond of the steel with the concrete.

517.5.8 Joints:

Joints shall be of the type and dimensions detailed and constructed at locations required by the Plans.

(a) Construction joints.

1. Longitudinal construction joints. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to the longitudinal joints; they shall be placed and rigidly secured by chairs or other approved methods. When adjacent lanes of pavement are constructed separately, tie bars may be bent at right angles against the form of the first lane constructed and subsequently straightened into final position before the concrete of the adjacent lane is placed or in lieu of bent tie bars, approved two piece connectors may be used. The construction joint shall be slightly tooled while concrete is still plastic and later sawed and sealed after concrete has hardened.

2. Transverse construction joints. Deformed steel tie bars shall be placed perpendicular to the construction joint through holes in the header set to form the butt joint, or by other approved methods. The construction joint may be slightly tooled while the concrete is still plastic, or after the concrete has hardened it may be ground to produce a straight, even, workmanlike butt joint.

(b) Weakened plane joints. Weakened plane joints shall be formed by sawing or placement of a plastic parting strip in accordance with the requirements of this Subsection or as otherwise approved by the ENGINEER.

1. Longitudinal weakened plane joints. Deformed steel tie bars may be pushed or otherwise inserted into position in the plastic concrete by an acceptable method. The weakened plane joint may then be made by sawing the joint in hardened concrete in accordance with Plan details.

   Longitudinal sawed joints shall be cut before any equipment or vehicles are allowed on the pavement.

2. Transverse weakened plane joints. Transverse weakened plane joints shall be formed either by inserting a plastic strip into plastic concrete or by sawing a groove in hardened concrete in accordance with Plan details.

Plastic strip shall be placed so that it is 1/8 inch below and perpendicular to the concrete pavement surface before finishing and texturing. Equipment and methods used to insert the plastic strip shall be capable of providing proper placement of the plastic strip without twisting or curling and shall provide a neat and workmanlike surface after installation. Splicing shall be with ends butted. All voids or tearing of the pavement surface caused by the insertion tool shall be reworked as necessary to provide dense homogenous concrete along each side of the plastic strip.

Time schedule for sawing transverse weakened plane joints shall be as follows: Every 2nd joint shall be sawed within 4 to 12 hours after pavement placement, provided that the concrete has sufficiently set so as to preclude any possibility of aggregate particles becoming dislodged by the action of the saw. Unless otherwise directed by the ENGINEER, the exact time of sawing will be as determined by the CONTRACTOR and will be dependent upon weather conditions, temperatures and other factors affecting the setting of the concrete. The intermediate joints shall be sawed within 48 hours after pavement placement. Requirements for sealing of sawed transverse joints are the same as for longitudinal weakened plane joints.

(c) Expansion joints. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved. The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than 1/4 inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. Plugs of concrete will not be permitted anywhere within the expansion space. Expansion joints shall be formed at all existing or proposed structures and features projecting through, into or against the pavement.

517.5.9 Final Strike-off, Consolidation and Finishing:

(a) Sequence. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.

The addition of superficial water to the surface of the concrete to assist in finishing operations will not normally be permitted. If the application of water to the surface is required, it shall be applied as a fog spray be means of approved spray equipment.

(b) Finishing at joints.

1. The concrete shall be placed under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection 517.5.6.

2. After the concrete has been placed and vibrated, the finishing machine shall be brought forward, operating in such manner as to avoid damage to joints. If operation of the finishing machine appears to be causing damage to the joints, the machine shall be stopped when the front screed is approximately 8 inches from the joint. The front screed shall be lifted, set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Another pass with the finishing machine over the joint without lifting the screeds will be required.

(c) Finishing. Unless otherwise specified, hand finishing methods will not be permitted, except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

Narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical may be finished by hand methods. Upon approval by the ENGINEER, the slump may be increased up to 1 inch above the maximum allowed in the Concrete

Table in Subsection 517.4 for concrete in areas not accessible to mechanical finishing methods. Concrete shall be struck off and screeded as soon as placed.

Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.

In operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

The use of vibrating roller screed type machines will be permitted for areas not accessible to normal finishing methods.

(d) Floating. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated as described below. Aluminum floats will not be permitted.

The CONTRACTOR may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with, the side forms.

If necessary, long-handled floats having blades not less than 5 feet in length and 4 inches in width may be used to smooth and fill in open-textured areas in the pavement. Such long-handled floats shall not be used to float the entire surface of the pavement. After floating, any excess water and laitance shall be removed from the surface of the pavement by a scraping straight edge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

(e) Final finish. After the surface has been straight edge tested and corrections made, a seamless strip of damp burlap, cotton fabric or other approved material shall be dragged longitudinally along the full width of pavement to produce a uniform surface of gritty texture. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of material at least three feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of sufficient layers of material and maintained in such condition that the resultant surface finish is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Where more than one layer of drag material is required, the bottom layer shall be approximately six inches wider than the layer above. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted.

(f) Edging at forms and joints. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of expansion joints, shall be worked with an approved tool. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

517.5.10 Curing:

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods. In all cases in which curing required the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour between stages of curing or during the curing period.

(a) Impervious membrane method. The entire surface of the pavement shall be sprayed uniformly with curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it shall be applied upon removal of the mats if mats are removed prior to the expiration of the 72-hour curing period.

Curing compound shall be applied under pressure, by mechanical sprayers, at a rate that does not exceed one gallon per 150 square feet of surface. The spraying equipment shall be the fully atomizing type equipped with a tank agitator. At the time or use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously be effective mechanical means. Hand spraying or odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compounds shall not be applied to the inside faces of joints to be sealed. Membrane curing compounds shall meet the requirements of the applicable quality standards in Section

517.2. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

(b) Other acceptable curing methods may be used upon approval.

517.5.11 Curing in Cold Weather:

When the air temperature may be expected to fall below 35 degrees F., the methods and materials used shall be such that a minimum temperature of 40 degrees F. will be maintained at the surface of the pavement. Any concrete damaged by frost action shall be removed and replaced at the CONTRACTOR'S expense.

517.5.12 Sealing Joints:

If the joints are to be sealed, they shall be filled with joint sealing material before the pavement is opened to traffic, and as soon after completion of the curing period as is feasible. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound and the joint faces shall be clean and dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the ENGINEER. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

The use of sand or similar material as a cover for the seal will not be permitted. Poured joint-sealing material shall not be placed when the air temperature in the shade is less than 50 degrees F. unless approved.

517.5.13 Concrete Pavement - Slip Form Method:

When the pavement is to be constructed without the use of fixed forms, the following provision shall apply:

(a) Grade. After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine.

In cases where stabilized bases are utilized and trimming the base is not practicable, and for any other type of base, the CONTRACTOR shall be responsible for irregularities caused by the CONTRACTOR'S work in the base, as they affect concrete pavement quantities.

If the density of the base is disturbed by the grading operations, it shall be corrected by additional compaction before concrete is placed. The grade should be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete.

(b) Placing and consolidating concrete. The concrete shall be placed with an approved slipform paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the Plans and Specifications. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering and spreading concrete shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason it is necessary to stop the forward movement of the paver, the vibratory and tamping element shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

(c) Finishing. The surface smoothness and texture shall meet the requirements of Subsection 517.5.9 (e).

(d) Curing. Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsections 517.5.10 and 517.5.11. The curing material shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

517.6 QUALITY CONTROL:

Concrete testing and laboratory testing services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

Should any concrete or foreign materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods. Concrete placed in forms shall be protected against the effects of rain. The CONTRACTOR shall furnish the concrete necessary for casting test beams and cylinders.

After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10 foot straight edge. For this purpose the CONTRACTOR shall furnish and use an accurate 10 foot straight edge swung from handles 3 feet longer than one-half the width of the slab. The straight edge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary. If the entire slab cannot be reached from the side, a working bridge shall be provided to enable this testing to be accomplished the full width of the slab. Advance along the road shall be in successive stages of not more than one-half the length of the straight edge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished.

High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straight edge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straight edge and the slab conforms to the required grade and cross section.

(a) All manholes, water valves, range boxes, etc. shall be flush to 1/4 inch below the final surface roadway grade.

(b) Where the departure from the design cross slope exceeds 1/2 inch in 10 feet the pavement shall be removed and replace.

(c) Areas showing high spots greater than 1/8 inch but less than 1/2 inch in 10 feet shall be ground to within 1/8 inch of design elevation.

517.7 CLEAN UP:

The surface of the concrete pavement shall be thoroughly cleaned upon completion of the work and the site left in a neat and orderly condition.

517.8 METHOD OF MEASUREMENT:

Concrete pavement will be measured by the square yard. The yardage will be the number of square yards of concrete pavement completed and accepted. The width for measurement will be the width of the pavement shown on the typical cross section of the Plans including additional widening where called for, or as otherwise directed in writing by the ENGINEER. The length will be measured horizontally along the center line of each roadway.

517.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to construct the concrete

pavement in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

No additional payment over the unit Contract Unit Price will be made for any pavement which has an average thickness in excess of that shown on the Plans.

518 CONCRETE CURB, GUTTER, SIDEWALK AND DRIVEWAYS:

518.1 SCOPE:

Concrete work shall consist of air entrained Portland Cement concrete constructed on a prepared subgrade in accordance with these Specifications. The completed work shall conform to the thicknesses and typical cross sections shown on the Plans. The completed work shall conform to the lines and grades shown on the Plans or to those established by the ENGINEER at the jobsite.

518.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 33: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

AASHTO T 23: Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field

ASTM D 994: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

ASTM D 1751: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 1752: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

518.3 SUBMITTALS:

The CONTRACTOR shall submit trip tickets for each load of concrete. Tickets shall show weight of all materials and additives used in each batch.

518.4 MATERIALS:

Concrete shall conform to the requirements for Class A, B, CG or P as shown in Section 925.

The joint fillers shall meet the requirements of one or more of the Quality Standards listed in Paragraph 518.2.

518.5 EXECUTION OF WORK:

518.5.1 Subgrade Preparation:

The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding, or otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and compaction shall extend a minimum of one foot outside the form lines.

The subgrade shall be compacted to the density shown on the Plans and trimmed to provide a uniform surface at the correct elevation.

518.5.2 Concrete Placement:

Concrete transported in truck mixers or truck agitators shall be delivered to the site of the Work and completely discharged within a period of ninety (90) minutes after the cement comes in contact with the mixing water or with the combined aggregates containing free moisture in excess of 2% by weight.

The concrete shall be placed either by an approved slipform/extrusion machine, by the formed method, or by a combination of these methods. The subgrade shall be conditioned to provide a uniformly moist surface when concrete is placed.

518.5.2.1 Machine Placement:

The slipform/extrusion machine shall be so designed as to place, spread, consolidate, screed, and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogenous concrete section. The machine shall shape, vibrate, and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly a

continuous forward movement as possible. All operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.

518.5.2.2 Formed Method:

The forms shall be of metal or other suitable material that is straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature may be used for curves having a radius of 100 feet or less. Division plates shall be metal.

The front and back forms shall extend for the full depth of the concrete. All of the forms shall be braced and staked so that they remain in both horizontal and vertical alignment until their removal. They shall be cleaned and coated with an approved form-release agent before concrete is placed against them.

The concrete shall be deposited into the forms without segregation and then it shall be tamped and spaded or mechanically vibrated for thorough consolidation. Low roll or mountable curbs may be formed without the use of a face form by using a straight edge and template to form the curb face. When used, face forms shall be removed as soon as possible to permit finishing. Front and back forms shall be removed without damage to the concrete after it has set.

518.5.3 Finishing:

The plastic concrete shall be finished smooth by means of a wood float and then it shall be given final surface texture using a light broom or burlap drag. Concrete that is adjacent to forms and formed joints shall be edged with a suitable edging tool to the dimensions shown on the Plans.

518.5.4 Jointing:

(a) Contraction Joints:

Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding 10 feet. Joint depth shall average at least one-fourth of the cross section of the concrete.

Contraction joints may be sawed, hand-formed, or made by 1/8 inch thick division plates in the form work. Sawing shall be done early after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by (1) using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete, or (2) inserting 1/8 inch thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set and while the forms are still in place.

(b) Expansion Joints:

Expansion joints shall be constructed at right angles to the curb line at immovable structures and at points of curvature for short radius curves. Filler material for expansion joints shall conform to requirements of one or more of the Quality Standards defined in Section 518.2 and shall be furnished in a single 1/2 inch thick piece for the full depth and width of the joint.

Expansion joints in a slipformed curb or curb-and-gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged. The CONTRACTOR may choose to place the filler and pour the concrete around it.

Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb-and-gutter immediately, installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discharged.

Construction joints may be either butt or expansion-type joints. Curbs or combined curbs and gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete, with similar spacing, however, contraction joint spacing shall not exceed 10 feet.

518.5.5 Protection:

The CONTRACTORS shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slipform construction, materials such as wood

planks or forms to protect the edges shall also be required. Concrete damaged by rain may be required to be removed and replaced at the CONTRACTOR'S expense.

Concrete being placed in cold weather during which the temperature may be expected to drop below 35 degrees F., shall be suitably protected to keep the concrete from freezing until it is at least 10 days old. Concrete injured by frost action may be required to be removed and replaced at the CONTRACTOR'S expense.

518.5.6 Curing:

Concrete shall be cured for at least 3 days after placement to protect against loss of moisture, rapid temperature change, and mechanical injury. Moist burlap, waterproof paper, white polyethylene sheeting, white liquid membrane compound, or a combination thereof may be used as the curing material. Membrane curing shall not be permitted in frost-affected areas when the concrete will be exposed to deicing chemicals within 30 days after completion of the curing period.

518.5.7 Backfilling:

The spaces in front and back of curbs shall be refilled with suitable material to the required elevations after the concrete has set sufficiently. The fill material shall be thoroughly tamped in layers.

518.6 QUALITY CONTROL:

Concrete testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

Prior to backfilling and after forms are removed, honeycombed, defective or damaged areas of concrete shall be repaired. Repairs shall be made within 7 days after the forms are removed.

518.7 CLEAN UP:

The surface of the concrete shall be thoroughly cleaned upon completion of the work, and the site left in a neat and orderly condition.

518.8 METHOD OF MEASUREMENT:

Concrete curbs or combined curbs and gutters of the types shown on the Plans and in the Proposal shall be measured along gutter flow line through inlets, catch basins, etc., by the linear foot to the nearest foot for each type, complete in place.

Concrete sidewalk, driveway and alley entrances of the types shown on the Plans and in the Proposal shall be measured corner to corner and computed to the nearest horizontal surface square yard.

518.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to construct the concrete curbs or combined curbs and gutters in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place.

519 ADJUSTING FRAMES, MANHOLE RINGS, VALVE BOXES AND METER BOXES:

519.1 SCOPE:

This work shall consist of adjusting all frames, manhole rings, or valve and meter boxes as indicated on the Plans or as designated by the ENGINEER. The frames and boxes shall be set to the grades specified and conform to the Standard Details and to these Specifications.

519.2 MATERIALS:

The CONTRACTOR may elect to remove existing frames, manhole rings, valve and meter boxes and to install new materials in lieu of re-installation at no additional cost to the Contracting Agency. New materials shall be installed in conformance with these Specifications and the Standard Details.

Existing frames, manhole rings, valve and meter boxes broken or damaged in removal or handling by the CONTRACTOR shall be replaced with new materials. The materials shall be installed in conformance with these Specifications and the Standard Details.

519.3 EXECUTION OF WORK:

Concrete shall conform to the requirements set forth in Subsection 701.4.1.

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519.3.1 Adjusting Manhole Rings:

The CONTRACTOR shall loosen frames in such a manner that existing structures will not be disturbed or damaged. Debris shall not be permitted to enter sanitary or storm sewer conduits. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames.

Rings shall be set to the elevations established by the ENGINEER and shall be firmly blocked in place with masonry or metal supports. Spaces between the ring and the old seat shall be sealed on the inside to prevent any concrete from entering the hand hole or manhole. Concrete shall be placed around and under the rings to provide a seal and properly seat the ring at the required elevation. Concrete shall be struck off flush with the top of the existing pavement or in accordance with the Standard Details.

519.3.2 Adjusting Valve and Meter Boxes:

Valve and meter boxes shall be adjusted to the new elevations indicated on the Plans or as established by the ENGINEER.

Adjustable cast iron boxes shall, if possible, be brought to grade by adjustment of the upper movable section. Any excavated area shall be filled with concrete to the level of the existing pavement or as directed by the ENGINEER.

Valve or meter boxes shall be adjusted to grade by installing a suitable extension of the same inside diameter as the existing box. The valve box top section shall be reinstalled in accordance with the Standard Details or as shown on the Plans.

Cast iron or plastic valve or meter boxes shall be extended in accordance with the manufacturer's recommendations.

519.4 CLEAN UP:

Waste and excess materials shall be removed and the area around the work shall be left in a neat and orderly condition.

519.5 METHOD OF MEASUREMENT:

The quantities measured will be the actual number of frames, manhole rings or valve and meter boxes of each type adjusted and accepted.

519.6 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price for each of the particular items listed in the Proposal. The payment shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the work.

520 IN PLACE COLD RECYCLED BITUMINOUS PAVEMENT:

520.1 SCOPE:

This work shall consist of pulverizing the existing asphalt pavement to the depth and width shown on the plans or in the proposal, mixing an asphalt binder agent and water (if required) with the pulverized asphalt pavement, then spreading and compacting said mixture as shown on the plans and as provided herein unless otherwise directed by the ENGINEER.

The CONTRACTOR shall furnish all equipment, tools, labor, all materials (except the pulverized bituminous material), and any other appurtenances necessary to complete the work.

520.2 MATERIALS:

Pulverized material shall conform to the following gradation:

SIEVE SIZE	PERCENTAGE RETAINED
2"	0
1 ½"	0 - 10

Blotter sand shall be any fine sand approved by the ENGINEER.

Emulsified asphalt shall be MS-1 and shall meet the requirements of KDOT Standard Specifications for State Road and Bridge Construction, 1980 or most recent supplement.

Asphalt Rejuvenating Agent shall be in accordance with the Supplemental Special Conditions.

520.3 WEATHER CONDITIONS:

Cold mill recycling shall not be done when it is raining or there is a threat of rain. The ambient temperature shall be at least 60 degrees F. and rising and the application shall cease when the temperature is 55 degrees F. and falling. Compaction shall be completed

when the atmospheric temperature is above seventy (70) degrees F. The above requirement may be waived, but only when so directed in writing by the ENGINEER.

520.4 SURFACE PREPARATION:

The pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

520.5 CONSTRUCTION REQUIREMENTS:

Should any subgrade areas need repairing, as determined by the ENGINEER, after removal of the existing pavement, it shall be done in accordance with subsection 104.04 and paid in accordance with subsection 109.05 of the KDOT Standard Specifications unless otherwise on the plans or in the contract.

The CONTRACTOR shall furnish a self-propelled machine capable of cutting and removing the bituminous pavement, in one pass, to the depth shown on the plans. The cutting machine shall have automatic controls capable of maintaining a uniform grade and cross slope. The existing asphalt pavement shall be pulverized to meet the materials section of this special provision without contamination from the subgrade material.

Provisions shall be made for the continuous weight measurement of the pulverized pavement material, interlocked with the additive metering device in order that the desired additive content will be maintained. Positive means shall be provided for calibrating the weight measurement device and the additive metering device.

The additive shall be applied in a mixing chamber which is capable of mixing the pulverized pavement material and additive to a homogeneous mixture. The additive pump will automatically shut off when delivery of pulverized material to the mixing chamber is stopped. The additive system shall maintain the binder amount within plus or minus 0.2 per cent of the desired rate. The mixture shall be placed in a windrow in such a manner that segregation does not occur.

The CONTRACTOR may add water to the pulverized material to facilitate uniform mixing when an emulsified binder agent is used. Water may be added prior to or concurrently with the emulsified binder agent provided it does not adversely affect the binder agent. Placement of the recycled mixture shall be accomplished with a self-propelled bituminous paver meeting the requirements of Section 601 of the KDOT Standard Specifications, without segregation, to the line and grades designated. When a pick-up machine is used to feed the windrow into the paver hopper, it shall be capable of picking up the entire windrow down to the underlying materials.

Compaction shall be completed using a rolling procedure established from the construction of a 500 foot test strip. The CONTRACTOR shall have, as a minimum,

the following self-propelled compaction equipment available during construction of the test strip: steel roller, double drum vibratory steel and pneumatic roller. The vibratory steel roller may also be used as the steel roller. The pneumatic roller shall have a minimum static weight of 25 tons and a minimum tire pressure of 90 psi. The CONTRACTOR shall provide a suitable gauge for determining air pressure in the tires.

The ENGINEER shall use an approved nuclear device to determine the density growth curve during construction of the test strip and density of the cold recycled material during construction of the project. The rolling of the test strip may be stopped when the density results of the last four (4) tests has not increased over one (1) pcf. The minimum density after final rolling with a steel roller shall be 97% of the maximum density obtained during construction of the test strip.

Construction of the test strip will be repeated if there is a significant change in the quantity of additive, recycled material, and/or weather conditions and the ENGINEER determines the test strip should be repeated. The maximum density obtained during construction of the latest control strip will be used for control.

If deemed necessary by the ENGINEER, the surface of the recycled material shall be given a smoke coat and blotted with fine sand at a rate specified by the ENGINEER.

Overlay: The surface course shall not be placed until the final moisture content of the recycled mixture is less than one and one-half (1 1/2) percent, unless approved otherwise by the ENGINEER.

Traffic Control: When traffic is to be carried through construction is shall be in accordance with Article 603.03 (k) of the KDOT Standard Specifications unless amended by the Special Conditions, with the recycled section re-laid prior to sundown so that two-way traffic can be maintained at night. The recycling operation shall be confined to the minimum practical area at all times.

Temporary Pavement Marking: When required, temporary centerline striping shall be applied to the completed recycled surface and the surface course in accordance with KDOT subsection 603.04.

520.6 METHOD OF MEASUREMENT:

In Place Cold Recycled Bituminous Material shall be measured per square yard.

Water will not be measured and paid for separately but shall be subsidiary to other items of work.

Emulsified Asphalt and Asphalt Rejuvenating Agent of the type shown on the plans or in the proposal will be measured by the Ton as set out in Section 109, KDOT Standard Specifications.

Temporary centerline striping will be measured per line of striping, per lift, per roadway mile to the nearest one-tenth mile with an odometer.

Blotter sand, incorporated into the project will be measured in the truck at the point of usage.

Traffic control shall be measured in accordance with KDOT Section 821.

520.7 METHOD OF PAYMENT:

The accepted quantity of "In Place Cold Recycled Bituminous Material", measured as provided above, will be paid for at the contract unit price bid per square yard.

The accepted quantity of "Emulsified Asphalt" or "Asphalt Rejuvenating Agent" of the type shown on the plans or in the proposal will be paid for at the contract unit price bid per Ton.

Temporary striping shall be paid for at the contract price bid per mile/line.

Blotter sand, if required, shall be paid for at the contract price bid per ton or cubic yard.

Traffic Control shall be paid for in accordance with KDOT Section 821.

The above prices shall be full compensation for milling. pulverizing, building test strip(s), adding asphalt binder agent, spreading, compacting, furnishing and placing all materials, for all labor, equipment, tools and incidentals necessary to complete the work.

RIGHT-OF-WAY AND TRAFFIC CONTROL

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601 CONSTRUCTION TRAFFIC CONTROL:

601.1 SCOPE:

Traffic control shall consist of traffic control devices and flagmen or pilot cars. All traffic control devices, the application of traffic control measures, and traffic regulation in these specifications are to supplement and are not intended to delete any of the provisions of the Contracting Agency's Traffic Barricade Manual, the Uniform Manual on Traffic Control Devices or any agency's Supplements to these Standards Specifications.

601.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

FHWA "Manual on Uniform Traffic Control Devices for Streets and Highways".

"Pavement Cuts for Utilities: A Guide to Their Accomplishment and Maintenance", Arapahoe County, CO June 1986.

601.3 SUBMITTALS:

The CONTRACTOR shall submit a plan for regulation of traffic only when required by the Special Conditions.

601.4 EXECUTION OF WORK:

Traffic control devices, flagging and pilot car operation shall be accomplished in accordance with the provisions of the Quality Standards listed in Paragraph 601.2.

The CONTRACTOR shall provide and maintain all necessary traffic controls to protect and guide traffic for all work in the construction area.

Existing traffic signs and street name signs shall be maintained, erect, clean and in full view of the intended traffic by the CONTRACTOR until such time as construction renders them obsolete. Signs and posts that must be removed shall be removed without damage, stored and reinstalled as directed by the ENGINEER.

Construction on any roadway, alley or refuse collection easement that might interfere with normal refuse collection shall not be initiated until the CONTRACTOR has made arrangements with the party or parties responsible for refuse collection in order that refuse collection service can be maintained.

Special traffic regulations will be defined in the Special Conditions.

601.4.1 Traffic Control Devices:

Traffic control devices shall consist of furnishing, erecting, and maintaining necessary and adequate devices for the protection of the work, the workmen and the traveling public.

(a) Temporary traffic control devices shall be used to guide traffic through construction areas. They include traffic cones to channelize traffic, portable barricades for warning, vertical panel channelizing devices to divert traffic, and lighting devices between the hours of sunset and sunrise.

(b) Advance warning devices shall be used to alert the motorist of an obstruction in the roadway. They include diamond-shaped signs, flags, and flasher type high level warning devices mounted 8 feet above the roadway.

601.4.2 Flagging:

Flagging shall consist of providing sufficient qualified flag persons or uniformed off-duty law enforcement officers to expedite safe passage of traffic.

601.4.3 Pilot Cars:

Pilot cars shall consist of providing automotive vehicles to guide traffic around or through the construction area. Pilot cars shall be equipped and identified as described in the Quality Standards listed in Paragraph 601.2.

601.4.4 Traffic Control Measures:

The application of traffic control measures shall be based primarily upon the conditions existing at the time such measures are deemed necessary. The CONTRACTOR shall provide and erect necessary and adequate devices prior to starting work that would interrupt normal traffic flow. The devices shall be removed when no longer required.

601.5 METHOD OF MEASUREMENT:

Traffic control devices flag persons or uniformed off-duty law enforcement officers and pilot cars will not be measured.

601.6 BASIS OF PAYMENT:

Unless otherwise stated in the Proposal and in the Project Special Conditions, payment will be made at a Contract Lump Sum Price.

604 GUARD RAIL:

604.1 SCOPE:

This work shall consist of the construction of guard rail in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established.

The construction of the various types of guard rail shall include the assembly and erection of all component parts and materials complete at the locations shown on the plans or as directed.

The types of guard rail are designated as follows:

Type 3	Guard Rail - W Beam
Type 3A	Guard Rail for Bridges - W Beam
Type 4	Guard Rail - Concrete Barrier - Precast - Portable or Cast-in-place
Type 6	Guard Rail - Thrie Beam

The CONTRACTOR may furnish either wood or steel posts and blocks for Guard Rail - Type 3 as shown on the plans. Except as designated on the plans, only one type of posts and blocks will be furnished for the project.

604.2 MATERIALS:

Materials shall meet the requirements specified in the following subsections of Section 900 - Materials:

"W" Beam Rail and Thrie Beam Rail
Guard Rail Hardware
Guard Rail Posts
Paint for field painting of guard rail shall conform to Section 9 .

Concrete for Type 4 Guard Rail shall conform to the requirements of Sections 701 or 702. Reinforcing steel shall conform to the requirements of Section 720.

Components on which the spelter coating has been burned by welding or otherwise damaged shall be either regalvanized, recaoted in accordance with AASHTO M 36, or

painted with one full brush coat of zinc rich paint meeting Military Specification DOD-P-21035A.

604.3 CONSTRUCTION REQUIREMENTS:

604.3.1 Post and Rail Elements:

(a) Posts:

Posts shall be set firm and aligned with a tolerance of plus or minus 1/4 in. from plumb, grades and lines as staked. All fittings and metal plates shall be placed securely in position to conform to designated dimensions and requirements.

Posts shall be set as required on plans by one of the following methods:

1. Driven in place.
2. Set in dug holes.
3. Set in concrete base.
4. Posts on bridges shall be as shown on the plans.

Driving of posts shall be accomplished with approved methods and equipment that will leave the posts in their final position free from any distortion, burring or any other damage.

Excavated post holes shall have a firm bottom and be backfilled with acceptable material placed in layers and thoroughly compacted.

Where required, posts shall be spliced with breakaway plates as shown on the plans.

Dissimilar metal-to-metal or aluminum-to-concrete post or rail installations shall have contact surfaces separated by an approved protective coating.

Wood posts cut in the field shall have the cut surfaces protected with two coats of hot creosote or a 5% pentachlorophenol-in-oil solution. When the cut surface is above ground the treating solution to be used shall be the same type as was used in the original treatment.

(b) Rail:

Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts in the finished rail shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts. Rail shall be

shop bent for installations on horizontal curves having a radius of 150 feet or less.

(c) Temporary End Treatment:

In construction zones not closed to traffic, installation of rail element shall closely follow the setting of posts to keep the number of posts without rail at a minimum. In order to minimize potential hazards, the ENGINEER may specify the direction in which the rail installation is to advance and the number of posts installed ahead of rail installation. At the end of the CONTRACTOR'S work day, ends of installed guard rail shall be treated as follows:

(1) If the end is at the location of a planned end section, install the end section.

(2) If the end is not at the location of a planned end section, the last rail section shall be installed with one end attached to the rail already in place and the free end resting on the ground. The free end on the ground shall be restrained by tying the rail to the posts by ropes or cables.

604.3.2 Concrete:

Concrete barrier shall be constructed by cast-in-place or precast methods as shown on the plans.

The trench for the base of the cast-in-place barrier shall be excavated to the lines and grades as shown on the plans or established. The bottom of the trench shall be compacted, watered, and shall be approved before placing concrete.

Precast barriers may be formed upside down to miniimize air pockets and improve surface finish. The base for placing barrier shall be prepared to the lined and grades shown on the plans or established. Holes in the concrete of the precast barrier used for fixtures to lift the section shall be filled with an approved sealing compound, mortar, or plug as directed.

When it becomes necessary to construct cast-in-place barrier sections because of transitions, split barriers or sections under 10 feet, the cast-in-place sections shalal be constructed complete with hardware to join the cast-in-place sections to the abutting precast sections.

Concrete finish for all cast-in-place or precast barriers shall be Class I in accordance with subsection 701.5.4 (2). Slip-form barriers shall not receive additional finishing unless permitted by the ENGINEER.

The surface of the barrier shall be tested with a 10 foot straightedge laid along the surface in a longitudinal direction. Deviation of the surface in excess of 1/4 inch from the lower edge of the straightedge except on sharp vertical curves shall be corrected by the CONTRACTOR at his expense. Allowance will be made on sharp vertical curves in order to maintain construction efficiency.

Where paving is removed or damaged due to his operations, the CONTRACTOR shall furnish an acceptable mix and shall repair the paving as required, at his expense.

Drill holes may be required in existing concrete to accommodate dowel bars. Dowel bars as dhown on the plans shall be grouted with approved non-shrink grout.

In construction zones not closed to traffic, the CONTRACTOR shall treat the ends of installed concrete guard rail as follows at the end of the work day:

(a) If the end is at the location of a planned end section, install the end section.

(b) If the end is not at the location of a planned end section, install a 12 foot precast-portable transition section conforming to plan details.

604.4 METHOD OF MEASUREMENT:

Guard rail will be measured by the linear foot along the centerline of the rail from end to end of completed and accepted rail as shown on the plans, including transitions, but excluding terminal sections and end anchorages.

End anchorages will be measured by the actual number placed and accepted. Eng anchorages shall include all concrete, reinforcing steel, four foot rail segments, anchor bolts, cable, rods, turnbuckles, backing rail, plates, bolts, nuts, washers and all other work and material necessary to complete the item.

Terminal sections will not be measured and paid for separately but shall be included in the work.

Posts, except for Type 3A guard rail, will be included in the quantities of guard rail of the specified type and not measured separately. Posts, blocks and backing plate for Type 3A guard rail when required shall not be measured separately but shall be included in the work.

Additional posts required for guard rail adjacent to bridges and obstructions, as shown on the plans, will not be measured and paid for separately but shall be included in the work.

604.5 BASIS OF PAYMENT:

The accepted quantities of guard rail will be paid for at the contract unit price for the type specified.

Payment will be made under:

PAY ITEM	PAY UNIT
Guard Rail, Type ____	Linear Foot
End Anchorage, Type ___	Each
Guard Rail, Type ____ (___Post Spacing)	Linear Foot

All work and materials necessary and incidental to the temporary treatment of guard rail ends will not be measured and paid for separately but shall be included in the work.

605 COLORED AND PATTERNED CONCRETE PAVEMENT:

605.1 SCOPE:

Work covered by this section consists of furnishing all tools, transportation, labor, equipment, accessories, services and material and in performing all operations in constructing colored and patterned concrete, constructed on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades, thickness, and typical sections as shown on the contract documents.

605.2 MATERIALS:

605.2.1 Portland Cement Concrete:

All materials shall be as specified in Section 925.

605.2.2 Curing Materials:

Color Wax curing compound shall be "Scofield Lithochrome Colorwax" or an approved equal meeting ASTM C 309. Color to be specified by the OWNER.

605.2.3 Integral Color Admixtures:

Color admixture shall be "Davis" colors or an approved equal. Project color to be specified by the OWNER.

605.2.4 Hardener-Enhancing Compound:

Hardener-enhancing compound shall be "Scofield Lithochrome Colorwax, meeting ASTM C 309, unless otherwise specified by the OWNER.

605.2.5 Plastic Liner:

Plastic liner shall be 10-mil polyvinyl chloride (PVC) black plastic, impervious, and shall meet ASTM D-1593.

605.3 MIX DESIGN:

605.3.1 Aggregate Size:

The colored and patterned concrete shall have a 3/8 inch maximum-sized aggregate.

605.3.2 Cement Content:

The minimum cement content shall be 6.0 sacks/cubic yard. The slump shall be 3 inch to 5 inch and the entrained air content shall be 5%-7%.

605.3.3 Minimum Compressive Strength:

All concrete shall have a minimum compressive strength at 28 days of not less than 3,500 psi for cylinders made and cured in the field.

605.4 BATCHING AND PLACING CONCRETE:

605.4.1 General:

Batching and placing shall be in accordance with the Section 925 with the following additions.

605.4.2 Test Section:

The CONTRACTOR shall place colored concrete, color hardener, pattern, and colored wax curing compound on a 4-foot test panel for approval by the OWNER prior to commencing the work. If the test panel is unacceptable to the OWNER, the CONTRACTOR shall construct additional test panels until the correct color and finish is approved by the OWNER. Workmen and equipment used on the test

panel shall be the same as that used in the final construction of the colored and patterned concrete pavement.

605.4.3 Colored Hardener:

Colored hardener, if desired by the OWNER, shall be applied evenly to the concrete surface while it is in the "plastic" stage by the "dry-shake" method. Each application rate shalal be a minimum of 60 pounds of hardener per 100 square feet of surface. Color hardener shall have two applications, and be wood floated after each application, using a trowel on the final float.

605.4.4 Pattern:

While the concrete is still in the plastic stage, the special pattern-forming tool shall be applied to make the desired pattern surface. The pattern shall be selected by the OWNER.

605.4.5 Curing:

The colored wax curing compound, thinned in the proportion of 4 parts wax to 3 parts mineral spirits (paint thinner) shall be applied uniformly with a roller or motor-driven power sprayer. The coverage shall be 600 to 650 square feet per gallon of unthinned curing compound.

605.5 METHOD OF MEASUREMENT:

The method of measuring the work for payment of the various items shall be by square yard of patterned concrete in place.

605.6 BASIS OF PAYMENT:

The unit price as bid shall include the furnishing of all labor, materials, and equipment necessary to construct the colored and patterned concrete pavement in accordance with the detailed drawings and construction plans. The unit price shall include all work necessary to place and strip forms, transport and place the colored concrete, furnish and install reinforcement, finish and cure concrete, install the pattern, and protect the colored and patterned concrete from traffic.

606 BOULEVARD GRADING:

606.1 SCOPE:

This grading shall include all work necessary to bring the surface of the boulevard between the back of curbs and sidewalks and/or the parkway between sidewalks and the right-of-way line, to the grade and cross-section shown on the plans or as directed by the ENGINEER. It shall also include median islands between divided roadways.

606.2 ROUGH GRADING:

(a) Fill material shall contain no rocks over 3 inches in diameter, broken concrete or debris of any nature.

(b) Backfill behind curbs and along the edges of the sidewalk shall be made immediately upon the completion of those items.

606.3 FINE GRADING:

(a) The finished surface shall be free from stone and all debris and be true to grade and cross-section after compaction to not less than 80% of maximum density, as determined by test methods specified in Section 810.

(b) Where existing boulevards are planted in grass, flowers, or shrubs and the level is somewhat above the top of the curb, or sidewalk, the parkway shall be graded back on a 4:1 slope from the edge of curb or sidewalk, with the least possible damage to the planted area.

606.4 BASIS OF PAYMENT:

Unless otherwise provided in the Special Conditions or Proposal, no payment will be made for boulevard grading as such; the cost thereof shall be included in the price bid for construction or installation of the items to which such grading is incidental or appurtenant.

607 TOPSOIL:

607.1 SCOPE:

This work shall consist of furnishing and hauling topsoil from an approved source and placing the topsoil as shown on the plans, in accordance with this specification and Special Conditions.

607.2 MATERIALS:

Topsoil shall conform to the requirements of Section 995.

607.3 CONSTRUCTION METHODS:

Prior to the excavation of topsoil, all grass, weeds, brush, stumps, loose rocks and other objectionable material shall be removed from the surface of the area from which the topsoil is to be removed.

The topsoil source shall be excavated in such a manner that all material excavated will be of the same composition and structure throughout.

Topsoil shall be spread over the areas and to the depths as specified, and shall be water settled.

After the topsoil has been spread, stumps, roots and other objectionable matter shall be removed from the surface of the area and disposed of in a manner satisfactory to the ENGINEER.

607.4 MEASUREMENT:

Unless otherwise specified, topsoil shall be measured by the cubic yard in place and loose after watering and settling.

607.5 BASIS OF PAYMENT:

The quantities measured as provided above, will be paid for at the contract price per cubic yard for furnishing and placing topsoil, which price shall be full compensation for the item complete, as described and specified.

CONCRETE STRUCTURES

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701 STRUCTURES, CAST-IN-PLACE CONCRETE:

701.1 SCOPE:

All cast-in-place concrete culverts, manholes, junction boxes, vaults, catch basins, retaining walls, abutments, piers, footings, foundations and similar structures shall conform to the requirements specified herein. Furnishing materials, mixing, transporting, placing, finishing, curing and other appurtenant items of the structures are included.

Bridge decks shall be defined on the Plans or in the Special Conditions.

701.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 33:	Preformed Expansion Joint Fillers for Concrete (Bituminous Type)
AASHTO M 148:	Liquid Membrane Forming Compounds for Curing
AASHTO M 153:	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M 171:	Concrete Sheet Materials for Curing Concrete
AASHTO M 213:	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO T 23:	Making and curing concrete compressive and flexural strength test specimens in the field
ASTM C 138:	Test for Weight Per Cubic Foot, Yield and Air Control (Gravimetric) of Concrete
ASTM C 143:	Test for Slump of Portland Cement Concrete
ASTM C 172:	Sampling Fresh Concrete
ASTM C 231:	Test for Air Content for Freshly Mixed Concrete by the Pressure Method
ASTM D 994:	Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

ASTM D 1752: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 1752: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

701.3 SUBMITTALS:

The CONTRACTOR shall submit the following:

701.3.1:

A concrete mix designed by an independent laboratory, including strength tests of 3 cylinders proportioned to mix design formula, shall be submitted to the ENGINEER for approval, not less than 3 working days prior to scheduled pour.

Each truckload of concrete shall meet the following slump requirements as determined by the slump testing procedures in ASTM C 143. Slump tolerance shall be + or - 1 inch. Slump shall be measured at point of incorporation into forms or discharged into pumping devices.

(a) Three inch slump for structural elements 12 inches and greater in thickness.

(b) Four inch slump for structural elements less than 12 inches in thickness and for all columns.

701.3.2:

Certification of quality of all cement, mortar, and grout mix design ingredients including admixtures with supporting test data and mill quality control results.

701.3.3:

Certification of quality of all curing materials and proposed methods of use.

701.3.4:

Trip tickets for each load of concrete. Tickets shall show weight of all materials and additives used, along with time water is added to each batch.

701.3.5:

All other submittals shall be defined in the Special Conditions.

701.4 MATERIALS:

The materials used in the concrete mix and the concrete shall meet the requirements of Section 925. All other materials shall meet the requirements of one or more of the Quality Standards listed in Section 701.2.

701.4.1 Classes of Concrete:

The Class of concrete used shall be as defined on the Plans or in the Special Conditions and shall conform to the requirements of Section 925.

701.4.2 Aggregates:

Aggregates shall be crushed rock or gravel (or a combination thereof) and sand conforming to the requirements of Section 901.

Aggregates for each batch of concrete shall be combined from materials separately stored in the various sizes and gradations required for the Concrete Mix Design. The proportions of each gradation used shall conform to the Concrete Mix Design. The maximum size aggregate used in the Concrete Mix Design shall not be larger than one fifth (1/5) of the narrowest dimension between the forms or larger than three-fourths (3/4) of the minimum clear spacing between reinforcing bars.

Aggregate samples for the Concrete Mix Design test cylinders shall be taken by or in the presence of the ENGINEER. Sampling methods used shall not cause segregation, degradation or proportions different that required by the Concrete Mix Design.

701.4.3 Aggregate for Mortar:

Aggregate for Mortar shall conform to the following gradation:

SIEVE DESIGNATION U.S. STANDARD SQUARE MESH	CUMULATIVE PERCENTAGE BY WEIGHT PASSING
No. 4	95 to 100
No. 8	80 to 90
No. 16	55 to 97
No. 30	30 to 60
No. 50	12 to 30
No. 100	0 to 10

701.4.4 Grout:

Non-shrink, non-staining, premixed grout shall be used for equipment and column bases and for drilled in anchors. Grout shall be mixed in accordance with the manufacturer's recommendations.

Grout composed of 1 part Portland Cement to 3 parts sand (by volume) and of the driest possible consistency shall be used for filling voids, honeycombs or damaged areas. Aggregate proportions may vary slightly to provide a workable mix.

701.4.5 Steps:

Step shall be firmly embedded in the walls of structures as required. Steps shall conform to the requirements of Section 930.

701.4.6 Cast Iron Grates, Frames and Other Castings:

Manhole rings and covers shall conform to the requirements of Section 930.

Grates, frames and other cast iron materials shall conform to the Contracting Agency's Standards as defined in the Special Conditions or as shown in the Standard Details.

701.5 EXECUTION OF WORK:

701.5.1 Subgrade Preparation:

The subgrade shall be excavated or filled to the required grades and lines. All soft, yielding or otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and compaction shall extend a minimum of one foot outside the form lines.

The subgrade shall be compacted to the density shown on the Plans and trimmed to provide a uniform surface at the correct elevation.

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until concrete has set. When subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

Concrete that is to rest on rock shall not be placed until rock is fully uncovered and surface rock is removed to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the ENGINEER. The base of structures shall be slush grouted as directed by the ENGINEER.

Concrete that requires filter or drain material as a subgrade shall not be placed until the filter or drain material is placed and de-watered. De-watering shall continue to the extent necessary to prevent any portion of the concrete from being carried away before the concrete has attained its final set. Placing the reinforcement and pouring of concrete shall follow placing and de-watering the filter or drain material as closely as practical.

701.5.2 Concrete Placement:

Concrete shall be delivered only in quantities required for placement within the specified time interval. Concrete having reached initial set prior to placement shall be discarded. No remixing with water or supplementing with other materials will be permitted once initial set has occurred.

Concrete shall be placed as nearly as possible to the final position to avoid segragation of the material or displacement of the reinforcement.

Concrete shall be placed through steel or steel lined open troughs, chutes or pipes. Troughs, chutes and pipes shall be clean and free from coatings or hardened concrete.

Concrete shall not be dropped a distance of more than 5 feet, unless approved in writing by the ENGINEER. Care shall be taken in placing concrete through reinforcement so that no segregation of course aggregate occurs. Splashing forms or reinforcement with concrete should be prevented. All hardened or partially hardened concrete on the forms or reinforcement above the level of previously placed concrete shall be removed before proceeding with the work.

Placement of concrete in monolithic structures shall follow the sequence shown on the Plans or as approved by the ENGINEER.

Concrete deposited in horizontal layers shall not exceed 36 inches depth within a single placement. Concrete shall be placed at a rate so that: (1) no concrete surface shall attain initial set before additional concrete is placed on it; and (?) yielding of forms is not so great as to cause the concrete surface exceed the specified tolerances.

All slab and floors shall be placed to the finish elevation in one continuous operation. Except, the CONTRACTOR may place a separate finish topping if prior approval is received from the ENGINEER. The structural slab thickness shall be increased by the thickness of the separate finish topping. The finished floor elevation shown on the Plans shall be maintained.

701.5.2.1 Cold Weather Placement:

Concrete shall be placed only when the temperature is at least 35 degrees F. and rising, unless approved by the ENGINEER.

Salt, chemicals or other materials shall not be mixed with the concrete for the purposes of preventing freezing. Accelerating agents may be used with written permission of the ENGINEER.

701.5.2.2 Hot Weather Placement:

The temperature of fresh concrete at the time of placement during hot weather shall be a maximum of 90 degrees F. to prevent accelerated setting of the concrete.

701.5.2.3 Concrete Placed Against Earth:

Earth cuts shall not be used as forms for vertical surfaces without prior approval of the ENGINEER or as shown on the Plans.

Concrete placed on or against earth shall be placed only upon or against firm, damp surfaces. Surfaces that are free from frost, ice, standing or running water. Concrete shall not be placed on mud or upon fill until the required compaction has been attained.

Slabs shall not be placed on dry porous earth. Polyethylene membrane may be laid over the surfaces to receive the concrete, provided the ENGINEER approves. If the ENGINEER approves, the membrane shall be a 0.004 inch thick clear polyethylene sheeting or polyethylene-coated water proof paper of the type specified for curing concrete. Tears in membrane shall be repaired.

701.5.2.4 Depositing Concrete in Water:

Concrete may be deposited in water provided the methods and equipment are specifically authorized by the ENGINEER.

The tremie method is one method that may be approved. The Tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept submerged continuously in concrete and the shaft kept full of concrete to a point above the water surface. Placing of concrete shall proceed without interruption until the top of the concrete has been raised to the required elevation.

701.5.3 Consolidation of Concrete:

All concrete shall be consolidated immediately after placing with high frequency internal vibrators. External vibrators shall be used where concrete is inaccessible for internal vibrators. Forms shall be constructed sufficiently rigid to resist displacement or damage for external vibration if external vibration is used.

Consolidation shall be accomplished by penetrating the concrete with the vibrator immediately after it is placed. The vibrator shall be moved throughout the mass so as to thoroughly work the concrete around reinforcement and embedded fixtures and into corners and form recesses. Vibrate the minimum time required to consolidate the concrete in place and not cause separation of the materials. Concrete shall be consolidated to the density required by the Concrete Mix Design. The vibrator size shall be selected to efficiently accommodate reinforcement clearances.

701.5.4 Finishing:

Concrete surfaces shall receive the class of finish shown on the Plans. The various classes of finish are described as follows:

(a) Class 1, Ordinary Surface Finish. Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced for form ties, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate and the surface left sound, smooth, even and uniform in color. Mortar used in pointing shall not be more than 30 minutes old. The mortar patches shall be cured as specified in Section 701.5.6 or other approved methods.

All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

(b) Class 2, Rubbed Finish. After removal of forms the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept moistened with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

(c) Class 3, Float Finish. This finish, for horizontal surfaces, shall be achieved by placing an excess of material in the form and removing or striking off the excess with a template, forcing the coarse aggregate below the mortar surface. Creation of concave surfaces shall be avoided. After the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine grained, smooth, but sanded texture.

(d) Class 4, Sand Blasted Finish. The cured concrete surface shall be sand blasted with hard, sharp sand to produce an even fine-grained uniform surface in which the mortar has been cut away. An exposed aggregate finish will not be required. However, aggregate exposed incidental to achieving the specified surface will be acceptable.

For colored concrete, the joints in the forms shall be sealed by an approved method.

(e) Class 5, Masonry Coating Finish. In lieu of a Class 2 Surface Finish, the specified surfaces may be coated with a pearl gray cement base concrete coating as specified herein:

Materials: Masonry coating shall be a hydraulic cement base coating designed for use on porous surfaces of concrete as a decorative, protective and water repellant coating. The powder shall consist of a heavy cement base coating packaged in a dry form and shall conform to Federal Specification TT-P-21, Type I, Class B. The liquid acrylic shall be a combination of polymers and modifiers designed for use with Portland Cement, shall be fully compatible with water and shall be a product of the manufacturer of the cement base powder. All materials shall be delivered to the project site in sealed containers bearing the manufacturer's original labels. Cement base and liquid acrylic shall be mixed according to the manufacturer's recommendations.

Preparation of Surface: Surfaces shall be thoroughly cleaned by approved methods, free of dirt, projections, loose mortar particles and laitance.

Mixing: One part by volume of liquid acrylic to three parts by volume of water shall be mixed in a clean container. The dry powder shall be added to the liquid mixture and stirred until the resulting mixture attains the consistency of a batter mix. If the components are hand mixed, the mixture shall set for 15 minutes, additional liquid shall be added, and the mixture shall be restirred to the batter consistency. The CONTRACTOR shall not use mixed quantities that cannot be applied within time limits specified by the manufacturer.

Application: The masonry coating shall be applied in two coats using a tampico fiber brush. The first coat shall be applied at the rate of approximately 2 pounds per square yard of surface area and the second coat at the rate of approximately one pound per square yard of surface area. The second coat shall be applied the day following the first application or before material has become too hard or glazed for good bond.

Surfaces to be coated shall be dampened immediately ahead of the application. The masonry coating shall not be applied as a thin coat, but shall be laid on the surface and leveled out. If the wall becomes dry or the coating starts to pull during application, the wall shall be dampened again. The mixture shall not be thinned. The mixture shall not be applied on frost-covered surfaces, frozen walls, when the temperature is below 40 degrees F. or when temperatures are predicted to fall below 40 degrees F. within 24 hours. If the surfaces have been exposed to hot sun conditions, they shall be cooled by hosing with clean water.

When the work progressing under hot sun, drying wind, or when evidence of extremely rapid drying appears, the finished surface shall be cured by fog spraying with water.

701.5.5 Protection:

The CONTRACTOR shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper, plastic sheeting or curing blankets. Concrete damaged by rain may be required to be removed and replaced at the CONTRACTOR'S expense.

701.5.6 Curing:

All finished surfaces, corners and edges shall be protected from stains, abrasion and breakage.

The CONTRACTOR shall maintain the concrete surface temperature above 50 degrees during the curing period when the ambient temperature is below 35 degrees F. The ENGINEER shall be responsible for determining the necessary for undertaking protective measures. The CONTRACTOR shall have on hand and ready for use a sufficient supply of straw, hay, grass, insulating batts or other suitable material to cover the newly placed concrete as necessary.

The concrete shall be maintained at a temperature of at least 50 degrees F. for the first 5 days, regardless or temperature conditions at time of placement. And, at a temperature above freezing for the remainder of the specified curing period. This period may be reduced to the time required for the concrete to attain minimum design strength. This period may be reduced to 72 hours, provided high early strength cement is used.

The methods proposed for heating the materials and protecting the concrete shall be approved by the ENGINEER.

Immediately after placing fresh concrete, all concrete shall be cured by one of the following methods. The ENGINEER shall approve the curing method proposed by the CONTRACTOR:

WATER METHOD: All surfaces other than slabs shall be protected from the sun and the structure kept set at least 5 days following concrete placement. Covering may be removed temporarily for finishing surfaces requiring a Class 2 finish, but the covering must be restored as soon as finishing is completed.

All concrete slabs shall be covered with suitable material immediately following placement so that concrete is kept thoroughly wet for at least 5 days. The concrete surface shall be kept moist at all times by fogging with an atomizing nozzle until the covering is placed.

MEMBRANE FORMING CURING COMPOUND METHOD. Curing compound may be applied only to those surfaces which are to receive a Class 1 or Class 4 final finish, unless compound used is harmless to joints or surfaces to be worked.

Curing compound shall be applied at the manufacturer's recommended coverage, unless otherwise directed by the ENGINEER. All concrete cured by this method shall receive two applications of curing compound. The first coat shall be applied immediately after stripping of forms and finish of surface. The concrete shall be thoroughly wet with water if the surface is dry. The curing compound shall be applied just as the surface film of water disappears. The second application shall be applied after the first application has set. During curing operations, any unsprayed surfaces shall be kept wet with water.

The coating shall be protected against marring for at least 10 days after application. Any marred coating shall be given an additional coating. Should the surface coating be subjected to continuous injury, water curing shall be applied at once.

The curing compound shall be thoroughly mixed according to the manufacturer's instructions, but not more than one hour prior to use.

Use of curing compound shall be discontinued if its use results in a streaked or blotchy appearance. Water curing shall be applied until the cause of the defective appearance is corrected.

FORM METHOD. Concrete shall be protected by forms for at least 5 days. Forms shall be kept moist, when necessary, during the curing period to insure the concrete surface remains wet.

BLANKET METHOD. Insulation blankets may be used in cold weather to maintain the required curing temperature and to retain moisture in the concrete. Blankets shall be secured at laps and edges to prevent moisture from escaping.

701.6 QUALITY CONTROL:

701.6.1 Delivery, Storage and Handling or Materials:

Cement shall be stored in weather-tight enclosures and protected against dampness, contamination or storage set. Lumpy or caked cement shall not be used.

Aggregates shall be stockpiled in a manner that shall minimize excessive segregation, contamination or mixing with other sizes of aggregates.

Admixtures shall be stored to prevent exposure to harmful temperature ranges, evaporation, contamination and damage. All admixtures shall be agitated in accordance with the manufacturer's recommendations prior to use.

701.6.2 Testing:

Concrete testing and testing laboratory services required shall conform to the applicable portions of Section 900 unless otherwise defined in the Special Provisions.

701.6.3 Acceptance of Concrete:

Field strength level of concrete shall be considered acceptable, provided the average test strength of 3 cylinders is not less than 80% of the specified laboratory design 28 day strength. And further provided, that no single test cylinder result falls more than 500 psi below the 80% level.

All placed concrete failing to meet the specified strength requirements density or surface requirements, or which may have frozen, shall be subject to corrective action as determined by the ENGINEER.

701.6.4 Repairing Concrete:

Concrete surfaces shall be inspected for defects immediately after form removal. Repair of defects shall be completed within 48 hours after form removal. Defects shall be inspected by the ENGINEER and the ENGINEER shall approve repair methods prior to repairs being undertaken.

All damaged and defective concrete shall be removed from the area to be repaired. Honeycombed, sand streaked and fractured concrete shall be considered defective. Repair areas shall be chipped to a depth of one inch. Edges of repair areas shall be squared to the surface to eliminate feather edges.

The repair area shall be clean, free of chipping dust, dried mortar and foreign material. Surfaces to be repaired shall be wet continuously for at least three hours prior to placing repair concrete or mortar. Repair surface shall not show free water at time repair material is placed.

The ENGINEER shall inspect repair area immediately prior to placement of repair material.

701.7 CLEAN UP:

The exposed surfaces of the concrete shall be thoroughly cleaned upon completion of the work and the site left in a neat and orderly condition.

701.8 METHOD OF MEASUREMENT:

Structural concrete will be measured by the cubic yard in accordance with the dimensions shown on the Plans. Voids larger than 5 cubic feet designed and built into the structure shall be deducted from the measured quantity. No deduction shall be made for the volume occupied by reinforcing steel, anchors, weep holes, piling, or rounded or beveled edges.

701.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price. The Bid Price shall be considered to include furnishing all labor, materials, tools and equipment, fine grading (+ or - 0.1 foot), placement, and removal of formwork, placement of concrete and doing all work required to construct the structures in accordance with the Project Plans and Specifications and shall be full compensation for the structures complete in place.

No additional payment over the Contract Unit Price will be made for any cast-in-place concrete which has an average thickness or volume in excess of that shown on the Plans.

702 PRECAST CONCRETE STRUCTURES:

702.1 SCOPE:

These units shall be cast in substantial forms. Structural concrete used shall attain a minimum 28-day compressive strength of 3,000 psi as determined in accordance with AASHTO T 22. When air-entrained concrete is specified, it shall have an air content of 5 to 8 percent by volume. The precast units shall be cured in accordance with AASHTO M 170. Additional reinforcement shalal be provided as necessary to provide for handling of the precast units.

A sufficient number of cylinders shall be cast and field cured from each batch, or truck-mixer load, of concrete to permit compression tests at 7, 14 and 28 days, and to allow for at least two cylinders for each test. When the strength requirement is met the units will be certified for use.

Cracks in units, honeycombe3d or patched areas in excess of 30 sq. in., excessive water absorption, or failure to meet strength requirements will be cause for rejection.

702.2 MEASUREMENT AND PAYMENT:

Precast concrete structures shall be measured and paid for on a unit price basis for each structure in place including all labor, materials, tools, fine grading, backfill materials and backfill and all other work required to construction the structures in accordance with the Plans and Specifications.

710 CONCRETE FORMWORK:

710.1 SCOPE:

All formwork for cast-in-place concrete structures shall conform to the requirements specified herein. Furnishing all materials and labor for placement and removal of formwork are included.

Bridge deck forms and falsework are excluded from this Specification.

710.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at time of bid shall apply.

ACI 347: Recommended Practice for Concrete Formwork.

710.3 SUBMITTALS:

The CONTRACTOR shall submit a description of the forming system with complete details. The location of all construction joints shall be detailed. The methods proposed for securing embedded items and block-out procedures shall also be defined.

All other submittals shall be defined in the Special Conditions.

710.4 MATERIALS:

Form lumber for all exposed concrete surfaces shall be dressed at least on one side and two edges and shall be constructed to produce mortar-tight joints and smooth, even concrete surfaces. Forms shall be filleted and chamfered as shown on the Plans. Forms shall be given a bevel or draft to assure easy removal from all projections.

Plywood shall be "B-B Plyform Class 1 Exterior" grade plywood, 5/8 inch minimum thickness in new or near new condition.

Metal forms shall be of sufficient thickness or braced to resist noticeable deflection from pressure of the concrete. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall hold the forms rigid during pouring and allow removal without injury to the concrete. Metal forms which do not provide a smooth surface or do not align properly shall not be used. Metal forms shall be free from rust, grease or other foreign matter.

Framing, studding and bracing shall be accomplished by use of standard or construction grade lumber, according to ACI 347.

Metal ties or anchorages within the forms shall be designed to permit their removal to a depth of at least 1/2 inch from the face without injury to the concrete. Form ties shall be designed to resist the loads imposed by freshly poured concrete and permit tightening and spreading of forms. Twisted wire loop ties and wooden spreaders shall not be used.

Non-staining form oil that will not impair the finished concrete surface may be used as a form coating. Lacquer, plastic or epoxy coated forms may be used in lieu of a liquid form coating. Form coatings containing mineral oils or non-drying ingredients shall not be used.

Standard patented and manufactured shores or sound construction grade lumber may be used for shores and falsework.

Chamfer strips shall be 3/4 inch 45 degree bevel wood strips or reuseable triangular plastic strips.

710.5 EXECUTION OF WORK:

710.5.1 Design of Formwork:

Formwork shall be designed to safely support the vertical and lateral loads applied until the loads can be supported by the concrete structure. Vertical and lateral loads shall be transferred by the formwork system to the ground or to adequately cured in-place construction.

Forms and falsework shall be designed to include live load, dead load, moving equipment operating on formwork, concrete, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of personnel and the structure during construction.

Shores and struts used shall be provided with means of positive adjustment capable of compensating for formwork settlement during placement operations. Wedges, jacks or a combination of both shall be used. Trussed supports shall be provided when adequate foundation for shores and struts does not exist.

Form facing materials shall be supported by structural members spaced to minimize deflection. Camber shall be designed into the formwork to compensate for anticipated deflections.

Formwork shall be designed to be readily removed without impact, shock or damage to concrete surfaces or adjacent material.

710.5.2 Construction of Forms:

Forms for exposed concrete shall be constructed of plywood, metal forms or other material specifically approved by the ENGINEER. Forms shall provide a smooth and continuous forming surface.

Forms for unexposed concrete may be identical to those used for exposed concrete. One inch thick construction grade shiplapped of tongue-and-groove lumber may also be used.

Form ties shall be tight fitting to prevent mortar leakage at holes in the forms. Ties shall be protected from rusting at all times. Form ties shall be installed at all vertical and horizontal construction joints to provide tight joints.

Lines, Levels and elevations shall be checked for accuracy and all inaccuracies corrected. Vertical and horizontal form position shall also be verified and corrected. All edging and bracing shall be completed prior to concrete placement.

All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms and excavated areas before concrete is deposited therein.

Pipes, castings, conduits, or inserted and embedded items shall be placed in the forms before pouring concrete. Cored openings or block-outs may be placed in the forms when specifically approved by the ENGINEER. Cores or blockout boxes shall be provided with continuous keyways or waterstops around the

periphery and tapered slightly to facilitate grouting. All inserted and embedded items shall be supported to ensure accurate alignment and minimize distortion during concrete placement.

710.5.3 Inspection:

The ENGINEER shall inspect the forms after reinforcing steel is placed and prior to concrete placement. The ENGINEER shall be notified at least 24 hours prior to scheduled concrete placement.

710.5.4 Form Removal:

Supports shall not be removed until the concrete has attained at least 80% of the specified 28 day strength or as specifically approved by the ENGINEER.

The forms for any portion of the structure shall not be removed until the concrete is strong enough to withstand damage when the forms are removed.

Side forms for cast-in-place beams, walls or other member where the forms do not resist dead load bending shall remain in place for at least 12 hours after concrete placement, exclusive of periods when ambient temperature is below 40 degrees F.

Forms may be removed earlier than defined above, provided high-early strength concrete is used. Removal time shall be as specifically approved by the ENGINEER.

All forms shall be removed except as provided on the Plans.

Form removal methods shall not cause over stressing. Supports shall be removed in a sequence that permits the concrete to gradually and uniformly absorb its weight stress. Supports and forms shall not be removed by high impact methods. Ties shall be broken after concrete has cured sufficiently to maintain unbroken bond with the tie rod.

710.5.5 Reuse of Forms:

Used forms intended for use for exposed concrete shall be reconditioned to "like new" conditions. All reused forms shall be cleaned, repaired and recoated before each reuse.

710.6 QUALITY CONTROL:

Form movement or deflection during concrete placement that results in finished surface variations in excess of the tolerances specified may be the basis for rejection and replacement of cast-in-place concrete.

710.7 CLEAN UP:

Forms, shores, struts, bracing, lumber and all trash shall be removed from the site upon completion of the work, and the site left in a neat and orderly condition.

710.8 METHOD OF MEASUREMENT:

Formwork shall not be measured, but shall be considered an integral part of cast-in-place concrete structures.

710.9 BASIS OF PAYMENT:

Formwork shall not be paid for separately, but shall be included in the Contract Unit Price for cast-in-place concrete structures.

720 CONCRETE REINFORCEMENT:

720.1 SCOPE:

All reinforcement for cast-in-place concrete structures shall conform to the requirements specified herein. Furnishing all materials and labor for placement are included.

720.2 QUALITY STANDARDS:

The latest published revisions of the Quality Standards in effect at time of bid shall apply.

AASHTO M 36:	Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
AASHTO M 53:	Axle - Steel Deformed and Plain Bars for Concrete Reinforcement
AASHTO M 55:	Welded Steel Wire Fabric for Concrete Reinforcement
ACI 315:	Manual of Practice for Detailing Reinforced Concrete Structures

ASTM A 185:	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A 615:	Billeted Steel Bars for Concrete Reinforcement
CRSI :	Manual of Standard Practice, Concrete Reinforcing Steel Institute

720.3 SUBMITTALS:

The CONTRACTOR shall submit bending and cutsheet schedules and drawings defining placing or reinforcing steel.

Mill test reports of each reinforcement shipment shall be submitted if requested by the ENGINEER.

All other submittals shall be defined in the Special Conditions.

720.4 MATERIALS:

All materials, manufacturing operations, testing and inspection of Concrete Reinforcement shall conform to the requirements of the applicable Quality Standards listed in Section 720.2.

Reinforcing bars shall be deformed steel bars of the size and grade detailed on the Plans.

Welded wire fabric shall be of the gauge and mesh specified on the Plans.

Tie wire shall be 16 gauge black annealed steel wire, except when epoxy coated reinforcing is used.

Reinforcing bar supports shall conform to Chapter 3 of CRSI Manual and shall be galvanized or plastic coated, where legs will be expossed in finished concrete surfaces. Otherwise, concrete bricks or mortar blocks may be used.

Reinforcement materials shall be delivered in bundles marked or identified to coordinate with the placement drawings. Materials shall be handled and stored to prevent contamination from dirt, oil and other materials that could affect bonding capacity with the concrete. Materials should be stored off ground in locations where the materials shall not be subject to abuse or damage.

720.5 EXECUTION OF THE WORK:

Reinforcement shall be accurately placed as shown on the Plans and shall be firmly and securely held in postion by using concrete or metal chairs, spacers, metal hangers and other approved devices or sufficient strength to resist crushing under full load.

Placement of reinforcement and placement tolerances shall conform to CRSI "Manual of Standard Practice".

Bar splices shall be placed at the locations shown or noted on the Plans. Bar splices shall be lapped at least 30 diameters, unless otherwise shown on the Plans. Lap splices shall be tied securely with wire to prevent displacement during pour. Welded wire fabric shall be lapped one full mesh and tied with wire.

Welded splices shown on the Plans shall be welded in accordance with AWS 12.1.

720.6 QUALITY CONTROL:

Steel testing and testing laboratory services required shall conform to the applicable portions of Section 800 unless otherwise defined in the Special Conditions.

Dirt, grease, oil, loose mill scale, excessive rust and foreign matter that may interfere with concrete bond shall be removed prior to placement.

Minimum concrete cover over the reinforcement detailed on the Plans shall be maintained throughout the construction.

720.7 CLEAN UP:

The stockpile site shall be left in a neat and orderly condition upon completion of the work.

720.8 METHOD OF MEASUREMENT:

The weight of reinforcing steel for payment shall be calculated using the theoretical length of bars placed and the unit weight per lineal foot specified in ASTM A 615.

720.9 BASIS OF PAYMENT:

Payment shall be made at the Contract Unit Price per pound of reinforcement. The Bid Price shall be considered to include all materials, labor, equipment and incidentals required to furnish and place concrete reinforcement in accordance with the Project Plans and Specifications and shall be full compensation for the item complete in place. No allowance will be made for supports, clips, tie wire or other materials used for fastening reinforcement in place.

730 ANCHORS, INSERTS AND EMBEDDMENTS:

730.1 SCOPE:

All anchors, inserts and embeddments for cast-in-place concrete structures shall conform to the requirements specified herein. Furnishing all materials and labor for placement are included.

730.2 QUALITY STANDARDS:

Nationally recognized quality standards applicable shall be shown on the Plans or defined in the Special Conditions. Only materials which are compatible with an embedded concrete environment shall be used.

730.3 SUBMITTALS:

The CONTRACTOR shall submit shop drawings detailing materials and placement for all anchors, inserts and embedded items, such as wall castings, pipe with seep rings, special castings, etc.

730.4 MATERIALS:

Anchor bolts shall conform to the material requirements and be of the size detailed on the Plans or defined in the Special Conditions.

Threaded or slotted inserts shall be stainless steel or galvanized malleable iron of the size and type detailed on the Plans or defined in the Special Conditions.

Embedded items shall be as detailed on the Plans or defined in the Special Conditions.

730.5 EXECUTION OF THE WORK:

Anchors, inserts and embedded items shall be placed in the forms at the locations shown on the Plans for embeddment of concrete. Aluminum items shall be coated with asphalt paint prior to embeddment. All items shall be set accurately and firmly held in position during concrete placement and until the concrete is set.

The ENGINEER may authorize drilled-in grouted anchors in lieu of embedded anchors. Holes for anchors may be drilled with diamond boring or rotary impact hammers or other means approved by the ENGINEER. Holes shall be cleaned and dried with compressed air, both the hole and embedded anchor shall be coated with bonding compound prior to insertion. Bonding mortar shall be epoxy grout type installed in accordance with the manufacturer's recommendations.

Studs of equal size and length may be substituted for anchor bolts provided nut fasteners are used.

Drilled-in studs or anchors utilizing mechanical expansion devices may be used if detailed on the Plans and specifically approved by the ENGINEER.

730.6 QUALITY CONTROL:

Dirt, grease, oil, loose mill scale, excessive rust and foreign matter that may interfere with concrete bond shall be removed prior to placement.

730.7 CLEAN UP:

Threaded and machined surfaces may require wire brushing or scraping to remove splatter or hardened concrete or other surface contaminants.

730.8 METHOD OF MEASUREMENT:

Anchors, inserts and embeddments shall not be measured, but shall be considered an integral part of the machinery, equipment, or materials to be attached to or mounted upon the cast-in-place concrete structures.

730.9 BASIS OF PAYMENT:

Anchors, inserts and embedded items shall not be paid for separately, but shall be included in the Contract Unit Price for the machinery, equipment or materials to be attached to or mounted upon the cast-in-place concrete structures.

740 JOINTS IN CAST-IN-PLACE CONCRETE:

740.1 SCOPE:

All construction joints, expansion and contraction joints, and water tight joints in cast-in-place concrete shall conform to the requirements specified herein. Furnishing all materials and labor for placement are included.

740.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply.

AASHTO M 33: Preformed Expansion Joint Fillers for Concrete (Bituminous Type)

AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

AASHTO M 173: Concrete Joint Sealer, Hot Poured Elastic Type

AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

740.3 SUBMITTALS:

The CONTRACTOR shall submit a list of joint materials to be used along with the names of the manufacture's and local suppliers.

The CONTRACTOR shall submit shop drawings detailing waterstop splice (weld) locations, intersection details, and support and forming details. Specifications and descriptive literature for the splice welding tools shall also be submitted along with the qualifications of the splice welder.

The CONTRACTOR shall submit drawings detailing all construction joints that are not shown on the Plans.

740.4 MATERIALS:

Joint bonding materials required for construction joints shall be as shown on the Plans or defined in the Special Conditions.

Joint sealer, preformed joint filler and joint waterstop materials shall conform to the requirements of the applicable Quality Standards listed in Paragraph 740.2.

Closed cell polyethylene backer-rod shall be used in sealant joints. The back-rod shall be resilient and approved by the sealant manufacturer. Backer-rod diameter shall be 1/8 inch larger than width of groove.

740.5 EXECUTION OF THE WORK:

740.5.1 Construction Joints:

Construction joints shall be located only as shown on the Plans or as approved by the ENGINEER prior to each pour. All construction joints shall be keyed, unless shown otherwise on the Plans.

Reinforcement shall be continued through the joint, unless shown otherwise on the Plans.

Bulkheads shall be constructed to mate waterstops and reinforcement to prevent concrete leakage.

Previously placed concrete shall be thoroughly roughened and air cleaned prior to placement of additional concrete. Place concrete continuously to a predetermined construction joint or level.

740.5.2 Expansion and Contraction Joints:

Joints shall be constructed in accordance with and at the locations shown on the Plans. Reinforcement shall not extend through joint, unless specifically shown on the Plans.

Preformed fillers shall be secured with fasteners and procedures recommended by the manufacturer.

Sealant surfaces shall be clean and free of oil, grease, residue and other foreign materials prior to application of primer or sealant. All joints shall be primed with a joint primer recommended by the sealant manufacturer.

Surfaces adjacent to joints shall be protected from sealant application. Back-rod shall be accurately placed in the joint groove to provide the depth of sealant detailed on the Plans.

Sealants shall be applied to fill the void to a level non-sag surface. Application procedure shall provide for a continuous application of sealant without intermediate stops and starts, and avoiding air entrapment.

Sealants shall be applied according to the manufacturer's recommendations.

Joints shall not be exposed to a hydrostatic pressure, until sealant has cured for at least 7 days.

740.5.3 Watertight Joints:

Waterstops shall be provided for and installed in all locations shown on the Plans. Reinforcement shall not extend through joint, unless specifically shown on the Plans.

Splices and intersections shall be made in accordance with the submittals.

Waterstops shall be installed in accordance with the manufacturer's installation instructions for continuous watertightness. The concrete shall be thoroughly vibrated or consolidated under and around the waterstop to achieve concrete contact with all waterstop surfaces. Hand placement of concrete may be required.

Waterstops shall be placed in the forms in a manner that will prevent deformation, distortion or displacement during concrete placement. Waterstop support during concrete placement shall conform to the manufacturer's published recommendations or to ENGINEER approved submittal.

740.6 QUALITY CONTROL:

Joint filler testing and laboratory testing services required shall conform to the applicable portions of Section 900 unless otherwise defined in the Special Conditions.
The manufacturer shall furnish certificates that all of the inspections and tests have been made and the results thereof comply with the requirements of the applicable standards specified in Section 740.2.

The CONTRACTOR shall furnish the ENGINEER two copies of the manufacturer's certificates.

740.7 CLEAN UP:

Clean up required shall conform to the requirement of Section 701.

740.8 METHOD OF MEASUREMENT:

Joints in cast-in-place concrete shall not be considered an integral part of cast-in-place concrete structures.

740.9 BASIS OF PAYMENT:

Joints in cast-in-place concrete shall not be paid for separately, but shall be included in the Contract Unit Price for cast-in-place concrete structures.

INSPECTION, TESTING, APPROVAL AND ACCEPTANCE

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801 SCHEDULE FOR MINIMUM MATERIALS SAMPLING, TESTING AND INSPECTION:

801.1 SCOPE:

The work covered by this Specification consists of the materials sampling, materials testing and materials inspection of materials specified for inclusion in the Work.

801.2 QUALITY STANDARDS:

The latest published revision of the Quality Standards in effect at the time of bid shall apply. The testing of all materials and construction shall be in conformance with the appropriate ASSHTO or ASTM specifications. A partial list of approved testing methods includes:

TEST PROCEDURES ASTM	AASHTO	
Attergerg Limits (LL & PL)	T 89 & T 90	D 4318
Gradation Analysis (except hydrometer)	T 27	D 422
CBR (as modified in Section 5.2.4.1)	T 193	---
R-value (subgrade & base)	T 190	D 2844
Marshall Stability	T 245	D 1559
R1Value	T 246	D 1560
Compaction Curve (standard)	T 99	D 698
Compaction Curve (modified)	T 180	D 1557
Compaction Curve (CTAB)	T 134	---
Field Density Test (Sand Cone)	T 191	D 1556
Field Density Test (Nuclear)	T 2?8/T 239	D 2922/D 3017
Field Density Test (Balloon)	T 205	D 2167
Concrete Slump	T 119	C 143
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801.3 SUBMITTALS:

Submittals are defined in each Specification included in Division 300, 400, 500, 600 and 700 of these Standards.

801.4 MATERIALS:

The materials to be sampled, tested and inspected are defined in Division 900 of these Standards.

801.5 EXECUTION OF THE WORK:

Materials sampling, materials testing and materials inspection shall conform to the requirements of the following table.

Additional sampling, testing and inspection requirements may be defined in portions of each section of Divisions 300, 400, 500, 600 and 700. If a conflict exists, the requirements of the following table shall govern.

The CONTRACTOR shall engage the services of a qualified and approved materials testing laboratory and include the costs of same in the Bid. A listing of approved materials testing firms is available from the OWNER. The laboratory shall perform or observe the performance of the specified sampling, testing and inspection defined in the following table. Inspection and inspectors duties defined in Section 213.9 are not included as part of the testing laboratories services.

All concrete technicians must be qualified as a level I Field Concrete Technician by ACI Standards or an equivalent program.

801.6 METHOD OF MEASUREMENT:

Materials sampling, testing and inspection shall not be measured but shall be subsidiary to and included in other Sections of these Standards.

801.7 BASIS OF PAYMENT:

Payment for materials sampling, testing and inspection shall be included in and subsidiary to payment for work included in other Section of these Standards.

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
305	GRADATION	1/200 cu yds or fraction thereof Required on Class 1 only	CP30	CP 31*	Required on Class 1 only	In place, before 901 compaction
STRUC-TURAL	ATTERBERG LIMITS	1/200 cu yds or fraction Class 1: 1 per source	T 89** T 90			
	MOIST-DEN CURVE	CLASS 2: follow instruc-ions in Section 306 of this Schedule	T 99 or T 180 T 100			
	IN-PLACE DENSITY	1/200 cu yds or fraction thereof	CP 22			In the compacted lift
		Minimum: 1/structure in roadbed, 1/abutment, pier, etc. in bridge	CP 80			
306 307	MOIST-DEN CURVE	1 per soil type		T 99 T 180	DENSITY: 1/500 cu yds when within 100 ft of bridge approach	In the top 2 ft of the finished sub-grade
COMP-ACTION	IN-PLACE DENSITY	1/2000 cu yds or fraction thereof of testable material		CP 22 CP 23 CP 25 CP 80	DENSITY:in compacted lift	Proof Rolling: ***

* CP indicates Colorado Procedure.
** T indicates standard AASHTO Procedure.
Laboratory indicates the CONTRACTOR'S designated testing laboratory.
COC indicates Certificates of Compliance.

*** After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heaviiy loaded vehicle. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of as least 18,000 pounds and a tire pressure of 90 psi. Subgrade which is pumping of deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yeilding base for subsequent paving courses. Contracting Agency shall be notified at least 24 hours before final proof-rolling.

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
309 WATERING	If potable, document in project records; no report needed. If not potable(or in doubt)submit laboratory analysis of mineral salt content, oil, acids, alkali, organic matter, or other injurious substance for intended use.					
EMULSIFIED ASPHALT (Dust Palliative): See Section 505 of this Schedule.						
503	GRADATION	1/1000 tons or fraction thereof on each class	CP 30	CP 31		Immediately after pug-mill mixing or from window
AGGRE-GATE BASE COURSE	ATTERBERG LIMITS	1/1000 tons or fraction thereof on each class		T 89 T 90		
	IN-PLACE DENSITY	1/500 feet in each travel lane At least 20 percent of tests within 1 foot of manholes, valves and curbs.	CP 80	CP 22		Compacted lift
	MOIST-DEN CURVE	1/source	T 180			
504	IN-PLACE DENSITY	1/500 feet in each traveled lane At least 20 percent of tests within 1 foot of manholes, valves and curbs.	CP 80	CP 22		In the compacted lift
PORTLAND CEMENT TREATED BASE	MOIST-DEN CURVE	1/source		T 134		
	GRADATION	Aggregate on 1/1000 tons or fraction thereof Six field prepared proctor mold samples shall be taken for each 500 tons placed and tested at 7 and 28 days to determine unconfined compressive strength.	CP 30	CP 31	Run Atterberg Limits before cement is added. No Atterbergs or gradation needed on old in-place aggregate	Immediately after pug-mill mixing or from roadway
	ATTERBERG LIMITS	Aggregate only 1/1000 tons or fraction thereof		T 89 T 90		

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
502 LIME TREATED SUB-GRADE	IN-PLACE DENSITY	1/500 lineal feet of travel lane	CP 23	CP 22 CP 80	Observation and testing is required on a full time basis	In the compacted lift
	MOIST-DEN CURVE	1 per soil type		T 99 T 180 T 220	Field Compacted	7-day strength and lime content (AASHTO T 232) determinations shall be required for each 500 tons of subgrade treated with a minimum of one per project.
901 FILTER MATERIAL	GRADATION	1/100 cu yds or fraction thereof	CP 30	CP 31	Report on DOH Form 6. See the Materials Manual for further details	In place for each class
901 BED COURSE	GRADATION	1/200 cu yds or fraction thereof	CP 30	CP 31	Report on DOH Form 6	In place
901 COVER COAT MATERIAL	GRADATION	1/200 tons or fraction thereof	CP 30	CP 31		Spreader

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
508 PLANT MIX BITUMINOUS BASE	ASPHALT CONTENT	1/1000 tons or fraction thereof	CP 41	CP 42	Observation and testing shall be on a full time basis during placement and compaction	Pugmill discharge at or behind paver
	GRADATION (Agg.)	1/1000 tons or fraction thereof		CP 31		
	IN-PLACE DENSITY	1/500 lineal feet of travel lane per lift *		CP 44 CP 81		DENSITY in compacted pavement
508 HOT BITTUMINOUS PAVEMENT	ASPHALT CONTENT	1/500 tons or fraction thereof of mix produced	CP 41	CP 42		Pugmill discharge at or behind paver
	GRADATION	Aggregate 1/500 tons or fraction thereof of mix produced		CP 31		
	FRACTURED FACES	1/2500 tons on crusher control samples or stockpile acceptance for commercial sources	CP 30	CP 45	Document Fractured Faces on sieve analysis work sheet	Crushing plant or stockpile
	IN-PLACE DENSITY	1/500 lineal feet of travel lane per lift *		CP 44 CP 81		ASPHALT Certified analysis

* Minimum of one test per each day of production

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Frequency	Procedures: Project Sampling	Procedures: Project Testing	Procedures: Remarks	Point of Acceptance
508 505 506	ASPHALT CEMENT ROAD OIL	Acceptance samples normally will be samples accompanying shipment. When field sampling is required, sample according to AASHTO T 40.				Conditionally accepted at the source
	LIQUID ASPHALT	For suppliers furnishing large quantities of bituminous mixtures to multiple customers asphalt cement acceptance samples shall be taken from the plant; sampling frequency shall be 1/500 tons of mix. See project Special Provisions for certification procedure.				
BIT-UMINOUS MATERIALS	LIQUID ASPHALT AGENT	When specified, check Certificate of Compliance accompanying shipment to determine if additive has been added.				
	EMULSIFIED ASPHALT	If samples are submitted, they are to be in non-metalic containers.				
	ASPHALT REJUVENATING AGENT Dilution Water	Follow instructions in Section 309 of this Schedule.				
517 PORTLAND CEMENT CONCRETE PAVEMENT	GRADATION (AGGREGATE)	1/1000 sq yds or fraction thereof for each size aggregate	CP 30	CP 31		
	MOISTURE CONTENT (FINE AGGREGATE)	1 per day and as often as needed for quality control	CP 30	CO 60		
	MOISTURE CONTENT (COARSE AGGREGATE)	1 per day min. where moisture content is greater than +0.5% from SSD condition	CP 30	CP 60		Stockpile belt, or bin
517 (cont)						

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Type of Test	Project Acceptance Test Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
517 (cont)	SLUMP	1/1000 sq yds and as often as needed for quality control *	T 141	T 110		
	AIR CONTENT	1/1000 sq yds and as often as needed for quality control *	T 141	T 119		
PORTLAND CEMENT CONCRETE PAVEMENT	UNIT WEIGHT AND CEMENT FACTOR	1/1000 sq yds and as often as needed for quality control	T 141 or nomograph	T 121		Mixer discharge or from freshly placed
	COMPRESSIVE	1/set of 6 cylinders ea. 2000 sq yds or major fraction thereof on ea. day pavement is placed	T 141	T 22	Test as follows: 2 at 7 days, 2 at 28 days & at a later date.	
	IN-PLACE DENSITY	1/1250 sq yds	CP 63	CP 82		
	THICKNESS	1/500 lin ft each traffic lane on freshly finished concrete and one core per lane mile	T 24 CP 46	T 148		Finished concrete

* The first three loads shall be tested for slump and air content. If any one test fails to meet requirements, slump and air content tests shall continue until three consecutive loads meet requirements. Thereafter, slump and air shall be tested at least every fifth load.

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
518	GRADATION	Sidewalks: 1/1000 sq yds or fraction thereof each size aggregate of concrete placed Curbing: 1/2000 lin ft or fraction thereof each size aggregate or concrete placed	CP 30	CP 31		Stockpile, belt, or bin
SIDEWALKS (CONCRETE) CURBING (CONCRETE)	MOISTURE CONTENT (FINE AGGREGATE)	1 per day and as often as needed for quality control	CP 30	CP 60		
	MOISTURE CONTENT (COARSE AGGREGATE)	1 per day minimum where moisture content is greater than +0.5% from SSD condition	CP 30	CP 60		
	SLUMP	The slump, air content and unit weight tests shall be carried out on the first truck of concrete for the daily placement and thereafter in conformance with the following table:	T 141	T 119		
	AIR CONTENT	1 set of tests for every 1000 sq yds or fraction thereof of concrete placed; 1 set of	T 141 T 199	T 152		Mixer Discharge
518 (cont.)	YIELD AND CEMENT	4 tests for every 2000 lineal ft or fraction thereof of curb and gutter placed.	T 141	T 121		or nomgraph
	COMPRESSIVE	Sidewalks: 1 set (4) of cylinders per 1000 sq yds or fraction thereof or concrete placed per day Curbing: 1 set (4) cylinders per 2000 lin ft or fraction thereof of concrete placed	T 141	T 22 T 23	Information cylinders may be cast at the discretion of the Project Engineer	

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
601	Concrete Footings:	Concrete - follow instructions in Section 701 & 925 of this Schedule.			Note: See CP 50 for instructions on checking torque on high strength high strength bolts when required	
	Reinforcing Steel:	Follow instruction in Section 720 of this Schedule				
	Steel Sign Posts, Wide Flange (WF) and Anchor Bolts: TORQUE TEST ALL BOLTS ACCORDING TO CO 50. U2 Type - field inspect. Make random check of weight, coating, and length for plan requirements. Square Tube Posts - may be used as alternate. Field inspect.					
TRAFFIC CONTROL DEVICES	Construction Traffic Control Signing:			Field inspect.		Document in Project Records.
	Sign Panels: The contractor shall provide the Project Engineer with copy of a Certificate of Compliance(furnished by supplier). Field inspect fabricated panels for correct legend and workmanship. Document in project records. No report necessary.					
	Lighting Fixtures. Flashing Yellow Beacons, Traffic Signal Systems: Field inspect for compliance with plans and specifications. Document in project records. No report necessary.					
	Anchor Bolts, Messenger Cables, Electrical Conduit, Pull Boxes, Direct Burial Cable, Vehicle Detector Wire Loop, Grounding and Bonding, Miscellaneous Hardware, and Barricades: Field inspect. Document in project records. No report necessary.					
701 740 925	GRADATION (AGGREGATE)	1/100 cu yds or fraction thereof of concrete placed for each size aggregate	CP 30	CP 31		Stockpile, belt or bin
	MOISTURE CONTENT (FINE AGGREGATE)	1 per day and as often as needed for quality control	CP 30	CP 60		
STRUCTURAL CONCRETE	MOISTURE CONTENT (COARSE AGGREGATE)	1/day min if moisture content is +0.5% from SSD condition	CP 30	CP 60		

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
701 740 925	SLUMP	1/set of cylinders and as often as needed for quality control BRIDGE DECKS: One per truck-	T 141	T 119		
	AIR CONTENT	1/set of cylinders and as often as needed for quality control	T 141	T 152 T 119		Mixer discharge, pump or conveyor belt
	YIELD & CEMENT FACTOR	1/set of cylinders and as often as needed for quality control	T 141	T 121 or nomograph		
STRUCTURAL CONCRETE	COMPRESSIVE STRENGTH	One set (4) cylinders per 100 cu yds or fraction thereof of concrete placed per days pour	T 141	T 22 T 23		Information cylinders may be cast at discretion of Project Engineer
IN-PLACE DENSITY		BRIDGE DECKS: 1/25 sq yds		CP 82		
STEEL DEPTH		BRIDGE DECKS: 1/25 sq yds		CP 63		

Incidental Items (non-pay)

Portland Cement: Mill certificate to be furnished.

Reinforcing Steel: Mill certificate to be furnished, See Section 420 of this Schedule.

Water: If potable, Document in Project Records. If not potable, or if in doubt, submit one liter sample per source in clean, non-metalic container to Laboratory before use.

Air Entraining Agents and Chemical Admixtures: An approved air entraining agent will be used by the Laboratory for each mix design. Other previously approved or standard brands may be substituted without prior approval or pretesting. If problems in the field develop, a sample may be requested. Only approved mix designs with admixtures will be allowed. Report all additives and dosages. No further action necessary.

(701-740-925)

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
701 740 925 (cont)	Other Additives: Contact Laboratory for sampling, testing, and documentation information before use. Curing Materials: Liquid membrane compound meeting AASHTO M 148 usually pretested. Check the container for either a label or a stencil. These labels or stencils verify pretesting and approval. Document membrane compound stating lot number, date, and quantity represented. All other curing materials document in project records. No report necessary. Epoxy for bonding fresh concrete to old concrete. Contact Laboratory for information on acceptable brands. Poured Filler: Hot - submit one 1000 g sample for each lot to Laboratory from unmelted stock. Cold - for single component, submit one 1000 g sample to laboratory. For two-component, submit appropriate proportions of each separate component (total of 1000 g) to Laboratory.					
STRUCTURAL CONCRETE	Preformed Filler(Expansion Joint Material): Preinspected Check for red tag bearing PRETESTED data. Submit data on the red tag. Cementitious Grouts: Contact Laboratory for information on acceptable brands. Class 5. Masonry Coating Finish: Contact Laboratory for information on acceptable brands.					
REIN-FORCING STEEL	Pretested sampling frequency shall be one sample per 20,000 lbs for each grade, size and brand. The contractor shall provide the Project Engineer with one copy of the invoice or shipping ticket accompanying each load of reinforcing steel delivered to the Project. The Project Engineer shall confirm that the material has been sampled and tested by contacting the contractor's designated testing laboratory before steel is placed. Steel Chairs: Field inspect. Document in project records. No report necessary.					

Schedule for Minimum Materials Sampling, Testing, and Inspection

Section	Project Acceptance Test: Type of Test	Project Acceptance Test: Frequency	Procedures: Project Sampling	Procedures: Project Testing	Remarks	Point of Acceptance
400	Corrugated Steel Pipe and End Sections. Field inspect for visible defects. Each shipment will be accompanied by a Manufacturer's Certificate of Compliance.					
	Asbestos Bonded CSP Bituminous Coated CSP and Precoated CSP. Field inspect for visable defect. Each shipment will be accompanied by a Manufacturer's Certificate of Compliance.					
	Corrugated Aluminum Pipe. Field inspect for visible defects. Each shipment will be accompanied by a Manufacturer's Certificate of Compliance.					
	Concrete Pipe and End Sections. Field inspect for visible defects. Each shipment will be accompanied by Manufacturer's Certificate for Concrete Pipe which gives inspection instructions.					
CULVERTS, SEWERS, MANHOLES, INLETS, AND METER VAULTS	Concrete Box. Same as Concrete Pipe.					
	Rubber Gaskets: No report required when shipped with pipe cleared by Certificate of Compliance.					
	Manholes, inlets, and Meter Vaults: The contractor shall provide the Project Engineer with copy of Certificate of Compliance (furnished by supplied).					
	Manholes, Inlets, and Meter Vaults: Components must meet individual specifications though not paid for separately.					
	Concrete: Follow instructions in Section 925 of this Schedule.					
	Reinforcing Steel: Follow instruction in Section 720 of this Schedule.					
	Inlet Grates and Frames, Manhole Rings and Covers, and Steps: Field inspect Document in project records. No report necessary.					
	ABS and PVC Pipe: Document the same as Manholes, Inlets and Meter Vault.					

840 INSPECTION, TESTING, APPROVAL AND ACCEPTANCE OF STREET AND ROADWAY RELATED WORK:

840.1 SCOPE:

The work covered by this Specification consists of the inspection, testing, approval and acceptance of street and roadway construction including appurtenances normally installed as part of the system. The work may include density testing, materials testing and tolerances checking of widths, thicknesses, cross slope, gradiants and related work when required by the Special Conditions.

840.2 SUBMITTALS:

Any submittal required shall be defined in the Special Conditions.

840.3 MATERIALS:

Equipment necessary for any of the tests shall be of the type, quality and capacity to perform the operations required to execute the tests specified, and shall be furnished by the CONTRACTOR along with all labor and materials including water.

840.4 EXECUTION OF THE WORK:

840.4.1 Inspection:

The CONTRACTOR shall have accomplished all inspections of excavation, embankment, roadway construction and appurtenances in conformance with Sections 300, 500, 600, 700, and Section 801.

The ENGINEER shall inspect and approve all work accomplished subject to the provisions of Section 801.

840.4.2 Cleaning:

Prior to testing or acceptance of any section of roadway, the CONTRACTOR shall remove all foreign matter from the system. Sweeping, flushing or other appropriate cleaning methods approved by the ENGINEER may be used.

840.3.4 Testing:

All testing shall comply with the requirements and frequently as described in Section 801 for the material or activity being tested.

840.4.4 Tolerances:

The construction specification tolerance list shown below shall provide the least possible standard of acceptance by the OWNER. This tolerance list shall be used by the CONTRACTOR to check his work prior to requesting any acceptance inspection. This list will be used by
the OWNER'S representative as a quality assurance check during construction and for the final inspection.

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
501.3.2	Subgrade Tolerance Earthwork	Variation for the subgrade plane shall not be more than 0.08' in soil nor more than 0.08' above or 0.50' below in rock. Where bituminous surfacing materials are to be placed on the subgrade, variation in the subgrade plane shall not vary more than 0.04'.
508.4.1	Range of tolerances for Plant Mix Bit. Base Job mix formula	*Passing No 8 and larger sieves +/-8% Passing sieves smaller than 8 and larger than No200 sieve +/-6% Passing No. 200 sieve +/-3% Bitumen +/-0.5% Temperature of Mixture when emptied from mixer +/- 20oF. *exclusive of the maximum size designated in the Special Conditions.
508.5.15	Surface Tolerance Plant Mix Bit, Base Course	Variation in 5' as measured with a 10' straight edge shall not exceed 1/4".

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
507.2	Percentage of Emulsified Asphalt in Treated Base	The percentage of emulsified asphalt.. within +/-0.3% by weight of dry aggregate.
507.3.3	Surface Tolerance-Emulsified Asphalt Treated Base	Variation in 5' as measured with a 10' straight edge shall not exceed 1/4".
503.6	Surface Tolerance Aggregate Base Course	Variation in 10' shall not exceed 0.04'. If a gravel surface is the final surface for the roadway or shoulder then the manholes, water valves, etc. shall be buried 6 inches + 1 inch below the final grade.
501.3.2	Subgrade Tolerance Reconditioning	Variation above or below subgrade plane shall not be more than 0.08'. Where bituminous surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04'.
502.5.3	Amount of Water in Lime Treated Subgrade	...a moisture content not less than optimum nor more than 5% points above optimum.
502.6	Subgrade Tolerance Lime Treated Subgrade	Variation above or below subgrade plane shall not be more than 0.08'. Where bituminous surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04'.
504.5.3	Amount of water in portland cement treated base	The percentage of moisture shall not be less than optimum nor more than 5% above optimum.

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
504.6	Surface Tolerance Portland Cement Treated base	*Variation in the finished surface shall not exceed 0.08' when tested with a 10' straight edge.
508.3	Range of tolerances for plant mix pavement job-	*Passing No. 8 and larger sieve +/- 8% mix formula Passing sieves smaller than No. 8 to larger than No. 200 +/- 6% Passing No. 200 sieve +/- 3% Bitumen +/- 0.5% Temperature of mixture when emptiedfrom mixer +/- 20oF. *Exclusive of the maximum size designated in the special Conditions.
508.5.14	Plant mix pavements	The variation between any two surface contacts of plant-mix pavements shall not exceed 1/4" in 5' measured with a 10 foot straight edge.
505.5 506.5	Application rate of prime and tack coat	The allowable variation from any specified rate shall not exceed 0.02 gallon per square yard.
511.5	Application rate of seal coat	"... with an allowable variation from any specified rate to exceed 0.02 gallon per square yard."
512.2	Range of tolerances for plant-mixed seal coat Job-mix formula	*Passing No. 4 sieve +/- 8% Passing No. 8 to No. 100 sieves (inclusive) +/- 6%

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
		Passing No. 200 sieve +/- 2%
		Bitumen +/- .05%
		Temperature of mixture when emptied from mixer +/- 20oF.
		*Exclusive of the maximum size designated in the special provisions.
517.5.3	Setting Forms for Concrete Pavement	Forms shall not deviate from true line by more than 1/4" at any point.
517.5.5	Batching Materials for PCC Pavement	Within a tolerance of 1% for cement, 1% for water and 2% for aggregate ..admixtures to +/- 3%.
517.5.5	Temperature of Mixed Concrete	Mixed concrete shall be not less than 50°F. nor more than 80°F. at the time of placing it in forms unless otherwise directed.
517.5.5	Heating water and/or aggregates	If air temp. is 35°F. or less at the time of placing, the Engineer will require water and/or aggregate heated to not less than 70°F. nor more than 150°F.
517.5.8	Expansion Joints in Concrete Pavement	Finished joints shall not deviate more than 1/4" in the horizontal alignment from a straight line.
517.6	Surface Tolerance Concrete Pavement	"Will not show surface deviation in excess of 1/8" when tested with 10' straight edge (exceeding 1/2" shall be removed and replaced)."

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
518.6	Curb, gutter and walk, crosspans, radii, etc.	Any localized humps and or depressions greater than 1/4" will require removal and replacement of the work in question. No ponding or water greater than 3/8" shall be allowed. Combination curb, gutter and walk and/or vertical curb and gutter flowline depth shall not vary from adopted standards by more than +1/2", measured vertically from the top of curb to the gutter invert. Pedestrian walks shall have a minimum of 2.0% and a maximum of 2.5% slope toward the roadway. Contraction and construction joints shall be placed at the standard spacing of 10 feet in curb, gutter, sidewalks, crosspans, trickle channel, etc. A minimum spacing of 5 feet will be allowed for repairs. Heave or settlement of sidewalk, relative to separate curb pour, greater than 1/2" shall be cause for corrective action. This provision shall not apply to transverse sidewalk joints. At the time of final acceptance inspection, the repair of all cracks will be completed.

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
		1. Cracks that are less than 1/4" wide, exhibit no horizontal or vertical shifting, and do not meet the conditions in 2), 3) and 4) below may, at the discretion of Arapahoe County, be sealed by routing approximately 3/4" to 1" deep by 1/4" wide and filling with Sikaflex 1-A or equal.
		2. Any crack that extends through a joint shall require removal and replacement of the entire cracked area.
		3. Any crack in a 4" thick walk will require removal and replacement of the entire cracked section between joints.
		4. Any longitudinal cracked section of concrete will require complete removal and replacement of that section between joints.
		5. Repair action for hairline cracks as determined in 1) above may be waived at the discretion of Arapahoe County. For the purpose of this section, a hairline crack is one that is reasonably immeasurable and without separation as determined by the OWNER.

TABULATION OF CONSTRUCTION TOLERANCES

Sub-Section	Subject	Tolerance
604.2	Guard Rail Posts	Posts shall be set firm and aligned with a tolerance of +/- 1/4" from plumb, lines and grades as staked.
603.3	Concrete Median Barrier	Deviation in excess of 1/4" from the lower edge of a 10-foot straight edge shall be corrected by the Contractor.
Sp.Cond.	Loop detector installation	...saw cut shall not vary more than 1/2" when checked with a 10' straight edge.
Sp.Cond.	Pavement Marking	A reasonably clean edge stripe of the designated width (+/- 3/4")...will paint a stripe with gap shown on plans. Application tolerance per gal. of paint.. 100 sq. ft. for paint and 4 oz. for beads.
Sp.Cond.	Thermoplastic Pavement Marking	"Thickness of material not less than 3/32" at the edges, nor less than 1/8" at the center.

APPENDIX

FORMULAE

CONVERSION FACTORS

Table 1	Acreage-Right-of-Way
Table 2	Square Yards of Road Surface for Various Road Widths
Table 3	Gallons of Asphalt Required per Mile for Various Rates of Application
Table 4	Tons of Aggregate Required per Mile for Various Rates of Application
Table 5	Storage Capacity (in tons) of Cone -or Tent-Shaped Stockpiles of Sand or Gravel
Table 6	Storage capacity (in tons) of Cone -or Tent-Shaped Stockpiles of Crushed Stone
Table 7	Loose and Compacted Weights of Various Materials
Table 8	Pounds of Aggregate Required per Square Yard for Various Cubic Yard Weights
Table 9	Cubic Yards of Material Required per 100 Lineal Feet for Various Loose Depths
Table 10	Cubic Yards of Material Required per Foot for a Typical Culvert Installation
Table 11	Length Measurements
Table 12	Volume Measurements
Table 13	Area Measurements
Table 14	Weights and Other Measurements
Table 15	Common Fractions to Decimal Numbers
Table 16	Quantity and Cost Estimation for Asphalt Paving

FORMS

- Notes
- Preconstruction Conference Agenda and Minutes
- Construction Engineering Memo
- Project Diary
- Record of Conversation

STANDARD PLATES

Table 1
ACREAGE-RIGHT-OF-WAY

WIDTH IN FEET	LENGTH IN MILES																		
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	2	3	4	5	6	7	8	9	10
1'	.0	.0	.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2
2'	.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.5	0.7	1.0	1.2	1.5	.7	1.9	2.2	2.4
3'	.0	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.7	1.1	1.5	1.8	2.2	2.6	2.9	3.3	3.6
4'	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.9
5'	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.9	5.5	6.1
6'	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.7	1.5	2.2	2.9	3.6	4.4	5.1	5.8	6.5	7.3
7'	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.7	2.6	3.4	4.2	5.1	5.9	6.9	7.6	8.5
8'	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.9	2.9	3.9	4.9	5.8	6.8	7.8	8.7	9.7
9'	0.1	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.0	1.1	2.2	3.3	4.4	5.5	6.5	7.6	8.7	9.8	10.9
10'	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	2.4	3.6	4.9	6.1	7.3	8.5	9.7	10.9	12.1
20'	0.2	0.5	0.7	1.0	1.2	1.5	1.7	1.9	2.2	2.4	4.9	7.3	9.7	12.1	14.6	17.0	19.4	21.8	24.2
30'	0.4	0.7	1.1	1.5	1.8	2.2	2.6	2.9	3.3	3.6	7.3	10.9	14.6	18.2	21.8	25.5	29.1	32.7	36.4
40'	0.5	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.9	9.7	14.6	19.4	24.2	29.1	33.9	38.8	43.6	48.5
50'	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.9	5.5	6.1	12.1	18.2	24.2	30.3	36.4	42.4	48.5	54.6	60.6
60'	0.7	1.5	2.2	2.9	3.6	4.4	5.1	5.8	6.6	7.3	14.6	21.8	29.1	36.4	43.6	50.9	58.2	65.5	72.7
70'	0.9	1.7	2.6	3.4	4.2	5.1	5.9	6.8	7.6	8.5	17.0	25.5	33.9	42.4	50.9	59.4	67.9	76.4	84.9
80'	1.0	1.9	2.9	3.9	4.9	5.8	6.8	7.8	8.7	9.7	19.4	29.1	38.8	18.5	58.2	67.9	77.6	87.3	97.0
90'	1.1	2.2	3.3	4.4	5.5	6.6	7.6	8.7	9.8	10.9	21.8	32.7	43.6	54.6	65.5	76.4	87.3	98.2	109.1
100'	1.2	2.4	3.6	4.9	6.1	7.3	8.5	9.7	10.9	12.1	24.2	36.4	48.5	60.6	72.7	84.9	97.0	109.1	121.2

Table 2
SQUARE YARDS OF ROAD SURFACE FOR VARIOUS ROAD WIDTHS

SQUARE YARDS OF ROAD SURFACE				SQUARE YARDS OF ROAD SURFACE			
ROAD WIDTH	PER LINEAL FOOT	PER 100 FEET	PER MILE	ROAD WIDTH	PER LINEAL FOOT	PER 100 FEET	PER MILE
6'	0.67	66.67	3,520	24'	2.67	266.67	14,080
7'	0.78	77.78	4,107	25'	2.78	277.78	14,667
8'	0.89	88.89	4,693	26'	2.89	288.89	15,253
9'	1.00	100.00	5,280	28'	3.11	311.11	16,427
10'	1.11	111.11	5,867	30'	3.33	333.33	17,600
11'	1.22	122.22	6,453	32'	3.56	355.56	18,773
12'	1.33	133.33	7,040	34'	3.78	377.78	19,949
13'	1.44	144.44	7,627	36'	4.00	400.00	21,120
14'	1.56	155.56	8,213	38'	4.22	422.22	22,293
15'	1.67	166.67	8,800	40'	4.44	444.44	23,467
16'	1.78	177.78	9,387	50'	5.56	555.56	29,333
17'	1.89	188.89	9,973	60'	6.67	666.67	35,200
18'	2.00	200.00	10,560	70'	7.78	777.78	41,067
20'	2.22	222.22	11,773	75'	8.33	833.33	44,000
22'	2.44	244.44	12,907	80'	8.89	889.89	46,933

Table 3
GALLONS OF ASPHALT REQUIRED PER MILE FOR VARIOUS RATES OF APPLICATION

ROAD WIDTH IN FEET	GALLONS PER SQUARE YARD																
	0.10	0.15	0.20	0.25	0.30	0.33	0.35	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.25	1.50	2.00
8'	469	704	939	1173	1408	1564	1643	1877	2347	2816	3285	3755	4224	4693	5867	7040	9387
9'	528	792	1056	1320	1584	1760	1848	2112	2640	3168	3696	4224	4752	5280	6600	7920	10560
10'	587	880	1173	1467	1760	1956	2053	2347	2933	3520	4107	4693	5280	5867	7333	8880	11733
11'	545	968	1291	1613	1936	2151	2259	2581	3227	3872	4517	5163	5808	6453	8067	9680	12907
12'	704	1056	1408	1760	2112	2347	2464	2816	3520	4224	4928	5632	6336	7040	8800	10560	14080
14'	821	1232	1643	2053	3464	2738	2875	3285	4107	4928	5749	6571	7392	8213	10267	12020	16427
15'	860	1320	1760	2200	2640	2933	3080	3520	4400	5280	6160	7040	7920	8800	11000	13200	17600
16'	939	1408	1877	2347	2816	3129	3285	3855	4693	5632	6571	7509	8448	9387	11733	14080	18773
18'	1056	1584	2112	2933	3168	3520	3696	4224	5280	6336	7392	8448	9504	10560	13200	15840	21120
20'	1173	1760	2347	3227	3520	3911	4107	4693	5867	7040	8213	9387	10560	11733	14667	17600	23467
22'	1291	1936	2581	3520	3872	4302	4517	5163	6453	7744	9035	10325	11616	12907	16133	19360	25813
24'	1408	2112	2816	3520	4224	4693	4928	5632	7040	8448	9856	11264	12672	14080	21120	28160	21120
25'	1467	2200	2933	3667	4400	4889	5133	5867	7333	8800	10267	11733	13200	14667	18333	22000	29333
26'	1525	2288	3051	3813	4576	5084	5339	6101	7627	9152	10677	12203	13728	15253	19067	22880	30507
28'	1643	2464	3285	4107	4928	5476	5749	6571	8213	9856	11499	13141	14784	16427	20533	24640	32853
30'	1760	2640	3520	4400	5280	5867	6160	7040	8800	10560	12320	14080	15840	17600	22000	26400	35200

Table 4
SQUARE YARDS OF ROAD SURFACE FOR VARIOUS ROAD WIDTHS

WIDTH OF AREA IN FEET	POUNDS PER SQUARE YARD														
	3	5	7	8	10	12	15	20	25	30	35	40	45	50	100
8'	7.0	12	16	19	23	28	35	47	59	70	82	94	105	117	235
9'	7.9	13	18	21	26	32	40	53	66	79	92	106	119	132	264
10'	8.8	15	20	23	29	35	44	59	73	88	103	116	132	147	293
11'	9.7	16	23	26	32	39	48	65	81	97	113	129	145	161	323
12'	11	18	25	28	35	42	53	70	88	106	123	141	158	176	352
14'	12	20	29	33	41	49	62	82	103	123	144	164	185	205	410
15'	13	22	31	35	44	53	66	88	110	132	154	176	198	220	440
16'	14	23	33	48	47	56	70	94	117	140	164	188	211	235	469
18'	16	26	37	42	53	63	80	106	132	158	185	212	238	264	528
20'	18	29	41	47	59	70	88	118	147	176	205	235	264	293	587
22'	19	32	45	52	65	77	97	129	161	194	226	258	290	323	645
24'	1	35	49	56	70	84	105	141	176	212	246	282	317	352	704
25'	22	37	51	59	73	88	110	147	183	220	257	294	330	366	733
26'	23	38	53	61	76	92	114	152	191	228	267	305	343	381	762
28'	25	41	57	66	82	99	123	164	205	246	287	328	370	410	820
30'	26	44	62	70	88	106	132	176	220	264	308	352	396	440	880

Table 5

STORAGE CAPACITY (IN TONS) OF CONE-OR TENT-SHAPED STOCKPILES OF SAND OR GRAVEL

STORAGE CAPACITY (IN TONS) OF CONE -OR TENT- SHAPED STOCKPILES OF SAND OR GRAVEL

Base Width (Diameter) in Feet

Length of Stockpile in Feet	10	15	20	25	30	35	40	45	50	55	60	65	70	75	
10	5														
12.5	7	-													
15	10	17													
17.5	12	22	-												
20	13	27	39												
22.5	17	33	49	-											
25	19	38	58	77											
27.5	21	43	68	92	-										
30	21	48	77	110	130										
32.5	26	54	87	120	150	-									
35	28	59	96	140	180	210									
37.5	31	64	110	150	200	240	-								
	40	33	70	120	170	220	270	320							
	42.5	36	75	120	180	240	300	350	-						
45	38	80	130	200	260	330	390	450							
47.5	40	86	140	210	280	360	430	500	-						
50	43	91	150	220	300	380	470	540	620						
52.5	45	96	160	240	320	410	500	590	670	-					
55	47	100	170	250	340	440	540	640	730	820					
57.5	50	110	180	270	370	470	580	690	790	890	-				
60	52	110	190	280	390	500	620	760	850	960	1100				
62.5	54	120	200	300	410	530	650	780	910	1000	1100	-			
65	57	120	210	310	430	560	690	830	970	1100	1200	1400			
67.5	59	130	220	330	450	590	730	880	1000	1200	1300	1500	-		
70	61	130	230	340	470	610	770	930	1100	1200	1400	1600	1700		
72.5	64	140	240	360	490	640	800	970	1100	1300	1500	1700	1800	-	
75	66	140	250	370	510	670	840	1000	1200	1400	1600	1800	1900	2100	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	

WIDTH (DIAMETER)

LENGTH

When length and width are equal, the stockpile is cone shaped.

WIDTH (DIAMETER)

LENGTH

Base Width (diameter) in Feet

For each additional 10 feet beyond the 75-foot length in this table, add the following values.

9	21	38	59	85	115	150	190	235	285	340	400	460	530

Table 6

STORAGE CAPACITY (IN TONS) OF CONE -OR TENT- SHAPED STOCKPILES OF CHRUSHED STONE

Base Width (Diameter) in Feet

Length of Stockpile in Feet	10	15	20	25	30	35	40	45	50	55	60	65	70	75	
10	5														
12.5	8	-													
15	11	19													
17.5	13	24	-												
20	16	30	44												
22.5	19	36	54	-											
25	21	42	65	86											
27.5	24	48	75	100	-										
30	26	54	86	120	150										
32.5	29	60	96	130	170	-									
35	32	66	110	150	200	240									
37.5	34	72	120	170	220	270	-								
40	37	78	130	180	240	300	350								
42.5	40	83	140	200	270	330	390	-							
45	42	89	150	220	290	360	440	500							
47.5	45	95	160	230	310	400	480	550	-						
50	47	100	170	250	340	430	520	610	690						
52.5	50	110	180	270	360	460	560	660	750	-					
55	53	110	190	280	390	490	600	710	820	910					
57.5	55	120	200	300	400	520	640	770	880	990	-				
60	58	110	210	320	430	560	690	820	950	1100	1200				
62.5	61	130	220	330	450	590	730	870	1000	1200	1300	-			
65	63	140	230	350	480	620	770	920	1100	1200	1400	1500			
67.5	66	140	240	360	500	650	800	980	1100	1300	1500	1600	-		
70	68	150	250	380	530	680	850	1000	1200	1400	1600	1700	1900		
72.5	71	150	260	400	550	720	900	1100	1300	1500	1700	1800	2000	-	
75	74	160	270	410	570	750	940	1100	1300	1500	1800	2000	2100	2300	
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	

Base Width (Diameter) in Feet

For each additional 10 feet beyond the 75-foot length in this table, add the following values.

11	24	42	66	94	130	170	210	260	315	375	445	515	590	

Table 7
LOOSE AND COMPACTED WEIGHTS OF VARIOUS MATERIALS

Type of Material	Loose: Pounds Per Cubic Foot	Loose: Pounds Per Cubic Yard	Loose: Approximate Pounds Per Square Yard Per 1-Inch Depth	Compacted: Pounds Per Cubic Foot	Compacted: Pounds Per Cubic Yard	Compacted: Approximate Pounds Per Square Yard Per 1-Inch Depth
Trap Rock	96	2590	72	122	3300	92
	100	2690	75	127	3420	95
	103	2780	77	131	3540	98
Granite or Limestone	90	2410	67	113	3060	85
	93	2500	69	118	3180	88
	96	2590	72	122	3300	92
Sandstone	82	2220	62	105	2830	79
	86	2320	64	109	2950	82
	90	2410	66	113	3060	85
	93	2500	70	118	3180	88
Sand	97	2630	73	105	2830	79
	101	2740	76	109	2950	82
	106	2850	79	113	3060	85
	110	2960	82	118	3180	88
Slag	55	1480	41	70	1890	53
	65	1760	49	83	2240	62
	76	2040	57	96	2590	72
	86	2320	64	109	2950	82
Asphalt Concrete	91	2480	69	115	3100	86
	100	2700	75	130	3510	97
	116	3130	87	145	3910	109
	128	3460	96	160	4320	120

Table 8

POUNDS OF AGGREGATE REQUIRED PER SQUARE YARD FOR VARIOUS CUBIC YARD WEIGHTS

Pounds of Aggregate Per Cubic Yard	Pounds of Compacted Aggregate Per Square Yard for Various Depths in Inches											
	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12
1800	50	100	150	200	250	300	350	400	450	500	550	600
1900	53	106	158	211	264	317	369	422	475	528	581	633
2000	56	111	167	222	278	333	389	444	500	556	611	667
2100	58	117	175	233	292	350	408	467	525	583	642	700
2200	61	122	183	244	306	367	428	489	550	611	672	733
2300	64	128	192	256	319	383	447	511	575	639	703	767
2400	67	133	200	267	333	400	467	533	600	667	733	800
2500	69	139	208	278	347	417	486	556	625	694	764	833
2600	72	144	217	289	361	433	506	578	650	722	794	867
2700	75	150	225	300	375	450	525	600	675	750	825	900
0800	78	156	233	311	389	467	544	622	700	778	856	933
2900	81	161	242	322	403	483	564	644	725	806	886	967
3000	83	167	250	333	417	500	583	667	750	833	917	1000
3100	86	172	258	344	431	517	603	689	775	861	947	1033
3200	89	178	267	356	444	533	622	711	800	889	978	1067
3300	92	183	275	367	458	550	642	733	825	917	1008	1100
3400	94	189	283	378	472	567	561	756	850	944	1039	1133
3500	97	194	292	389	486	583	681	778	875	972	1069	1167
3600	100	200	300	400	500	600	700	800	900	1000	1100	1200

Table 9

CUBIC YARDS OF MATERIAL REQUIRED PER 100 LINEAL FEET FOR VARIOUS LOOSE DEPTHS

Width of Area in Feet	Cubic Yards of Loose Aggregate Required for Various Depths in Inches														
	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	6"	8"	10"	12"
8'	1.2	1.9	2.5	3.7	4.9	6.2	7.4	8.6	9.9	11.1	12.3	14.8	19.8	24.7	29.6
9'	1.4	2.1	2.8	4.2	5.6	6.9	8.3	9.7	11.1	12.5	13.9	16.7	22.2	27.8	33.3
10'	1.5	2.3	3.1	4.6	6.2	7.7	9.3	10.8	12.3	13.9	15.4	18.5	24.7	30.9	37.0
11'	1.7	2.5	3.4	5.1	6.8	8.5	10.2	11.9	13.6	15.3	17.0	20.4	27.2	34.0	40.7
12'	1.9	2.8	3.7	5.6	7.4	9.3	11.1	13.0	14.8	16.7	18.5	22.2	29.6	37.0	44.4
14	2.2	3.2	4.3	6.5	8.6	10.8	13.0	15.1	17.3	19.4	21.6	25.9	34.6	43.2	51.9
15'	2.3	3.5	4.6	6.9	9.3	11.6	13.9	16.2	18.5	20.8	23.1	27.8	37.0	46.3	55.6
16'	2.5	3.7	4.9	7.4	9.9	12.3	14.8	17.3	19.8	22.2	24.7	29.7	39.5	49.4	59.3
18'	2.8	4.2	5.6	8.3	11.1	13.9	16.7	19.4	22.2	25.0	27.8	33.3	44.4	55.6	66.7
20'	3.1	4.6	6.2	9.3	12.3	15.4	18.5	21.6	24.7	27.8	30.9	37.0	49.4	61.7	74.1
22'	3.4	5.1	6.8	10.2	13.6	17.0	20.4	23.8	27.2	30.6	34.0	40.7	54.3	67.9	81.5
24'	3.7	5.6	7.4	11.1	14.8	18.5	22.2	25.9	29.6	33.3	37.0	44.4	59.3	74.1	88.9
25'	3.9	5.8	7.7	11.6	15.4	19.3	23.1	27.0	30.9	34.8	38.6	46.3	61.7	77.2	92.6
26'	4.0	6.0	8.0	12.0	16.0	20.1	24.1	28.1	32.1	36.1	40.1	48.1	64.2	80.2	96.3
28'	4.3	6.5	8.6	13.0	17.3	21.6	26.0	30.2	34.6	38.9	43.2	51.9	69.1	86.4	103.7
30'	4.6	6.9	9.3	13.9	18.6	23.1	27.8	32.4	37.0	41.7	46.3	55.6	74.1	92.6	111.1

Table 10
CUBIC YARDS OF MATERIAL REQUIRED PER FOOT FOR A TYPICAL CULVERT INSTALLATION

Depth of Cut to Flow Line (In Feet)	D =	12"	15"	18"	24"	30"	36"	42"	48"	60"
	t =	2"	2 1/4"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	
D = Diameter of Pipe		2'	0.19	0.16	0.12	-	-	-	-	-
		3'	0.32	0.29	0.25	0.23	0.18	-	-	-
t = thickness of Pipe		4'	0.45	0.42	0.38	0.38	0.36	0.32	0.26	-
Road Surface		5'	0.59	0.56	0.52	0.54	0.54	0.53	0.49	0.42
		6'	0.62	0.69	0.65	0.69	0.72	0.74	0.73	0.68
D = 2t = 12"		7'	0.85	0.82	0.78	0.85	0.90	0.95	0.96	0.94
36" Minimum Depth		8'	0.99	0.96	0.92	1.00	1.09	1.16	1.19	1.20
of		9'	1.12	1.09	1.05	1.16	1.27	1.36	1.43	1.46
Cut		10	1.25	1.22	1.18	1.31	1.45	1.57	1.66	1.72
D t		11'	1.39	1.36	1.32	1.47	1.63	1.78	1.90	1.98
D/4		12'	1.52	1.49	1.45	1.62	1.81	1.98	2.13	2.24
Flow Line										

Table 11
CONVERSION FACTORS - LENGTH MEASUREMENTS

To Convert	To	Multiply By
Inches	Feet	0.08
Inches	Yards	0.03
Feet	Inches	12
Feet	Yards	0.33
Feet	Rods	0.06
Yards	Inches	36
Yards	Feet	3
Yards	Rods	0.18
Rods	Inches	198
Rods	Feet	16.5
Rods	Yards	5.5
Miles	Feet	5280
Miles	Yards	1760
Miles	Rods	320

Table 12
CONVERSION FACTORS - VOLUME MEASUREMENTS

To Convert	To	Multiply By
Cubic Feet	Cubic Inches	1728
Cubic Feet	Cubic Yards	0.04
Cubic Feet	Gallons	7.48
Cubic Yards	Cubic Feet	27
Cubic Yards	Gallons	202
Quarts	Pints	8
Quarts	Gallons	0.25
Gallons	Pints	8
Gallons	Pints	4
Gallons	Cubic Feet	0.13

Table 13
CONVERSION FACTORS - AREA MEASUREMENTS

To Convert	To	Multiply By
Square Inches	Square Feet	0.007
Square Feet	Square Inches	144.00
Square Feet	Square Yards	0.11
Square Yards	Square Inches	1,296.00
Square Yards	Square Feet	9.00
Square Yards	Square Rods	0.03
Square Rods	Square Feet	272.25
Square Rods	Square Yards	30.25
Acres	Square Feet	43,560.00
Acres	Square Yards	4,840.00
Acres	Square Rods	160.000

Table 14
CONVERSION FACTORS - WEIGHTS AND OTHER MEASUREMENTS

To Convert	To	Multiply By
Ounces	Pounds	0.06
Pounds	Ounces	16.00
Tons (short)	Pounds	2,000.00
Tons (long)	Pounde	2,240.00
Miles/Hour	Feet/Minute	88.00
Miles/Hour	Feet/Second	1.47
Meters	Inches	39.37
Meters	Feet	3.28
Meters	Yards	1.09
Meters	Rods	0.20

Table 15
CONVERSION FACTORS - COMMON FRACTIONS TO DECIMAL NUMBERS

DECIMAL		DECIMAL		DECIMAL		DECIMAL	
FRACTION	EQUIVALENT	FRACTION	EQUIVALENT	FRACTION	EQUIVALENT	FRACTION	EQUIVALENT
1/2	25	1/7	.14	4/10	.4	11/12	.92
1/3	.33	2/7	.29	5/10	.5	1/16	.06
2/3	.67	3/7	.43	6/10	.6	2/16	.13
1/4	.25	4/7	.57	7/10	.7	3/16	.19
2/4	.5	5/7	.71	8/10	.8	4/16	.25
3/4	.75	6/7	.86	9/10	.9	5/16	.31
1/5	.2	1/8	.13	1/12	.08	6/16	.38
2/5	.4	2/8	.25	2/12	.17	7/16	.44
3/5	.6	3/8	.38	3/12	.25	8/16	.50
4/5	.8	4/8	.5	4/12	.33	9/16	.56
1/6	.17	5/8	.63	5/12	.42	10/16	.63
2/6	.33	6/8	.75	6/12	.50	11/16	.69
3/6	.50	7/7	.88	7/12	.58	12/16	.75
4/6	.67	1/10	.1	8/12	.67	13/16	.81
5/6	.83	2/10	.2	9/12	.75	14/16	.88
3/10	.3	10/12	.83	15/16	.94		

Table 16
QUANTITY AND COST ESTIMATION FOR ASPHALT PAVING

THICKNESS	LBS SQ. YARD	TONS SQ. YARD	$ PRICE PER TON OF MIX													
			COSTS PER SQUARE YARD													
1"	110	.0550	0.33	0.36	0.39	0.41	0.44	0.47	0.50	0.52	0.55	0.66	0.78	0.88	1.00	1.10
1 1/2"	165	.0825	0.50	0.54	0.58	0.62	0.66	0.70	0.74	0.78	0.83	1.00	1.16	1.32	1.48	1.66
2"	220	.1100	0.66	0.72	0.77	0.83	0.88	0.94	0.99	1.05	1.10	1.32	1.54	1.76	1.98	2.20
2 1/2"	275	.1375	0.83	0.89	0.96	1.03	1.10	1.17	1.24	1.31	1.38	1.66	1.92	2.20	2.48	2.76
3"	330	.1650	0.99	1.07	1.16	1.24	1.32	1.40	1.48	1.57	1.65	1.98	2.32	2.64	2.96	3.30
3 1/2"	385	.1925	1.16	1.25	1.35	1.45	1.54	1.64	1.74	1.83	1.93	2.32	2.70	3.08	3.48	3.86
4"	440	.2200	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.08	2.20	2.64	3.08	3.52	3.96	4.40
4 1/2"	495	.2475	1.49	1.60	1.73	1.86	1.98	2.10	2.23	2.35	2.48	2.98	3.46	3.96	4.46	4.96
5"	550	.2750	1.65	1.79	1.92	2.06	2.20	2.34	2.48	2.61	2.75	3.30	3.84	4.40	4.96	5.50
5 1/2"	605	.3025	1.82	1.97	2.12	2.27	2.42	2.57	2.72	2.88	3.03	3.64	4.24	4.84	5.44	6.06
6"	660	.3300	1.98	2.14	2.31	2.48	2.64	2.81	2.97	3.14	3.30	3.96	4.62	5.28	5.94	6.60
6 1/2"	715	.3575	2.15	2.32	2.50	2.68	2.86	3.04	3.22	3.40	3.58	4.30	5.00	5.72	6.44	7.16
7 1/2"	825	.4125	2.48	2.68	2.88	3.09	3.30	3.50	3.71	3.92	4.13	4.96	5.76	6.60	7.42	8.26
8"	880	.4400	2.64	2.86	3.08	3.30	3.52	3.74	3.96	4.18	4.40	5.28	6.16	7.04	7.92	8.80
8 1/2"	935	.4675	2.81	3.04	3.27	3.51	3.74	3.97	4.21	4.45	4.68	5.62	6.54	7.48	8.42	9.36
7"	770	.3850	2.31	2.50	2.70	2.89	3.08	3.27	3.46	3.66	3.85	4.62	5.40	6.16	6.92	7.70
9"	990	.4950	2.97	3.22	3.46	3.71	3.96	4.20	4.45	4.70	4.95	5.94	6.92	7.92	8.90	9.90
9 1/2"	1045	.5225	3.14	3.40	3.66	3.92	4.18	4.44	4.70	4.96	5.23	6.28	7.32	8.36	9.40	10.46
10"	1100	.5500	3.30	3.58	3.85	4.13	4.40	4.68	4.95	5.23	5.50	6.60	7.70	8.80	9.90	11.00

POUNDS PER SQUARE YARD ARE BASED ON A YIELD OF 110 LBS. PER SQUARE PER INCH

NOTES:

PRECONSTRUCTION CONFERENCE AGENDA AND MINUTES

_____ _____
Contracting Agency Contractor

DATE: _____

PROJECT: _____

LOCATION: _____

ATTENDANCE:

1. The following personnel will be administering the project:

   (1)

   (2)

   (3)

2. Contractor Representatives:

   (1)

   (2)

   (3)

3. The following subcontractors will be used on the project:

   (1)

   (2)

   (3)

4. Project Time Count: Begin: _____Working Days __

5. Project Schedule:

6. Utilities Involved:

7. Haul routes and type of equipment:

8. Traffic Control

   Traffic Control Supervisor: _____

   Method of handling traffic: _____

9. Reduction of speed limit:

10. Sources of materials and supplies:

11. Alternate materials to be used:

12. Special provisions and general conditions:

13. Right-of-way considerations:

14. Monthly progress estimates:

    The contractor shall invoice Arapahoe County on a monthly basis on the proper forms outlined in the Contract Documents.

    Estimate date: _____

CONSTRUCTION ENGINEERING MEMO

CONTRACTING AGENCY: _____

TO: _____

ATTENTION: _____

PROJECT: _____ DATE: _____

_____

_____

_____

_____

Signed: _____

Title: _____

CONTRACTOR'S COMMEMTS:

Received By: _____

PROJECT DIARY

CONTRACTING AGENCY: _____

Total days charged to date:____

Project:_____ Date: _____, 19_

Hrs worked: ___Approx. No. Emp: ___Weather: ____Temp: ___

Time lost & reason:

Superintendent: _____

_____

_____

_____

_____

_____

_____

Signing and Barricading _____

Traveled Roadway Condition _____

Signed _____ Title _____

RECORD OF CONVERSATION

PROJECT: _____

Incoming Call ___ Outgoing Call ___ Office Visit ___ Field Visit ___

To/From _____ Title: _____

Company: _____ Phone No: _____

Subject: _____

By: _____ Date: _____ Time: _____

Summary of Discussion:

_____

_____

_____

_____

_____

Instructions Issued Or Conclusions Determined:

_____

_____

_____

_____

_____

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MATERIALS

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901 AGGREGATES:

901.1 CONCRETE AGGREGATES:

The grading and composition requirements for coarse and fine aggregates for concrete shall conform to the following tables.

COARSE AGGREGATES FOR PORTLAND CEMENT CONCRETE	
SIEVE SIZE OR TEST PROCEDURE	PERCENT PASSING OR TEST REQUIREMENT
2"	100
1½	95-100
¾"	35-70
⅜"	10-30
#4	0-5
#200	1.0, Max.
% Wear	45, Max.
Clay Lumps * Friable Particles, %	2.0, Max.
Coal & Lignites, %	0.5, Max.
Sodium Sulfate Soundness %	12, Max.

FINE AGGREGATES FOR PORTLAND CEMENT CONCRETE	
SIEVE SIZE OR TEST PROCEDURE	PERCENT PASSING OR TEST REQUIREMENT
3/8"	100
No. 4	95-100
No. 16	44-80
No. 50	10-30
No. 100	2-10
No. 200	3, Max.
Friable Particles, %	1.0, Max.
Coal & Lignites, %	1.0, Max.
Deleterious Material	3, Max.
(AASHTOT11), %	80, Min.
Sand Equivalent (AASHTO	2.50-3.50
T176), %	20.0, Max.
Fineness Modulus	
Sodium Sulfate Soundness, %	

901.1.1 Coarse Aggregate for Concrete

Coarse aggregate for concrete shall conform to the requirements of AASHTO M 80, except that the percentage of wear shall not exceed 45 when tested in accordance with AASHTO T 96. Coarse aggregate shall conform to the grading in above table.

901.1.2 Fine Aggregate for Concrete:

Fine aggregate for concrete shall conform to the requirements of AASHTO M 6. The amount of deleterious substances removable by elutriation shall not exceed 3 percent by dry weight of fine aggregate when tested in accordance with AASHTO T 11, unless otherwise specified. The minimum Sand Equivalent, as tested in accordance with AASHTO T 176 shall be 80, unless otherwise specified. The Fineness Modulus shall not be less than 2.50 nor greater than 3.50, unless otherwise approved.

901.2 AGGREGATE FOR BASES:

901.2.1 Aggregate Base Course Material:

This material shall consist of hard, durable particles or fragments of stone or gravel, crushed to required sizes, containing an appropriate quantity of sand or other finely-divIded mineral matter which conform to the requirements of AASHTO M 147, and to Section 703.03, CDOH Standard Specifications. In addition, the material must have an R-value of 78 or greater of a CBR or 80+ and must be moisture stable. Moisture stability is determined by R-value testing which shows a drop of 12 points or less in R-value between exudation pressures of 300 psi and 100 psi.

Only aggregate from OWNER approved sources shall be used, unless otherwise approved in writing by the OWNER. Approval of sources will be at the discretion of the OWNER and submissions will, at a minimum, consist of supplying documented gradation, Atterberg limits and CBR/R-value testing on an annual basis.

Only two (2) types of crushed aggregate base course are acceptable. The gradation specifications for these two types of base course are listed below:

AGGREGATES BASE COURSE MATERIALS		
SIEVE SIZE	PERCENT PASSING	
	CLASS 5	CLASS 6
1 ½"	100	
1"	95-100	
3/4		100
No. 4	30-70	30-65
No. B		25-55
No. 200 *	3-15	3-12
Liquid Limit (LL)	30 Maximum	30 Maximum
*ASTM (C117)		

901.2.2 Cement Treated Aggregate Base Course:

This material shall consist of a mixture of aggregate materials, Portland cement and water as outlined in Section 308 of the CDOH Standard Specifications (latest revision). Acceptable aggregates include CDOH Classes 4,5, and 6. Other aggregates may be used, if previously approved by the ENGINEER.

The materials to be used in construction shall be tested and a mix design submitted to the ENGINEER. As a minimum, the mix design report shall contain a description of material sources, gradations and Atterberg Limits of Aggregates, cement type, Proctor compaction curves and unconfined compressive strength results for each mix, strength versus cement content curves, a design mix and special construction procedures recommended. Testing shall be in accordance with appropriate AASHTO specification.

To be approved, the mix shall have a 7 day compressive strength of at least 650 psi and no more than 1,000 psi. The minimum acceptable cement content shall be 5 percent by weight. Only mix designs approved by the OWNER shall be used. Approvals are required on a project basis, or an annual basis for suppliers.

901.4 AGGREGATE FOR COVER COAT MATERIAL:

Aggregate for cover coat material shall be crushed stone, crushed slag, or crushed or natural gravel. Aggregates shall be composed of clean, tough, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces and free from fragments coated with dirt or other objectionable matter. Slag shall be air cooled blast-furnace slag, reasonably uniform in density.

The aggregate shall conform to the following requirements:

(a) Percentage of wear, Los Angeles Test (AASHTO T 96), not more than 40.

(b) Weight per cubic foot, pounds (blast-furnace slag), not less than 70.

(c) At least 50 percent of the gravel retained on the No. 4 sieve shall have at least one fractured face, except that natural gravel need not adhere to this requirement.

Only one type of aggregate shall be used on the project, unless alternate types are approved.

When tested in accordance with AASHTO T 182, aggregate shall have a retained bituminous film above 95 percent.

GRADATION
SPECIFICATIONS FOR COVER
COAT AGGREGATE

SIEVE SIZE OF DESIGNATION	PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVES OF THE INDICATED SIZES			
	TYPE I	TYPE II	TYPE III	TYPE IV
3/4 inch	100	---	---	---
1/2 inch	95-100	100	100	100
3/8 inch	40-70	90-100	---	70-100
1/4 inch	---	45-70	---	25-50
No. 4	0-10	---	0-40	---
No. 8	0-3	0-4	0-10	0-4
No. 16	---	---	---	---
No. 30	---	---	---	---
No. 100	---	---	---	---
No. 200	0-2	0-2	0-2	0-2

901.5 MINERAL FILLER:

Mineral filler shall conform to the requirements of AASHTO M 17 and shall consist of rock, dust, slag dust, hydrated lime, hydraulic cement, fly ash or other suitable mineral matter. It shall be free of organic impurities and agglomerations. When used, it shall be dry enough to flow freely.

Mineral filler shall be graded within the following limits:

SIEVE	MASS PERSENT PASSING
No. 30	100
No. 50	95-100
No. 200	70-100

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Mineral filler shall have a plasticity index not greater than 4 excluding hydrated lime and hydraulic cement.

901.6 STRUCTURE BACKFILL MATERIAL:

(a) Class 1 structure backfill shall meet the following requirements when tested with laboratory sieves:

SIEVE DESIGNATION	% BT WEIGHT PASSING LAB SIEVES
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

In addition, this material shall have a liquid limit not exceeding 35 and a platicity index of not over 6 when determined in conformity with AASHTO T 89 and T 90 respectively.

(b) Class 2 structure backfill shall meet the following requirements when tested with laboratory sieves:

CLASS 2 STRUCTURAL BACKFILL

SIEVE DESIGNATION	DRY SITES % BY WEIGHT PASSING LAB SIEVS	WET SITES % BY WEIGHT PASSING LAB SIEVS
2 inch	100	100
No. 4	30-100	90-100
No. 50	10-60	10-60
No. 200	5-20	0-2

In addition, this material shall have a Liquid Limit not exceeding 25 and a Plasticity Index of not over 6 when determined in conformity with AASHTO T 89 and T 90, respectively.

901.7 AGGREGATE FOR PIPE BEDDING:

Aggregate for bedding potable water pressure transmission pipe, non-potable water pressure transmission pipe, gravity flow sanitary sewer pipe, gravity flow storm sewer pipe, and gravity flow surface drainage pipe (culverts) shall be crushed rock, gravel, sand and soil or a combination thereof, conforming to the gradation range set forth in the following table as shown on the Plans, Standard Details or defined in the Special Conditions. All materials shall be free of frozen lumps and organic materials that, in the opinion of the ENGINEER, will be injurious to the pipe.

GRADATION TABLE FOR PIPE BEDDING

SIEVE SIZE DESIGNATION	PERCENTAGE PASSING DESIGNATED SIEVES AND NOMINAL SIZE AASHTO M 43 OR ASTM C 33 OR ASTM D 448						SQUEEGEEOR CRUSHER FINES
	No. 4	No. 6	No. 7	No. 8	No. 57	No. 67	
2		100	---	---	---	---	---
1 ½	90-100	---	---	---	---	---	---
1"	20-55	100	---	---	100	100	---
¾"	0-15	90-100	100	---	90-100	90-100	---
½"	---	20-55	90-100	100	---	---	---
⅜"	0-5	5-15	40-70	85-100	20-55	20-55	100
No. 4	---	0-5	0-15	10-30	0-10	0-10	30-100
No. 8	---	---	0-5	0-10	0-5	0-5	---
No. 16	---	---	---	0-5	---	---	0-10

901.8 AGGREGATE FOR PIPE BACKFILL:

Aggregate for backfilling potable water pressure transmission pipe, non-potable water pressure transmission pipe, gravity flow sanitary sewer pipe, gravity flow storm sewer pipe, and gravity flow surface drainage pipe (culverts) shall be soil or soil aggregate mixtures conforming to Subsection 901.7 or materials developed on the site that are acceptable to the ENGINEER.

901.9 FILTER MATERIAL:

Filter material for gravity flow subsurface drainage pipe shall consist of free draining sand, gravel, slag or crushed stone conforming to the grading requirements set forth in the following table:

GRADATION SPECIFICATIONS
FOR FILTER MATERIAL

SIEVE SIZE DESIGNATION	PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVES		
	CLASS A[1]	CLASS B	CLASS C
3"	100	---	---
1½"	---	100	---
¾"	20-90	---	100
No. 4	0-20	20-60	60-100
No. 16	---	10-30	---
No. 50	---	0-10	10-30
No. 100	---	---	0-10
No. 200	0-3	0-3	0-3

[1] 3" material shall not be placed within 6" of the subsurface drainage pipe.

The ENGINEER shall determine the class of filter material during the progress of construction unless otherwise defined in the Special Conditions.

901.10 AGGREGATE FOR PLANT MIXED SEAL COAT:

Aggregates for plant mixed seal coat shall consist of clean, hard, durable fragments of crushed stone, crushed gravel, or crushed slag. When crushed gravel is used, at least 90 percent by weight of the particles retained on the No. 4 sieve shall have at least one fractured face when tested in accordance with Colorado Procedure 45. The aggregate shall have a percentage of wear of not more than 45 when tested in accordance with AASHTO T 96.

The aggregates for the mixture shall be graded and combined in such proportions that the resulting composite blend meets the requirements of the job-mix formula for the project. The job-mix formula with the allowable tolerances shall be within the master range set forth in the following table:

MASTER RANGE TABLE FOR
PLANT MIXED SEAL COAT

SIEVE DESIGNATION	RANGES OF JOB-MIX TOLERANCES	PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVE		
		TYPE A OPEN GRADED	TYPE B MEDIUM GRADED	TYPE C DENSE GRADED
½"		100	100	100
⅜"		97-100	97-100	97-100
No. 4	± 8%	30-50	40-65	77-97
No. 8	± 6%	5-20	20-47	60-83
No. 50	± 6%	---	4-18	16-40
No. 500	± 2%	2-7	2-9	4-11

901.11 QUALITY CONTROL:

Aggregate testing and testing laboratory services required shall conform to the applicable portions of Section 801 unless otherwise defined in the Special Conditions.

The CONTRACTOR may be required to submit certification signed by the aggregate producer. The certification shall include a statement that all aggregates conform to the requirements of the applicable Quality Standards and set forth the gradation furnished.

Materials developed on-site shall be approved by the ENGINEER before being incorporated in the Work.

901.12 METHOD OF MEASUREMENT:

Aggregates normally are subsidiary materials to other Bid Items and are not measured or paid for as aggregates.

Aggregates materials which are listed as specific Bid Items in the Proposal shall be measured by the Ton.

901.13 BASIS OF PAYMENT:

Aggregate materials which are listed as specific Bid Items in the Proposal shall be paid for at the Contract Unit Price per ton, and shall include all equipment, labor and incidental costs thereto.

903 RIPRAP:

Rock used for riprap or wire enclosed riprap shall be hard, durable, angular in shape, and be free from cracks, overburden, shale and organic matter. Neither breadth nor thickness of a single stone shall be less than 1/3 its length and rounded stone shall not be used. The rock shall sustain a loss of not more than 40% after 500 revolutions in an abrasion test (Los Angeles machine - ASTM C-535) and shall sustain a loss of not more than 10% after 12 cycles of freezing and thawing (AASHTO test 103 for ledge rock procedure A). Rock having a minimum specific gravity of 2.65 is preferred; however, in no case should rock have a specific gravity less than 2.50. Classification and gradation for riprap are shown in the following table and figure and are based on minimum specific gravity of 2.50 for the rock. Because of its relatively small size and weight, riprap bypes VL and L must be buried with native soil and revegetated to protect the rock from vandalism.

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d50 * (INCHES)
Type VL	70-100 50-70 35-50 2-10	12 9 6 2	6 **
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9 **
Type M	70-100 50-70 35-50 2-10	21 18 12 4	12
Type H	100 50-70 35-50 2-10	30 24 18 6	18
Type VH	100 50-70 35-50 2-10	42 33 24 9	24

* d50 = Mean particle size

** Bury types VL and L with native top soil and revegetate to protect from vandalism.

From Urban Drainage and Flood Control District Standard

909 HYDRATED LIME:

Hydrated lime shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200-mesh sieve shall not exceed 10% when determined in accordance with ASTM C 100. (Drying of the residue in an atmosphere free from carbon dioxide will not be required).

910 HOT BITUMINOUS PAVEMENT:

This material shall consist of a mixture of aggregate, filler (if required) and asphalt cement. The aggregate mixture shall meet the grading requirements of the job mix formula. Tests on the aggregates for cleanliness, abrasion loss and fractured faces shall meet the requirements shown below. The job mix formula shall establish a single percent passing each sieve size, an optimum percent of asphalt cement to be added to the aggregate and a recommended mix temperature when discharged at the plant.

MATERIAL SPECIFICATIONS FOR HOT BITUMINOUS PAVEMENT

SIEVE SIZE OR TEST PROCEDURE	MATERIALS SPECIFICATIONS FOR HOT BITUMINOUS PAVEMENT	
	E MIX	EX MIX
3/4"	100	---
1/2"	---	100
No. 4	38-72	45-78
No. 8	25-58	30-60
No. 200	3-12	3-12
% Wear, AASHTO T-96	45, Max.	45, Max.
One Crushed Face on +4	50, Max	50, Min.
Index of Retained Strength ASTM D-1075	75, Min.	75, Min.

(a) Aggregates shall not contain clay balls, organic matter, or other deleterious substances.

(b) After the job mix formula is established, all mix furnizhed for the project shall conform to it within the following range of tolerances.

MIX TOLERANCES	
Max. Size	± 0 percentage points
Passing No. 8 and Larger	± 8 percentage points
No. 8 to No. 100	± 6 percentage points
Passing No, 200	± 3 percentage points
Asphalt Content	± 0.5 percentage points
Discharged Mix Temperature	+ 20°F

used to meet the requirement for Index of Retained Strength, if necessary. Such additives may be hydrated lime, Type I Portland cement, or anti-stripping agents approved by the Department of Highways.

(d) The asphalt cement used shall be grade AC-10.

A mix design, including the job mix formula, shall be submitted for review and approval a minimum of seven (7) days prior to placing mix on the project. The mix design shall be performed using either the Marshall or Hveem Procedures as outlined in The Asphalt Institute's, "Mix Design Methods for Asphalt Concrete" (MS-2). Mix design parameters for each of the procedures are shown in the following table:

MIX DESIGN CRITERIA

TEST	MARSHALL (50 BLOWS) AASHTO T 245	HVEEM AASHTO T 246
Strength or Stability	1,500 lbs	R1 90+, Min.
Flow, 0.01"	8-18	8-18
VMA, (E mix)	14, Min.	14, Mim.
VMA, (EX Mix)	15, Min.	15, Min.
Air Voids, Total Mix, %	3-6	3-6

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911 PAVING ASPHALT:

911.1 ASPHALT CEMENTS:

Asphalt cements shall conform to the requirements of AASHTO M 226, Table 1. Asphalt for dampproofing shall conform to the requirements of AASHTO M 115.

911.2 TARS:

Tars for road construction shall conform to the requirements of AASHTO M 52. Tars for dampproofing shall conform to AASHTO M 118.

912 LIQUID ASPHALTIC MATERIALS:

Liquid asphaltic materials shall conform to the requirements of AASHTO M 81, M 82, and ASTM D 2026 for the designated types and grades. Primer for dampproofing shall meet the requirements of AASHTO M 116.

913 EMULSIFIED ASPHALTS AND REJUVENATING AGENTS:

913.1:

Emulsified asphalts shall conform to AASHTO M 140 and M 208 for the designated types and grades. Emulsified asphalt for tack coat, Grade SCC-1h shall conform to AASHTO M 208 except that the penetration requirements of the residue shall be minimum 40 to maximum 120.

913.2:

Asphalt rejuvenating agent shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the following physical and chemical requirements.

SPECIFICATION DESIGNATION	TEST METHOD REQUIREMENTS	
Viscosity, S.F., at 77°F., Sec.	ASTM D 244	15-40
1 Residue, % Min	ASTM D 244	60-65
2 Miscibility Test	ASTM D 244	No coagulation
3 Sieve Test, % Max	ASTM D 244	0.10
Particle Charge Test	ASTM D 244	Positive
Tests on Residue from ASTM D 244 (Mod):		
Viscosity, c.s., 140oF	ASTM D 445	100-200
Asphaltenes, % Max	ASTM D 2006-70	0.75
4 Maltenes Dist. PC+A1	ASTM D 244	0.3-0.5
RATIO S + A2		

1 ASTM D244 Modified Evaporation Test for percent of residue is made by heating 50 gram sample to 300°F. until foaming ceases, then cool immediately and calculate results.

2 Test procedure identical with ASTM D244 except that .02 Normal Calcium Chloride solution shall be used in place of distilled water.

3 Test procedure identical with ASTM D244 except that distilled water shall be used in place of 2% sodium oleate solution.

4 In the Maltenes Distribution Ratio Test by ASTM Method D 2006-70

PC = Polar Compounds
A1 = First Acidaffins
A2 = Second Acidaffins
S = Saturates

913.3 SAMPLING AND TESTING:

(a) Refinery Samples and Certificates of Compliance:

Refineries, and jobbers or distributors supplying the project from large central storage facilities, shall obtain a one-quart sample from each loaded conveyance destined directly for the project. This sample, together with a serial-numbered Certificate of Compliance (C.O.C.) in duplicate on forms supplied by the OWNER, shall accompany the conveyance to the project. Both the label or tag on the refinery sample and the C.O.C. shall include the following:

1. Shipment identification number.
2. Storage tank or blend number from which shipment was drawn.

(b) Certified Analysis:

Within 10 days of first shipment of material to the project, a single copy of a clearly legible Certified Analysis typical of each storage tank or blend shall be sent directly to the OWNER.

One Certified Analysis may cover any number of shipments to various projects so long as it is representative of the material being supplied. Whenever material is added to the storage tank or there is a significant change in blend proportions or base stocks, a new Certified Analysis shall be submitted within 10 days of the first shipment of material to the projects.

(c) Sampling:

The ENGINEER may at any time, sample any shipment or the material in the CONTRACTOR'S work tanks.

915 SLURRY SEAL:

915.1 GENERAL:

Slurry seal shall consist of a mixture of asphalt emulsion, mineral aggregate, mineral fillers, and water properly proportioned and mixed.

915.2 MINERAL AGGREGATES:

Mineral aggregate shall consist of sound and durable sand and/or crushed stone and approved mineral filler where required. Sand and crushed stone shall conform to applicable requirements of Section 901. Mineral fillers shall conform to requirements of ASTM D-242 and shall be considered as part of the blended aggregate, and shall be used when required, in the minimum amounts. Mineral fillers shall only be used if needed to improve the workability or stripping characteristics of the aggregate emulsion mixture. Ninety percent of aggregates retained on the No. 50 sieve shall have at least one fractured face produced by crushing. Material passing the No. 50 sieve shall contain at least 10 percent natural uncrushed sand. The material shall be non-plastic when tested in accordance with ASTM D-424. The sand equivalent shall be not less than 50. The abrasion loss per ASTM C-131 shall not exceed 35 percent. The grading of the aggregate shall conform to the following:

SIEVE SIZE	TYPE I PERCENT PASSING	TYPE II PERCENT PASSING	TYPE III PERCENT PASSING
3/8"	100	100	100
No. 4	100	85-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-60	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	10-20	5-15	5-15
Emulsified Asphalt content as a % of Dry Wt. of	8	16	14
Aggregate (Approx) Pounds of Aggregate per sq. yd. (approx.)	8-10	12-18	18-25

Mineral fillers such as hydrated lime, portland cement, limestone dust, fly ash, shall be considered as part of the blended aggregate and shall be used, when required, in the minimum amounts. They shall meet the gradation requirements of ASTM D-242. Mineral fillers shall only be used if needed to improve the workability or stripping characteristics of the aggregate emulsion mixture.

All material samples shall be furnished by the CONTRACTOR at no additional cost to the Contracting Agency. All materials and material sources shall be approved prior to use of materials in the work and samples shall be submitted for approval not less than 7 days before commencing construction. Additional samples of materials shall be furnished during construction, upon request.

915.3 BITUMINOUS MATERIALS:

The emulsified asphalt shall made a homogeneous mix with good suspension of the aggregate particles and shall conform to the requirements of Section 913 for Types SS-1h and CSS-1h, or other approved cationic emulsion as ordered by the ENGINEER.

The tack coat shall consist of 1 part of emulsified asphalt conforming to the type specified for the slurry seal, and 3 parts water.

1cc 8

915.4 WATER:

Water from any domestic source will be satisfactory provided that it is found to be compatible with the slurry ingredients intended for use.

915.5 TEST CERTIFICATES AND REPORTS:

Test certificates and reports for the bituminous materials shall be furnished in accordance with Section 913.3.

915.6 CONVERSION OF QUANTITIES:

When pay quantities of emulsified asphalt are determined from volumetric measurements, the volumetric measurement at any temperature shall be reduced to the volume the material would occupy at 60 Degrees F. in accordance with ASTM D-1250. In converting volume to weight, the computations shall be based on the following data:

GRADE	GALS. PER TON	LBS. PER GAL.
Material	at 60°F	at 60°F
All Grades	240	8.33

916 PRECOATED CHIPS:

916.1 GENERAL:

Precoated ship seals shall consist of one or more applications of bituminous or asphalt-rubber material, followed by an application of precoated stone chips, smoothed and compacted, on existing roadway in accordance with this specification.

916.2 MATERIALS:

916.2.1 Bituminous Materials:

The bituminous binder for precoating shall be asphalt cement, of any standard paving grade as specified in Section 911.

916.2.2 Stone Chips:

The cover material for the paving asphalt binder shall be stone chips having a percentage of wear not to exceed 40 at 500 revolutions when tested in accordance with AASHTO T-96.

Sodium sulphate soundness test shall be in accordance with AASHTO T-104 and shall not show a loss in excess of 12 percent. A minimum of 75 percent of the material, by weight, retained on the No. 8 sieve, shall have at least one fractured face produced by crushing.

Grading of the stone chips when tested in accordance with AASHTO T-11 and T-27 shall comply with the following. When sealing low-volume traffic streets only, the grading shall be 1/4 inch nominal size as follows:

SIEVE SIZE	PERCENT PASSING
3/8"	100
1/4"	80-100
No. 8	0-5
No. 200	0-2

When sealing high traffic-volume streets only, the grading shall be 3/8 inch nominal size as follows:

SIEVE SIZE	PERCENT PASSING
1/2"	100
3/8"	70-10
1/4"	0-10
No. 8	0-5
No. 200	0-2

917 ASPHALT-RUBBER:

917.1 GENERAL:

Hot asphalt-rubber seal shall consist of a mixture of hot paving grade and ground tire rubber combined with heat into a visco-elastic composition. After application it shall be immediately covered with cover aggregate.

917.2 MATERIALS:

917.2.1:

The asphalt shall be as per Section 911.

917.2.2:

The granulated rubber shall meet the following requirements:

The specific gravity of the material shall be 1.15 +/- .02 and shall be free from fabric, wire, or other contaminating materials except that up to 4 percent of calcium carbonate may be included to prevent the particles from sticking together.

917.2.3:

The cover aggregate shall conform to the requirements of Section 916. The grading of cover aggregate shall comply with the respective tables for light traffic use and for heavy traffic use. Cover aggregate shall be hot precoated chips in accordance with Section 512.

Except where materials are being obtained from a previously approved source, the CONTRACTOR shall furnish samples for testing in accordance with the applicable portions of Section 801.

917.2.4:

The kerosene shall have an initial boiling point of not less than 350°F.

925 PORTLAND CEMENT CONCRETE:

925.1 PORTLAND CEMENT CONCRETE:

This material shall consist of a mixture of coarse and fine aggregates, Portland cement, water and other materials or admixtures as required. Colorado Department of Highways Class "P" or "AX" mix shall be used.

925.1.1:

Portland cement shall comply with the Colorado Department of Highways requirements. The type of cement shall be Type II or Type II Modified unless sulfate conditions dictate otherwise. Table 2.2.3 in Chapter 2.2 of ACI 201 indicates recommendations for sulfate resistance.

925.1.2:

Fine aggregates shall meet Colorado Department of Highways Section 703.01 requirements and gradation as shown in Subsection 901.1.

925.1.3:

Coarse aggregates shall meet Colorado Department of Highways Section 703.02 requirements and gradation as shown in Subsection 901.1.

925.1.4:

Fly Ash shall comply with Colorado Department of Highways Section 701.02.

Water shall meet the requirements of Colorado Department of Highways Section 712.01.

925.1.5:

Air entraining and chemical admixtures shall meet the requirements of Colorado Department of Highways Sections 711.02 and 711.03. No chloride containing additives shall be permitted.

925.2 STRUCTURAL CONCRETE:

925.2.1:

Class A, B or D concrete shall be used on structures as listed on the following tables.

CONCRETE MATERIAL SPECIFICATIONS *

CONCRETE CLASS	LABORATORY DESIGN MINIMUM (A) COMPRESSIVE STRENGTH 28 DAYS	CEMENT CONTENT (CEMENT FACTOR) RANGE (b)		WATER CONTENT RATIO (lbs H_2O per lbs	% ENTRAINED & ENTRAPPED	CONSISTENCY AGGREGATE AASHTO	COARSE AGGREGATE AASHTO DESIGNATIO	FINE AGGREGATE AASHTO DESIGNATIO
		MINIMUM lbs per cu yd	MAXIMUM lbs per cu yd					
A	3750	550	600	0.500	4-7	2-4	467	34-39
B	3750	550	600	0.530	5-8	1-4	67	34-44
(h) D	5625	635	800	0.443	5-7	1-2 ½ (r)	67	36-42

NOTE: Concrete mixtures that do not conform to the above table, but are required for special uses will be designed or the purpose intended. These include light weight concrete, colored concrete, lean concrete, grouting mixtures patching mixtures and concretes that require special cements, possolans or aggregates not covered in the Standard Specification.

* From CDOH Standard Specifications Section 601.02

The following notes apply to the table shown above.

(a) Not a field specification requirement. The desired minimum field strength is 80% of the specified laboratory strength.

(b) Laboratory mix design will require at least 15 to 20 lbs. more cement than the minimum amount shown. This will allow for field adjustment of entrained air and water as necessary for controlling consistency and still remain within the limits of the table.

(c) The water/cement ratio reported in the laboratory mix design will be sufficiently below that shown to permit the addition of water during field mixing in the amount allowed by the Specifications.

(d) The point of acceptance for consistency requirements will be at the mixer discharge for transit mixed concrete.

(e) For concrete aggregate gradation see the following table.

(h) An approved water reducer will be required for this class.

(r) The design slump will be between 1 and 2 1/2 inches and will be shown on the mix design sheet for the combination of materials to be used. The field slump shall be within 3/4" of the design slump.

(t) The maximum field water-cement ratio will depend on the desired ultimate strength. A maximum of 0.443 when used in deck concrete and for other structures will be shown on the design mix.

(u) Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F and not more than 80°F at the time of placing it in the forms.

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CONCRETE AGGREGATE GRADATION TABLE*
PERCENTAGES PASSING DESIGNATED SIEVES AND NOMINAL SIZE DESIGNATION
COARSE AGGREGATES (From AASHTO M43)

FINE AGGREGATE										
*No. 3	*No. 4	*No. 6	*No. 7	*No. 8	*No. 57	*No. 67	*No. 357	*No. 467	AASHTO	M6
Sieve Size	2" to 1"	1½" to ¾"	¾" to ⅜"	½" to No. 4	⅜" to No. 8	1" to 4"	¾" to No. 4	2" to No. 4	1-½" to No. 4	⅜" to No. 100
2-½"	100	---	---	---	---	---	---	100	---	---
2"	95-100	100	---	---	---	---	---	95-100	---	---
1-½"		90-100	---	---	---	100	---	---	---	---
1"	35-70	20-55	100	---	---	95-100		100	35-70	---
¾"	0-15	0-15	90-100	100	---	---		90-100	---	35-70
½"	---	---	20-55	90-100	100	25-60	---	10-30	---	---
⅜"	0-5	0-5	0-15	40-70	85-100	---		20-55	---	10-30
4	---	---	0-5	0-15	10-30	0-10		0-10	0-5	0-5
8	---	---	---	0-5	0-10	---	0-5	---	---	---
16	---	---	---	---	0-5	---	---	---	---	45-80
50	---	---	---	---	---	---	---	---	---	10-30
100	---	---	---	---	---	---	---	---	---	---

Additional primary grading may be permitted, when produced on the project, provided the theoretical combination meets the specifications for combined aggregate sizes. Size No. 357 is a combination of No. 3 and No. 57. Size No. 467 is a combination of No. 4 and No. 67.

* From CDOH Specifications Section 703

926 CONCRETE CURING MATERIALS AND ADMIXTURES:

926.1 CURING MATERIALS:

Curing Materials shall conform to the following requirements as specified:

Burlap Cloth made from Jute or Kenaf	AASHTO M 182
Liquid Membrane-Forming Compounds for Curing Concrete	AASHTO M 148
Sheet Materials for Curing Concrete	AASHTO M 171

Straw used for curing shall consist of threshed straw of oats, barley, wheat or rye. Clean field or marsh hay may be substituted for straw when approved by the ENGINEER. Old dry straw or hay which breaks readily in the spreading process will not be accepted.

926.2 Air-Entraining Admixtures:

Air-entraining admixtures shall conform to the requirements of AASHTO M 154.

Admixtures which have been frozen will be rejected.

926.3 Chemical Admixtures:

Chemical admixtures for concrete shall conform to the requirements of AASHTO M 194.

Admixtures which have been frozen will be rejected.

927 STEEL REINFORCEMENT

927.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating or any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the ENGINEER. When required by the ENGINEER, the CONTRACTOR or supplier shall furnish a spot sample taken on the project and notify the ENGINEER as to when and where they will be available. Such samples shall be furnished at the expense of the CONTRACTOR or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the ENGINEER. The CONTRACTOR shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM A-615 and the shapes shall conform with ASTM A-670.

In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of ACI-318.

The various grades of steel not be used interchangeably in structures.

927.2 Wire Reinforcement:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A-82.

927.3 Wire Mesh Reinforcement:

Mesh reinforcements shall conform to ASTM A-185. The gage of the wire and the dimension of the mesh will be specified in the special provisions to shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

927.4 Wire Ties:

Wire for ties shall be black, annealed, not lighter than 16 gage.

929 EXPANSION JOINT FILLER:

929.1 PREMOLDED JOINT FILLER:

Expansion joint filler material shall consist of premolded strips of a durable resilient compound and comply with ASTM D-1751, D-1752 or D-2628, as specified by the Contracting Agency.

929.2 POUR TYPE JOINT FILLERS:

Pour type joint fillers shall comply with ASTM D-1850, D-1190, D-1854, or with the following formulation, as specified by the Contracting Agency.

Asphalt latex joint filler shall consist of asphalt latex emulsion and sodium fluosilicate furnished in separate containers and mixed on the site. The emulsion shall consist by volume of 60 parts AR-1000 asphalt conforming to the requirements of Section 911. 40 parts of synthetic latex, GRS-Type 4, and 5 to 10 parts of sodium fluosilicate, half strength. The emulsion and sodium fluosilicate shall not be mixed until the joint is ready to be filled. The amount of sodium fluosilicate to be mixed with the emulsion shall be approximately 3 to 5 percent by weight of the emulsion. The joint to be filled shall be thoroughly cleaned and surface dry.

The sealing compound shall consist of paving asphalt, Grade AR-1000 conforming to the provisions of Section 911, emulsified with rubber latex in the presence of a suitable emulsifying agent. Rubber latex designated as GRS-Type 4, or any other approved type, containing approximately 40 percent solids.

The resulting emulsion shall consist of a minimum of 55 percent of paving asphalt and a minimum of 36 percent of rubber latex and shall conform to the requirements set forth in the following table.

ASPHALT LATEX EMULSION JOINT SEALING COMPOUND			
SPECIFICATION DESIGNATION	TEST METHOD	LIMITS	REMARKS
Furol Viscosity at 77°F	AASHTO T-72	50-250	Before adding gelling agent
Sieve Test	AASHTO T-59	1% Maximum	Before adding gelling agent.
Penetration at 77°F	AASHT D-217	50-250 Minimum	The penetration test is made on a specimen prepared by stirring 5% of sodium fluosilicate into the asphalt latex emulsion in a 6 ounce deep ointment can. The specimen is then allowed to stand in the air at a temperature of 77°F. ±20 for a period of 30 minutes and is then penetrated with a grease cone under a total load of 150 grams.
Elasticity		70%	After addition of 5% of sodium fluosilicate and curing for 24 hours at 100°F. ±2°, the specimen shall have an elastic recovery of not less than 70%.
Dehydration		Loss 30% Maximum	Twenty-five grams of emulsion, prior to adding the gelling agent, is placed in an 8 ounce flat ointment can and dehydrated in a suitable oven maintained at a temperature of 200°F. ±2o for a period of 24 hours.
Time of Set		15-60	After mixing emulsion with 1% to 4% by minutes weight of powdered sodium fluosilicate the emulsion shall harden or develop a set in from 15 to 60 minutes, under field conditions.

929.3 TEST REPORT AND SHIPMENT CERTIFICATE:

Each shipment shall be accompanied by a certificate in triplicate from the supplier that the material will comply with the above specifications and such certificate shall be delivered to the ENGINEER. The certificate shall show the shipment number for the entire lot of material contained in the shipment and shall also show a list which will enable the ENGINEER to identify each individual container by the supplier's batch number, with which each container shall be plainly marked.

929.4 APPLICATION:

At no time shall emulsion types by subjected to a temperature below 40°F. Prior to application, the material may be warmed, if necessary, to permit proper pouring of the joints. The method of heating shall be carefully controlled to avoid overheating of any part of the container or mixture and under no circumstances shall emulsions be heated to a temperature greater than 130°F.

Joints and cracks shall be thoroughly cleaned by hand or mechanical means immediately in advance of pouring the filler material. When new pavement has been cured by the Pigmented Sealing Compound Method, the joints and cracks shall be thoroughly scrubbed by means of a wire brush or a cloth mop saturated with gasoline or by other approved means.

All joints and cracks shall be surface dry before application of the joint sealer. No sealer shall be placed during unsuitable weather or when the atmospheric temperature is below 50°F, or when weather conditions indicate that the temperature may fall to 32°F. within 24 hours.

The joints and cracks shall be filled in a neat and workmanlike manner by means of a cornucopia pot or other approved method.

930 MANHOLES:

930.1:

All manholes shall be constructed with precast sections unless otherwise approved.

930.2:

Precast concrete manhole sections shall be manufactured to standards at least equal to or greater than the requirements of the Standard Specifications for Precast Reinforced Concrete Manhole Sections, ASTM Designation C-478. The internal, diameter for manholes shall be forty-eight (48) inches unless shown otherwise. Manholes shall conform to all requirements as shown on the detail drawings. Manholes shall have steps unless otherwise specified. Precast manhole joints shall be made watertight with Ram-Nek and primer must be used in accordance with the manufacturer's instructions.

930.3:

Lift Holes will be allowed, but must be sealed with non shrink grout before backfilling.

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930.4:

The concrete base shall be cast-in-place concrete for the size and depth shown on the drawings. Concrete used for bases shall have a twenty-eight (28) day compressive strength of at least three thousand (3,000) pounds per square inch. Approved precast concrete bases will be allowed if placed in an approved manner.

930.5:

Manhole frames and covers shall be of the Colorado Springs pattern, round base, 22-1/8 inch opening lids 1-1/8 inch thick, non-locking type, with frame and cover weighing approximately 327 pounds. Cover and frame seat shall be machine finished to 327 pounds. Cover and frame seat shall be machine finished to prevent any rocking of cover in its associated frame. Covers shall have the word "STORM SEWER" clearly cast on its surface. Frames and covers shall be by J MARK CORP J-1071, MUNICIPAL CASTINGS 330/330A, CASTINGS INC. MH 310 COVER B or approved equal.

930.6:

All manhole steps shall be cast-iron or aluminum alloy and of a pattern approved by the ENGINEER and/or OWNER. Steel or wrought iron steps of any kind will not be permitted. Aluminum steps shall be drop-front design with minimum tread width of 9 inches and minimum weight of 2.23 pounds. Copolymer polypropylene coated steel steps Model PS-2-PF as manufactured by M.A. Industries are also approved.

935 REINFORCED CONCRETE PIPE AND BOX CULVERTS:

935.1:

Circular reinforced concrete pipe shall meet the requirement of ASTM C-76 and the requirements contain herein. Elliptical reinforcing will only be allowed if so designated in the Special Coiditions.

935.2:

Arch Culvert reinforced concrete pipe shall meet the requirements of ASTM C-506 and the requirements contained herein.

935.3:

Eliptical reinforced concrete pipe shall meet the requirements of ASTM C-507 and the requirements contained herein.

935.4:

Reinforced Concrete Box Culvert shall meet the requirements of ASTM C-789 or ASTM C-850 whichever applies and the requirement contained herein.

935.5:

All pipe and culvert shall be designed in accordance with the design tables provided in the ASTM Specifications. Modified or Special designs will not be allowed unless so stated in the Special Conditions. The pipe shall meet the requirements of the pipe class as specified on the Plans or Special Conditions.

All cement shall be Type II modified. Concrete pipe shall be steam cured and shall not be shipped from the point of manufacture for at least five days after having been cast. Each joint of pipe shall be 7'-6" or greater in length.

Acceptance of the pipe shall be on the basis of plant load bearing tests, material tests and inspection of the completed product. Three-edge bearing tests shall be for the 0.01 inch crack and the ultimate strength. All testing shall be done in accordance with ASTM C-497. All tests required by the OWNER for a basis of acceptance shall be paid for the CONTRACTOR. The OWNER reserves the right to sample and test any pipe after delivery and to reject all pipe represented by any sample which fails to comply with the specified requirements. Should any piece of pipe fail to pass its test, the OWNER shall select at least one more piece of pipe for testing.

Joints for the circular reinforced concrete pipe shall be all rubber gasket conforming to ASTM C-443, latest revision. The gasket shall be attached to the spigot of the pipe and shall make the joint flexible and watertight. The CONTRACTOR may use butyl mastic joint sealant in rope or trowel applied form in lieu of rubber gaskets for circular pipe if approved in writing by the OWNER. For all non circular pipe and culvert butyl mastic joint sealant must be used. The CONTRACTOR shall submit test results and material specifications on the sealant to the OWNER before the OWNER gives written approval of its use. This sealant must be made specifically for permanently sealing joints in tongue and groove concrete sewer pipe, must adhere tightly to the pipe surface, and form a tight flexible joint. The gaskets or sealants shall be installed as directed by the manufacturer of the pipe.

The CONTRACTOR shall be required to submit Drawings, specifications, and other data showing complete details of the design, fabrication and construction of the reinforced concrete pipe to the OWNER for review before manufacture of the pipe begins. These submittals shall include data on all materials proposed to be used in the pipe, the size and location of each cage of the reinforcement, joint details including reinforcement, gasket details, and test results on materials, joints, and pipe.

1020

936 NON-REINFORCED CONCRETE PIPE:

This pipe shall conform to the requirements of AASHTO M 86 for the specified diameters and strength classes.

944 ABS TRUSS PIPE AND FITTINGS:

944.1 GENERAL:

Truss pipe is defined as an internally-braced double-walled ABS composite pipe conforming to ASTM D-2680. When noted on the plans or in the Special Conditions gravity sanitary sewer system may be constructed using truss pipe for diameters not exceeding 15 inches.

Truss pipe shall have both ends of each pipe length sealed at the factory such that the inert filler material between the two concentric thermoplastic tubes is impervious. All field cuts shall be sealed according to the manufacturer's recommendations.

944.2 COUPLINGS AND FITTINGS:

Fittings for truss pipe may include couplings, wyes, tees elbows, caps, plugs adapters, manhole water stops and clamps. All couplings and fittings shall be assembled by a chemically welded method. Solvent shall be of the type recommended by the pipe manufacturer. Each solvent weld type coupling of fitting shall be accurately formed and entirely compatible in joining the pipe to assure a leak-proof joint. Couplings and fittings shall be manufactured from the same material from rubber, polyurethane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal of superior to the pipe itself.

944.3 SOLID WALL PIPE AND FITTINGS:

944.3.1 General:

When noted on the plans or in the special provisions, sewer and drain solid wall pipe and fittings may be used for 4-inch and 6-inch service lines, risers and fittings.

944.3.2 Materials:

Sewer and drain solid wall pipe shall be manufactured or virgin ABS compound as specified in ASTM D-1788, Types I and IV, excepting that the minimum heat deflection temperature (ASTM D-648) shall be 180°F.

944.3.3 Strength:

Test samples of pipe, 6 inches long, shall be cut from full length sections and tested by the method outlined in ASTM D-2412. The pipe shall be deflected at least 35 percent without failure and the stiffness at 5 percent deflection shall equal or exceed the value listed in Table below after the test samples have been immersed in a 5 percent solution by weight of sulfuric acid and n-Heptain for a period of 24 hours prior to testing. Failure is defined as rupture of the pipe wall.

Stiffness factor may be computed by the method outlined in ASTM D-2412 or by dividing the load in lbs/linear inch by the deflection in inches and 5 percent deflection (F/delta Y in Table below:)

NOMINAL SIZE	F/DELTA Y 2.5% MIN.
4"	55 lb./in.^{2}
6"	55 lb./in.^{2}

944.3.4 Couplings and Fittings:

All Couplings and fittings shall be assembled by a chemically welded method. Each solvent weld type coupling or fitting shall be accurately formed and entirely compactible with the Sewer and Drain Solid Wall Pipe to assure a leak proof joint. Couplings and Fittings shall be manufactured from the same material as the pipe except that caps, plugs and adapters may be fabricated or molded from rubber, polyurerthane or other suitable compounds. The couplings and fittings shall have chemical and physical properties equal or superior to the pipe itself.

944.4 MANHOLE CONNECTIONS:

A clamp gasket or approved equivalent method shall be provided at manhole entry or connection to reduce infiltration and exfiltration. Where precast manholes are used, entrance holes must be large enough to allow for proper grouting around the manhole gasket.

944.5 CERTIFICATION:

A certificate from the manufacturer shall be furnished attesting that the pipe meets the requirements of ASTM D-2680.

944.6 IMPERFECTIONS:

Any imperfections which in the opinion of the ENGINEER may adversely affect the performance of the pipe or joints shall be cause for rejection.

944.7 INSTALLATION AND TESTING:

Truss pipe shall be installed in accordance with applicable provisions of Section 401. In addition to the tests prescribed in Section 401, the ENGINEER may, at his option, require a deflection test on all or any part of the line. Any pipe which shows a deflection in excess of 5% shall be removed at no cost to the Contracting Agency.

945 PVC SEWER PIPE AND FITTINGS:

945.1 GENERAL:

This specification covers the requirements of polyvinyl chloride (PVC) plastic sewer pipe and fittings for gravity flow sewers. When noted on the plans or in the Special Conditions, gravity sewers may be constructed using PVC pipe for diameters not exceeding 15 inches. Pipe, fittings, couplings and joints shall be in conformance with the requirements of ASTM D-3034, SDR-35, except as modified herein.

945.2 MATERIALS:

945.2.1 Caps and Plugs:

Caps and plugs for building connections may be molded or fabricated from rubber, polyurethane or other suitable compound.

945.2.2 Gaskets:

Rubber gaskets shall be manufactured from a synthetic elastomer and shall comply in all respects with the physical requirements specified in ASTM F-477.

945.2.3 Lubricant:

The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe.

945.4 JOINING SYSTEMS:

Joints for the piping system and fittings shall consist of an integral bell gasketed joint designed so that when assembled, the elastomeric gasket located within the bell is compressed radially on the pipe or fittings spigot to form a positive seal. The joint shall be designed so to prevent displacement of the gasket from the joint during assembly and when in service.

All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

The bell and spigot configuration for the fittings shall be compatible to those used for the pipe.

Joints shall provide a permanent seal against exfiltration and infiltration. All surfaces of the joint upon which the gasket may bear shall be smooth and free of any imperfections which could adversely affect sealability.

The assembly of the joints shall be in accordance with the pipe manufacturer's recommendations.

945.5 FITTINGS:

Fittings for PVC pipe may include elbows, wyes, tee wyes, double bell couplings, manhole couplings, manhole adapter rings, plugs, caps, adapters and increasers.

Manhole couplings shall be manufactured from asbestos cement and incorporate an elastomeric gasket moisture barrier.

945.5.1 Manhole Connections:

A manhole adapter gasket or approved equivalent method shall be provided at manhole entry or connection to prevent infiltration and exfiltration. Where precast manholes are used, entrance holes shall be large enough to allow for proper grouting around the manhole ring.

945.5.2 Certification:

A certificate from the manufacturer shall be furnished certifying that the pipe and fittings meet the requirements of ASTM D-3034, SDR-35, F/Delta Y = 46 psi at 5% deflection.

945.7 IMPERFECTIONS:

Any imperfections which in the opinion of the ENGINEER may adversely affect the performance of the pipe or joints shall be cause for rejection.

945.8 INSTALLATION AND TESTING:

PVC pipe and fitting installation shall be in accordance with the applicable provisions of Section 401. In addition to the tests prescribed in Section 401, the ENGINEER may, at his option, require a deflection test on all or any part of the system. Prior to acceptance by the Agency any part which shows deflection in excess of 5% of the actual inside diameter shall be corrected at no cost to the Agency having jurisdiction.

If the Contracting Agency after acceptance but prior to the termination of the warranty period determines that the long term deflection has exceeded 7 1/2% of the actual inside diameter, that portion of the installation shall be corrected at no cost to the agency.

946 METAL PIPE:

946.1 CAST IRON PIPE:

This pipe shall conform to the requirements of AASHTO M 64 or ASTM A 716 for the specified diameters and strength classes. Unless otherwise specified either smooth, corrugated or ribbed pipe may be furnished.

946.2 CORRUGATED STEEL PIPE AND PIPE ARCHES:

Corrugated steel pipe and band coupling shall be manufactured in accordance with AASHTO SPECIFICATION M-36. All pipe must be fully coated inside and outside. Bituminous material coating shall meet AASHTO Specification M-190, Type A with a minimum inside and outside coating thickness of 0.05 inches. Polymer coating shall meet AASHTO Specifcation M-246 and polymer coated pipe shall meet AASHTO Specification M-245. Polymer coating shall be a minimum of 10 mils thick on both the inside and outside of the pipe. All lining and coatings shall be free of sags or runs. Aluminum coated steel sheet conforming to AASHTO Specification M-274 may be used, in which case bituminous or polymer coatings will not be required. Coupling Bands for aluminum coated steel pipe shall be made of the same material as is the pipe.

Welded seam helical pipe shall have two annular corrugations rolled in each end. Welded seam helical pipe shall be joined with 0-ring Hugger Type bands. Polymer coated steel shall not be used in making welded helical pipe.

946.2.1:

All coupling bands shall be the same base metal and spelter coating as the pipe. All couplings shall have gaskets.

Bands with 2 2/3" x 1/2" corrugations or 2" x 1/2" corrugations. The bands shall be formed to fit the pipe shape specified and shall be not less than 7 inches wide for pipe 6 to 30 inches in diameter, 12 inches wide for pipe 36 inches to 60 inches in diameter, and 24 inches for pipe 66 to 120 inches in diameter. Bands shall be either two-piece or one-piece.

Bands with 3" x 1" corrugations. The bands shall be formed to fit the pipe shape specified and shall not be less than 14" wide for pipe 36" through 54" in diameter, and 20" wide for pipe 60" and larger in diameter. Bands shall be either two-piece or one-piece unless otherwise specified.

The bands shall: Have end connection angles, conform to ASTM A-36, be zinc coated in accordance with ASTM A-153, be not less than 2 inches by 2 inches by 3/16 inch by the width of the band minus 1 inch, be adequately fastened to each end of band and half bands. The bands shall be of such length as to hold the two connected sections of pipe rigidly together when tightened in place by the connection bolts furnished. The 7 inch bands shall have at least two zinc coated bolts per connection, conforming to ASTM A-307, grade A, electroplated in type RS, not less than 1/3 inch in diameter. The 12 inch bands shall have not less than three and the 24 inch bands not less than five such bolts per connection.

946.2.2:

Field cutting of the corrugated steel pipe shall not be allowed, and closure pieces shall be furnished and installed where standard pipe lengths cannot be installed.

946.2.3:

After the lining and coating have been applied, the corrugated steel pipe shall be handled, shipped, and/or stored in a manner which shall prevent the lining and coating from being damaged. During storage on the construction site, the CONTRACTOR shall protect the pipe from becoming heated by the sun, damaging either the lining or coating. Equipment and/or tools used in loading, unloading, or installing the pipe shall not damage the coating. The CONTRACTOR shall prevent stones, rocks, etc. from damaging the coating during the backfill operations.

946.2.4:

All coating or linings which have been damaged prior to or during laying of the pipe, fittings, or couplings or placing the backfill shall be repaired in strict conformity with the pipe manufacturer's instructions and recommendations, using materials of a type and quality equal to that in originally coating the pipe. Copies of the manufacturer's instructions and recommendations shall be furnished to the OWNER'S Authorized Representative prior to starting the pipe installation.

946.3 CORRUGATED STEEL PIPE FOR UNDERDRAINS:

This pipe shall conform to the requirements of AASHTO M 36, Type III, except that all reference to "sleeve type coupler" or "coupling" as described in subsection 21.4 therein shall be disregarded. Sleeve type couplers or couplings will not be permitted.

Type III Class IV pipe (semicircular), as defined in AASHTO M 36, may be used in place of circular underdrain up to 8 inch diameter.

946.4 BITUMINOUS COATED CORRUGATED STEEL PIPE DOR UNDERDRAINS:

The pipe shall conform to the requirements of AASHTO M 36, Type III for the specified diameters.

Underdrain, fittings, elbows, end sections and coupling bands shall be fully coated with bituminous material conforming to the requirements of AASHTO M 190, Type A coating or materials conforming to the requirements of AASHTO M 243, except that the use of tar base material will not be permitted. Coatings shall be shop applied. The finished coat shall uniformly cover the surface to be protected. The coating shall not contain any visible holidays, bubbles or bare spots. Minimum thickness shall be 50 mils measured on the crest of the corrugations.

In complying with AASHTO M 190, each section shall be given a double dip application. In the first immersion, the section shall remain submerged until the metal has reached a temperature that will allow the hot bituminous material to penetrate and seal each joint.

Other coatings meeting the requirements of AASHTO M 190 or M 243 will be acceptable upon written approval by the ENGINEER.

Materials meeting the requirements of AASHTO M 243 shall be uniformly applied by spray, trowel or brush to the entire designated surface to be coated, to a minimum thickness of 50 mils. The coating shall be dry to the touch prior to any handling or backfilling operations.

Special fittings and elbows for underdrains shall be of the same gage as the conduit to which they are joined.

The specified minimum size of perforations shall apply after coating.

946.5 CORRUGATED ALUMINUM PIPE:

This pipe and coupling bands shall conform to the requirements of AASHTO M 196.

946.6 CORRUGATED ALUMINUM PIPE FOR UNDERDRAINS:

This pipe shall conform to the requirements of AASHTO M 197.

946.7 EXTENSIONS:

Connecting bands and extensions to existing culverts shall be of the same type metal or alloy, unless otherwise shown on plans.

946.8 REPAIR OF DAMAGED COATING:

Units on which the spelter coating has been damaged shall be either regalvanized as provided under AASHTO M 36 or painted with one full brush coat of a zinc rich paint meeting Military Specification MIL-P-21035, or by other approved process on properly cleaned surface, as determined by the ENGINEER.

Bituminous coated material which has been damaged shall be repaired with field-applied asphalt mastic conforming to AASHTO M 243. Other coating material may be used, provided it is, in the opinion of the ENGINEER, equal to the asphalt mastic specified.

946.9 INSPECTION:

Corrugated metal pipe manufactured or stored within the State will be inspected according to applicable AASHTO Designations. In addition, approval of culvert pipe fabricated outside the State and shipped directly to the job site will be based on field inspection and sampling plus certified mill reports covering base metal and spelter. Samples will be obtained by the OWNER and will be identified by pipe diameter, date and heat number.

961 STRUCTURAL PLATE PIPE, ARCHES, AND PIPE ARCHES:

961.1 GENERAL:

Structural plate pipe, arches and pipe arches shall be of the sizes, and dimensions designated on the plans or in the Special Conditions and as specified herein.

961.2 MATERIALS:

Plates, nuts and bolts shall conform to the specifications of AASHTO M-167.

Galvanized surfaces which are damaged shall be repaired in accordance with the provision in Section 971.

Bituminous coating shall conform to the provisions of AASHTO M-190.

Damaged bituminous coatings shall be repaired by the CONTRACTOR at his expense by applying bituminous material conforming to AASHTO M-190.

961.3 IDENTIFICATION:

The gages of structural plates will be identified on the plans in accordance with the following:

Each installation will be designated not only by size, but also by symbol indicating the number and gage of plates required. Thus. (412-18) will be used to designate an installation for 1 plate length composed of 4.12 gage plates and 1.8 gage plate, the heaviest to be placed in the invert.

961.4 DISTORTION:

In advance of placing backfill material around circular structural pipes, the pipe shall be distorted.

Distortion may be performed either at the fabricating shop or in the field.

If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5 percent for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field the method of distortion shall conform to the details shown on the plans. The vertical diameter shall be increased to the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates - 1 percent.

Pipes using 5 or 7 gage top and side plates - 2 percent.

Pipes using 8, 10 or 12 gage top and side plates - 3 percent.

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

965 RUBBER GASKETS FOR CONCRETE PIPE:

965.1 GENERAL:

The joints of concrete pipe shall be O-ring rubber gasket joints conforming to ASTM C-361 except the composition and properties of the rubber gaskets shall be as follows:

All rubber gaskets shall be extruded or molded and cured in such a manner as to be dense, homogenous, and free from porosity and other imperfections. The tolerance for any diameter measured at any cross section shall be +/- one-thirty-second inch. All gaskets shall be manufactured from a synthetic rubber compound in which the elastomer is neoprene, exclusively. Said compound shall contain not less than 50 percent by volume of neoprene, shall contain no deleterious substances, and shall conform to the following requirements:

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PHYSICAL PROPERTIES	RUBBER GASKETS	
	VALUE	METHOD OF TEST
Tensile strength, minimum psi	2100	ASTM D-412
Elongation at break, minimum %	425	ASTM D-412
Shore Durometer hardness, Type A. (1)	50-60	ASTM D-2240
Compression set, Maximum, % of Original deflection. (2)	20	ASTM D-395
Accelerated agin, tensile strength, %. (3)	80	ASTM D-572
Maximum increase over original shore		
Durometer value after accelerated aging.	8	ASTM D-2240
Specific gravity	0.95-1.45 ± 0.05	ASTM D-297

Pipe manufacturer shall select value suitable to type of joint.

(2) Use Method B, except disc shall be 1/2 inch long section of rubber gasket stock.

(3) Percent of tensile strength, after aging by the oxygen-pressure chamber (96 hours, 158 +/-1.8°F. 300 +/- 15 psi.) of the tensile strength before aging.

It is the intent of these specifications that the gasket container shall be a preformed rectangular groove so constructed that when 2 pipes are joined together the rubber gasket shall be compressed and for all practical purposes substantially fill and be largely confined within the rectangular groove.

The CONTRACTOR shall submit for approval details of the shape and size of the gaskets he proposes to furnish. The CONTRACTOR shall also submit certified test results in triplicate showing the physical properties of the materials used in the manufacture of gaskets.

970 STRUCTURAL AND RIVET STEEL, RIVETS, BOLTS, PINS, AND ANCHOR BOLTS:

970.1 GENERAL:

All steel, unless otherwise designated on the plans or in the Special Conditions, shall conform to the requirements of ASTM A-36.

Report of Tests: Before fabrication, the CONTRACTOR shall furnish to the ENGINEER a certified mill report in triplicate, for each identifiable melt of steel or iron from which the material is to be fabricated. The report shall include the chemical and physical tests required by the ASTM specifications.

Additional Tests: The Contracting Agency reserves the right to require and to make additional mill and laboratory tests. The number of such additional tests will be limited as follows, except that in the case of failure of the material to comply with the ASTM requirements, more tests will be made:

Structural steel, 1 complete test for each heat or each 10 tons of identifiable stock. Rivets, 1 complete test for each size. Bolts, 1 complete test for each lot.

Identifiable stock is material for which authentic records of the chemical and physical properties are available.

Test specimens shall be furnished, cut, and machined in accordance with the ASTM specifications for the material to be tested, as referred to herein. Test specimens shall be furnished and machined by the CONTRACTOR at no additional cost to the Contracting Agency.

Mill Tolerances: Rolling and cutting tolerances, permissible variations in weight and dimensions, defects and imperfections shall not exceed the limits for structural steel contained in ASTM A-6.

Stock Material: When the CONTRACTOR proposes to use material already in stock, he shall notify the ENGINEER of such intention at least 10 days in advance of beginning fabrication, to permit sampling and testing.

970.2 STRUCTURAL STEEL:

Stock Materials: The CONTRACTOR shall select the material he wishes to use from stock. The CONTRACTOR shall furnish 3 certified mill reports for each of the heat numbers. Two samples shall be taken by a representative of the ENGINEER from each heat number, one for the tension test and one for the coldbend test. If the heat numbers cannot be identified, the representative of the ENGINEER shall select random test specimens from the unidentifiable heats. The number of such test specimens shall be at the discretion of the ENGINEER. The cost of all tests on stock material shall be borne by the CONTRACTOR.

High Strength Low-Alloy Structural Steel: The material shall conform to the requirements of ASTM A-242, A-440, A-441, A-374, A-375 or A-446 Grades C, D or E as specified in the Special Conditions.

Copper bearing structural steel shall conform to the requirements of ASTM A-36, A-245, A-570, A-440 or A-446 as specified in the Special Conditions.

970.3 RIVETS:

Stock Material: Rivets taken from identifiable stock shall be accepted by the ENGINEER in accordance with this specification.

Rivets from unidentifiable stock, for which authentic records of the chemical and physical properties are not available, shall not be used except where shown on the plans or when approved by the ENGINEER.

High-Strength Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502.

Structural Rivet Steel: The material shall conform to the requirements of ASTM A-502, except that the test specimen shall be bent upon itself when performing the bend test.

970.4 BOLTS:

Unfinished Bolts: The bolts shall have square heads and square nuts unless otherwise specified. The bolts shall be long enough to extend entirely through the nut but not more than 1/4 inch beyond. Washers shall not be furnished unless specified.

Steel bolts shall conform to the requirements of ASTM A-307, except that steel manufactured by the Acid Bessemer process shall not be used.

High Strength Bolts: High strength bolts shall conform to the provisions of the specification for the design, fabrication and erection of structural steel for buildings of the AISC.

970.5 ANCHOR BOLTS:

Anchor bolts shall be manufactured from steel conforming to ASTM A-36 or A-307.

970.6 MILD-STEEL FORGINGS FOR STRUCTURAL PURPOSES:

Steel forgings shall be made from steel of forging quality and shall conform to the requirements of ASTM A-235. They shall be Class C forgings with a maximum carbon content of 0.35 percent and shall be given a thorough annealing. The metal shall have a minimum Brinnel hardness number of 130, and a maximum of 190, when tested in accordance with ASTM E-10.

971 GALVANIZING:

971.1 GENERAL:

Materials shall be hot-dip galvanized and the weight and uniformity of coating determined in accordance with the standard specifications given in the following table:

GALVANIZING SPECIFICATIONS		
MATERIAL	ASTM SPEC	WEIGHT COATING Oz./Sq. Ft. (Minimum)
Corrugated Metal Pipe	A-44	1.80
Flat Steel or Iron Sheets	A-525	1.25
Iron or Steel Wire	A-116	0.80
Chain Link Fabric	A-392	1.20
Barbed Wire	A-121	0.50
Steel Pipe Rails	A-120	1.80
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manholes and Catch Basin Steps, and Curb Armor	A-123	2.00
Bolts, Nuts, Washers, Anejor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A-153	1.25

971.2 WORKMANSHIP:

The galvanizing shall be applied in such a manner that the spelter will not peel off. The finished product shall be free from blisters and excess spelter, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting and other fabricating shall all be done as far as is practicable

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before the galvanizing. No member shall be galvanized which is out of alignment. All members (nuts, bolts, washers, etc.) shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings due to poor workmanship, rough handling, or any other reason shall be cause for rejection.

971.3 TEST COUPONS:

Test coupons for determining the quality of the galvanizing shall be wired to the materials to be galvanized before immersion in such a manner as to represent the amount of coating deposited on the materials.

971.4 REPAIR OF GALVANIZED SURFACES:

Unless otherwise specified, where galvanized surfaces are field or shop cut, broken, burned or abraided, thus breaking the galvanizing, the locations thus damaged shall be repaired to the satisfaction of the ENGINEER with zinc dust-zinc oxide coating conforming to AASHTO M-36.

972 CHAINLINK:

972.1 GENERAL:

All material shall be new and the CONTRACTOR, upon request, shall furnish to the Contracting Agency, a certificate of inspection stating that the posts, rails and braces have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

Unless specifically designated by type in the plans or specification, the CONTRACTOR may utilize any one of the three types of posts, rails and braces listed.

972.2 POSTS, RAILS AND BRACES:

The nominal outside diameter of Types A, B, and C shall be in accordance with the Table shown below:

Type A: Shall be black steel pipe, hot dipped zinc coated both inside and outside. The weight of the zinc coating, inside and outside, shall be not less than 1.8 ozs. per square foot +/- 0.1 ozs. The base material and manufacturing shall conform to ASTM A-53 and A-120.

Type B: Shall be steel pipe, manufactured from hot-rolled, steel strip ASTM-569. During manufacturing, the outside surface shall have a hot-dipped zinc coating, weight not less than 1.0 ozs. per square foot +/- 0.1 ozs.; followed by a chromate conversion coating, weight not less than 30 micro-grams per square foot +/- 10 micro-grams and an electrostatically

applied acrylic coating, .0005 inches thick +/- .0002 inches. During manufacturing, the inside surface shall be coated with a zinc based paint, .0005 inches thick +/- .0002 inches. The wall thickness shall be such that the product of the yield strength and section modules shall be not less than that of pipe meeting the requirements of ASTM-120.

Type C: Shall be steel pipe manufactured from high strength, cold-rolled, hot-dipped zinc coated, steel, ASTM A-526. The weight of the zinc coating, inside and outside, shall be not less than 1.0 ozs. per square foot +/- 0.1 ozs. The wall thickness shall be such that the product of the yield strength and section modules shall not be less than that of pipe meeting the requirements of ASTM-120.

NOMINAL USE	AISC DESIGNATION		
	NOMINAL O.D.	TYPE (Inches)	TYPE DIAMETER
End, corner, slope and gate posts for single gates 6' or less in width and double gates 12' or less in width for fence 72" or higher	Pipe	32½	Schedule 40
End, corner, slope and gate posts for single gates 6' or less in width and double gates 12' or less in width for fence less than 72" in height	Pipe	2½	2, Schedule 40
Gate posts for single swing gates over 6' but not over 13' in width and double swing gates over 12' but not over 26' in width or for all slide gates with leaves larger than 6'	Pipe	43½	Schedule 40
Gate posts for single swing gates over 13' but not over 18' in width and double swing gates over 26' but not over 36' in width	Pipe	6⅝	6, Schedule 40
Gate posts for single swing gates over 18' in width and double swing gates over 36' in width	Pipe	8 5/8	8, Schedule 30
Pipe 2½ Line Posts for fence higher than 72"	H-Section	2¼ x 1⅞	2, Schedule 40
Pipe 2½ Line Posts for fence 72" or lower	H-Section	1⅞ x 1⅜	1¼, Schedule 40
Pipe 1 ⅜ Top Rail and braces	H-Section1	½ x 1¼	1¼, Schedule 40
Frame for gates Pipe 2		1½	Schedule 40
Stiffners for gates	Pipe 1 ⅜	1½	Schedule 40

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All unit weights shall be subject to the standard mill tolerance of +/- 5 percent.

Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps. H-Section posts will require no caps.

Top rail shall be furnished in random lengths of approximately 20 feet where required.

972.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A-392 or ASTM A-491. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh and galvanized after fabrication. Fabric less than 60 inches wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. Fabric 60 inches or greater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

972.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than three-sixteenths inch x 3/4 inch.

972.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

972.6 FITTINGS:

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent

lengths of rail in alignment pipe posts shall be of 13 gage steel or heavier single piece construction and a type that can be attached to the tops of the posts. Extension arms for barbed wire on H-Section posts shall be of the bent post type. Extension arms shall carry 3 wires at approximately 5 1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the ENGINEER.

972.7 BARBED WIRE:

Barbed wire shall be 4 point pattern, composed of 2 strands of 12 1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A-121.

975 BRICK AND CONCRETE BLOCK:

975.1 BRICK:

975.1.1 Clay or Shale Brick:

Brick shall conform to the requirements of one of the following specifications:

Sewer Brick - AASHTO M 91.
Building Brick - AASHTO M 114.

975.1.2 Concrete Brick:

Concrete brick shall conform to the requirements of ASTM C55.

975.2 MASONRY BLOCK:

Concrete masonry blocks may be rectangular or segmented and, when specified, shall have ends shaped to provide interlock at vertical joints. The blocks shall conform to the requirements of ASTM C 139, or, for hollow blocks, to ASTM C 90, Grade N-I for exterior of S-II for interior. Dimensions and tolerances shall conform to the above applicable requirements or those specified on the plans.

976 MASONRY MORTAR AND GROUT:

976.1 MASONRY MORTAR:

Masonry Cement shall conform to the requirements of AASHTO M 150.

Aggregate for masonry mortar shall conform to the requirements of AASHTO M 45.

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Proportions for masonry mortar by volume shall be 1 part masonry cement to 3 parts sand (maximum).

Mortar sand shall be measured in a damp loose condition. Masonry mortar shall be mixed in power mixers.

978 LUMBER:

978.1 GENERAL:

Unless otherwise specified or shown on the plans, all lumber shall be Douglas Fir or graded pine and shall be selected as to grade and shall conform in all particulars to the standard grading and dressing rules of the West Cost Lumber Inspection Bureau.

Plywood shall be not less than 3 ply, manufactured and graded in accordance with the standard grading rules of the APA.

Lumber for uses listed shall not be lower than the following grades:

USES	GRADE
(A) Permanent Construction,such as bridges and culverts	Select Structural, for beams and stringers Construction, for balance of structure
(B) Minor permanent construction, such as fences, guard rails and posts, pavement headers, bulk-heads, retaining structures, etc.	Construction.
(C) Falsework and studs, and wales for formwork	Construction, for framing, beams or timbers.
(D) Form sheeting for nonshowing surfaces of concrete	Standard, for boards; shiplap; or any grade of plywood.
(E) Form sheeting for showing surfaces of ornamental concrete.	C and Better Industrial clear; concrete form grade of plywood; or overlay plywood.
(F) Form sheeting for curved soffits of bridge & tunnel arches, plastered or unplastered.	Select Merchantable, board; concrete form grade of plywood; or overlay plywood.

(G) Soffits of beams and girders and slabs between beams and girders; for beam and girder sides; except ornamental concrete; and for headwalls or endwalls of culverts or covered conduits.	Concrete form grade of plywood; or overlay plywood.
(H) Form sheeting for showing surfaces of channel walls or interior surfaces, except floors; for covered conduit and all other showing surfaces not specified above.	Tongue and groove flooring equal to C and Better flat grain; concrete form grade of plywood; or overlay plywood.
(I) All other lumber	Construction.

978.2 REDWOOD:

Redwood lumber shall be selected as to grade and shall conform in all particulars to the standard specifications for grades of California Redwood of the California Redwood Association.

Redwood lumber for the uses listed shall not be lower than the following grades.

USES	GRADE
(A) Bridges, culverts, and guardrail posts.	Dense Structural.
(B) All other Redwood Lumber	Foundation.

978.3 GRADE MARKING:

Lumber. Each piece of lumber shall bear an official grade mark which, unless authorized otherwise, shall be the grade mark adopted by one of the following associations:

(A) For Douglas Fir - and Pine	The West Coast Lumber Inspection Bureau or other agency approved by the ENGINEER.
(B) For Redwood	The California Redwood Association.

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Plywood: Each sheet of plywood shall bear the official stamp of the APA stating the grading of the sheet.

979 WOOD PRESERVATIVES:

979.1 GENERAL:

This work shall consist of treating lumber, timber, and piling. Lumber, timber, and piling to be treated shall conform to the requirements of the specifications of the specification of the AWPA and as specified herein.

Where practical, lumber to be treated shall be cut to size and framed, prior to treatment. Proper allowance for shrinkage in the sizes of lumber shall be made by the CONTRACTOR where it is necessary to meet definite dimenmsions shown on the plans.

979.2 OIL TYPE PRESERVATIVE TREATMENT:

Preservatives under this specification shall be creosote, cresote-coal tar solutions, cresote petroleum solutions, or pentachlorphenol in petroleum oils, conforming to AWPA specification and as specified by the ENGINEER.

Treatment: The treating operations shall conform to the applicable requirements of the AWPA specifications.

Unless indicated otherwise on the plans or in the Special Conditions, the amount of preservative to be retained and the treating process to be used for the various types of service shall conform to the appropriate AWPA specification.

Incising: Unless otherwise specified, timber to be treated under this specification that is 3 inches or more in nominal thickness and 4 inches or more in nominal width, shall be incised before treatment as a means of securing penetration of the preservative. If such thickness is less than 4 inches, the material may be incised on the wide faces only; otherwise, all 4 faces shall be incised.

979.3 WATER BORNE SALT PRESERVATIVES TREATMENT:

Preservatives under this specification shall conform to the requirements of AWPA specifications unless approved in writing by the ENGINEER, but restricted to the following preservatives:

Chromated Zinc Chloride (CZC)
Tanalith (Wolman Salts)
Ammoniacal Copper Arsenite (Chemonite)
Chromated Zinc Arsenate (Boliden Salt)
Chromated Copper Arsenate (Erdalith)

979.4 FIELD TREATMENT OF CUT SURFACES:

When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with 2 coats of the same kind of preservative in conformance with AWPA specification. The maximum protection requirement specified therein shall be met in all instances.

990 PAINT:

990.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight cointainers, appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture.

990.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distributrion and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or Special Conditions by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the ENGINEER. Information required by the ENGINEER as proof of the comparative quality shall be furnished by the CONTRACTOR.

990.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

990.4 MATERIALS:

Materials shall conform in all respects to the requirements of reference specifications indicated for such material.

Upon request of the ENGINEER, the CONTRACTOR shall furnish a certification from the manufacturer that the material conforms with this specification.

PAINTS	SPECIFICATION
Basic Lead Silico Chromate Shop Primer	TT-P-615, Type II
Maroon Intermediate Field Coat	TT-P-615, Type II (Note 1)
Structural Steel Bridge Paint	Subsection 990.4.4
White Wood Primer	TT-P-25
Outside White Paint	TT-P-102, Class A
Exterior Black Paint	TT-P-61
Black or White Baking Enamel	TT-E-489, Class B
Federal Yellow Enamel	TT-E-489, Class A
Aluminum Paint	Subsection 990.4.4
Pavement Marking Paint	Subsection 990.4.3
Masonry Emulsion Paint	TT-P-19B

Note 1 Pigment Composition: Basic Lead Silico Chromate - 64.3% min., Red Iron Oxide (85% Fe_2O_3) - 34.0 to 36.0%, Suspending Agent 0.5 to 0.7%.

990.4.1 Structural Steel Bridge Paint:

Material	Proportion Min.%	Max. %
Pigment, 990.4.4(a)	36.0	--
Vehicle, 990.4.4(b)	61.0	64.0

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Properties of Finished Paints

Color	708.03(a), 1-5
Weight per Gallon	10.5 lbs., min.
Paint, Non-Volatile	69.0% Min.
Vehicle, Non-Volatile	53.0%, Min.
Fineness of Dispersion (Hegman)	5 min.
Consistency (Krebs-Stormer)	70 to 85 KU
Drying Time: Set to Touch	4 hrs., Max.
Dry Through	15 hrs., Max.
Coarse Particles & Skins	1.0% Max.
Water	0.5% Max.

(a) Recommended Pigment Composition for Color: (See subsection 990.4.4(a) for pigment specifications)

	Proportions Min.%	Proportions Max.%
1. Std. Green Bridge Paint: Color No. 14223		
Basic Lead Silico Chromate	40.0	--
Titanium Dioxide	--	30.0
Phthalocyanine Blue and auxiliary toning colors	--	2.0
Chromium Oxide	25.0	---
Organo - montmorillonite Gelling Agent	0.6	1.0

	Proportions Min.%	Proportions Max.%
2. Spruce Green Bridge Paint: Color No. 24159		
Basic Lead Silico Chromate	24.5	---
Chromium Oxide Green	24.5	---
Titanium Dioxide	24.5	---
Magnesium Silicate	---	24.5
Burnt umber & lamp black, tinting pigments	1.1	---
Organo-montmorillonite	0.9	---

3. Rust Beige Bridge Paint:
Color No. 20233

Basic Lead Silico Chromate	34.0	---
Magnesium Silicate	---	22.0
Titanium Dioxide	34.0	---
Iron Oxide and Burnt Umber (shading pigments)	---	9.0
Organo-Montmorillonite	1.0	2.0

4. Sand Biege Bridge Paint:
Color No. 20450

Basic Lead Silicate Chromate	35.0	---
Titanium Dioxide	48.0	---
Magnesium Silicate	---	13.0
Iron Oxide & Phthalo blue (shading pigments)	---	3.0
Organo-montmorillonite	1.0	2.0

5. Mocha Brown Bridge Paint:
Color No. 10075

Basic Lead Silico Chromate	40.0	---
Red Iron Oxide	20.0	---
Black & Yellow Iron Oxide	8.0	---
Magnesium Silicate	31.0	---
Organo-mintmorillonite	---	1.0

(b) Vehicle Composition

Alkyd Resin Solution, Fed. Spec. TT-R-266, Type 1, Class D	70.0% Min.
Raw Linseed Oil, ASTM D-234	5.0% Min.
Mineral Spirits, ASTM D-235, Driers, ASTM D-600, and necessary additives	24.0% Max.

990.4.2 Aluminum Paint:

The paint shall be supplied ready-mixed in the proportion of two pounds of aluminum paste (ASTM D-962, Type II, Class B) to one gallon of mixing varnish (see subsection 990.4.4(c). Aluminum paint shall dry to touch in 1/2 to 4 hrs and dry hard in not less than 18 hrs. Leafing will be inspected for acceptance on a vertical primed steel surface at a spreading rate of 400 sq. ft. per gallon.

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990.4.3 Pavement Marking Paint:

Material	Proportion by Weight	
	White	Yellow
Pigment Composition	49.0 to 51.0%	49.0 to 51.0%
Pigment:		
Titanium Dioxide, ASTM D-476, Type III, min	24.0%	---
Chrome Yellow, Medium, ASTM D-211, Type III, min	---	26.0%
Aluminum Silicate, Calcined, Min.*	26.0%	14.0%
Silica, Min*	50.0%	60.0%
Pigment Suspending Agents Subsection 990.4.4(b)	**	---
Vehicle Composition:		
Alkyd Resin Solution, subsection 990.4.4(d), min	74.0%	75.0%
VM & P Naptha, Fed. Spec. TT-N-95 b Type I; Driers ASTM D-600, Cl.B;* and Anti-skinning Agent, max	26.0%	25.0%

* Information on the source of materials to be used for Aluminum Silicate and Silica shall be submitted to the Division's Materials Laboratory for approval prior to use. Only sources with satisfactory records of performance will be approved.

Suitable amount organo-montmorillonite to achieve the desired storage and stability requirements, shall be added.

PROPERTIES OF FINISHED PAINT

Color of Yellow Paint	33538
Reflectance of White Paint	80 min.
Fineness of Dispersion (Hegman)	2 min.
Consistency (Krebs-Stormer)	70 to 80 KU
Drying Time, ASTM D-711, Minutes to no-pick-up	45 min.

990.4.4 Materials	Specifications:
(a) Paint Pigments:	
Basic Lead Silico Chromate	ASTM, D-1648
Chrominum Oxide, (Green)	ASTM, D-263
Magnesium Silicate	ASTM, D-605
Phthalocyanine Blue	ASTM, D-963
Titanium Dioxide	ASTM, D-476, Class IV
Red Iron Oxide	ASTM, D-84, Class 1
Black Iron Oxide	ASTM, D-769
Yellow Iron Oxide	ASTM, D-768

(b) Organo-montmorillonite shall be an organic ammonium compound of montmorillonite with a high gelling efficiency in a wide range of organic liquids. It shall be a fine, creamy, white powder with maximum water content of 3.0% and a maximum of 5.0% retained on the No. 200 sieve. Organo-montmorillonite shall be pre-wetted with methanol or ethanol as recommended by the manufacturer.

(c) Varnish for Aluminum Paint.

MATERIAL	SPECIFICATION
Resin - 100% Phenol Formaldehyde	MIL-R-15189A
Oil-Tung	ASTM D-12
Mineral Spirits	ASTM D-235
Xylene	ASTM D-364
Driers - Cobalt and/or manganese	ASTM D-600

PROPERTIES OF VARNISH

Viscosity (G-H)	A-C
Oil Length	33 gal.
Nonvolatile	55% min.
Proportion of Thinners 90%	
Mineral Spirits	10% Xylene
Color (Hellige)	12 max.
Zinc Reactivity	None
Kauri Reduction	140% min.
Rosin and Rosin Derivatives	None
Appearance	Clear and Transparent
Drying Time: Set to Touch	1 to 3 hrs.
Dry Hard	18 hrs. max.

Alkali Resistance - No visible attack to film dried 72 hours after 8 hours in 5% sodium hydroxide solution at 70oF.

(c) Alkyd Resin Solution for Pavement Marking Paint:

Type of Alkyd Resin	Medium Length, Soya and/or Linseed Oil Modified
Type of Solvent	VM & P Naphtha, TT-N-95, Type 1
Visocity (G-H)	Z-Z2
Color (Gardner-Hellige, Disc 620 C-40)	8 max.
Nonvolatile Solids	49.0 to 51.0%
Oil Acids (N-V Basis)	50% Min.
Phthalic Anhydride (N-V Basis)	33%, Min.
Acid Value (N-V Bases)	4 to 10
Unsaponifiable Matter (N-V Basis)	1.0% Max.
Iodine Value of Extracted Fatty Acids	120 Min.
Rosin and/or Rosin Derivatives	None

990.4.5 Pavement Primers:

Primers shall conform to the following or shall be an approved equal and as recommended by the thermoplastic material manufacturer.

The primer materials may be accepted at the job site on the basis of a manufacturer's certification or they may be sent to the OWNER for testing, in which case 3 weeks should be allowed between sampling and intended use.

(a) Bituminous Pavement Primer: The primer for bituminous pavement shall consist of butadinestyrene or neoprene dissolved and/or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weigfht, and at 70oF. and 60 percent R.H., a 6 mil. film shall dry to tack-free in less than five (5) minutes.

(b) Concrete Pavement Primer: The primer for Portland Cement concrete shall be an epoxy resin meeting the following requirements:

	Part A	Part B
Weight per gallon, min.	8,095 lbs.	7,405 lbs.
Epoxy Equivalent of solids	185-200	
Potlife of mixture	24 hrs. min. when kept in closed container at 72oF.	

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Total Mixture (A & B)

Reactive solids content, by wt., min. 50% (Note 1). The mixing ratio shall be 2 parts of A to 1 part of B, by volume.

NOTE (1):

Reactive solids content shall be determined by blending one part by weight of Part A with one by weight of Part B and allowing this mixture to react (which occurs after solvent evaporation). A solids content of this reacted mixture is determined after constant weight is reached in an oven at 105oC.

990.4.6 Masonry Coating:

Masonry coating shall be a hydraulic cement base coating designed for use on porous surfaces of concrete as a decorative, protective and water repellant coating. The powder shall consist of a heavy cement base coating packaged in a dry form and shall conform to Federal Specification TT-P-21, Type I, Class B. The liquid acrylic shall be an approved combination of polymers and modifiers designed for use with portland cement, shall be fully compatible with water and shall be a product of the manufacturer of the cement base powder. All materials shall be delivered to the project site in sealed containers bearing manufacturer's original labels.

990.5 INSPECTION AND TESTING:

The manufacturer shall notify the OWNER well in advance of actual paint manufacture in order to arrange for sampling and testing of raw materials and inspection of paint production.

Test methods shall be according to ASTM or, if not covered therein, Federal Test Method Standard No. 141.

All paint shall have been approved before delivery and each container shall bear a "Pretested and Approved" label.

990.6 PACKAGING:

Paint shall be supplied in approved air tight containers filled on the basis of actual weight per gallon at 77°F.

Each container shall be plainly labeled as to name of paint and corresponding specification number according to subsection 990.4 as well as manufacturer and batch number.

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992 DUST PALLIATIVE:

992.1 GENERAL:

Since the establishment of grades will not normally be required to the application of this palliative, and since there is always the possibility that the Contracting Agency will grade in this area, the Contracting Agency will not assume any responsibility for the maintenance of this work. The CONTRACTOR will, however, be responsible for obtaining satisfactory results within the limits of the materials and the requirements of these specifications.

Sufficient grading shall be done prior to treatment to provide reasonable drainage.

Except as stated in the Special Conditions, the material to be used shall be the type designated by the ENGINEER.

992.2 TYPE AND APPLICATION OF MATERIALS:

(A) Asphalt Base Type:

Designation	Specification Requirements
(1) SC 70	In Accordance With Section 912
(2) MC 70	In Accordance With Section 912
(3) RC 70	In Accordance With Section 912
(4) PS 300	Fuel Oils, Pacific Specifications
(5) No. 5	Fuel Oils, Commercial Standard Specifications
(6) No. 5	(Heavy) Fuel Oils, ASTM D-396

Sand shall be uniformly applied over the fresh coat of oil. The amount shall be sufficient to serve as a blotter and insure that pickup and tracking will not occur. This will normally range between 10 and 25 pounds per square yard.

The rate of application of the cutback asphalt shall be approximately 0.3 gallons per square yard.

Application shall be made by an approved pressure-type asphalt distributor truck.

Care shall be taken to prevent the splattering of oil on curbs, sidewalks, fences, buildings, etc., and a shield shall be used where so ordered by the ENGINEER.

The application of the oil shall be restricted to some extent by weather conditions. The spreading of liquid asphalt will not be permitted when, in the opinion of the ENGINEER, weather conditions are detrimental to performance of first class work.

(B) Petroleum Resinous Type:

The material shall be a light yellow emulsion. Coherex or approved equal, suitable for use as an agglomerant for soil particles. The emulsion shall contain 60 +/- 3 percent of a thermo-plastic resinous petroleum fraction characterized by the following properties:

Specification Designation	ASTM Test Method	Requirements
Viscosity, SUS at 100oF., Sec.	D-88	6000 min.
Residue, %	D-95	60 +/- 3
Asphaltenes, %	D-2006	0.75 max.
Saturated Hydrocarbons, %	D-2006	20 max.
Flash Point, CO, ° F.	D-92	400 min.
Specific Gravity, 60/60° F	D-1298	1.00 min.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at ordinary temperatures, excluding freezing or boiling, for a minimum of 3 months. It shall be miscible with water in all proportions, including a ratio of 1 part emulsion to 5 parts water. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil surface and not form a skin at the surface or a crusted surface.

Immediately after compacting, the 1 to 5 diluted emulsion shall be applied in 1 to 3 applications, as required, at a rate of approximately 0.17 gallons per square yard per application. The material shall be applied by means of a thoroughly cleaned bituminous distributor or other approved means.

(C) Lignin Based Types:

Lignin sulfonates, a residual co-product of wood pulping by the sulphite process in the manufacturer of cellulose products. This material may be supplied in either the granulated solid or liquid form, liquid form to contain 50 +/- percent lignin solids by weight. The application rate shall be such that the residual lignin solids constitute approximately 1 percent by weight of the soil being treated. One gallon of 50 +/- 2 percent solids lignin sulfonate concentrate* will usually result in the required residual content for a soil volume of 1 square yard 6 inches deep.

*Lignin sulfonates are usually diluted to 10 to 25 percent solids before application. The rate of dilution is variable and shall be determined by the ENGINEER.

Application of this material may be made by either a pressure type water sprinkling truck or an asphalt distributor, however, the same precautions to prevent contamination of adjacent objects will be required as in the case of the asphalt base products. For other than skin treatments, multiple applications and some scarifying and blading may be necessary.

992.3 METHOD OF MEASUREMENT:

The ENGINEER shall order the rate of application of all materials. This is a contingent item and quantities may be increased or decreased as required or eliminated entirely from the contract.

Asphalt base types shall be measured by the ton completed and accepted in place.

Petroleum resinous types shall be measured by the diluted gallons completed and accepted in place.

Lignin based types shall be measured by the pounds of residual solids applied, completed and accepted in place.

Sand for blotting shall be measured by the ton.

992.4 PAYMENT:

Payment will be made for the above items bid in the proposal form for the applicable item and shall constitute full payment for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Payment for all asphalt base items shall be by the ton.

Payment for all petroleum resinous types shall be by the diluted gallon at 60oF.

Payment for lignin based types shall be by the pound of solid content of lignin sulfonate and included wood sugars.

Payment for sand for blotting shall be by the ton.

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995 LANDSCAPE MATERIAL:

995.1 GENERAL:

Material used for landscaping purposes shall be in conformance with this Section.

The commons and scientific names of plants shall conform to the approved names in Standard Plants Names (SPN) or its successor. American Association of Nurserymen (ASN). For identification and inspection, durable, legible labels, bearing the plant's name in water-resistant ink, shall be attached to all nursery stock or container of stock delivered to the project site.

995.2 TOPSOIL:

Topsoil shall be a fertile, friable soil, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth. At least 10 days prior to delivery of topsoil to the site, the CONTRACTOR shall furnish the ENGINEER at no additional cost, with a soil sample from each source for analysis and tests.

To be acceptable the pH factor shall not exceed 8.0 or be lower than 5.5 , soluble salts shall not exceed 1500 PPM, the plasticity index shall be in the range of 3 and 15 inclusive, and it shall contain approximately 1 1/2%, by dry weight, of organic matter either natural or added. Gradation shall be in accordance with the table shown below:

Sieve Size	Percent Passing
1"	100
1/2"	95-100
No. 4	90-100
No. 10	70-100
No. 200	15-70

995.3 SOIL FERTILIZING MATERIAL:

Fertilizing material shall comply with the applicable requirements of the State Agricultural Code. All fertilizing material shall be packaged, first grade, commercial quality products identified as to source, type of material, weight and manufacturer's guarantee analysis. It shall not contain toxic ingredients or fillers in quantities harmful to human life, animals or plants. It shall be delivered in unopened containers and shall have the chemical analysis as specified in the plans or specifications. Material which has become caked or otherwise damaged shall not be used.

995.4 ORGANIC SOIL CONDITIONERS:

In general, soil conditioners shall consist of a ground or processed wood product derived from redwood, ground or shredded fir, redwood or ponderosa bark. It shall have a nitrogen content of 1%, a pH not exceeding 7.5 and organic matter not less than 85%. Its gradation shall be such that atleast 85% passes the 1/4 inch screen. In addition, it shall be treated with a non-toxic agent so as to be hygroscopic.

When manure is used as a soil conditioner, it shall be the product of yard fed cattle, free of weed seeds, straw or any other inert material and aged at least 3 months. This manure shall have been processed by grinding and screening and shall be of a consistency that will readily spread with a mechanical spreader.

995.5 CHEMICAL SOIL CONDITIONER:

Chemical soil conditioners such as soil sulfur, gypsum or iron additive shall be commercially approved brands designated for agricultural use. Material which has become caked or otherwise damaged shall not be used.

995.6 SEEDS:

Seeds shall be fresh, clean seeds, pre-mixed to the specified proportion. They shall be delivered to the site in original, unopened containers bearing the dealer's guaranteed analysis and germination percentage. They shall have a certificate or a stamp or a release accomplished by an agricultural commission.

995.7 PLANTS TREES, AND SHRUBS:

995.7.1 GENERAL:

All landscape stock shall be grown in nurseries approved by the State Department of Agriculture. They shall have a growth habit normal to the specie. Stock shall be sound, healthy and vigorous; free from insect pests, sun scald, excessive bark abrasions and other objectionable disfigurements. They shall have normal, well-developed branch systems and vigorous, fibrous root systems which are neither root nor pot-bound and are free of kinked or girdling roots.

All stock shall have been grown in pots, cans, tubs, or boxes for a minimum of three months and a maximum of one year. They shall have sufficient roots to hold earth together after removal from the containers. This earth shall be free from noxious weeds including bermuda grass.

Stock shall be inspected and approved by the ENGINEER at the CONTRACTOR'S storage site prior to delivery to the project.

977.7.2 FLATTED PLANTS:

Flatted plants shall be grown and remain in the flats until transported to the project site. The soil and spacing of the plants in the flats shall insure the minimum disturbance of the root system at transplanting.

997.7.3 TREES:

Trees shall be of the specified height, spread and caliper and shall stand erect without support. The height shall be measured from the root crown to the last division of the terminal leader with the branches in a normal position and the caliper shall be measured 12 inches above the crown roots.

995.7.4 Shrubs:

Shrubs shall be of the specified type, height and spread. They shall be selected from high quality, well-shaped stock.

995.8 MISCELLANEOUS MATERIAL:

995.8.1 Headers and Stakes:

Lumber for landscaping shall be construction heart, rough-sawn redwood in the sizes specified; splicing will not be permitted. Stake used with header boards shall be 2 x 4 inches, pointed and at least 18 inches long.

995.8.2 Tree Stakes:

Unless otherwise specified, tree stakes shall be 2 x 2 inch redwood posts, free of knots and reasonably straight, and of sufficient length to properly support the tree.

995.8.3 Tie Wires:

Tie wire shall be No. 12 AWG zinc coated wire and the cover for this wire shall be 1/2 inch garden hose.

APPENDIX E-3

SUGGESTED PREQUALIFICATION SCHEME
FOR CONTRACT ROADWORKS AND BRIDGEWORKS

AURORA ROADS

SUGGESTED PREQUALIFICATION SCHEME FOR CONTRACT ROADWORKS AND BRIDGEWORKS

GUIDELINES AND CONDITIONS (SEPTEMBER 1991)

1. Introduction

Contractors wishing to tender for road and/or bridge works above certain limits must first become prequalified to do so. Contractors are prequalified on a yearly basis and must apply each year to have that prequalification renewed. All contractors must apply for prequalification to be eligible to tender for AURORA ROADS contracts after 1 April 1992.

The aim of the prequalification scheme is to classify Contractors commensurate with their technical expertise, financial capacity and overall performance, affording protection to both AURORA ROADS and Contractors against over-commitment.

2. Inviting Tenders

A tender advertisement will normally specify the minimum prequalification class applicable to that tender. Only Contractors prequalified at that class or higher will be eligible to tender. A tender from a tenderer not so qualified will be considered to be non-conforming.

Where it is considered appropriate, AURORA ROADS will use other forms of tendering, vis. Open Tender, Preregistration, and Tender by Invitation. These forms of tendering will take precedence over prequalification.

3. Prequalification Categories

Contractors need only apply for prequalification in the following work categories:

- Road Construction Works
- Bridge Construction Works

Prequalification is not required for other categories including separate road and bridge materials supply contracts, bituminous surfacing and asphalt paving and other special classes of work.

4. Prequalification Classes

A. Roadwork

Financial Limit	Roadwork Class
₱ 10 m	No Prequal Reqd
30 m	R3
60 m	R6
100 m	R10
200 m	R20
400 m	R40

B. Bridgework

Financial Limit	Bridgework Class
₱ 10 m	No Prequal Reqd
20 m	B2
40 m	B4
80 m	B8

Tenders for a roadwork class above R40 and bridgeworks class above B8 will be by preregistration.

Note 1. When bridgeworks are included in a contract which is predominantly roadworks and a minimum prequalification class is stated for both roadwork and bridgework in the advertisement, the roadworks Contractor is to be separately prequalified to the appropriate class for those bridgeworks, or shall nominate a suitably prequalified bridgeworks Contractor as a subcontractor.

Note 2. When roadworks are included in a contract which is predominantly bridgeworks and a minimum prequalification class is stated for both roadwork and bridgework in the advertisement, the bridge Contractor is to be either separately prequalified to the appropriate class for those roadworks or shall nominate a suitably prequalified roadworks Contractors as a subcontractor.

Note 3. The prequalification class applied to combined roadwork and bridgework contracts will be based on the total estimated value of the contract.

5. Application for Prequalification

Contractors are invited to apply for prequalification by completing and submitting an application form - "Application for Prequalification - Contract Roadworks and Bridgeworks".

Details of the Contractor's organization, current and complete projects, management capabilities, technical expertise, construction plant and financial capacity are required. Details of the Contractor's Quality Assurance System will be required from Contractors wishing to prequalify for classifications R40, R20 or B8.

AURORA ROADS will undertake such investigations as necessary to ensure that the Contractor has performed satisfactorily for the purposes of prequalification.

AURORA ROADS will undertake a company search to ensure that the Contractor is a bonafide registered company or business, and will undertake other searches and inquiries, including bank references, to ensure that the Contractor has the financial capacity appropriate to the prequalification class sought. Contractors shall, on request, provide any necessary authority to enable these searches and inquiries to be carried out.

If necessary, an interview will be arranged between the Contractor and AURORA ROADS "Contractor Prequalification Committee" to clarify details of the application in order to assess the Contractor's technical and financial capacity, and project management ability.

6. Assessment and Notification

Application for prequalification will be assessed by the "Contractor Prequalification Committee" comprised of the following Authority Officers:

(List Authority Officers)

The authority period for prequalification applications will be a minimum of six weeks and contractors shall allow at least this minimum period for assessment of either initial applications, or applications for upgrading. Applicants will receive written notification of their assessment and until such written approval has been received, the Contractor shall not be eligible to tender for work in that prequalification class.

7. Prequalification Period, Upgrading and Renewal

All prequalification classifications will be reviewed annually and will remain current until 31st December each year unless the Committee becomes aware of circumstances that warrant earlier review. In addition to advertisements calling for renewed (or new) applications, AURORA ROADS will forward an application form to each prequalified Contractor and invite re-application for the following year. Applications will be requested in October of each year.

Applications for initial prequalification may be submitted at any time during the year and any prequalification class approved will remain current until 31st December of that year unless otherwise advised.

An application for upgrading of prequalification class will only be considered at times other than the annual calling of applications, when a Contractor can demonstrate that the company structure has changed significantly as a result of amalgamation, rationalization or other such factors since the last classification. At the time of such application, full particulars of the new circumstances of the Contractor must be provided and all differences highlighted.

8. Reviewing, Rescinding or Downgrading Prequalification

Where in the opinion of AURORA ROADS, a prequalified Contractor's performance of contract works for any client is significantly unsatisfactory or a material change takes place to the technical or financial capacity or the management and/or the organization of the Contractor which is likely to have an adverse effect on its performance, AURORA ROADS may in its absolute discretion rescind the prequalification or reduce the class of prequalification. Before such action is taken, the Contractor will be given an opportunity to show cause why the prequalification should not be rescinded or reduced in class. The Contractor will also be given details of the matters prompting the request to show cause.

AURORA ROADS reserves the right to review any prequalification at any time. Records will be kept of Contractor's performances with particular regard to the following:

- Standard of work;
- Performance of Quality Management System Contracts;
- Managerial Performance (including management and supervision of subcontractors and effective site and industrial relations);
- Adherence to, and respect for, contract provisions;

- Payment for sub-contractors and suppliers;
- Adherence to Contract Works Agreement;
- Time taken for completion;
- On-site cooperation in the achievement of AURORA ROADS objectives.
- Job safety record;
- Provision for traffic (where applicable);
- Incidence of claims found to be frivolous or exaggerated;
- Provision of required insurance cover.

Generally, AURORA ROADS will particularly scrutinize a Contractors' initial work for AURORA ROADS and initial works in a new prequalification class.

9. Appeals

If a Contractor is not satisfied with the classification(s) of prequalification determined by AURORA ROADS, the Contractor may appeal against the determination. The appeal must be received within 30 days of the date of the letter advising of the classification of prequalification determination.

Appeals will be considered by a "Contractor Prequalification Appeals Committee" comprised of four members as follows:

AURORA ROADS Officers

(list 2 names and titles)

Industry Representatives - any two of the following:

- one representative from the Construction Contractors
- one representative form the Road Contractors
- one representative from another industry organization

10. Related and Subsidiary Companies

Prequalification of a Contractor does not extend to related or subsidiary companies owned or controlled by the Contractor.

Any such company should apply for prequalification in its own right.

11. Changes to Contractor

Prequalified Contractors are required to immediately advise the Authority of any significant change to its financial or technical capacity, ownership or holding.

12. Disclaimer

A determination by AURORA ROADS of any application for prequalification or for upgrading of prequalification is to be at its absolute discretion.

AURORA ROADS shall not be held liable for any costs or damage incurred in the exercise of such discretion or the discretion to rescind or reduce in category any prequalification.

13. Confidentiality

The prequalification of Contractors for AURORA ROADS works is solely for the benefit of AURORA ROADS and its Contractors. No information relating to prequalification may be used by Contractors in advertising or for any promotional purpose or be published in any form without the written consent of AURORA ROADS.

No responsibility is accepted for any consequences arising from the use of any such information.

14. Conditions of Tender

Approval to a prequalification class provides eligibility for a Contractor to tender but does not obviate the need for a Contractor to meet the Conditions of Tendering of any Invitation to Tender issued by AURORA ROADS. Assessment of tenders by AURORA ROADS will include, among other things, the technical and other special requirements of the contract, the tenderer's current commitments and current available resources including finances.

15. Insurance

AURORA ROADS requires the Contractor to take out a Public Liability Policy of Insurance which is to include a cross-liability clause in which the insurer agrees to waive all rights of subrogation or action that it may have or acquire against all or any of the persons comprising the insured and for the purpose of which the insurer accepts the term "insured" as applying to each of the persons comprising the insured as if a separate policy of insurance has been issued to each of them (subject always to the overall sum insured not being increased thereby). It is a requirement of each contract that the policy is to be in the joint names of AURORA ROADS, the Contractor and all subcontractors employed in relation to the Works.

Details of the Contractor's current insurance policies must be included in the application for prequalification, together with evidence that the Contractor is registered as an employer for the purposes of the Accident Compensation under the laws of the Republic of the Philippines.

16. Quality Systems Contracts

It is the AURORA ROADS policy that future contracts will be performed under a quality assurance system and that such a system shall be in accordance with Manual of Engineering Practice No. 73 Quality in the Constructed Project published by the American Society of Civil Engineers, 345 E. 47th Street, New York, NY 10017-2398, published 1990.

AURORA ROADS will adopt a phased introduction of quality assurance for contract works generally in accordance with the following timetable:

1. Roadwork

	Contract Value	Date for Introduction of QA Contracts
a)	greater than ₱ 400 m (Pre-registration)	July 92
b)	₱ 200 m (R20)	July 92
c)	₱ 100 m to ₱ 200 m (R10)	July 92
d)	₱ 60 m to ₱ 100 m (R6)	Jan. 93
e)	₱ 30 m to ₱ 60 m (R3)	July 93

f)	₱ 10 m to ₱ 30 m	July 93
g)	₱ less than $0.5 m	July 93

2. Bridgeworks

	Contract Value	Date for Introduction of QA Contracts
a)	greater than ₱ 80 m (Pre-registration)	July 92
b)	₱ 40 m to ₱ 80 m (B8)	July 92
c)	₱ 20 m to ₱ 40 m (B4)	Jan. 93
d)	₱ 10 m to ₱ 20 m (B2)	Jan. 93
e)	less than ₱ 10 m	Jan. 93

All contractors wishing to prequalify in the R20, R10 or B4 classifications to be eligible to tender for contracts within these classifications after 1 July 1992, must now submit details of their quality systems. Submitted information shall include a Quality Manual and other details as included in the forms for Application for Prequalification - Contract Roadworks and Bridgeworks.

17. General

The Contractor must submit with its application, any additional requirements as specified in the request for prequalification.

On applying for or for upgrading of prequalification, a Contractor is deemed to have accepted these conditions as may be varied from time to time.

Contractors wishing to prequalify should submit application forms to:

(list name and address)

no later than _____(date)_____

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AURORA ROAD

APPLICATION FOR PREQUALIFICATION

CONTRACT ROADWORKS AND BRIDGEWORKS

(SUBMITTED INFORMATION WILL BE TREATED AS CONFIDENTIAL)

Business Name of the organization under which tenders will be submitted (a reference hereafter to "your organization" means this organization and not an associated or related organization.):

.....

Address .....

Telephone No. ..... Fascimile No. .....

Contact Person .....

Position in Company .....

Prequalification Class being applied for (please indicate *x*)

Roadwork (Select one only)		Bridgework (Select one only)	
R3	( )	B2	( )
R6	( )	B4	( )
R10	( )	B8	( )
R20	( )		
R40	( )		

Is the business currently prequalified with AURORA ROADS? .....

If so, indicate which Class(es) .....

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1. **Business Identification**

(a) State whether business is:

Individual, Partnership or Limited Liability Company? .....

.....

(b) If partnership, give full names and addresses of all partners:

.....

.....

.....

(c) Location of Registration of Company or Business Name

.....

(d) Registration No. .....

(e) If registered outside the Philippines, please provide Location of Incorporation:

.....

(f) Address of Registered Office .....

.....

2. **Company Organization**

Brief description of the present organization of the applicant, including names and qualifications of principals, partners, or directors (as the case may be).

.....

.....

.....

.....

3. **Business History**

How many years has the organization operated as a Contractor under:

(a) Its present business name .....

(b) A former business name .....

(c) State former name .....

4. **Other Business**

Is the business financially interested in other types of business? (Give details)

.....

.....

.....

.....

.....

.....

5. **Association Membership**

Is the business a member of the Construction Industry Association of the Philippines, the Philippine Contractors Accreditation Board, the Philippine Contractors Association, Inc., or other similar Associations?

Yes/No If yes, state which Association(s) .....

.....

6. **Experience**

How many years experience has the organization had in the type(s) of work being applied for?

(a) As a Contractor .....

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(b) As a Sub-Contractor .....

State Name of Contractor .....

.....

7. **Current Projects**

Please list on the attached Appendix A the contracts your organization is presently undertaking.

8. **Past Experience**

Please list on the attached Appendix B the contract works completed in the last five years by your organization. Identify those works done as a subcontractor.

9. **Technical Experience of Personnel**

Please set out on the attached Appendix C the experience and qualifications of the principal members of your present organization (include on-site supervisory staff).

10. **Construction Equipment**

Please list on the attached Appendix D the construction equipment currently available to your organization.

11. **Additional Information**

(a) Has your organization or any prior organization similarly managed and/or controlled ever failed in the last five years to complete a contract, had a contract partially or fully taken over or had a contract varied to delete substantial work to overcome poor performance under the contract?
Yes/No If yes, when, where, why? . .....

.....

.....

.....

.....

.....

(b) Has any partner, principal, or individual in the business ever been associated with any other organization which has failed in the last five years to complete a contract?

.....

If so, state name of individual or organization and reason for failure:

.....

.....

.....

.....

.....

(c) Has your organization or any prior organization similarly managed and/or controlled, in the last five years been declared bankrupt, entered into receivership, management agreement, scheme or composition pursuant to any Bankruptcy Act Code?

.....

If so, give details .....

.....

.....

(d) Give details of all current employees (numbers by trade classification, union membership)

.....

.....

.....

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.....

.....

12. Financial Information

The following documents (which shall remain confidential and be returned upon request to the applicant after evaluation) are to be attached to this application:

(a) Copies of Financial Accounts for the last two financial years, including:

- Trading Account
- Profit and Loss Account
- Balance Sheet
- Signed Auditor's Report
- Signed Director's Report (when Applicant is a Company)

(b) In the case where the applicant is a Company and its current year accounts have not been audited, the following certificate is to be signed by a Director of the applicant:

"I certify that the accounts attached are true copies of those lodged or to be lodged with the appropriate Corporate Commission of the Republic of the Philippines.

_____ _____

(Witness) (Signed)

(c) Details of any Debentures or Charges or other forms of security affecting the assets of the Company.

.....

.....

13. Financial References

Particulars of applicant's Bank or other Financial Institution to which AURORA ROADS is authorized to refer to for financial details.

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Account Name: .....

Bank: .....

Branch: .....

Address: .....

14. **Further Financial Information**

Is there any further financial information of a confidential nature which the applicant would like to advise the Prequalification Committee personally at an interview? Yes/No

15. **Insurances**

(a) Public Liability Insurance

Insurer ..... Sum Insured .....

Policy No. .....

(b) Professional Indemnity

Insurer ..... Sum Insured .....

Policy No. .....

Signed: .....
Company Secretary or Director

Designation: .....

Date: .....

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Appendix A

CURRENT CONTRACTS

Location	Description of Work	Contract with (Client)	Contract Value	Original/ Estimated Date of Completion	Monthly Expenditure/ Production Rates	Client Contact Person

Appendix B

PAST EXPERIENCE - CONTRACT WORKS

Location	Description of Work	Contract with (Client)	Original/ Final Contract Value	Original/ Actual Contract Period and Completion Date	Average/ Maximum Monthly Progress Payment

Appendix C

TECHNICAL EXPERIENCE OF PERSONNEL

Name	Professional/Technical Qualification	Present Position	Experience Indicate Type of Work Give Location and brief description of project State position held and duration thereof

CONSTRUCTION EQUIPMENT
(List Plant Available)

Quantity	Description of Plant Item Include Model No., Capacity etc.	Year of Manufacture	Condition	Present Location
A. PLANT FULLY OWNED BY COMPANY SEEKING PREQUALIFICATION				
B. PLANT FULLY OWNED BY RELATED OR SUBSIDIARY COMPANIES				
C. PLANT LEASED, HIRED, OR SUBJECT TO HIRE PURCHASE BY CONTRACTOR				

APPENDIX G

TERMS OF REFERENCE

APPENDIX G

TERMS OF REFERENCE

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Appendix G

TERMS OF REFERENCE FOR A FEASIBILITY STUDY OF THE AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT IN AURORA PROVINCE

I. OBJECTIVES

The objectives of this Terms of Reference and the study are to determine the technical and economic feasibility in terms of the optimum level and timing for improvement of the Baler-San Luis-Maria Aurora-Dipaculao Circumferential Road, the Baler-Dingalan and the Dingalan-Palayan Road, hereinafter referred to as the Aurora Roads Infrastructure Development Project (ARIDP), identified and briefly described in Appendix I, to induce economic development, to remove existing transportation constraints and to assist in achieving the socio-economic objectives inherent in the Government of the Philippines's (GOP) economic development policy for the country as a whole and for the Aurora Province in particular. The objectives of the GOP's development plans are to attain a balanced agro-industrial development, national productivity and economic recovery, raise income and promote the redistribution of income. Specifically, the study should determine the economic feasibility of constructing new road links, and reconstructing and rehabilitating existing roads.

The study shall generate suitable project package for the ARIDP which would include optimally phased investment programs, consistent with the GOP's development plans. The study shall also identify the complementary investments needed to assure the success of the initial investments.

Specifically, as part of the overall project objectives, the study is expected to:

A. Substantiate the need for construction/ upgrading of the proposed ARIDP within the context of national and regional socio-economic development goals.

B. Provide recommendation for improving management, maintenance and administration of the corresponding transport system.

C. Estimate the volume and type of road passenger and cargo traffic to be handled within the project areas annually for the next fifteen (15) years and the constraints likely to be encountered in the efficient handling of such traffic.

II. BACKGROUND

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A. GENERAL

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The Philippine development efforts in the medium term period 1987-1992 are principally directed towards the attainment of: (1) alleviation of poverty, (2) generation of more productive employment, (3) promotion of equity and social justice, and (4) attainment of sustainable economic growth. An employment oriented rural-based strategy is being pursued to directly address these goals.

The GOP's goal is to reinforce the physical foundation of the economy to support these development thrusts. Specifically, the GOP's Department of Public Works and Highways (DPWH) seeks to install and improve essential transport infrastructure, especially in the rural areas. This is being carried out through an infrastructure program focused on a dual role: first, in a supportive capacity to physically interact and provide the basic support facilities needed to facilitate the activities of the leading production sectors; and next, in an active capacity, to induce development in the desired areas.

A major component of this infrastructure program is improvement/ construction of highway transport facilities which has been, and will continue to be, the dominant mode of transportation in the Philippines. Highway transport accounts for about 22 billion ton-kilometers per year or 60 percent of the total domestic freight traffic, and around 53 billion passenger-kilometers per year or 80 percent of the total domestic passenger traffic.

Consistent with the goal to increase employment opportunities, to increase income and to alleviate poverty; the less developed regions has been given emphasis in terms of development programs and projects that increase production and enhance economic development.

To achieve GOP's goal the DPWH, is building up its pipeline of ready to design/ build road projects, for implementation by use of local resources or possible foreign financial assistance. The ARIDP detailed feasibility study would include the Baler-San Luis-Maria-Aurora-Dipaculao Circumferential Road with an estimated length of 41.05 km., the Baler-Dingalan Road with an estimated length of 70 km. and the Dingalan-Palayan Road with an estimate length of 80 km.. The total length of the roads identified for study is approximately 191 km..

Of all the provinces in Luzon it is arguable that Aurora has the poorest access and the least developed transport systems. In spite of a long coastline, its exposure and remoteness has left the province's port locations undeveloped and under-utilized. Due to tenuous road links the commercial air service from the province has been halted. The local road network is virtually confined to the vicinity of the main towns and there is a poor intra-provincial link between the three main geographical zones in the area. As of 1988, the province's effective road network extend to about 1,458 kilometers. Gravel pavement is accounted for 97.46% while asphalt and concrete pavement are accounted for a merely 2.19% and 0.35% respectively. The jurisdiction of the road system is 16% national,

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8% provincial, 9% municipal and 67% barangay.

The feasibility studies are expected to determine the extent and nature of required improvements, the economic justification and the development of a suitable and optimal investment program. The findings of the study are intended for use by the GOP for seeking local funds or financial assistance from foreign assistance/ development institutions to implement portions of the road network found feasible.

B. PROJECT RATIONAL

Rapidly increasing demands for the improvement of transport condition in Aurora Province caused the GOP to conduct a feasibility study of the transport infrastructures in Aurora Province within the Rural Roads Development Program II in 1982. Several of the roads under the study were recommended for further study and/or detailed engineering design. The outcome of these studies are published in the following reports and can be obtained from DPWH:

1. Rural Roads Development Program II, Final Report, Aurora, October 1982.

2. Third Road Improvement Project/T.A., Aurora Final Report, February 1985

However, due to financial constraints, very few of these projects were implemented. The significant increase in population and vehicles have resulted in poor transportation service, inadequate capacity of the network and lack of safety, causing high rate of accidents. This condition is further aggravated by the poor pavement conditions of the roads due to inadequate and insufficient maintenance funds and operations.

Baler, San Luis, Maria Aurora and Dipaculao, the four (4) central municipalities of the province, are at present hampered by transportation problems. While business activities and land uses/urbanization have expanded, the road improvements are taking a rather slower pace. Poor level of service and longer travel time have become inevitable particularly along major roads leading to the four (4) municipality centers. These problems are having an adverse effect on trade and commerce between these four municipality centers, neighboring towns and barangays. With limited access roads and inadequate capacity of the existing roads, the disruption of local seasonal access within Central Aurora would persist. Construction of new bridges and improvement of existing thorough fare should provide the solutions for elimination of the present problems.

C. LOCATION OF THE PROJECT

The ARIDP Project is located in Aurora Province. It includes: a road starting from the town proper of Baler, connecting the

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municipalities of San Luis, Maria Aurora, Dipaculao and Baler to complete a circumferential road connecting these four municipality centers; a road from Dingalan to Palayan; a road from Baler to Dingalan, and; segements connecting these roads as required.

III. METHODOLOGY

A. The Consultant shall analyze the feasibility of constructing new or upgrading the existing components into an all-weather (typhoon resistant) highway network to complement and link with other roads servicing the project areas.

B. The Consultant shall rank the feasibility of each segment of the ARIDP according to its order of importance to the national economy. For general presentation purposes, the economic indicators should be shown for each road component broken down into unfeasible and feasible sections. The feasibility should, however, also be shown by homogeneous sections.

C. The Consultant shall conduct detailed technical investigations and analyses as needed and as described briefly in the following sections, for tha construction/ upgrading of the ARIDP.

D. The Consultant shall conduct detailed economic and financial analyses as described briefly in the following sections, for the construction/upgrading of the road components.

E. The Consultant shall prepare a detailed environmental assessment for the areas served by the ARIDP. The environmental study shall place special emphasis on adverse environmental effects on the forest reserves that may be traversed with the construction of the new highway, and recommended mitigation measures which may be appropriate.

F. The Consultant shall conduct the overall study in two stages, to be developed in progressive order: (i) preliminary general gathering of data, field reconnaissance, and review of all available information to develop, (ii) a comprehensive feasibility study of the ARIDP based on analyses of economic, engineering or technical, environmental, financial factors and implementation- concerns.

G. In conducting the study, the Consultant shall use the existing feasibility studies mentioned in Sec. II A. However, the Consultant shall update the existing data and conduct a full feasibility study for the road segments not included in the previous studies.

IV. SCOPE OF THE STUDY

A. GENERAL CONSIDERATIONS

The Consultants shall:

1. Review previous reports and/or studies relevant to the

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project areas on transport infrastructure and development aspects, including inter alia the UNDP/IBRD Philippine Transport Survey (PTS), IBRD-financed NTPP, the first and second IBRD Road Feasibility Study , and all other available data and/relevant information prepared by the DPWH.

2. Review all available data, information and reports which would be relevant and useful for carrying out the study.

3. Perform field reconnaissance of the Aurora and Nueva Ecija Provinces with regard to:

(a) The existing condition of the road network under study.

(b) Tentative identification of alternative improvement levels.

(c) Location of additional traffic survey stations.

(d) Locally available data on economic activities.

4. Review GOP's Policies and Plans that have a bearing on the development of the transport infrastructure on the Aurora Province.

5. Utilize the data and information obtained from DPWH. However, the Consultant shall remain solely responsible for the accuracy of the data, supervising all field surveys and investigations, laboratory testing, performing such supplementary works as may be necessary, and the findings and/or recommendations presented in their reports.

6. Perform the study in accordance with accepted professional standards utilizing sound engineering and economic evaluation practices. The Consultant's scope of work shall cover but not necessarily be limited to the items listed in the subsequent paragraphs.

B. ECONOMIC CONSIDERATIONS

The Consultant must conduct the following activities and provide the requested information:

1. Socio-Economic and Demographic Profiles

(a) A description of the Aurora Provinces's socio-economic conditions and demographic characteristics i.e. population, population density and urban-rural distribution; in-migration and out-migration levels and patterns; employment levels and income stratification; vehicle registration data by type; weight and class and other related information.

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(b) A description of agricultural activities, trade and commodity flows, such as cropland area and production; grain facilities; forest and grazing lands; fishery resources; livestock industries; agricultural markets; manners of transport; location of agricultural processing facilities servicing the project areas; commodity outflow and inflow patterns for raw; semi-processed and processed products; and other related information.

(c) A description of mining and industrial processing plants; production volume and delivery points; mining activities; output and delivery points; modes of cargo transport and frequency of transport schedules; and mobility of industrial and mining labor force.

2. Relationship of the Roads to the Development of the Aurora Province

(a) Discussions on the extent to which the ARIDP will stimulate economic development in the Aurora Province.

(b) Discussions on the value of a dependable road network within the context of the national economy.

(c) Discussions on the relative priority of the ARIDP in the Regional Investment and Development Program for the Aurora Province.

(d) Discussions on the extent to which the ARIDP will facilitate national and regional movement of people and commodities, and promote trade.

(e) Discussions on the extent the ARIDP will stimulate private investment opportunities which is a primary objective of the PAPS Program.

3. Relationship of the Project to Other Transport Systems

(a) Anticipated effect of the ARIDP on the present distribution of traffic among various types of transport and on the economics of other transport systems in the Aurora Province.

(b) Estimated or actual comparable transportation costs for the other transportation systems.

(c) Capital and operating costs of the existing road network servicing the Aurora Province.

4. Anticipated Increase in Economic Benefits as a Result of the Project

(a) Increase in general tax receipts which will result

from increased economic and industrial activities;

(b) Increased business income in the areas influenced by the ARIDP.

(c) Social, political and other indirect economic benefits;

(d) Direct benefits to the population in the areas influenced by the ARIDP through local expenditure of project funds for labor, materials, food, rent, etc.

(e) Increase in opportunities for enhanced levels of investment.

(f) Increased economic activity directly induced by the project. For this purpose the net value added of benefits accruing the generated traffic, using the so called 50% rule, shall be adopted.

(g) Development benefits accruing to traffic generating sectors as a result of cheaper, faster and more reliable transport.

(h) Social benefits shall also be defined and qualified to the extent possible, and both quantifiable and non-quantifiable benefits will be discussed in the light of their importance to the national economic objectives of the GOP, with particular emphasis in the areas influenced by the roads. In this context due consideration shall be given to the social, environmental and economic impact of the improvement of these roads to:

(1) The identification of beneficiaries.

(2) Relative income status and socio-economic characteristics of the beneficiaries.

(3) Pattern of distribution of benefits.

(4) Any other element having important influence on the well-being of the population in the Project areas.

In particular, the Consultant shall provide a clear distribution of these benefits which are expected to accrue to small farmers (including tenants), landless labor and other under- privileged groups such as in the form of improved access to and from markets for agricultural products and inputs, increased employment and mobility and improved access to health and education facilities.

5. <u>Anticipated Reductions in Economic Costs as a result of</u>

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the project.

(a) Reductions in basic Traffic Costs in terms of fixed and running costs for vehicles and reductions in travel time.

(b) Reductions in road maintenance and repair cost.

(c) Reduction in vehicle operating costs, considering the present road condition as well as the proposed improved condition for different vehicle types.

(d) Reduction in road-user transport costs including higher load capacity for goods carrying vehicle (suitably broken down into normal, diverted and generated traffic components) for all traffic, including and excluding savings in travel time for passenger traffic.

6. Effects on Development in the Aurora Province

The Consultants shall conduct additional traffic surveys, including traffic counts, origin-destination studies and loadometer surveys; and shall establish traffic projections for the economic life (minimum 15 years) of the traffic generating sources based on the national, regional and sectoral plans, including plans for other transport modes, and other factors including:

(a) Population growth and changes in rural and urban population distribution;

(b) National and regional economic growth and per capita income growth.

(c) Development of agricultural and forestry resources.

(d) Development of vehicle fleet.

(e) Development of the tourism industry, considering likely future growth and prospects, public and private sector plans for tourism infrastructure development in various locations within the project area and their impact on traffic and induced benefits;

(f) Development of manufacturing and processing industries, and mineral resources.

(g) Development potential in areas with untapped resources.

(h) Development of trade and commerce.

(i) Planned infrastructure development.

(j) Likely traffic diversion from other modes to the roads due to the proposed improvements and also the interdependence between the roads (including existing roads within the network but not directly included in this Study) as it affects traffic generation and assignment.

7. Economic Evaluation and Determination of Economic Costs

(a) For traffic assignment purposes, consider the competitive and complementary characteristics of the roads among themselves and with other highways and components of the transportation system (including coastal shipping ports), and assess the transport costs by other modes.

(b) After considerations of all the factors mentioned above, and after determination of the appropriate opportunity cost of capital (or its range), perform economic analysis with a view to determine the size and timing of execution of the project, by comparing estimated economic costs (as distinct from the financial costs) with the benefits expected to be derived (for the economic life of the roads) from the alternative improvement levels.

(c) Estimate the future vehicle operating costs, considering the present road condition for vehicle types with the assistance of the DPWH. If found suitable, make use of DPWH base year traffic estimates and traffic forecasting methods.

(d) In general, the economic analysis shall be performed on a "with" and without" basis by the determination, among other things, of the relevant economic indicators and their consideration as they affect project implementation. These indicators include, inter alia, the following for both individual project items on whole and where necessary, incremental analysis:

(1) Internal Rate of Return.

(2) Net Present Worth.

(3) Benefit-Cost ratio.

(4) First Year Benefit-Cost Ratio.

(e) Shadow pricing methods shall also be applied in economic evaluation analysis for labor and foreign exchange. However, the economic costs, benefits and economic feasibility indicators shall be presented with and without shadow pricing elements. The Consultant

shall solely be responsible for these analyses but shall coordinate same with the National Economic Development Authority (NEDA).

(f) All economic indicators and all parameters (i.e. traffic growth factors, project costs, vehicle operating costs, etc.) shall be subjected to sensitivity analyses of sufficient range and detail to permit rational examination of possible implementation alternatives (both of scale and timing).

(g) It is envisaged that the Consultant will incorporate social benefits (with appropriate weighage) in the determination of the socio-economic feasibility indicators. However the economic indicators shall also be shown including efficiency pricing. The Consultant shall provide an in-depth review and evaluation of the relevant information in this regard on the evaluation and the methodology used, and its effect on scope, timing and scale of the recommended feasible Roads.

C. ENGINEERING AND TECHNICAL CONSIDERATIONS

1. The Project's Influence Area

The Consultant shall provide a geographic description of the Aurora Province, its physical characteristics, land area, regional geology, topography, water resources, utilities, climate and weather conditions, political subdivisions, identity and brief profiles of GOP offices/leadership (i.e. key personnel/contacts with DPWH, NEDA, DA, NPC, etc.) expected to be involved in the project.

2. A Description of the Existing Roads and Transport Network

The Consultant shall provide a description of the existing roads and transport system on the following minimum items:

(a) A description of existing roads including their terminal points, length, major population centers traversed, land use, terrain, etc; major geometric features such as alignment, width of road right-of-way, width of pavement and shoulders; condition of pavement, shoulders, base and sub-base, and drainage.

(b) A description and verification of the existing major highway network(s) in the Aurora and Nueva Ecija Provinces, broken down into segments as classified by the Regional Office of the DPWH indicating general or special functions, uniform traffic volumes, vehicle type compositions , service areas and population or industries served.

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(c) Provide an inventory and verify as much as possible, the physical condition, level of usage, and limitations of existing highways and roads.

(d) A description of other transport modes serving the Aurora Province, such as air transport, domestic and international shipping, railroad, etc. indicating general or special functions, service area and population or industries served.

3. Development and Assessment of Alternatives

(a) The proposed routes for the various segments of the ARIDP as recommended by the DPWH is shown in Appendix I. A description of the various road sections indicating their classification, length, width, type of pavement and surface condition may be available in the documents mentioned in Sec. II A or DPWH. The Consultant shall provide a "sampling" of several identified alternative highway routes and compare these with the proposed route in terms of environmental effects, technical or engineering soundness and cost effectiveness. The Consultant must provide an opinion (based on technical, economic and environmental aspects) as to the practicality and complexity of constructing the ARIDP.

The Consultant shall subject the proposed route and the other identified alternative routes to the Environmental Checklist for the initial determination of environmental impact which is attached to this document.

(b) As a result of the general assessments developed under the preceding sections, the Consultant shall recommend the most viable route.

(c) The Consultant shall develop a prioritization of project components according to engineering and cost projections. The typical prioritized element shall consider:

(1) highway links with the present system;

(2) highway links with population centers;

(3) highway links with agriculture centers;

(4) highway links with new areas, new highway alignment.

Priorities shall be given to the enhanced design of structures with the highest technical standards over high grade highways with the understanding that the ARIDP would

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be upgraded to the quality of the structure at a later date assuming there could be financing limitations for the overall project.

4. Design Criteria

The Consultant shall:

(a) Develop appropriate standards for geometric, pavement designs and construction to meet the requirements of the projected traffic on the components of the ARIDP. Particular attention should be given to the choice between various types of pavement, based on appropriate and economic and engineering studies, including construction costs, maintenance costs and vehicle operating costs.

(b) Study the hydrological conditions (including available data) in the areas traversed and provide appropriate recommendations and design criteria for the size and location of appropriate culverts and bridges to properly provide adequate drainage and flood protection against erosion and scour forces both for road formations and bridge foundations.

(c) Study the geological conditions in the areas traversed and, on the basis of geotechnical investigations performed (and also utilizing all available data), provide appropriate recommendations and design criteria to permit proper foundation design for roads and bridges, with particular attention to slope stability problems in mountainous regions where side hill cuts and high fills may be encountered.

5. Surveys and Preliminary Plans

The Consultant shall conduct the following investigations and provide requested maps and plans.

(a) Initiate and conduct the necessary field investigations including topographic, pavement and geotechnical investigations and testing (both field and laboratory) in order to gather data for the preparation, among other things, of cost estimates.

(b) Identify alternative alignments for the components of the ARIDP, including new alignments, minor deviations from the present alignments and bypasses around urban areas as may be found necessary, based on the findings of the field investigation and studies of topographic maps and aerial photographs, and determine the extent of improvements needed.

(c) Supervise the setting out and establishment at appropriate locations of reference points for key

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controlling points of the survey line and sufficient bench marks for identification and use during subsequent engineering surveys.

(d) Preliminary alignment map of proposed location based on ground surveys, aerial surveys, topographic map and other sources.

(e) Preliminary plan and profile drawings with established grades and general drainage schemes and typical cross-sections sufficient to permit reasonably firm estimates of earthwork quantities.

(f) Rainfall and run-off data calculations of stream flow estimates sufficient to permit rational design for drainage structures.

(g) Sketches, diagrams or photographs of typical existing drainage works, bridges, retaining walls, tunnels and other significant structures.

(h) Preliminary plans for modification of existing structures and for construction of typical new structures, culverts, drainage ditches, etc., in sufficient detail to permit reasonably close estimate of work quantities.

(i) Results of soil and sub-base investigations for determination of quality of foundations for fills and major structures and for location of quarries and borrow pits of construction materials.

6. <u>Engineering and Construction Standards</u>

The Consultant shall provide the following:

(a) A scope of work for engineering services for final design, preparation of specifications, preparation of contract documents, and recommendations for evaluating bids, awarding contracts and supervising construction.

(b) Outline specifications defining the proposed standards of quality of construction and/or other installations which will have a major effect on the cost of construction with specific justification for any unusual standards which are proposed to fit local standards.

(c) Information on alternative construction methods suitable for the Aurora Province including labor intensives methods which might be relatively advantageous for remote places. The Consultants shall recommend on the optimum construction method suitable for Province.

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7. Availability of Local Resources and Equipment

The Consultant shall evaluate the availability of the following:

(a) Skilled and unskilled labor, including "trainability".

(b) Technical and supervisory personnel.

(c) Training requirements for development, operation and maintenance.

(d) Major construction materials: cement, asphalt, aggregates, water, base course materials, reinforcing steel, culvert pipes, etc.

(e) Housing, food, fuel/ lubricants, repair shops, etc.

(f) Suitable site for construction camp or yards.

(g) Construction equipment.

(h) Local subcontractors.

(i) Capability of the regional office of DPWH to finance and administer the maintenance of the components of the ARIDP. Need for legislative, organizational or budgetary changes to accomplish continued supervision and maintenance of the Roads.

8. Special Construction or Installation Problems Foreseen

The Consultant shall investigate and provide information on:

(a) Climatic conditions, especially time and length of wet and dry seasons, and periods of daylight, as they affect construction schedule, equipment use and labor force.

(b) Probable detours of traffic during construction.

(c) Limitations on construction schedule due to long lead-time for equipment and material procurement.

(d) Steps which must be taken to provide specialized tools, test equipment, together with associated spare parts for a continuous satisfactory operation.

(e) Evaluation of potential major causes of delay such as land slides, earthquakes, floods, labor troubles, political disturbances, delay in providing access to

land, unavailability of local funds or local trained or trainable personnel.

9. Plan for Execution of the Project

The Consultant shall provide:

(a) Proposed engineering construction schedule, broken down by major items of the project, in the form of a bar chart, with explanations. The schedule should address the effect of construction/ improvements on the traffic.

(b) General plans for grading operations as related to equipment requirements, haul distances, requirements for haul roads and access roads to quarries and borrow pits, etc.

(c) Planned procurement of major items of materials, supplies and equipment, recognizing current GOP restrictions on source and shipping.

(d) A realistic time schedule for implementing the various components of the project. This will include sufficient time lapse for procedural matters, design solicitation and award of tenders as well for construction of the various project components.

(e) Recommendations for general guidelines to develop an optimum set of contract package, e.g. by road sections, by construction cost, by geographical areas and/or political subdivisions, which will guide the contracting or implementing agency in preparing bid documents for the construction/upgrading of the ARIDP.

10. Operation and Maintenance Organization

The Consultant should assess and report on:

(a) Regional Office of DPWH and Local Government's present and proposed operations and maintenance organization.

(b) Regional office of DPWH and Local ernment's ability to provide personnel and finances for the necessary level of maintenance for the ARIDP.

(c) Availability of equipment and trained maintenance personnel.

(d) Plan for recruiting and training of all required personnel.

(e) Regional Office of DPWH and Local Government's

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ability to finance additional maintenance work, and plans for providing funds at proper time.

D. FINANCIAL ASPECTS

1. Estimated Capital Cost

(a) The Consultant shall prepare the total estimated capital cost, in U.S. dollars and Philippines pesos. (This shall be done separately for each phase of the project if phased construction is contemplated.) The cost estimate for each road shall be subdivided into lengths suitable for separate construction contracts.

(b) The capital cost should be broken- down into the estimated cost of land and right of way acquisitions, engineering, construction, taking the experience of recent bids into account. Contingencies and allowances for possible escalation of unit costs between the time of this study and the time of actual construction, shall be provided separately

(c) For economic evaluation purposes the improvement costs (construction, final engineering, supervision and right-of-way acquisition) should be in constant prevailing prices, on a "with" and "without" basis and be included in the evaluation analysis as separate items.

(d) The foreign currency component (distributed into direct and indirect) will include, inter alia, such items as depreciation on equipment, materials and supplies for which the Philippines is a net importer, wages of foreign firms. The local currency component will include the acquisition of right-of-way, cost of local materials and supplies, local wages, etc. Two estimates shall be prepared. One assuming the contractor is foreign and one assuming that he is local.

(e) The Consultant shall indicate construction unit prices as well as the costs for each homogeneous section of the project and project as a whole. Construction materials have to be classified into locally available and imported items respectively.

2. Maintenance and Operation Cost

(a) The Consultant shall estimate the annual cost of labor, supervision, supplies and spare parts, administration and maintenance in US dollars and Philippines pesos. Maintenance cost shall be separated into routine and periodic costs, calculated and appropriately distributed within the economic life time of the Roads.

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(b) The Consultant shall outline a plan showing in detail the required personnel training and procurement of additional maintenance equipment or spare parts regardless of whether funds are required as a loan or grant or are supplied by GOP.

E. ENVIRONMENTAL ASSESSMENT

1. Final Work Program

(a) The consultant is to prepare the Final Work Program based on consultation with Philippine Environmental Management Bureau (EMB), Committee on Official Development Assistance (CODA) and United States Agency for International Development (USAID).

2. Coordination with Local Representatives, EMB, CODA and USAID

(a) The Consultant shall confer with the local representatives, EMB staff, CODA staff and USAID staff concerning the Critical Project/Area designation, the USAID Threshold Decision and the USAID Initial Environmental Examination in reference to Philippine Presidential Decree No. 1586 and Section 216.3, 22 United States Code of Federal Regulations (CFR), respectively.

(b) The Consultant shall hold scoping session early on as required by Section 216.5, 22 CFR and seek input from the EMB in the preparation of the Environmental Impact Assessment (EIA) and/or Environmental Impact Statement (EIS) pursuant to Philippine Presidential Decree No. 1586.

3. Gather existing condition data.

(a) The Consultant shall gather data and perform field work to determine existing conditions on the following subjects: soils, cultural/archaeology, groundwater/surface water quality, vegetation, climate, natural hazards, energy, utilities, traffic counts, noise monitoring, land use, scenic resources and habitats.

(b) A determination of general baseline conditions may also be necessary for the alternatives. Specific information yet to be collected is noted below.

4. Initial Environment Examination

(a) The Consultant shall identify generic environmental problems with each alternative and shall provide the information on which to make a critical project or area determination.

(b) The Consultant shall develop a matrix for evaluation of alternatives and assist as needed in the completion of any Environmental Check List.

(c) The Consultant shall work with EMB, CODA and USAID to develop criteria by which to evaluate alternatives.

(d) The Consultant shall prepare an Initial Environmental Examination for selected alternatives, and hold a scoping session to focus on primary issues.

5. Preliminary - Draft EIA/EIS

The consultant shall prepare the Draft and Final EIA/EIS conforming with guidelines established by Philippine Presidential Decree No. 1586, Part 216, 22 CFR, the U.S. Council on Environmental Quality (CEQ) and the U.S. National Environmental Policy Act (NEPA). Cumulative impacts on specific resources of project proposals and secondary projects on the surrounding area must be identified. The documents must address attaining and maintaining and any adopted Environmental Thresholds and should address each of the following topics.

(a) EARTH - Earth should include a discussion of the site topography, floodway, drainage, geology/seismicity, and soils. A thorough discussion of existing conditions, impacts and mitigation measures is required. Impacts must be assessed on the following conditions at minimum: project proposals relating to land coverage, environmental restoration, any thresholds, future water, waste water and/or drainage development plans and compliance with any applicable local laws and regulations.

(b) AIR - Climate and air quality should include a discussion of the regional basin air setting including a general discussion of sources, air quality standards and existing Basin air quality. The project will generate emissions from vehicles and possible secondary stationary sources. These emissions could impact local features. The consultant may be required to use a computer traffic or emissions model and/or other comparable simulation to determine air quality impacts and shall use applicable emission rates. Thresholds shall be addressed to determine compliance and appropriate mitigation measures.

(c) WATER QUALITY - This section should discuss the potential water quality impacts from surface run-off, potential flooding, impervious cover, and the effectiveness of proposed retention/treatment systems. The impact on the ocean and stream environment zones and 100 year flood plains as a result of the project shall be addressed. The consultant shall evaluate vegetation

proposals to determine impacts of water and fertilizer requirements. The impacts of the project should be evaluated to determine compliance with any thresholds, national or regional plans, goals and policies, the water and/or waste water development plans and World Health Organization (WHO) water quality recommendations.

(d) VEGETATION - Assess impacts from tree removal, introduced species, and riparian disturbance at a minimum. Determine compliance with thresholds and national or regional plans, goals and policies.

(e) WILDLIFE AND FISHERIES - Field reconnaissance may be required to determine the presence of habitats or nesting sites for sensitive species. Project proposals that could impact these resources include physical (including noise and light) disturbance and pesticide, herbicide and other chemically tainted run-off into surface water. Any impact of a particular alternative on marine habitats and aquatic ecosystems (coral reefs, wet lands, etc.) should be evaluated. These and other impacts on wildlife and habitats shall be evaluated against thresholds and national or regional plans, goals and policies, and requirements of the departments concerned with fish and game.

(f) NOISE - Discuss the potential impact of the proposed uses and determine compliance with the established noise levels for the site/route. Also, determine impacts on surrounding sensitive land uses. Background noise monitoring may be required and the consultant may need to gather additional data. Evaluate impacts with respect to thresholds and national or regional plans, goals and policies. Identify mitigation measures.

(g) LAND USE - Discuss the existing and proposed on-site land uses and their relationship to adjacent uses. Discuss the worst case combination of land uses and special events. Examine the project's relationship to any local zoning code and general plan area statements for consistency.

(h) RISK OF UPSET AND SAFETY - The Consultant shall determine any potential impacts from storage or use of chemicals (disinfectants), hazardous materials and/or wastes. A brief discussion should be prepared discussing potential for storage, containment, emergency procedures and disaster preparedness. In particular, risk and upset due to earthquakes should be addressed.

(i) POPULATION - Discuss the existing and proposed location, distribution, density or growth rate of human population and the relationship to adjacent areas. Population and employment forecasts shall be reviewed and

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analyzed. Discuss the worst case combination of population distribution and density. Discuss any social, cultural or economic demands created by the project.

(j) HOUSING - Discuss how the proposal will affect existing housing in the region and area. How will the proposal affect vacancy rates, demand, construction in the adjacent areas and the area in general?

(k) TRANSPORTATION/CIRCULATION - Circulation should be assessed with respect to changes in the congestion levels on all roads affected by the project. In particular, the impact of any heavy vehicles should be addressed. The consultant should prepare a level of service analysis for the roads and intersections affected by the project.

(l) PUBLIC SERVICES AND UTILITIES - Address impacts on demand for utility connections and water service.

(m) ENERGY - The consultant shall address the amount of energy used by the project and the impact on existing and future energy resources. Any substantial increase in demand upon existing sources and the affect on development of new sources of energy should be discussed.

(n) SCENIC RESOURCES/AESTHETICS - Perform a light and glare analysis based on lighting requirements and identify proposed project features to be seen from surrounding sensitive land uses. Assess compliance with any thresholds, Design Standards, and any Code requirements.

(o) HISTORICAL/ARCHAEOLOGICAL RESOURCES - Assess project impacts on known historical features and ancestral lands. The historical/archaeological report should provide all necessary data concerning ancestral lands and archaeological sites of significance in the area. Identify mitigation measures necessary.

(p) CULTURAL/SOCIOECONOMIC CONDITIONS - The consultant shall discuss the impact of the project with respect to cultural or socioeconomic conditions including but not limited to its effects on settlement/resettlement patterns, property compensation, adequacy of service to disadvantaged/lower socioeconomic groups, "affordability", preservation of lifestyles and cultural heritage.

(q) CONSTRUCTION IMPACT - The consultant shall determine any construction activities which will have a significant impact not described in other environmental categories. This would include: material disposal problems, transportation congestion and re-routing, additional

noise, additional air pollution, disruption and relocation of utilities, interference with commercial residential activities and re-routing of emergency services.

6. Environmental Impact Assessment/Statement

The EIA/EIS shall include the following introductory or sum sections.

(a) INTRODUCTION - The consultant shall use informa provided by the EMB, CODA and USAID to summarize pla proposals, site location information, and plan goals objectives.

(b) DISCUSSION OF ANY SIGNIFICANT OR ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED IF TH PROPOSAL IS IMPLEMENTED - The consultant shall descr the kinds and magnitude of significant impacts which cannot be reduced in severity without considering an alternative plan. The overriding considerations impo in continuing to propose the plan not withstanding t impacts shall be described in detail.

(c) DISCUSSION OF MITIGATION MEASURES PROPOSED TO MINIMIZE SIGNIFICANT IMPACTS - The consultant shall provide a discussion of mitigation measures incorpor into the plan to reduce significant impacts identifi throughout the analysis to acceptable levels. The b for considering impacts acceptable shall also be described.

(d) DISCUSSION OF MONITORING REQUIREMENTS NECESSA ASSURE MITIGATION MEASURE SUCCESS - The consultant work with the EMB, CODA and USAID to identify monit needed for each mitigation measure identified as necessary to reduce impacts. This shall include a monitoring schedule and identification of responsib party.

(e) DISCUSSION OF ALTERNATIVES TO THE PROPOSED AC -The consultant shall prepare a list and description alternatives to the proposed action. These alternati shall be evaluated based on the differences in impa they produce as compared to the preferred alternati

In addition, alternative sites shall be evaluated. EMB, CODA and USAID will assist in preparing summar information on each site to be included in the docu Each site will then be evaluated based on the crite developed in the proposal.

(f) DISCUSSION OF THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINT

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AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY - The consultant shall describe the cumulative and long-term effects of the proposed project which either significantly reduces or enhances the state of the environment from the perspective that each generation is trustee of the environment for future generations.

(g) DISCUSSION OF ANY IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED - The consultant shall describe the extent to which the proposed plan curtails or expands the density and range of beneficial uses of the environment. Any irretrievable and significant commitments of resources shall be evaluated to assure that such current consumption is justified. Also, irreversible damage can result from environmental accidents associated with the project.

(h) DISCUSSION OF GROWTH INDUCING AND CUMULATIVE IMPACTS -The consultant must address whether or not project will have the potential to be growth inducing or if a number of incremental impacts will exceed the carrying capacity established.

(i) SUMMARY - The consultant shall prepare a brief summary of the proposed plan and its consequences. This shall include: mitigation measures incorporated into the project to reduce impacts, and areas of controversy known to the participants in the project.

7. Screening Process

The preliminary environmental assessment shall be used to screen and review engineering designs options. Determine if revisions with the preliminary designs are needed to mitigate environmental effects.

8. Mitigation Plan

The Consultant shall develop a detailed mitigation plan for the selected alternative and prepare final EIA/EIS in accordance with the EMB Procedures, Development Assistance Committee (DAC) Environmental Guidelines (Organization for Economic Co-Operation and Development-1988) and AID Agency formal Environmental Procedures.

9. Response to Agency Comments, Final EIA/EIS

After agency and/or local representative circulation of the Draft EIA/EIS (DEIA/DEIS), the consultant shall prepare a response to each comment received. All revisions to the draft document necessary shall be made.

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10. Environmental Compliance Certificate - Environmental Management Bureau EIS Review Committee

The consultant shall prepare all the necessary documentation and reports including but not limited to the data gathering, plan preparation, documents, publication and Environmental Impact Statement for use by the EMB EIS Review Committee so that an Environmental Compliance Certificate may be obtained for the project.

F. COST, BENEFITS AND SOURCE OF FUND

The Consultant shall provide the following financial information:

1. Estimated total cost of the project.

2. Amount and source of funds supplied or to be supplied by GOP for Engineering, land, right-of-way, equipment, labor or other purposes.

3. Amount of financing to be requested from Donor.

4. Source and availability of any additional funds required.

5. Extent to which the Local Government will waive or defer payment of direct taxes or import duties affecting project construction and operation.

6. Currency control regulations and effective rate of exchange used in evaluating Philippines pesos in terms of U.S. dollars.

7. Summary of tangible and intangible benefits as described in Section IV above, with estimate of monetary value so far as practical.

8. Annual cost, including interest and amortization of investment and operating and maintenance charges.

9. Comparison of benefits and cost.

REQUIRED SUBMISSIONS

A. INCEPTION REPORT

The Consultant shall submit an Inception Report outlining the detailed work program and proposed methodology for the Feasibility Study after completion of one week of field work. (5 copies)

B. PRELIMINARY REPORT

The Consultant shall submit a Preliminary Report after completion of the initial investigations and analyses of the different alternatives upon completion of one and months of study work. The

Preliminary Report will discuss and compare alternatives, and clearly identify and justify the recommended alternative. The report will include the initial findings as well as preliminary layout of the forms to be used for various investigations and calculations. (10 copies)

C. INTERMEDIATE REPORT

Subject to directives by USAID and GOP to the contrary, the Consultant shall proceed with preparation and submittal of an Intermediate Report including a Feasibility Study Report giving the results of the feasibility study for the Consultant's recommended alternative within one month and three weeks of starting work (10 copies)

D. DRAFT FINAL REPORT

Subject to directives by USAID and GOP to the contrary, the Consultant shall proceed with preparation and submittal of a Draft Final Report giving the results of the feasibility study and cost estimates for the Consultant's recommended alternative within two and one half months of starting work. The Draft Final Report will identify the proposed investment priorities utilize appropriate technology, are technically and environmentally sound and financially and economically viable. Economic and financial internal rates of return shall be calculated for the proposed investments and appropriate sensitivity tests undertaken. The report shall include all relevant information (maps, plans, specifications, etc.) which supports the conclusions in sufficient detail to enable the calculations to be verified and allow re-calculation with modification of the key assumption without the need for supplementary data. (10 copies)

E. FINAL REPORT

The Consultant shall submit the Final Feasibility Study complete with Plans, Technical Specifications and Cost Estimates, including comments from the Draft Final Report within 3 months from the receipt of notice to proceed (25 copies). The Final Feasibility Study shall include a summary that includes the following.

1. The location, nature and extent of proposed construction or rehabilitation for the ARIDP.

2. The relation to other roads and highways in Aurora and Nueva Ecija Provinces.

3. A description of the major features of the proposed roads.

4. A reference to any applicable reports or long range development plans, which should be attached or readily available at a convenient location.

5. The summary shall contain a brief statement of conclusion

as to relative benefits and cost as a result of the project. Taking into consideration the advantages in safety, increase in traffic, direct and indirect contributions to economic infrastructure, nation building and economic development.

VI. SCHEDULE

The work shall be completed in 4 months, broken down as follows:

1st Week	-Inception Report with work program and proposed methodology.
Within 1 month	-Preliminary Report on initial investigations and analysis including the recommended alternative.
Within 2 months	-Intermediate Report with feasibility study results of different alternatives and consultants recommended final alternative.
Within 3 months	-Final Feasibility Study with Plans, maps, technical specifications and cost estimates for the final alternative.
Within 4 months	-Final Plans, Feasibility Studies and all data and test results collected during the study period.
Total 4 months	

ESTIMATED LEVEL OF EFFORT

A. The estimated Level of Effort for technical staff is shown in Section B.

B. Administrative/Support Staff

	Person Month
1. Secretary	4.0
2. Clerk/Typist	4.0
3. Word Processors (4)	9.0
4. Janitor/Utility	4.0
5. Drivers (4)	16.0
6. Administrative Assistant	4.0
7. Accountant	4.0
TOTAL -	45.0

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A. WORK SCHEDULE AND REPORT SUBMISSION

Contractor shall perform the services required in this Delivery Order in accordance with "Section B" of this Delivery Order entitled "Project and Report Schedule," or as arranged between Contractor and USAID.

Contractor shall submit the reports indicated in Section 4 of the FS and EA SOWs to USAID based on the schedule set forth in "Section B" of this Delivery Order entitled "Project and Report Schedule," or as arranged between Contractor and USAID.

B. REPORTING RESPONSIBILITIES

Contractor shall report to the project manager identified in "Block 6." of the cover sheet of this Delivery Order.

In addition, for the performance of the services required under this Delivery Order, the Contractor shall liaise with:

1) Mr. Jose B. Gloria
Project Manager
Project Management Office
DPWH, EDSA, Quezon City

2) Mr. Florante Soriquez
Project Director
DPWH-RIF-PMO
Motorpool Compound
Chicago Street
Port Area, Manila

C. CONTRACTOR PERSONNEL

Contractor shall assign staff in accordance with "Section C" of this Delivery Order entitled "Personnel Schedule."

D. ESTIMATED LEVEL OF EFFORT

For the performance of the services required in this delivery order, including the submission of the required reports and deliverables, Contractor shall provide the estimated level of effort stated in "Section B" of this Delivery Order entitled "Project Schedule."

E. COST CEILING

The Cost Ceiling for the performance of services in this Delivery Order shall not exceed the amount stated in Section D entitled "Cost Ceiling".

SECTION B. PROJECT AND REPORT SCHEDULE

LOUIS BERGER INTERNATIONAL, INC.
February 8, 1991
March 25, 1991(revised)

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
Contract No. 492-0452-C-00-0099-00

PROPOSED WORK SCHEDULE
A FEASIBILITY STUDY OF THE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

TASK NO.	TASK DESCRIPTION	MAY 1991	JUNE 1991	JULY 1991	AUGUST 1991	SEPTEMBER 1991	REMARKS
		1					
1.	Mobilize Study Team(assume NTP May 1, 1991)	X					
2.	Collect & Review Existing Reports/Information/Data	<==========>					
3.	Visit Site & Relevant Agencies	<=======>					
4.	Field Reconnaissance	<==========>	<==========>				
	Economic Data	<---------->	-------->				
	Topographic/Geometric Data	<-------->	-------->				
	Traffic Data		<---------->				
	Soils & Materials Investigation	<-------->	<---------->				
	Hydrology/Drainage Information		<---------->				
	Establish Design Criteria		<------->				
5.	Describe Existing Road & Transport Network	<=======>					
6.	Develop Social/Economic/Demographic Profiles		<==========>				
7.	Develop Traffic Projections		<==========>				
8.	Develop/Assess Improvment Alternatives		<==========>	<========>			
	Alignments/Drainage/Quantities		<---------->				
	Cost Estimating		<---------->				
	Environmental Analysis		<---------->	-------->			
	Economic Cost/Benefit Analysis/Prelim Ranking		<-------->	-------->			
				15			
9.	Prepare PRELIMINARY Report/Recommendations			<=======>			
				31			
10.	USAID & GOP Review/Approval			<=======>			

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LOUIS BERGER INTERNATIONAL, INC.
February 8, 1991

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
Contract No. 492-0452-C-00-0099-00

PROPOSED WORK SCHEDULE
A FEASIBILITY STUDY OF THE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

TASK NO.	TASK DESCRIPTION	MAY 1991	JUNE 1991	JULY 1991	AUGUST 1991	SEPTEMBER 1991	REMARKS
11.	Develop Detailed Feasibility Study				<==========>		
	Engineering Analysis				<---------->		
	Cost Estimates				<------->		
	Environmental Analysis				<---------->		
	Economic Analysis				<---------->		
	Financial Analysis				<------->		
	Prioritization/Implementation Plan				<---------->		
					31		
12.	Prepare/Submit DRAFT Final Report/Drawings				<=======>		
						15	
13.	USAID & GOP Review/Approval					<=======>	
14.	Prepare Scope of Work for Final Design		<========	==========	==========	==========>	
15.	Develop Implementation Plan				<==========	==========>	
						30	
16.	Prepare FINAL Submission					<=======>	
	SUBMISSION SCHEDULES						
			6				
	Inception Report(5 copies)	------- 36 days ------>					
				15			
	PRELIMINARY Feasibility Analysis Report(10 copies)	----------	---- 76 days ----	-------->			
					31		
	DRAFT Feasibility Report/Drawings(10 copies)				--- 31 days ---->		
						30	
	FINAL Feasibility Report/Drawings(25 copies)					|- 15d ->	

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SECTION C. PROPOSED PERSONNEL SCHEDULE

LOUIS BERGER INTERNATIONAL, INC.
February 8, 1991
March 22, 1991(revised)

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
Contract No. 492-0452-C-00-0099-00

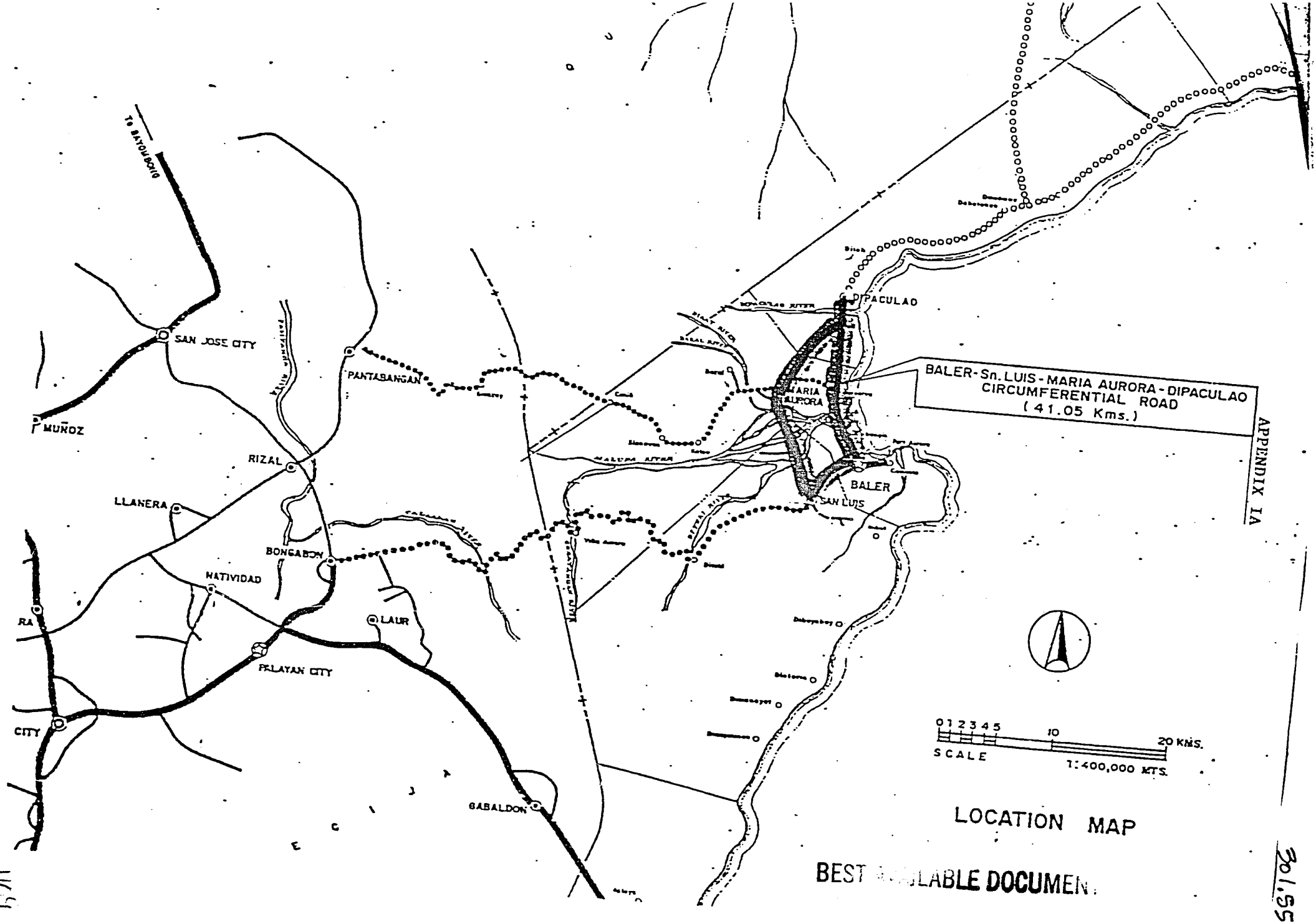
PROPOSED PERSONNEL SCHEDULE
A FEASIBILITY STUDY OF THE
AURORA ROADS INFRASTRUCTURE DEVELOPMENT PROJECT

	POSITION	NAME	MAY 1991	JUNE 1991	JULY 1991	AUGUST 1991	SEPTEMBER 1991	MAN-DAYS	MAN-MONTHS
	EXPATRIATE PERSONNEL:								
*	Team Leader/Sr.Hwy Engineer	Kent Lande(LBII)	<==	==	==	==	==>	152.0	5.00
*	Transport Economist	G. Oman(LBII)	<==	==	==	==	==>	152.0	5.00
*	Development Economist	N. Heseltine(LBII)	<==	==	==>			92.0	3.02
*	Environmental Specialist	W. Cummings(LBII)	<==	==	==>			92.0	3.02
							TOTAL	488.0	16.04
	FILIPINO PERSONNEL:								
*	Sr. Highway Engineer	M.D. Furiscal(TAP)	<==	==	==	==	==>	152.0	5.00
	Traffic Engineer	R. Montemayor(TAP)	<==	==	==>			92.0	3.02
	Development Economist	W. Mirasol(TAP)	<==	==>				61.0	2.01
	Transport Economist	J.P. Supangco(TAP)	<==	==	==	==>		92.0	3.02
	Structural Engineer	R. Villaranda(TAP)	<==	==>		<==	==>	92.0	3.02
	Drainage Engineer	F. Castillo(TAP)	<==	==>		<==	==>	122.0	4.01
	Soils/Materials Engineer	R. Abne(TAP)	<==	==	==>	<==	==>	107.0	3.52
	Environmental Specialist	M. Arevalo(CMSI)	<==	==	==>			92.0	3.02
	Environmental Specialist	M.S. Posadas(LBII)	<==	==	==>			92.0	3.02
	Cost Engineer	F. Posecion(CMSI)	<==	==	==	==>		122.0	4.01
	Economic Researcher(2)	C. Frigillano(TAP)(1)	<==	==	==>			182.0	5.98
	Sr. Draftsperson	A. Fernandez(CMSI)	<==	==	==	==	==>	152.0	5.00
	Drafters	CMSI/TAP	<==	==	==	==	==>	256.0	8.42
	Sr. Surveyor	P. Revillos(TAP)	<==	==>				61.0	2.01
	Survey Parties(2 of 3 pers)	CMSI/TAP	<==	==>				250.0	8.22
							TOTAL	1925.0	63.28

* These are key personnel and can be changed only with USAID approval. Others can be changed at Contractor's discretion with equally qualified staff.

BEST AVAILABLE DOCUMENT

108



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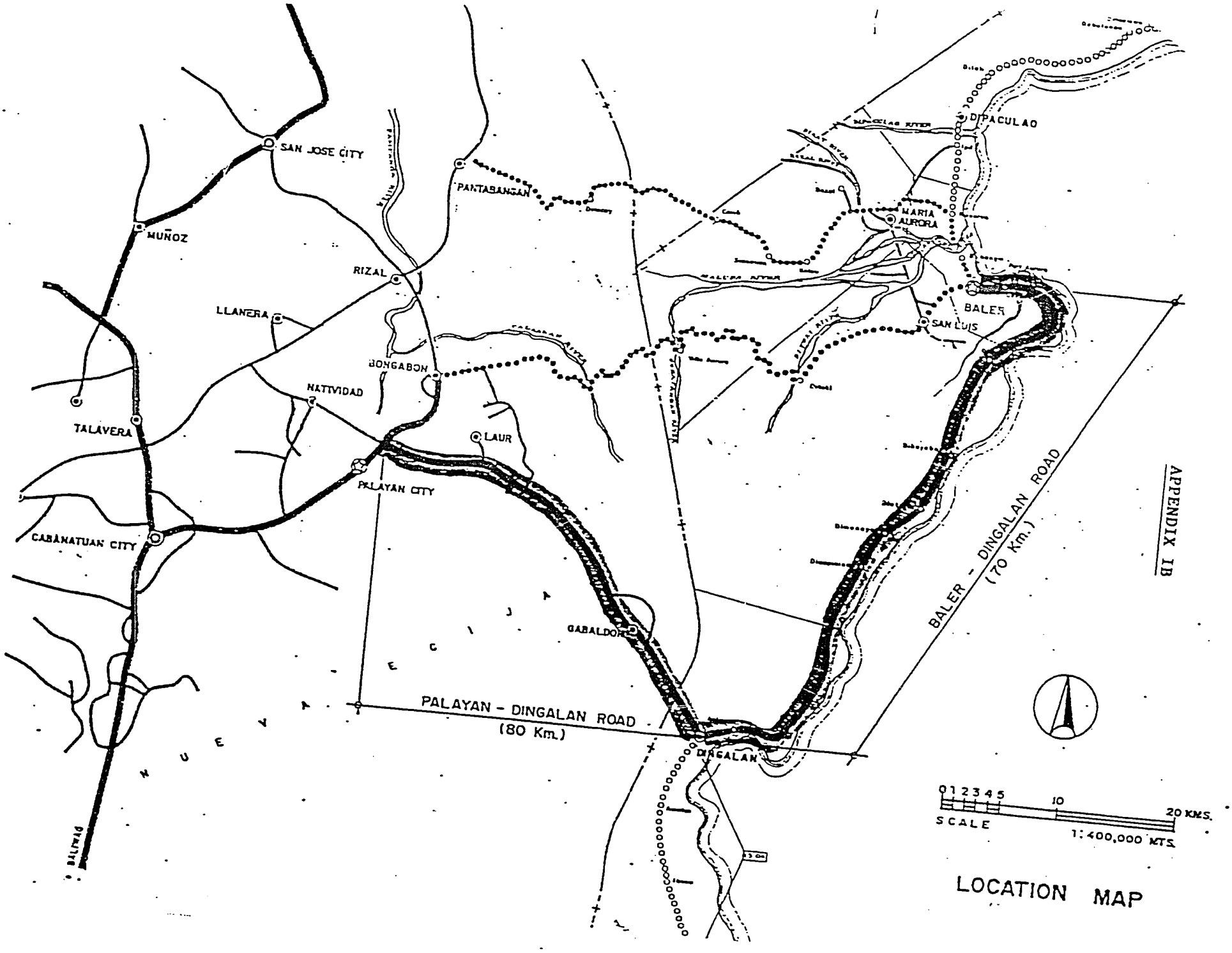

LOCATION MAP

APPENDIX IB

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APPENDIX I.1

SERVICES AND FACILITIES TO BE PROVIDED BY THE GOVERNMENT

The Government will provide the Consultants to the extent possible, with all available data on:

(a) The present organization and function of the Government departments or other agencies responsible for transport;

(b) The organization and function of sub-units of Government or local governments, or of other agencies concerned with highways or highway transport;

(c) The economic development plans of the Philippines, both national and regional, including population, agricultural, mining and industry;

(d) Traffic data along the national highway network;

(e) Maps of the country and its transport network, including existing inventory data;

(f) Vehicle operating costs on ideal roads as well as on roads the standards of which deviate from the ideal, for the Consultants' review and further calculations;

(g) Previous studies sponsored by the Government on transportation and development that will have an impact on transportation requirements;

(h) Maintenance costs for different road types.

In connection with the Consultants' works which require cooperation of other government agencies, including local authorities, the Government will provide necessary liaison and ensure that the Consultants have access to all information required for the completion of the study.

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