PN-ABL-689

ENVIRONMENTAL ASSESSMENT
FINAL REPORT

FOR

REPUBLIC OF THE PHILIPPINES
PHILIPPINE PORTS AUTHORITY
AND
COORDINATING COUNCIL OF THE PHILIPPINE ASSISTANCE PROGRAM

MAKAR WHARF
GENERAL SANTOS CITY

Prepared by:

LOUIS BERGER INTERNATIONAL, INC.

in association with

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GLOBETROTTERS ENGINEERING CORPORATION

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CONSULTANT MANAGEMENT SERVICES,INC.

ERNST & YOUNG

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October 21, 1991

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Subject: **FINAL REPORT, ENVIRONMENTAL ASSESSMENT**

Project: **DELIVERY ORDER NO. LBII-02**
MAKAR WHARF FS AND EA
PHILIPPINE ASSISTANCE PROGRAM SUPPORT (PAPS) PROJECT
CONTRACT NO. 492-0452-C-00-0099-00

Dear Mr. Sundermann:

In accordance with Item 4.03 of the Scope of Work, we submit herewith three (3) copies of the Final Report of the Makar Wharf Environmental Assessment. In accordance with our previous discussions, we are concurrently distributing copies of this report as per the attached distribution lists.

The final report of the Environmental Assessment incorporates a few minor changes from the draft report, including the realignment of the secondary access road to the proposed port expansion area. Public comments and recommendations to the draft Environmental Assessment are also included in Appendix E, Summary of Public Recommendations, together with requested additional information or explanations.

We trust that the information, analyses and conclusions in the Final Report will allow you and the Philippine Ports Authority to plan the next steps in the development of Makar Wharf.

Very truly yours,
LOUIS BERGER INTERNATIONAL, INC.

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TABLE OF CONTENTS

	Page No.
COVER LETTER	
EXECUTIVE SUMMARY	xvii
CHAPTER 1 PROJECT DESCRIPTION	
1.1 PROJECT SETTING	1 - 1
1.1.1 Location	1 - 1
1.1.2 Purpose	1 - 1
1.1.3 Stage in Planning Process	1 - 3
1.2 EXISTING FACILITIES AND CONDITION	1 - 3
1.2.1 The Wharf	1 - 4
1.2.1.1 Wharf Structure	1 - 4
1.2.1.2 Piles	1 - 6
1.2.1.3 Fendering System	1 - 7
1.2.1.4 Mooring Accessories	1 - 7
1.2.1.5 Kerbs	1 - 7
1.2.1.6 Ladders	1 - 7
1.2.2 Buildings	1 - 8
1.2.3 Internal Roads and Open Spaces	1 - 9
1.2.4 Road Access	1 - 9
1.2.5 Water Supply	1 - 10
1.2.6 Sewerage and Drainage	1 - 10
1.2.7 Communications	1 - 11
1.2.8 Power	1 - 11
1.2.9 Other Facilities	1 - 11

Page No.

1.3 RECOMMENDED PROPOSED IMPROVEMENTS 1 - 12

1.3.1 Phase I 1 - 12

1.3.1.1 Construction 1 - 13
1.3.1.2 Operation 1 - 13

1.3.2 Phase II 1 - 15

1.3.2.1 Construction 1 - 15
1.3.2.2 Operation 1 - 19

1.4 PROJECT ALTERNATIVES 1 - 19

1.4.1 No Action 1 - 20
1.4.2 Alternative Areas for Expansion 1 - 20

1.4.2.1 Expansion to the Southeast 1 - 20
1.4.2.2 Expansion to the Northeast 1 - 22
1.4.2.3 Comparison of the Two Alternatives 1 - 22

1.4.3 Alternative Facilities 1 - 23

1.4.3.1 Location of Proposed Bulk Corn Handling Facilities 1 - 23
1.4.3.2 Location of Livestock Terminal 1 - 26

1.4.4 Staged Implementation 1 - 27

CHAPTER 2 EXISTING ENVIRONMENT

2.1 INTRODUCTION 2 - 1

2.1.1 Methodology 2 - 1
2.1.2 Length of Project 2 - 1
2.1.3 Study Area 2 - 2

Page No.

2.2 LAND USE AND PLANNING 2 - 2

2.2.1 Existing Land Use in Labangal 2 - 6
2.2.2 Development Plans 2 - 6

2.2.2.1 Agro - Processing Center at Tambler 2 - 11
2.2.2.2 Fish Port at Tambler 2 - 12
2.2.2.3 General Santos Air Service Improvement Project 2 - 12

2.3 SOCIO-ECONOMIC CONDITIONS 2 - 13

2.3.1 General Santos City 2 - 13

2.3.1.1 Population 2 - 13
2.3.1.2 Housing, Utilities and Community Infrastructure 2 - 14
2.3.1.3 Education, Health and Social Services 2 - 15
2.3.1.4 Employment and Income 2 - 16

2.3.2 Lower Makar 2 - 16

2.3.2.1 Area and Settlement History 2 - 16
2.3.2.2 Population 2 - 17
2.3.2.3 Housing and Community Infrastructure 2 - 17
2.3.2.4 Education, Health and Social Services 2 - 20
2.3.2.5 Income and Livelihood 2 - 20
2.3.2.6 Social and Political Organization 2 - 21
2.3.2.7 Women 2 - 22
2.3.2.8 Community Problems 2 - 22

2.3.3 Badjao Community 2 - 23

2.3.3.1 Area and Settlement History 2 - 23
2.3.3.2 Population 2 - 23
2.3.3.3 Housing and Community Infrastructure 2 - 25
2.3.3.4 Education, Health and Social Services 2 - 27
2.3.3.5 Income and Livelihood 2 - 28
2.3.3.6 Social and Political Organization 2 - 29

2.3.4 The Workforce at the Wharf 2 - 30

Page No.

2.4	PHYSICAL ENVIRONMENT	2 - 30
2.4.1	Climate	2 - 30
2.4.1.1	Major Air Streams	2 - 32
2.4.1.2	Rainfall	2 - 32
2.4.1.3	Temperature	2 - 34
2.4.1.4	Relative Humidity	2 - 34
2.4.1.5	Prevailing Winds	2 - 34
2.4.2	Air Quality	2 - 34
2.4.2.1	Total Suspended Particulates	2 - 43
2.4.2.2	Noise Levels	2 - 43
2.4.3	Water Resources and Water Quality	2 - 43
2.4.3.1	Present Status of Water Resources and Use	2 - 47
2.4.3.2	Present Status of Water Quality	2 - 52
2.4.4	Oceanography	2 - 62
2.4.4.1	Tides	2 - 63
2.4.4.2	Currents	2 - 63
2.4.4.3	Waves	2 - 66
2.4.4.4	Sediment Transport	2 - 66
2.4.5	Geology, Soils and Topography	2 - 66
2.4.5.1	Geology	2 - 69
2.4.5.2	Soils and Land Forms	2 - 69
2.4.5.3	Soil Erosion	2 - 71
2.4.5.4	Topography	2 - 75
2.4.5.5	Present Land Use and Vegetation	2 - 75

Page No.

2.5 BIOLOGICAL ENVIRONMENT 2 - 80

2.5.1 Marine 2 - 80

2.5.1.1 Fisheries 2 - 80
2.5.1.2 Marine Habitat 2 - 91

2.5.2 Terrestrial 2 - 101

2.5.2.1 Wildlife and Wildlife Habitat 2 - 102
2.5.2.2 Vegetation 2 - 103

2.6 CULTURAL ENVIRONMENT 2 - 104

2.6.1 Archaeological or Historical Sites 2 - 104
2.6.2 Cultural or Religious Groups 2 - 105

CHAPTER 3 PREDICTED ENVIRONMENTAL CONDITIONS WITHOUT PROJECT

3.1 LAND USE AND PLANNING 3 - 1

3.2 SOCIO-ECONOMIC CONDITIONS 3 - 1

3.2.1 Population 3 - 1
3.2.2 Housing and Community Infrastructure 3 - 2
3.2.3 Education, Health and Social Services 3 - 2
3.2.4 Income and Livelihood 3 - 3
3.2.5 Social and Political Life 3 - 3

Page No.

3.3	PHYSICAL ENVIRONMENT	3 - 4
3.3.1	Air Quality	3 - 4
3.3.1.1	Total Suspended Particulates	3 - 4
3.3.1.2	Noise Levels	3 - 4
3.3.2	Water Resources and Water Quality	3 - 5
3.3.2.1	Water Supply and Demand Scenarios	3 - 5
3.3.2.2	Water Quality and Water Pollution Without the Project	3 - 7
3.3.3	Oceanography	3 - 19
3.3.4	Geology, Soils and Topography	3 - 19
3.4	BIOLOGICAL ENVIRONMENT	3 - 20
3.4.1	Marine	3 - 20
3.4.1.1	Fisheries	3 - 20
3.4.1.2	Marine Habitat	3 - 20
3.4.2	Terrestrial	3 - 21
3.5	CULTURAL ENVIRONMENT	3 - 21
3.5.1	Archaeological or Historical Sites	3 - 21
3.5.2	Tribal or Religious Groups	3 - 21

Page No.

CHAPTER 4 ASSESSMENT OF ENVIRONMENTAL IMPACTS

4.1 EFFECTS ON LAND USE 4 - 1

4.2 EFFECTS ON SOCIO-ECONOMIC CONDITIONS 4 - 1

4.2.1 Housing and Community Infrastructure 4 - 2
4.2.2 Education, Health and Social Services 4 - 2
4.2.3 Income and Livelihood 4 - 3
4.2.4 Community Perceptions toward Relocation 4 - 3

4.2.4.1 Lower Makar 4 - 3
4.2.4.2 Badjao Community 4 - 5

4.3 EFFECTS ON THE PHYSICAL ENVIRONMENT 4 - 5

4.3.1 Air Quality 4 - 5

4.3.1.1 Total Suspended Particulates during Construction 4 - 5
4.3.1.2 Total Suspended Particulates during Operation 4 - 6
4.3.1.3 Noise Impacts from Construction 4 - 6
4.3.1.4 Noise Impacts from Operation 4 - 6

4.3.2 Water Resources and Water Quality 4 - 9

4.3.2.1 Phase I 4 - 9
4.3.2.2 Phase II 4 - 10

4.3.3 Oceanography 4 - 14

4.3.3.1 Nearshore Currents 4 - 14
4.3.3.2 Changes in Local Sediment Transport and Beach Stability 4 - 15

4.3.4 Geology and Soils 4 - 15

Page No.

4.4 EFFECTS ON THE BIOLOGICAL ENVIRONMENT 4 - 15

4.4.1 Marine Environment 4 - 15

4.4.1.1 Fisheries 4 - 15
4.4.1.2 Marine Habitat 4 - 16

4.4.2 Terrestrial Environment 4 - 17

4.5 CULTURAL ENVIRONMENT 4 - 17

4.5.1 Archaeological or Historical Sites 4 - 17
4.5.2 Tribal or Religious Groups 4 - 18

4.6 AESTHETIC EFFECTS

4.6.1 Lands 4 - 18
4.6.2 Atmosphere 4 - 18
4.6.3 Water 4 - 19

4.7 POTENTIAL FOR CUMULATIVE EFFECTS WITH OTHER PROJECTS 4 - 19

CHAPTER 5 MITIGATIVE MEASURES

5.1 MITIGATION FOR THE SOCIO-ECONOMIC EFFECTS 5 - 1

5.1.1 Community Information Campaign and Consultative Meetings 5 - 1
5.1.2 Compensation and Security of Tenure 5 - 1
5.1.3 Site Selection and Development 5 - 2
5.1.4 Community Organizing and Development 5 - 3
5.1.5 Monitoring 5 - 3
5.1.6 Timetable 5 - 3

Page No.

5.2 MITIGATION FOR EFFECTS ON PHYSICAL ENVIRONMENT 5 - 4

5.2.1 Air Quality 5 - 4

5.2.1.1 Total Suspended Particulates 5 - 4
5.2.1.2 Noise Impacts 5 - 4

5.2.2 Water Quality and Water Resources 5 - 5

5.2.2.1 Mitigation of Impacts of Port Construction 5 - 5
5.2.2.2 Mitigation of Impacts of Port Operation 5 - 7

5.2.3 Oceanography 5 - 7

5.3 MITIGATION FOR EFFECTS ON BIOLOGICAL ENVIRONMENT 5 - 8

5.3.1 Marine 5 - 8

5.3.1.1 Fisheries 5 - 8
5.3.1.2 Marine Habitat 5 - 8

5.3.2 Terrestrial Environment 5 - 9

5.4 MITIGATION FOR EFFECTS ON CULTURAL ENVIRONMENT 5 - 10

5.5 MITIGATION FOR AESTHETIC EFFECTS 5 - 10

5.6 MITIGATION FOR CUMULATIVE IMPACTS 5 - 10

LIST OF TABLES

		Page No.
2-1	Land Uses in Barangay Labangal and General Santos City	2 - 7
2-2	Comparison of Land Uses in Barangay Labangal and Other Urban Barangays	2 - 9
2-3	Population Distribution Among the Badjao, by Age and Sex, 1990	2 - 25
2-4	Climatological Normals for General Santos City (1949-1986)	2 - 33
2-5	Climatological Extreme Values for General Santos City (as of 1986)	2 - 33
2-6	Ambient Total Suspended Particulate Matter Concentrations at the Makar Wharf	2 - 44
2-7	Observed Noise Levels at the Makar Wharf	2 - 45
2-8	Major Investors in General Santos City	2 - 48
2-9	Results of Water Quality Analysis for Coastal Marine Water of Sarangani Bay	2 - 53
2-10	Mean and Minimum Values of Water Quality for Coastal and Marine Water of Sarangani Bay	2 - 55
2-11	Distance and Depth Profiles of Water Quality of Coastal and Marine Water of Sarangani Bay	2 - 56
2-12	Percent Exceedances of Water Quality Criteria for Coastal and Marine Waters of Sarangani Bay	2 - 58
2-13	Results of Water Quality Analysis for Well Waters	2 - 61
2-14	Area Distribution of Slope, Erosion, Land Use and Geology by Land Management Unit (LMU)	2 - 72
2-15	Summary of Land Use and Vegetation in Makar River Watershed	2 - 79

Page No.

2-16	Number of Fishing Boats Landing in GSC (1988)	2 - 84
2-17	Fish Production Statistics for GSC (1989)	2 - 85
2-18	Municipal Fisheries Production of GSC (1988)	2 - 86
2-19	Percentage Relative Abundance of Fishes Landed in Municipal Fisheries of GSC	2 - 88
2-20	Municipal Fishing Boats and Fishermen in Six Fishing Barangays in GSC	2 - 91
3-1	Predicted Average Noise Levels Along Main Road Without the Project	3 - 5
3-2	Summary of Pollutants Discharged into the Aquatic Environment	3 - 12
3-3	Organic Pollution in Sarangani Bay	3 - 13
3-4	BOD and SS Values in mg/l in Wastewaters of Agro-based Industries	3 - 14
3-5	Detected Average Concentrations of Toxic Metals in Sarangani Bay	3 - 15
3-6	Average Concentrations of Toxic Metals from Point and Non-Point Sources	3 - 15
3-7	Lethal Toxicity of Metals to Marine Organisms	3 - 16
4-1	Typical Noise Emissions of Construction Equipment	4 - 7
4-2	Expected Noise Level in dB (A) at Various Distances from the Construction Equipment	4 - 7
4-3	Environmental Quality Standards for Noise	4 - 8
4-4	Predicted Average Noise Levels Along the Main Road with the Project	4 - 8

LIST OF FIGURES

		Page No.
1-1	Location of Makar Wharf	1 - 2
1-2	Layout of Existing Port Facilities	1 - 5
1-3	Staged Implementation Plan - Phase I	1 - 14
1-4	Staged Implementation Plan - Phase II	1 - 16
1-5	Alternatives for Location for Expansion	1 - 21
1-6	Alternative Locations for Bulk Corn Handling Facility	1 - 24
2-1	Makar Wharf Study Area	2 - 3
2-2	Makar River Watershed Study Area	2 - 4
2-3	Labangal and Neighboring Barangays of General Santos City	2 - 5
2-4	Land Use in Barangay Labangal and Vicinity	2 - 8
2-5	Sketch Map of Lower Makar Community	2 - 18
2-6	Sketch Map of Badjao Community	2 - 24
2-7	Local Climate According to Corona's Classification	2 - 31
2-8	Wind Rose, Jan./Feb.	2 - 35
2-9	Wind Rose, Mar./Apr.	2 - 36
2-10	Wind Rose, May/June	2 - 37
2-11	Wind Rose, July/Aug.	2 - 38
2-12	Wind Rose, Sept./Oct.	2 - 39
2-13	Wind Rose, Nov./Dec.	2 - 40
2-14	Wind Rose Annual Average	2 - 41

Page No.

2-15	Location of Air Quality Sampling Stations	2 - 42
2-16	Water Quality Sampling Locations	2 - 46
2-17	Location of Major Industrial Establishments on the West Side of Sarangani Bay	2 - 49
2-18	Calculated Depth-Averaged Wind-Driven Current Speed at Sarangani Bay	2 - 64
2-19	Calculated Depth-Averaged Wind-Driven Current Speed at Sarangani Bay	2 - 65
2-20	Wave Predictions	2 - 67
2-21	Qualitative Comparison between 1972 and 1991 Hydrographic Surveys	2 - 68
2-22	Geological Map and Location of Soil Observation	2 - 70
2-23	Land Management Unit Map of Makar River Watershed	2 - 74
2-24	Erosion Map	2 - 76
2-25	Slope Map	2 - 77
2-26	Present Land Use/Vegetation Map	2 - 78
2-27	Marine Survey Sites	2 - 92
2-28	Development of Makar Cove Reef Platforms	2 - 94
2-29	Schematic Distribution of Marine Habitats and Substrate Types of the Dumpao Point Reef Platform	2 - 97
2-30	Schematic Cross Sections of the Dumpao Reef Platform	2 - 98
E5-1	Existing Land Use	E - 5 - 10
E5-2	Mean Values of Climatological Normal/Extreme for General Santos City	E - 5 - 11

		Page No.
E5-3	Staged Implementation Plan - Phase I	E - 5 - 12
E5-4	Staged Implementation Plan - Phase II	E - 5 - 13
E5-5	Annual Average Perceptive Shock in the Philippines	E - 5 - 14
E5-6	Epicenter of Destructive Philippine Earthquake	E - 5 - 15
E5-7	Location of Earthquakes Epicenter in the Period 1949-1976 (Mindanao Island)	E - 5 - 16
E5-8	Distribution of Earthquake Generators in the Philippines	E - 5 - 17
E5-9	South Cotabato Province Geological Map	E - 5 - 18

LIST OF PLATES

ES-1	Oblique Aerial View of Makar Wharf	xviii
2-1	View North from Existing Makar Wharf	2 - 10
2-2	Lower Makar Settlement Directly West of the Makar Wharf	2 - 19
2-3	Basketball Court and Houses in Purok Lower Makar	2 - 19
2-4	Typical Badjao Houses	2 - 26
2-5	Typical Badjao Houses	2 - 26
2-6	Adult Tuna Weighed at the General Santos City Fish Market	2 - 81
2-7	Typical Catch of "Stonefishes" from Small Banca Fishermen	2 - 89
2-8	A Badjao Small Banca Fisherman	2 - 89
2-9	Dumpao Point Intertidal Area	2 - 98
2-10	Discharge of the Silway River	2 - 99

LIST OF APPENDICES

		Page No.
Appendix A	METHODOLOGIES	
A-1	Water Quality Sampling and Analysis	A - 1 - 1
A-2	Approved Methods of Analysis for Water Quality Criteria	A - 2 - 1
A-3	Geology, Soils, Topography Methodology	A - 3 - 1
A-4	Municipal Fisher Folk Questionnaire	A - 4 - 1
A-5	Marine Habitat Methodology	A - 5 - 1
A-6	Summary of Marine Habitat Surveys	A - 6 - 1
Appendix B	CONTACT LIST	B - 1
Appendix C	REFERENCES	C - 1
Appendix D	TECHNICAL INFORMATION	
D-1	Water Quality Criteria for Coastal and Marine Waters	D - 1 - 1
D-2	Effluent Standards: Conventional and Other Pollutants in Inland Water Class D, Coastal Water Class SC and SC and Other Coastal Water not yet Classified	D - 2 - 1
D-3	Effluent Standards: Toxic and Other Deleterious Substances	D - 3 - 1
D-4	National Standards for Drinking Water	D - 4 - 1
D-5	International Standards for Drinking Water (WHO, 1971)	D - 5 - 1
D-6	Copies of Certificate of Analysis for Water Quality Parameters Analyzed for Makar Study	D - 6 - 1
D-7	Detailed Soil and Land Use Descriptions	D - 7 - 1

Page No.

D-8	Major and Secondary Fish Group Landed in General Santos City	D - 8 - 1
D-9	Representative Genera Recorded from the Dumpao Point Reef Platform	D - 9 - 1
D-10	List of Fauna in Makar and Its Immediate Vicinity	D - 10 - 1
D-11	List of Flora in Makar and Its Immediate Vicinity	D - 11 - 1
D-12	Dolefil-USAID Sarangani Bay Marine and Inland Resource Conservation Projects	D - 12 - 1
Appendix E	SUMMARY OF PUBLIC RECOMMENDATIONS	
E-1	Summary of Scoping Session Recommendations	E - 1 - 1
E-2	Review Comments of Construction Control Services Corporation - Philippine Assistance Program Support (PAPS), Received June 1991	E - 2 - 1
E-3	Review Comments of Environmental Management Bureau	E - 3 - 1
E-4	Review Comments of USAID/Washington Received September 2, 1991)	E - 4 - 1
E-5	Further Information Requested by the Environmental Management Bureau Regarding Makar Wharf Environmetal Assessment	E - 5 - 1
Appendix F	LIST OF PREPARERS	F - 1
Appendix G	ENVIRONMENTAL PLAN OF ACTION	G - 1
Appendix H	LIST OF ACRONYMS	H - 1

EXECUTIVE SUMMARY

Makar Wharf is located in General Santos City, South Cotabato, on the northeast coast of Sarangani Bay. The existing Wharf incorporates the original pier; subsequent extensions in 1958, 1967, and 1970; and an another extension and expansion of facilities in in 1976 to create the existing facility.

An additional expansion to Makar Wharf has been proposed as part of the Mindanao Development Project (MDP) funded under the Philippine Assistance Program, to accommodate an expected increase in cargo handling as a result of other MDP initiatives and expected growth and development in South Cotabato.

Feasibility and Environmental Studies were undertaken to identify and recommend a technically feasible, economically justified, socially and environmentally sound, and cost effective plan for upgrading the port facilities to serve the needs of South Cotabato until the year 2010.

Based on the findings of the Feasibility Studies, the Draft Environmental Assessment has been conducted on the recommended improvements to the port. The Feasibility Study has recommended a two phase, staged implementation to improve and expand the Makar Wharf. Phase I will entail improvements to port management and operations, some repairs to the existing wharf, construction of a container storage area within the existing port, and installation of equipment and navigational aids. Phase II will entail more extensive port expansion to the northeast including a Wharf extension of 150 m, a fill area to accommodate a new container terminal and a livestock terminal, dredging along the wharf extension to -15 m, construction of a livestock terminal with waste treatment facilities, and an additional access road to the port.

A possible location for a bulk grain handling facility at the port has also been examined. However, no recommended site has been presented pending a decision being taken on the feasibility of such a facility. Therefore, additional impacts specific to such a facility have not been addressed.

The current environmental condition of the northeast coast of Sarangani Bay is characteristic of an already developed, rapidly growing and somewhat degraded urban area. The port is situated in barangay Labangal, one of four urban barangays of General Santos City. While industrial land use is less in Labangal than in other urban barangays, this will change in the near future due to the development of an industrial estate of over 900 ha in Labangal.

Two communities are located on either side of the port area. Lower Makar, a long established purok of 2,704 inhabitants, is found to the southwest, while Venil, a smaller, recently established, Badjao community of 570 inhabitants, lies to the northeast.

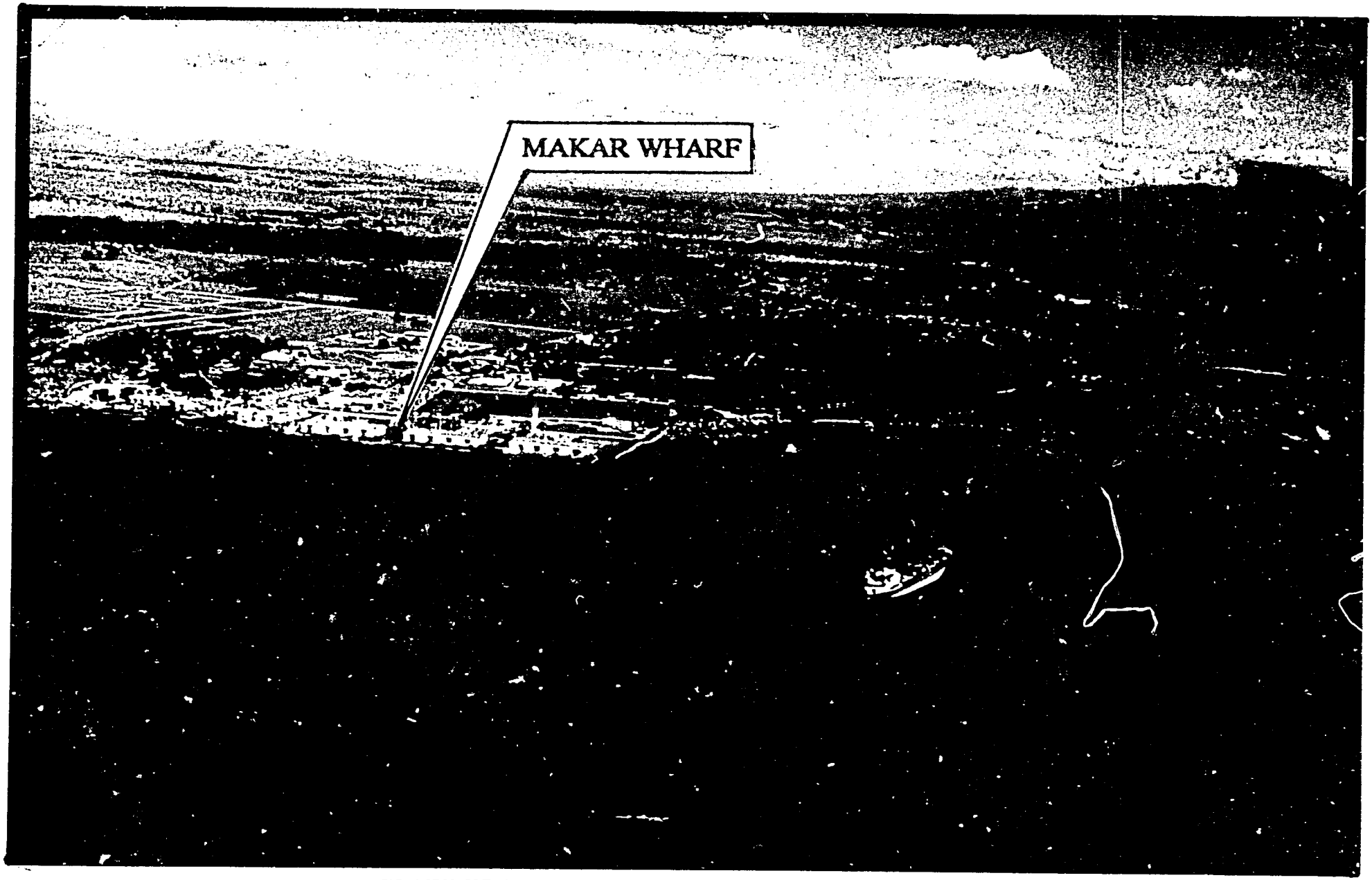


PLATE ES-1 **Oblique Aerial View of Makar Wharf**

Two communities are located on either side of the port area. Lower Makar, a long established purok of 2,704 inhabitants, is found to the southwest, while Venil, a smaller, recently established, Badjao community of 570 inhabitants, lies to the northeast.

Air quality baseline data indicated conditions that are well within Philippine standards for particulates and noise. Water quality baseline data revealed some exceedance of water quality standards in Sarangani Bay, particularly for concentrations of some heavy metals. Water quality studies also indicated that Sarangani Bay, particularly the northeast portion, acts as the receiving body of water for domestic and industrial effluents, as well as for drainage from agricultural lands. Projected growth and development in the area could further add to this water quality degradation.

The fisheries of Sarangani Bay are considered to be depleted, and anecdotal information indicates that fish catch per unit effort is declining and small (municipal) boats must travel further afield for their catch. While the tuna fishery of General Santos City appears to be thriving, this fishery takes place well outside of Sarangani Bay and hence, the influence of the port.

Marine habitat in the study area has already been severely degraded due to previous expansion of the wharf and extensive development along the Labangal coastline. Marine surveys reported limited habitat and species diversity, and identified siltation, overfishing and habitat displacement as primary factors affecting coastal marine habitats in the study area.

The terrestrial habitat of the study area is characterized by encroachment of the urban environment. Little undisturbed land remains and therefore, most of the species found are adapted to human development. No rare or endangered species are known to occur in the immediate area of the port.

The most significant impact expected to result from the proposed port expansion will be the relocation of the Badjao community. While this community has very limited services, its current proximity to schools and health care does contribute to its overall standard of living. The unique cultural requirements of the Badjao include a basic need to live by the sea and therefore, an appropriate relocation site may be difficult to find. However, with proper planning and community involvement, it is believed that their needs can be met with minimal social disruption.

There will be some temporary water quality impacts during dredging and construction activity that are unavoidable. Because the duration of the dredging is expected to be less than six months and currents in the area are not strong, the effects will be short term and localized. There is also expected to be a net benefit to water quality with the construction of a livestock terminal and waste treatment facilities, which will improve present handling of animal wastes and meet effluent standards.

There will be a permanent loss of a nominal amount of marine habitat when the intertidal area

is filled and dredged. However, the remaining Dumpao Reef is already in a degraded condition and future conditions are not expected to improve given planned development for the area and its proximity to the urban core.

A number of mitigation measures have been proposed for what are considered the most significant impacts resulting from the project construction and for the lesser impacts of overall port operation.

The major mitigation that is required is a comprehensive plan for the relocation of the Badjao community that will include consultative meetings, compensation, site selection and development, community organizing and development and monitoring the community once it has been reestablished. It is suggested that this process begin as soon as the decision to proceed with port expansion is made in order to avoid unnecessary anxiety in the community and to ensure that the size of the community to be relocated does not increase significantly.

Mitigation measures for the effects of dredging are also proposed, including recommendations for the type of dredging to be used and the best methods of disposal. Monitoring of water quality should take place during dredging and construction and may be continued during port operations to ensure effluent standards are being met. An existing water quality monitoring program being conducted by Mindanao State University (MSU) as a part of a USAID-Dolefil project, could be augmented to include Makar Wharf, thereby continuing to strengthen MSU's capacity in water quality analysis.

While the marine habitat that will be lost is already considered degraded, mitigation has been proposed to transplant soft corals at the site to a more acceptable area in order to compensate for this minimal loss. This could also dovetail with existing marine rehabilitation programs that are underway in Sarangani Bay.

The overall conclusion of the Environmental Assessment is that the proposed port expansion will have minimal net environmental impacts given the current conditions and projected environmental conditions without port expansion. Identified impacts can be mitigated for and the planning time provided by the two phase implementation plan will allow the proponent to adequately address the most significant impact, that of the relocation of the Badjao community.

While somewhat removed from the specific effects of the port, the Consultant has included recommendations that generally address the cumulative development pressures that are being exerted on the environment of Sarangani Bay. Possible strategies for coastal resource management have been identified to encourage the government agencies responsible to develop a plan for the sustainable development of the Sarangani Bay area.

CHAPTER 1

PROJECT DESCRIPTION

1.1 PROJECT SETTING

1.1.1 Location

The existing Makar Wharf or Port of General Santos City is situated at the head of Sarangani Bay in General Santos City, South Cotabato, roughly midway along the southern coast of Mindanao.

General Santos City is composed of 26 urban and rural barangays or townships. Dadiangas, which is the principal town, is the administrative and social center of General Santos City. The Makar Wharf is located in Barangay of Labangal which is situated at about three km southwest of Dadiangas. The wharf's name was derived from its proximity to the mouth of the Makar River and Makar Cove in Sarangani Bay.

Sarangani Bay is about 16 km across at its widest and is about 33 km long from its entrance in the Celebes Sea. It is aligned roughly SSW-NNE and is very deep reaching 1,450 m (791 fathoms) at its entrance. The Makar Wharf is situated in the NW corner of the bay, south of a low headland known as Dumpao Point and north of Calumpang Point. Roughly halfway between these two points is the dry riverbed of the Makar River which formerly discharged into Makar Cove. The southwestern tip of the existing wharf is about 350 m away from the mouth of the former Makar River.

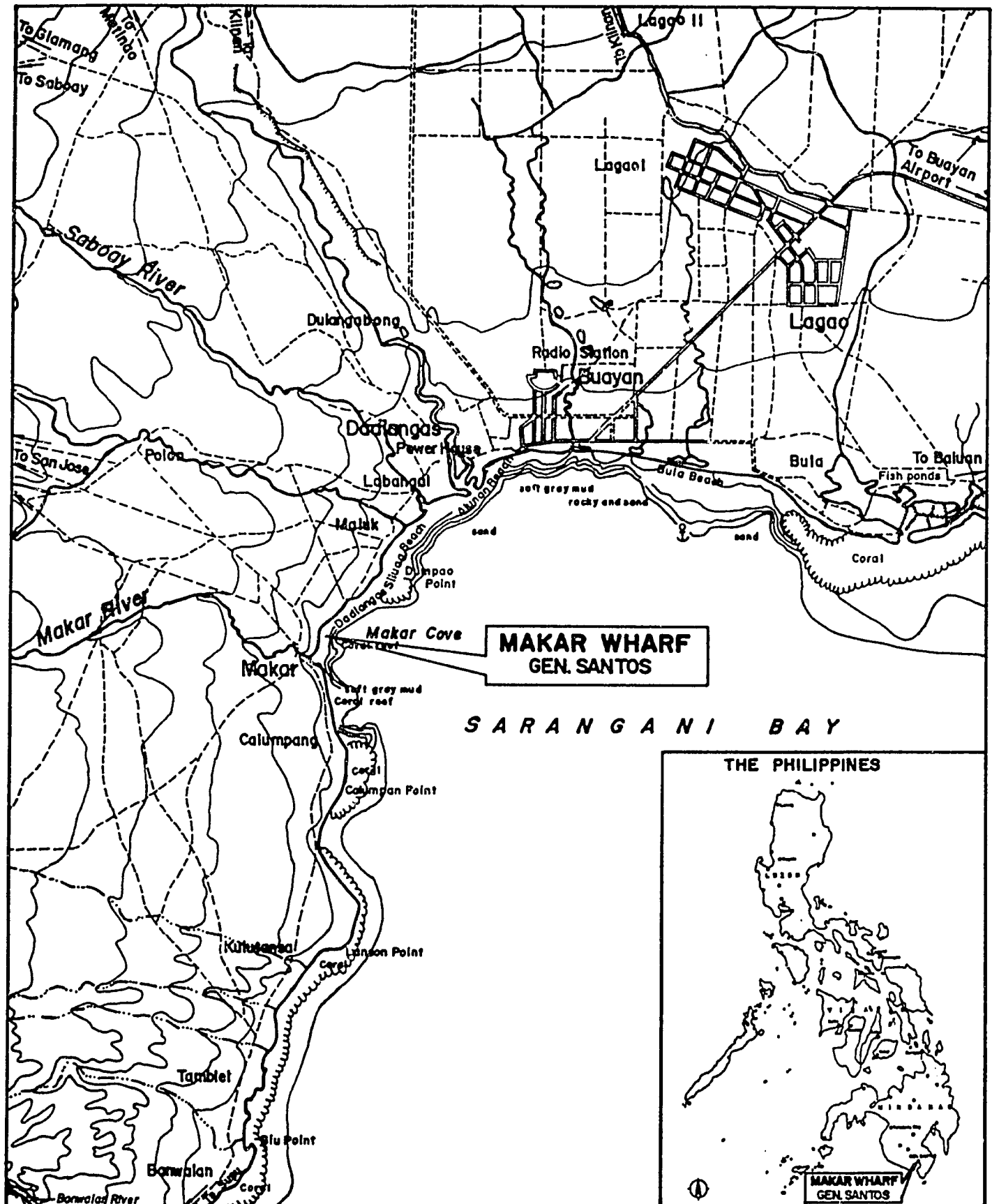
A map showing the location of Makar Wharf is shown in Figure 1-1.

1.1.2 Purpose

The Makar Wharf is an existing national port of the Philippine Ports Authority (PPA). Specifically, the project proponent is:

Project Development Department
Philippine Ports Authority
Marsman Bldg., South Harbor, Port Area
Manila, Philippines

As part of the Mindanao Development Project, (MDP), funded under the Philippine Assistance Program (PAP), the proposed improvements to the Makar Wharf seek to capitalize on the



PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0452-C-00-0089-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 1-1
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • ERNST & YOUNG INT'L. • GLOBETROTTERS ENG'G. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	LOCATION OF MAKAR WHARF	

potential for expanded agri-business within South Cotabato. The MDP, is a six year, $ 75 million project to support private sector led growth in General Santos City/South Cotabato in accordance with Philippine-US Multilateral Assistance Initiative/PAP objectives.

The purpose of the MDP is to accelerate infrastructure improvements and to encourage maximum private sector participation in new investments. The proposed wharf expansion is considered necessary to handle expected increase in cargo transport as a result of other MDP initiatives and normal growth.

1.1.3 Stage in Planning Process

Feasibility Studies have been conducted to identify and select a technically feasible, economically justified, socially sound, cost-effective, staged implementation plan for improving and upgrading the Makar port facilities in order to adequately serve the needs of South Cotabato to the year 2010.

Concurrent with the Feasibility Studies, this Environmental Assessment has been conducted in order to incorporate an environmental component into the overall plan for the proposed improvements.

The Feasibility Studies include projections of the potential demands on the port and recommend a scheme to meet the year 2010 demands. This includes preliminary design and cost estimates. The Environmental Assessment has used the information provided in the Feasibility Studies to determine potential impacts of the proposed improvements and recommend mitigation measures that can be incorporated into the proposed scheme for the port expansion. Based on the financial, technical, social and environmental feasibility, an overall decision on the feasibility of the project will be taken by the Government of the Philippines.

1.2 EXISTING FACILITIES AND CONDITION

The Makar port started in 1954 with the construction of a 21-meter long T-shaped pier head, connected to the road by a causeway. In 1958 the pier head was extended on both sides, each extension being 48 meters long. A small upland area was created by partially filling in the area behind the pier. A small passenger and cargo shed was built on this area.

Between 1967 and 1970 the pier was extended further in both directions, including a short narrow angled extension at the southwestern end. The area behind the pier was filled and several buildings were erected in this new upland area. With these improvement, the berthing structure became a 241.5 meter long and 9-meter wide marginal wharf with a mostly unpaved upland area and several private buildings belonging to shipping lines.

In 1972, Sir William Halcrow and Partners prepared the first relevant feasibility study for Makar Wharf for the United Nations Development Programme and the World Bank. It determined that the wharf structure was not sufficiently strong for modern traffic and basically recommended the following improvements:

- strengthening of the existing structure by redriving and extending all piles, strengthening pile caps, and placing a reinforced concrete overlay over the entire wharf;
- replacing all wooden fender piles with rubber fenders, placed on a new fascia beam;
- extending the wharf in two steps by 300 meters and creating additional upland area by backfilling behind the new wharf extension.

The Philippine Ports Authority (PPA) had not been created and the improvements were built between 1976 and 1978 for the Department of Public Works and Highways.

At present, the Makar Wharf includes a total land area of 10.11 hectares with a docking length of 561 meters which could accommodate berthing spaces for about seven vessels at a given time. Berth spaces at the wharf are numbered consecutively starting from the west proceeding to the east. Berths 1 through 4 are along the 261 meter length of the original wharf. Berths 5 through 7 are along the 300 meters of the newer wharf addition.

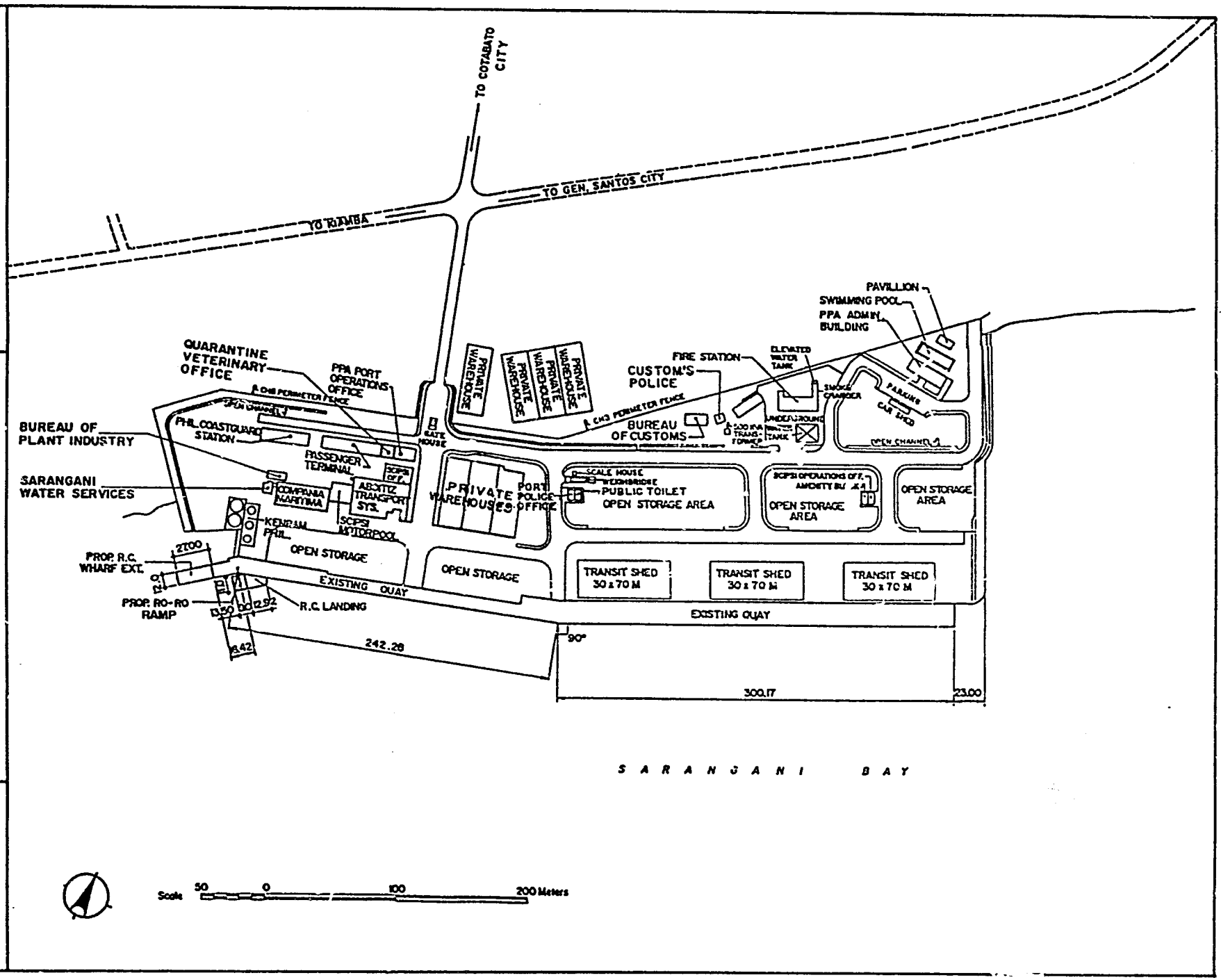
Port facilities in the area include an administrative building, fire station, elevated and underground water tanks, port lighting, concrete roadways, fire hydrants, five open storage areas, six private warehouses, three transit sheds, two amenity blocks, a passenger terminal, and offices of local shipping and cargo handlers, customs bureau, coast guard offices,port police, palm oil storage tanks, truck scale house and weighbridge and others.

A plan showing the wharf layout and location of the port facilities is included in Figure 1-2.

1.2.1 The Wharf

1.2.1.1 Wharf Structure

The wharf is a reinforced concrete structure which is a typical open-piled quay with raking piles. The total length of the quay is composed of about 153 bents or rows of pilings spaced three to five meters apart. Rock bunds enclose the reclaimed areas and the fill material is retained behind the wharf by reinforced concrete sheet piles.



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO.: 492-0452-C-00-0006-00

LOUIS BERGER INTERNATIONAL, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LAYOUT OF EXISTING PORT FACILITIES

FIGURE 1-2

The original berthing face of the wharf was 21 m long and aligned at about 18 degrees to the shoreline, lying roughly NE-SW. It was built in 1954 as a causeway with a reinforced concrete T-head pier with a design live loading of 200 pounds per square foot (psf). In 1958, both ends of the T-head were extended with two piers, 48 m long each, and with the same design live loading of 200 psf. In addition, an area of 30 m X 32 m was reclaimed and a passenger and cargo shed were built on it. The third phase of development was completed in 1970 with the extension northeastward of about 60 m together with a rock causeway and further reclamation behind the extension and the existing NE arm of the wharf. In addition, the wharf was extended southwestward a further 67.5 m. Finally, at that time a 16.5-m extension was built, angled at 22.5 degrees to the SE end. Design live loading for these extensions was increased to 300 psf.

The most recent extension to the wharf was completed in 1978, extending the northeastern end of the wharf by an additional 300 m, that forms an angle of 5 degrees with the original quay line. Reclamation behind the extension furnished additional upland area. A design live loading of 300 psf was used for this quay extension. Also included in this development phase was the rehabilitation of the existing quay.

An ocular inspection of the top deck shows signs of repair. Cracks on the deck's wearing course, caused by temperature change and shrinkage, were patched with cement and epoxy grout. These cracks apparently do not affect the structural integrity of the deck slab.

Ongoing settlement of the earth fill behind the sheet pile walls were also observed. The difference in levels of the quay deck and the adjacent slab on fill was measured to be about a maximum of 60 mm. This is typically due to the long-term consolidation of the fill. The observed settlement, however, is not indicative of a major failure of the sheet pile system.

A brief inspection of the underdeck at the older section of the quay showed that maintenance and rehabilitation work had been made mostly by epoxy applications or injections and concrete guniting. Traces of patched concrete to replace spilled concrete were also noted. A significant number of cracks still existed on beams, pile tips and slab soffits in spite of the recent guniting repairs. Recommendation for a thorough inspection and remedial measures have been presented in the Feasibility Report.

1.2.1.2 Piles

Foundation piles for the wharf are of pre-stressed precast concrete. A total of 199 piles were driven in the old quay and 556 piles in the new quay with a total of about 15,450 m of pile length. Bearing capacity of the piles is about 60 mt.

A random ocular survey of the pile tips and jackets above the water level revealed cracks on the pile tips and jackets under the older quay area. The cracks indicate that the piles were subjected to tension at one time or another, probably during an earthquake or due to horizontal loads from vessels.

6

1.2.1.3 Fendering System

The fendering system of the wharf is intended to absorb the impact energy of the vessel berthing at the quay. Horizontal, vertical and diagonal tubular rubber fenders, about 400 mm in diameter, are suspended by means of galvanized steel chains. Vertical fenders had been installed at each of the 129 bents of the quay wall. However, at the time of inspection, all of the vertical fenders were missing, except at the southwestern corner of the quay wall. Twenty one out of 319 horizontal and diagonal fenders are also missing. The Philippine Ports Authority (PPA) has in previous years followed a program of replacing fenders as they are ripped off but fell behind in this task. At this point, the PPA has a budget appropriation of about P 500,000 for the replacement and maintenance of the fender systems.

1.2.1.4 Mooring Accessories

Cast-iron mooring bitts or bollards are spaced every 15 m on the edge of the deck. Single bitts of 30-ton capacity are installed in the old quay and double bitts (open-choke type) of 60-ton capacity are installed at the new quay.

1.2.1.5 Kerbs

Most timber kerbs at the quay edges have been replaced with concrete kerbs, although some timber kerbs are still intact. Ongoing maintenance activities continue to replace the old timber kerbs. Anchorage for the new concrete kerbs is provided by welding the reinforcements to the anchor bolts originally intended for the timber kerbs. Some of the concrete kerbs already in place in the old quay have already been damaged, probably by the Ro-ro (Roll-on, Roll-off) vessel landing and by heavy equipment.

1.2.1.6 Ladders

Steel ladders, spaced every 100 to 120 m, are provided at the face of the dock. They serve not only to allow access to vessels of low freeboard and to small boats, but also as a safety measure for anyone who falls into the water. The ladders show a high degree of corrosion and need immediate replacement.

1.2.2 Buildings

The buildings within the port area comprise the following:

- Administration Building. This two-storey reinforced concrete building housing the Philippine Port Authority (PPA) Office is 10 m X 30 m in area with a flat roof deck. Situated at its rear is a 8 m X 25 m untiled swimming pool and a temporary pavilion building made of wood & bamboo sidings and nipa roofing. The open parking area at its front is concrete paved and a structural steel carshed is provided for eight cars.

- Guest House. This 10 m X 18 m bungalow type structure has four bedrooms, living room, dining room and kitchen. One of the rooms is currently occupied by the PPA Port Manager.

- Fire Station Building. The building has two bays, one vehicle maintenance bay and equipment bay. However, no fire fighting vehicle exists at the port and the building is used for storage.

- Transit Sheds. There are three transit sheds which provide covered storage for cargo. The sheds are about 30 m X 70 m in size and made of locally fabricated steel trusses and painted GI roof sheeting on steel columns and hollow blockwork walls. Shed No. 1 is leased by Trans-Asia Shipping and also houses the pilot's office. Shed No. 2 is leased by Fertimix, a dealer in fertilizers. Shed No. 3 is leased by the National Food Authority.

- Private Warehouses. These private warehouses were erected by the shipping offices on lots leased from the PPA. The five warehouses are leased by the following shipping offices: Aboitiz Shipping, Sulpicio Lines, William Lines, Lorenzo Shipping, and Sampaguita Shipping. Sampaguita Shipping now occupies the warehouse previously owned and built by Compania Maritima. Each of the warehouses occupy an area of about 1000 sq m.

- Open Storage Areas. Of the five storage areas, Nos. 1 to 3 are located behind the transit sheds. They are asphalt-paved but the paving is scoured due to normal wear and tear brought about by heavy container traffic. Repaving of the storage areas is now necessary. The two other open storage areas are located in front of the private warehouses near the older quay area. These storage areas are concrete paved.

- Passenger Terminal Building. The terminal can house approximately 300 passengers in the waiting area. A part of the terminal building is used by the PPA Port Operations Office and another part by the Bureau of Quarantines.

8

- SCIPSI Administration Office and Motorpool. The South Cotabato Integrated Port Services, Inc. (SCIPSI) provides stevedoring and arrastre services for the port. The administration office is a two-storey building. A clinic for the port workers is also located in the building.

- Office Buildings of other government agencies. There are four of these offices. Two are occupied by the Bureau of Customs, another by the Philippine Coast Guard, and a fourth one by the Bureau of Plant Industry.

- Amenity Blocks. There are two amenity blocks, one located at each of two of the open storage areas behind the Transit Sheds. Amenity Block No.1 houses the Ports Police Office and the Public Toilet. Half of Amenity Block No. 2 houses the SCIPSI Operations Office.

- Gate House. This is the control point of the port and is situated at the single entry and exit point of the port area. Only vehicles with pass stickers are allowed entry by the Port Police. Vehicles without stickers are charged an entrance fee of P 5.00 per entry.

- Storage Tanks. The five oil storage tanks are owned and operated by Kenram Philippines and are being used primarily for palm oil.

1.2.3 Internal Roads and Open Spaces

All roads within the port area are concrete-paved, except the access road to the Passenger Terminal and the Philippine Coast Guard Office. Pavement consists of a 20 cm concrete slab, reinforced with wire mesh.

Five open storage areas occupy 20,925 sq m or 16.9 percent of the total port area. They are mostly paved with asphaltic concrete. Of the total area, 56,944 sq m or 46.1 percent are open spaces, mostly unpaved.

1.2.4 Road Access

The roads in the immediate vicinity of Makar Wharf are shown on Figure 1-2. From the Gate House, a road, approximately 150 m long, leads to an intersection. The road continues on a heavily traveled section in the general direction of Marbel and Cotabato. This section is presently the main connection to Dadiangas. At the intersection, the road to the southwest leads to the industrial area of General Santos, including the proposed Tambler Agro-Industrial Complex. The road from the intersection to the northeast leads directly to Dadiangas, but is not so heavily traveled, due to lack of paving and a sub-standard bailey bridge with a wooden deck. A one-kilometer section of this road is presently being paved with concrete.

9

At the North corner of the port area, in the vicinity of the Administration Building, is a paved road that leads to and ends at the port fence. This road was planned in 1972 with the idea that it would eventually become a second access to the port.

1.2.5 Water Supply

There are two existing water supply systems operating in the port of Makar: the Philippine Port Authority (PPA) water supply system and the Sarangani Water Supply Services, now known as the C. Limjap Water Services. The PPA water system consists of two 200 mm diameter deep wells, both 85 m deep. Both wells have submersible pumps and are powered by 40 hp electric motors. The wells are said to be overflowing almost year round except in cases when droughts affect the area. Water from these wells is stored in a 400,000 liter underground concrete water tank. It takes 6-7 hours for the two submersible pumps to fill the concrete tank.

An additional two pumps are used to convey water into a 200 mm diameter pipeline located under the wharf's deck to supply berthed ships. These pipelines are in a deteriorated condition and the PPA engineers are planning to replace them. A 40,000-liter elevated concrete water tank also exists which draws water from the underground water tank, for distribution to different port facilities and buildings by gravity. Pipelines for these facilities are found to be in good condition. The system has the capacity to supply water at the rate of 35,000 liters/hr.

C. Limjap Water Services facilities include a 76 m deep well with a 100 mm diameter pipe and a pump powered by a 10 H.P. electric motor. It has also a concrete tank with a capacity of 140,000 liters. The water is being conveyed into a 75 mm diameter pipe by the use of a 15 hp electric motor which draws water from the tank. It has also an existing pipeline which is located along the top edge of the wharf and is in a very deteriorated stage. The system has the capacity to provide water to berthed ships at the rate of 15,000 to 20,000 liters/hour depending on the ship's location.

The water distribution for the berthed ships is being shared by the two water supply services. Seventy percent of the demand is being supplied by C. Limjap and thirty percent by PPA. For the year 1990, PPA had supplied 35,577,000 liters of water; in 1989 21,658,730 liters; 31,397,000 liters in 1988; 24,126,000 in 1987 and 12,048,130 liters in 1986. If 70% of demand is supplied by C. Limjap Water Services it can be estimated that for the year 1990 alone a total of 118,590,000 liters have been supplied by the two water systems.

1.2.6 Sewerage and Drainage

The Makar Wharf has an existing storm drainage and sewerage system. Storm drains consist mostly of reinforced concrete pipe with diameters of 490 mm to a maximum of 910 mm . A lined trapezoidal ditch is also existing. Generally no flooding has occurred in the entire port area.

10

Effluent from each building and amenities is collected into septic and leaching chambers. It is conveyed by a 100-mm diameter castiron pipe to catch drains, then into storm drainage system and finally to sea. Liquid waste from vessels can not be accommodated and ships are being told to dispose of their waste at high sea.

1.2.7 Communications

The Makar facility has telephone connections and intercoms to communicate between offices. The telephone lines are only good for domestic calls within the city. Long distance calls are made through an operator. Hand held radios are also available but their use is limited only to police operation.

1.2.8 Power

Mindanao Power Grid-System Load Demand vs. Installed Capacity information indicates the maximum forecast plant capacity per year is enough to supply expanding electrical load. The increase in electrical load due to expansion and new residential, commercial and industrial facilities, is matched by an increase in planned plant capacity through new power plants.

The power demand of Makar Wharf will be small even after any proposed expansion, compared with the demand of the industry in the area, hence enough power will be available, if the grid capacity is expanded as planned.

Even with the best power system, power interruptions cannot be avoided due to natural phenomena such as storms, earthquakes, etc. In the past, power service in General Santos City suffered from frequent and long outages. Frequency of outages ranges from 2 to 15 per month and total duration of outages from 1 to 50 hours a month. To mitigate the effects of power outages on the port operations at Makar Wharf, a standby generator set is recommended.

1.2.9 Other Facilities

- Port Lighting. Illumination for night operations are provided by outdoor flood lights at strategic points on the quay and open storage areas. A 500 KVA Transformer Station is provided for the ports electrical requirements.

- Truck Scale House and Weighbridge.

- Security Fencing. A chain link security fence is provided to fence off the existing port. The fence is over 2 meters high topped by strands of barbed wires.

1.3 RECOMMENDED PROPOSED IMPROVEMENTS

Feasibility Studies being conducted concurrently with the Environmental Assessment have determined a number of criteria that should be satisfied for any future expansion of the wharf. These criteria are to ensure the maximum flexibility for port operations and for future expansion, should it be necessary. The criteria are as follows:

- No partial expansion should be undertaken at this time or in the future that will present problems for later expansion stages.

- Container operations are increasingly important at Makar Wharf. The container loading and unloading facilities are, at present, very inadequate. Any wharf expansion should address itself to this problem and provide the necessary facilities to load and to unload containers and to store and handle them at a yard expressly designed for that purpose.

- Steps should be taken at the first stage of expansion to allow for further improvement and more advanced equipment to be introduced at later stages of development.

- Any wharf extension should provide ample container storage area, without any major building or obstruction hindering free movement of containers in the area.

In order to meet these criteria, the Feasibility Study has recommended a two-phase approach to the Makar Wharf expansion to meet the needs of the port until the year 2010. Phase I will include primarily operational and management improvements with some repair work to existing facilities. Phase II will include the extension of the Wharf for additional berth space, the construction of a container yard, construction of a livestock terminal, and the installation of navigational aids and other equipment for port operation. Section 1.4 also describes the potential for a bulk grain handling facility and presents alternatives for such a facility. However, because it has not yet been determined if this is a viable project, and no location has been selected, it has not been included as a recommended improvement.

The schedules for improvements described below are all approximate and are based on the approval and financing of the project by December 1991.

1.3.1 Phase I

The most substantial portion of Phase I includes port management and operational improvements. These will include organizational reform, changes in port operations and port fees, creation of an information database, improvements to statistics collection, increase in use of weigh scales, termination of private leases on transit sheds, and alteration to existing usage patterns of the quays to prevent heavy equipment from being used on the wharf. In addition to these

management improvements, some wharf repairs are required and a container yard will be constructed (known as container yard I). The proposed Phase I improvements are shown in Figure 1-3. The construction and operation of the Phase I facilities are described below.

The schedule of Phase I activities, based on a start date of December 1991 is shown in Table 1-1.

1.3.1.1 Construction

- Container Yard I

  Container yard I will be located in what are now open storage areas to the south west of the transit sheds (Figure 1-3). The construction of these areas will require the removal of curbs and gutters, levelling the area with vibrating rollers, laying down a thin layer of sand and paving with concrete. The final storage area will be a total of approximately 15,500 square meters.

- Other Works

  In addition to the construction of the container yard, the electrical system, sanitary system and the existing wharf structure will be repaired.

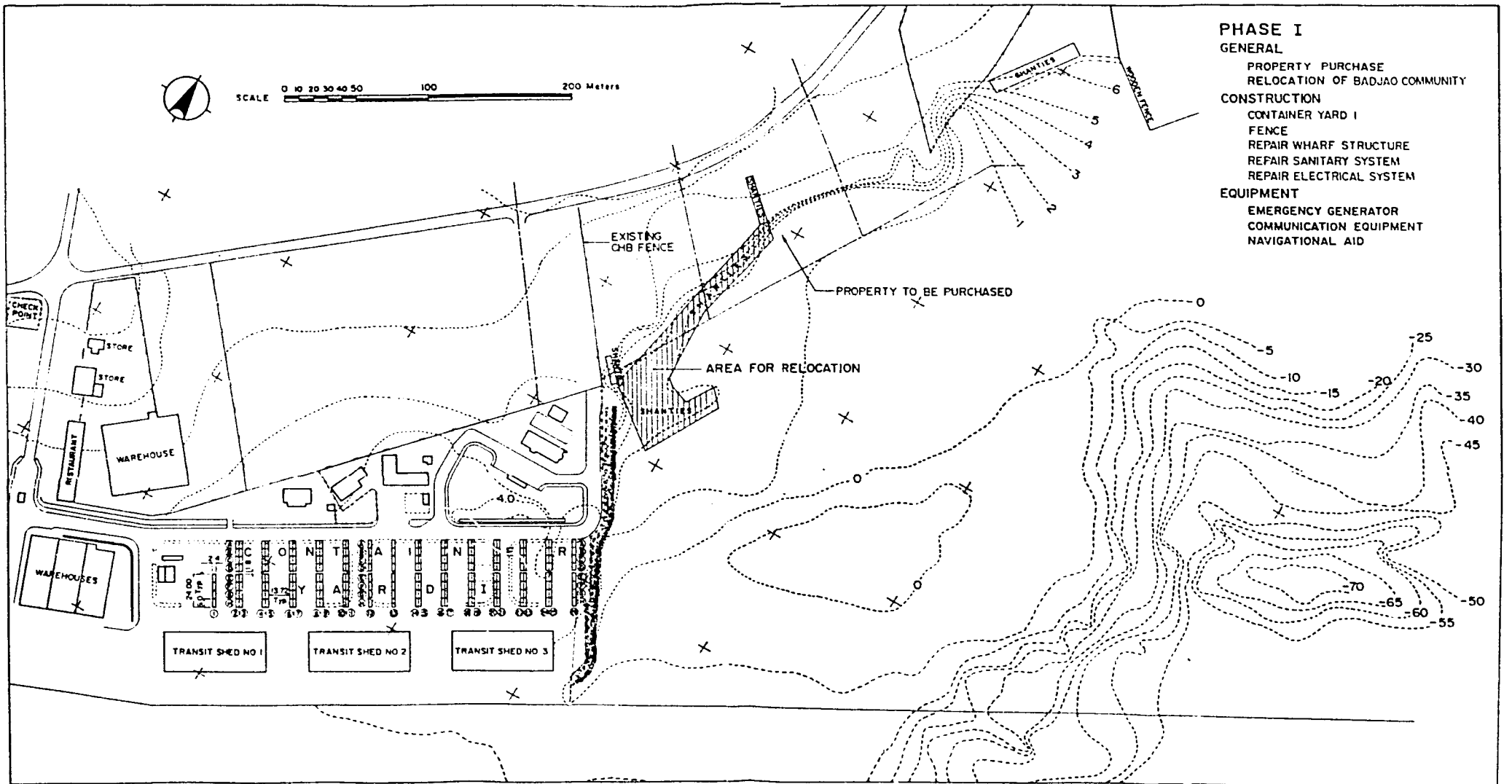
  During Phase I, an emergency generator, communications equipment and navigational aids will be purchased and installed.

- Work Force Requirements

  This phase of port improvements is not expected to required significant extra work force. Construction supervision may require the services of a company located outside General Santos City, however, it is expected that the bulk of the work force will be hired from within General Santos City. Therefore, no additional housing requirements will be required. Those workers required for construction supervision can be accommodated in existing facilities in General Santos City.

1.3.1.2 Operation

The proposed Phase I improvements have been suggested in order to improve the current operations at the Makar Wharf and to better accommodate existing and projected cargo increases. Most of the suggested improvements are expected to increase efficiency at the port as well as provide for more accurate record-keeping. No changes in the labor forces will result in the proposed improvements.



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT 492-0452-C-00-0088-00

LOUIS BERGER INTERNATIONAL, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

STAGED IMPLEMENTATION PLAN – PHASE I

FIGURE 1–3

1.3.2 Phase II

Phase II improvements represent the bulk of new facilities that have been recommended by the current Makar Wharf Feasibility Study. These improvements include the extension of the wharf by 150 m, filling behind wharf extension to provide for an area for a container terminal, dredging to -15 m at the face of the wharf to accomodate containership draft, construction of the container yard, construction of a livestock terminal and ancillary waste disposal system, and construction of an additional dedicated access to the port. The layout of these components are shown in Figure 1-5. The construction and operation of these facilities is described below.

1.3.2.1 Construction

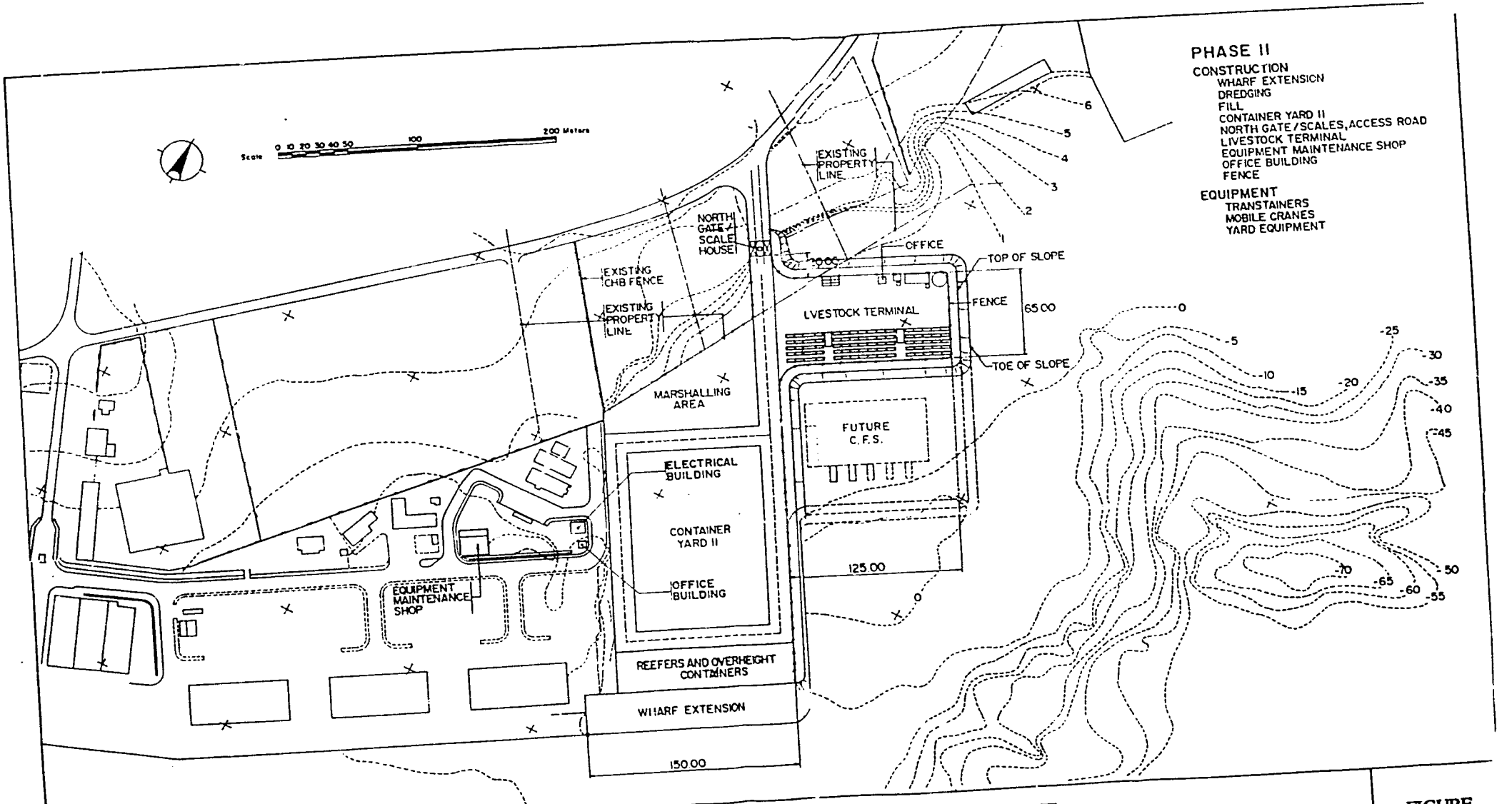
- Wharf Extension and Container Terminal

Because the construction of the wharf extension and container terminal are a continuous process, they are described here under one construction activity. Prior to the beginning this construction activity, a geotechnical survey has been recommended in order to better define the foundation parameters for the wharf construction. The detailed design will be based on these surveys. However, subject to detailed design, the following is a general outline of the expected process to construct the wharf extension, construct a dike for fill and construct the container terminal, with the ancillary dredging and pile driving.

(a) Initially, steel sheet piles will be driven into the substrate along the 150 m long face of the proposed wharf extension, plus an additional length of 150 m to stabilize the dredge slope.

(b) A minimal amount of the upper clay layer will then be dredged in order that the dike may be constructed. The dike defines the boundary of the reclamation area which will include area for the container terminal and the livestock terminal. This dike is constructed of well graded aggregate and will serve as a containment structure for the granular dredge spoils. The waterside face of the dike is overlain with a select granular filter rock, and protected by rip-rap armour rock. Approximately 35,000 m^3 of borrowed select granular fill is required for the construction of the dike. In addition, there is a requirement for approximately 2,250 m^3 of borrowed select filter rock. The existing eastern slope face of the port development is protected by rip-rap. This rip-rap will be removed prior to construction and stockpiled. A total of 6,960 m^3 of rip-rap is required for slope protection. Approximately 1,900 m^3 of the rip-rap is recyclable from the existing eastern slope. The remainder will be from a borrow source. The borrowed materials required for the dike construction are

15



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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

STAGED IMPLEMENTATION PLAN – PHASE II

FIGURE 1–4

available from sources in the Silway, Buayan and Sinawal Rivers. Dike construction activity is expected to take approximately two months.

(c) A total area of 1.7 ha will be dredged once the dike is constructed if the dredge depth is -15 m. This includes the 150 m face of the wharf extension plus another 150 m for ship maneuvering room. Geotechnical results and availability of equipment will dictate the type of dredging employed. However, the preferred choice at this time is a clam-shell dredge. Approximately 42,800 m^3 of the dredge material is sand, which will be used as fill behind the dike. Another 115,000 m^3 of potential clay material will also be dredged and will have to be disposed of. Options for this are presented in Chapter 5, Section 5.2.2. The dredging activity is expected to take approximately three months.

(d) After dredging has progressed, the pile diving activities may start. These piles are the foundation for wharf. Approximately 568 pre-cast concrete piles are required. It is estimated that this will take six months.

(e) Concurrently with the initial pile-driving and on-going dredging, fill material will also be brought in from the borrow sources to augment the filling in of the reclamation area. A total of approximately 72,000 m^3 of granular fill material is required for the reclamation. Approximately 42,800 m^3 will be obtained from dredging, and the remainder will be obtained from borrow sources.

(f) As pile-driving progresses cast-in-place concrete pilecaps elements will be constructed. These pilecaps support the pre-cast concrete slabs which form the deck of the wharf. This is an ongoing process as piles are being driven.

(g) After the deck is completed, the mechanical and electrical system are installed and then the entire deck is overlain with a gravel ballast layer subsequently paved.

- Livestock Terminal

The preferred location of the livestock terminal is shown in Figure 1-4. Alternative locations are discussed in Section 1.4. The livestock terminal will consist of an open sided covered building over a pen area. The building will have textured concrete floors, potable water, a plumbed manifold for providing the disinfectant wash down water and electric lights. The terminal includes a waste treatment plant to handle the animal waste products. The waste treatment plant provides primary treatment to animal wastes with added chlorination in compliance with the Department of Environment and Natural Resources effluent

standards. The effluent from the waste treatment plant will be discharged into the sea through an outfall located under the proposed wharf. The proposed terminal size and waste water treatment plant is designed to accommodate 8,000 hogs. New pens may be added, if needed in future.

- North Gate and Access Road

Presently all land traffic passes through the only existing gate. The original plan for the 1976 northeastern expansion provided for a second gate by building an internal road northeast of the Administration Building that now terminates at the boundary of the port area. The construction of the proposed container yard north of the transit sheds requires this second gate. It would be located, as shown on Figure 10-2, not in continuation of the indicated internal road as originally planned, but connecting to the road running north of the port area farther east, closer to the center of activities, between CSY II and the Livestock Terminal. This gate and access road are exclusively for containers and all are container traffic must use this gate, thus ensuring proper separation of the container traffic from all other traffic.

The Gate House will be similar to the existing one, but located in a more ample area. A truck scale should be located in each of the two lanes, at the gate, to automatically weigh each incoming and each outgoing container truck.

The cost of the access road and the gate, including the two truck scales, is included in the cost of the wharf extension and the CSY II.

The proposed new gate is needed to obtain the full benefits of the Container Storage Yard II. All container traffic would otherwise pass through the port, interfering with the general cargo traffic to and from the other berths. The new proposed access, combined with Container Yard II, will eliminate this interference and permit traffic separation between container traffic and other traffic in the port.

- Other Works

Along with these major construction activities, some equipment purchases and installation will be required. A mobile crane, transtrainers and miscellaneous yard equipment is envisioned.

- Workforce Requirements

The construction of the container terminal is not expected to require large numbers of workers at one time. It is expected that most of the labor will be

hired in General Santos City, with project management personnel and technical specialists hired from elsewhere as required. An estimated breakdown is 100 local laborers and 20 from elsewhere. Most of those from outside General Santos City could be adequately accommodated in the City.

1.3.2.2 Operation

All of the proposed Phase II facilities have been suggested in order to further enhance the operation of the current port. The container terminal is proposed in order to respond to the increased containerized cargo traffic demand at Makar. The location of the terminal and additional access provided in Phase I will serve to seperate the higher speed container operations from the traditional breakbulk and bulk cargo operations at the existing facility.

The livestock terminal is proposed to alleviate what is now an inefficient and unsanitary system of livestock handling. In 1990, approximately 300,000 head of livestock were shipped through Makar Wharf. Mid-forecasts prepared for the Feasibility Study suggest 426,000 head for the year 2000 and 610,000 head for the year 2010. Given these numbers, a more efficient method of handling livestock is considered necessary.

The additional facilities will require some extra workers for port operations. Approximately 24 employees will be required to run the livestock terminal. Of these, nine will be skilled. Approximately 34 employees will be required to run the container terminal, of which 25 will have to be skilled.

1.4 PROJECT ALTERNATIVES

Project alternatives include: no expansion, alternatives to the area of expansion, inclusion of bulk corn handling facilities, and staged implementation of the port expansion. The possibility of relocating the port entirely was eliminated very early in the Feasibility Study based on the existing condition of Makar Wharf and the economic costs of creating an entirely new facility. The alternatives examined are discussed below. The recommended improvements outlined in Section 1.3 identify the preferred course of action based on the Feasibility Studies undertaken by Louis Berger International, Inc. (LBII). This Section provides a brief discussion on the number of alternatives that have been or are being considered.

19

1.4.1 No Action

In 1990, a total of 845,000 mt of cargo was handled at Makar Wharf and future mid-range projections for the year 2010 estimate 1.4 million tons per year (LBII, 1991). A range of cargo projections was used for the Makar Wharf Feasibility Study. For purposes of this study the mid-range figure have been selected as a point of reference. With current operating practices, this volume of cargo could begin to hamper the port's efficiency. In addition, the continuing trend towards use of containers would further hamper the port's ability to handle future traffic and may result in increased waiting times for ships at the port. Since containers are currently stored outside the port area, increased movement of the containers would likely result in traffic congestion at the single entry point that now exists at the port.

Given the projected development plans for the General Santos City area, and the proposed Agro-Processing Center, more pressure is expected to be exerted on the port in future.

1.4.2 Alternatives Areas for Expansion

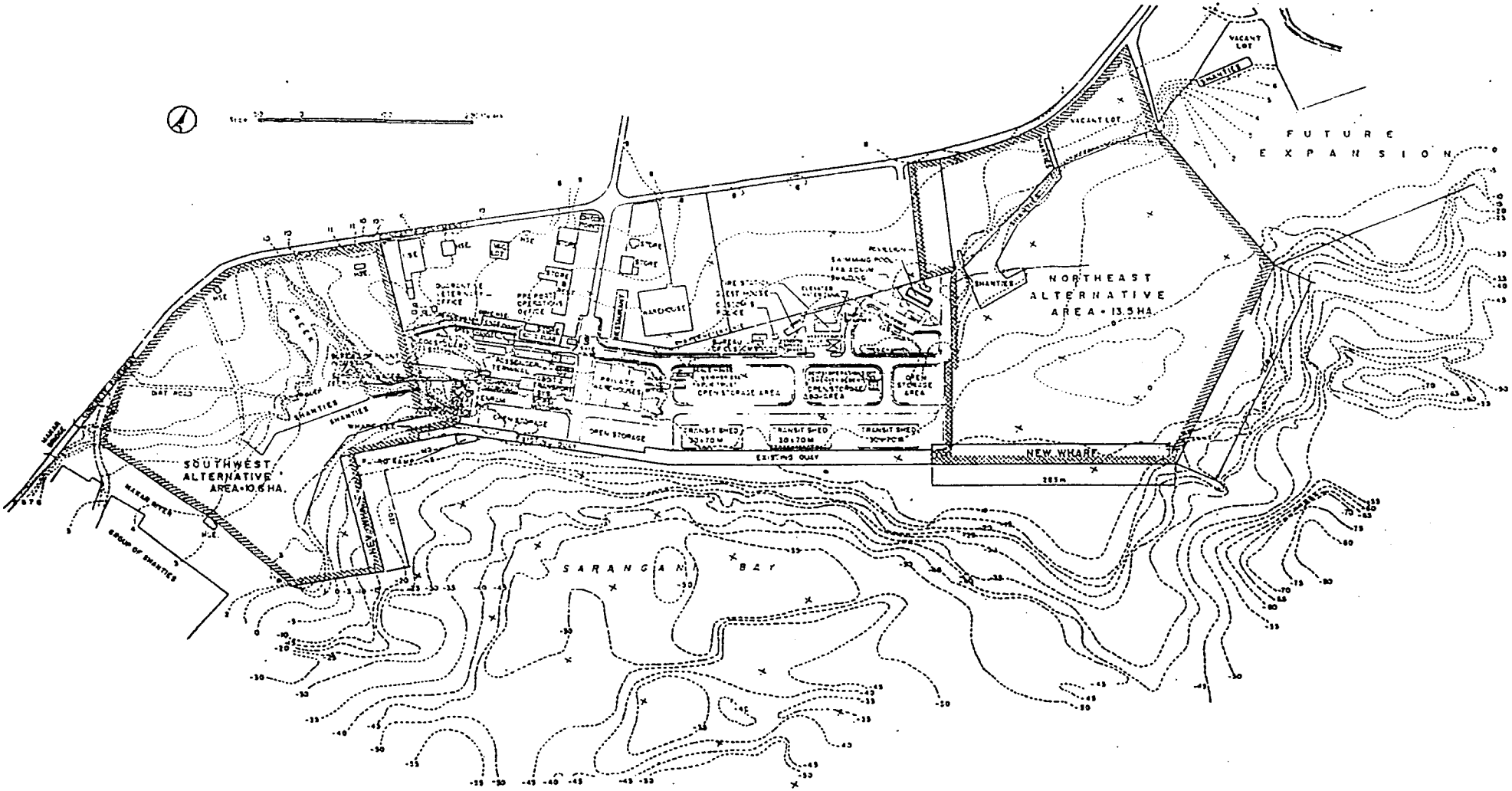
1.4.2.1 Expansion to the Southwest

Early in the development of the port, an extension to the southwest was built to the wharf. Due to the configuration of the seabed in that area, it was built at an angle to the rest of the wharf as a "dogleg". This portion of the wharf is presently being extended by a further 27 m as part of the ro/ro (roll-on-roll-off) ramp.

A further extension of the wharf by 60 m in order to provide another berth would bring the end of the wharf to the Mean Lowest Low Water(MLLW) mark (Figure 1-5). While this would make this leg of the wharf approximately 100 m long, a considerable amount of dredging would be required to obtain a satisfactory water depth (i.e. -15 m).

The southern end of this berth would also be very close to the mouth of the Makar River. A comparison of soundings from 1972 and those completed for the Feasibility Study indicate that some sedimentation has occurred in this area in the last 20 years. This river, now dry at its discharge since it has been diverted upstream for irrigation purposes would not pose a problem to this extension unless flow was redirected to the river in the future.

The area behind the wharf face would then have to be filled in order to provide for the space for a container yard. This area is heavily built up and includes private property which would have to be purchased.



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ALTERNATIVES FOR LOCATION OF EXPANSION

FIGURE 1–5

1.4.2.2 Expansion to the Northeast

The northeast extension of the port would entail a straight continuation of the existing wharf (Figure 1-5). The configuration of the seabed makes this alignment possible, as confirmed by a 1991 hydrographic survey. This alignment would allow for an addition of a total of approximately 290 m of wharf. Should additional wharf space be required in future, a turn of approximately 110 degrees could be made and a second extension of approximately 270 m could be built. The alignment would be along the 15 m contour line. Future expansion would be possible by extending a third alignment approximately 70 degrees to the east, providing another 190 m of wharf (Figure 1-5).

The original extension of the wharf (see Section 1.2) was made in 1976 in the northeasterly direction. While there were concerns at the time that wind and wave conditions may be too harsh without the protection of Calumpang Point, studies done at the time indicated that a properly designed fender system and normal seamanship would minimize any problem. This as proved to be the case and only very small ships have difficulties with their loading and unloading operations, while no major problems have been experienced in berthing and unberthing ships. The further extension is not expected to have much harsher conditions (LBII, 1991) but it may be necessary, on occasion, to provide tug assistance to some vessels under severe weather conditions.

The northeastern expansion includes filling behind the wharf which would require the relocation of the Badjao community now present along the shoreline to the northeast of the port facilities. However, the number of dwellings and families to be relocated is considerably less than the Lower Makar community to the southwest of the port.

1.4.2.3 Comparison of the two alternatives

- The southwest extension (SWE) would provide only one additional berth that would be too short for longer container ships. When a second container berth becomes necessary, it would have to be built at a different site, causing operational problems. The northeast extension (NEE) will initially provide an additional berth with options for extending along the same alignment for another container ship berth.

- The NEE additional wharf would provide a total straight berthing length of almost 300 m in future allowing for flexible berth allocation to ships. The SEE does not give this flexibility.

- Once the NEE or portions have been built, further extensions are relatively simple, while the SWE would require any further expansion to be located at the northeast.

22

- At the NEE, a large container yard can be provided without major property acquisitions while the SEE would require acquisition of private properties and clearing.

- The SWE would require relocation of a longstanding, large community (see Section 2.3.2) and purchase of a considerable amount of property, whereas the NEE requires the relocation of a much smaller community that has been located there for a much shorter time (Section 2.3.3). While the Badjao to the northeast have unique cultural characteristics and needs, the Consultant feels that with adequate planning, these needs can be met at a relocation site.

1.4.3 Alternative Facilities

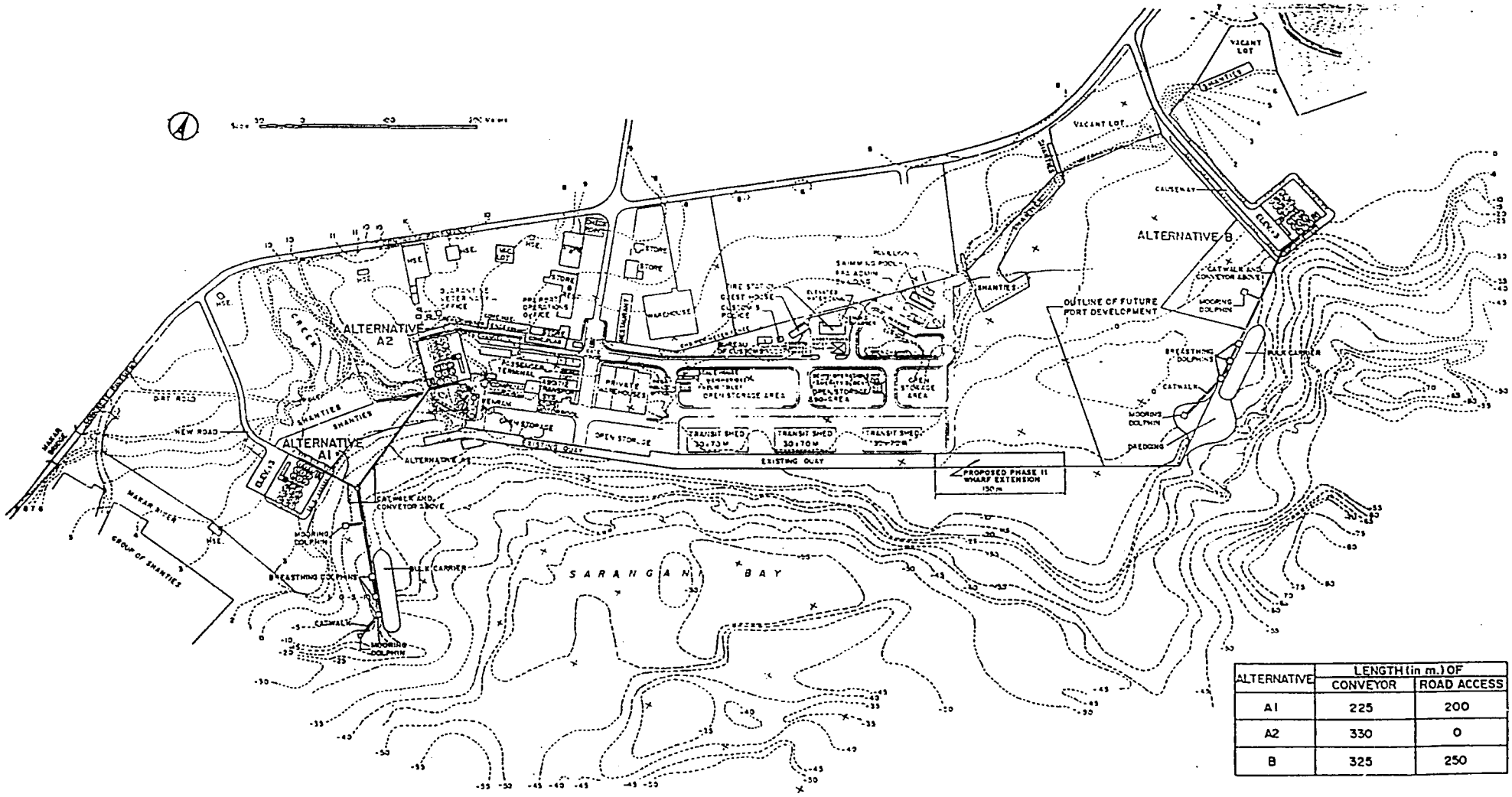
The major facility suggested for the port over and above the required container yard and additional wharf space, is a bulk grain handling facility. As there are a number of uncertainties with locating these facilities at the Makar Wharf, the Feasibility Studies have presented a number of options for locating the facilities and have also presented a plan for expansion of the Wharf, excluding these facilities.

Because of the uncertainty of whether a Bulk Corn Handling Facility will even be located at the wharf, and the specific configuration of the port layout, should there be one, it was impossible to make specific recommendations regarding environmental impacts and mitigation. The consultant has, therefore, endeavoured to provide an assessment of the kinds of "generic" effects that may be the result of such a facility, most particularly, dust emissions. The Consultant recommends that should the Bulk Corn Handling Facilities be included in the port facility, a brief assessment of construction required should be conducted to determine if additional environmental impacts may be expected and appropriate mitigation be incorporated into detailed design.

1.4.3.1 Location of proposed Bulk Corn Handling Facilities

In its final report, STV/Lyon Associates, Inc. (1991), proposes to place the corn storage silos and grain drying facilities on the now open spaces behind the easternmost transit shed. While this location may appear reasonable when the proposed bulk facilities are considered independently from the overall port planning standpoint, a reconsideration of this choices was warranted. For a number of technical reasons, the present LBII Feasibilty Studies have proposed alternate locations for the handling facilites (Figure 1-6).

There is also the question of timing of construction of these facilites. Bulk loading facilities require bulk receiving facilities; there are none in the Philippines at present aside from General Milling's private operation. Nearly 40% of corn shipments are destined to the National Capital Region; although construction of a bulk receiving facility has been proposed for that locale by



ALTERNATIVE	LENGTH (in m.) OF	
	CONVEYOR	ROAD ACCESS
A1	225	200
A2	330	0
B	325	250

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ALTERNATIVE LOCATIONS FOR BULK CORN HANDLING FACILITY

FIGURE 1–6

STV/Lyon and Associates that firm indicated that it would not be operational before 1996, a date which, given subsequent delays, has become 1997. The other pressing needs for port operations must be met before such a date.

Finally, there is the question of the uncertainty of future corn flows out of Makar Wharf. If the proposed shifts toward higher value-added production occur, South Cotabato will ship out relatively more live animals or even frozen meats, and corn shipments may decrease over time. Thus, under various scenarios,. bulk loading facilities may not be needed.

In view of the uncertainties with the corn bulk handling facilites, the Feasibility Studies have presently two contingencies. For the first contingency, the assumption is that the corn bulk handling facilites (CBHF) are being built at Makar Wharf; the second contingency group assumes that they are not being implemented. The Feasibility Studies have identified two alternatives for locating the facilites:

- Southwest Location Alternative - Figure 1-6 shows two alternatives for the location of the CBHF: in the southwest and in the northeast. The location shown for the silo complex is very tentative and will need to be confirmed during the final design stage of the facilities. The location shown for the ship loading facilities is based on the 1991 hydrographic survey and on the overall planning for the port expansion, as presented in other sections of this report.

  The silos and corn receiving facilities for the southwest location would be placed in the open port area west of the palm oil installation (Alternative A2). It is not an ideal location for the silos, mainly because of the reduced space available at that site, which would present certain traffic problems for the corn delivery trucks, although the problems do not seem unsurmountable. The advantage of this site is that no property acquisition would be required. There are many vacant lots in the general area that could be utilized for the receiving and storing facilites, although they are in private hands and would have to be acquired. Another potential site is located further to the southwest outside the present port property. (Alternative A1)

  To load corn in bulk into ships, no full wharf or pier is required. Hence the Feasibility Study proposed that an open berth be provided for the bulk carriers, by constructing three breasting dolphins plus two mooring dolphins. The three towers supporting the shiploading spouts would be placed on the three dolphins and connected to the silo assembly by a conveyor. Catwalks would allow access to the vessel. Line-handling would be facilitated by catwalks leading to the mooring doplhins.

  The dolphins should be placed to provide a water depth of at least 14 meters at the face of contours. This would allow the berthing of ships with much more than 7000 DWT indicated in the STV/Lyon Associates report. If corn should

ever be exported from General Santos, foreign ships could also berth at the facility. The great distance between the silo assembly and the berth is the main disadvantage of the location. The proximity between the silo assembly and the berth is the main disadvantage of the location. The proximity of this location to the mouth of the Makar River apparently constitutes another disadvantage, but the river is now normally dry and no regular river discharges or sedimentation problems are anticipated at this location.

- Northeast Location

Any open berthing space for corn bulk carriers located northeast of the existing wharf would have to stay clear of the future northeast expansion of the port, intended as a container terminal. The location closest to the existing wharf and yet fulfilling the indicated conditions is shown on Figure 1-6. Again, it is located along the 14-m contour line of the seabed. It would also consist of three breasting dolphins and two mooring dolphins, all connected to the shore by catwalks.

Figure 1-6 also shows a possible site for the silo complex, on a presently vacant lot which would have to be purchased from its present owner. Alternatively, the silo complex could be located on a man-made island close to the berthing space. (Alternative B)

Because no firm choice can be made regarding the location of the corn handling facilities, the Envronmental Assessment has not examined the potential for expansion past the inital phases recommended. Specifics on the bulk corn handling facilites are unavailable and a firm decision of the likelihood of proceeding, is not imminent. Consequently, the Environmental Assessment has assessed possible impacts and mitigation measures only in generic terms and in terms of alteration of the area outlined for a northeast expansion. A future Environmental Assessment of proposed bulk handling facilities could be conducted with minimum effort using baseline data from this report and addressing the construction plans of any proposed facilites.

1.4.3.2 Location of Livestock Terminal

The livestock terminal location, Alternate 1, is just north of the existing transit sheds in the space presently used as open container storage. The advantages of this location is that it places the shipping operation relatively close to the face of quay. The transit distance between the quay and the terminal is minimal. A terminal in this location is suitable for either a chassis or straddle carrier container operation. It is also possible to herd the live animals loose across the deck to the shipping vessels if that method is employed at a future date. There are a few disadvantages however which may make this location undesirable. The odors associated with

a livestock terminal may be objectionable to the present users of the port in the immediate vicinity of the terminal. In addition, this location will introduce a significant amount of farm truck traffic into the central body of the port.

For Alternate 2, the livestock terminal is located near the north boundary of the proposed reclamation area. The advantages of this location is that it is on space that is available to the port. In addition, it is located well away from the body of the port, so the objections to the odors will be minimized. Traffic associated with the terminal is also diverted away from the body of the port, and will hence be easier to manage. This location can be served by either a chassis or straddle carrier container operation. The disadvantages are an increased transit distance to the face of the quay. Herding animals across the apron for direct loading will be difficult to manage. The livestock terminal also occupies space that may be used for container stacking operations.

The terminal location in Alternate 3 is located in a vacant space immediately north of the port boundary. The advantages of this location is that it is on undeveloped land immediately adjacent to the proposed new entry gate to the port. It is well away from the central body of the port, so the objections to the odors will minimized. Traffic associated with the terminal is away from the body of the port, and will have the least impact on the traffic in general. This location will be best served by a chassis container operation. Straddle carriers are not particularly well suited for this location because of the potential traffic conflicts between the straddle carriers and the arriving/departing container trucks. The disadvantages are an increase transit time to the face of the quay. It will be impractical to herd loose animals to the face of the quay from this location. In addition, it is on property that is not presently owned by the port. This property would need to be acquired by the port.

The Feasibility Study has recommended Alternate 2 as the preferred location for the livestock terminal. It provides the best service with a minimum impact to the other port operations.

1.4.4 Staged Implementation

The recommended proposed improvements (Section 1.3) represent a staged implementation of the project. The Terms of Reference for the project required the consultant to meet the needs of the Makar Wharf to the year 2010. The recommended improvements, which include a two-phase approach, meet those needs. In addition, they also provide options for future expansion of the port, as needed. The environmental assessment considered the maximum area required for any future expansion of the wharf and, examined the direct impacts on the surrounding environment including those areas that would be used for future phases of the expansion beyond 2010 (i.e. area for northeast expansion).

CHAPTER 2

EXISTING ENVIRONMENT

2.1 INTRODUCTION

2.1.1 Methodology

In order to described the current environmental setting or context in which the existing wharf exists and the proposed improvements may be undertaken, studies of the existing environment were conducted.

The methodology for collecting data on the various components of the environment varied with the parameters studied. In general, literature survey, site reconnaissance and contact with appropriate government agencies was undertaken. Where it was determined that insufficient secondary data was available to adequately describe the existing environment, additional primary data was collected through field studies. In addition, some "ground truthing" of the secondary data was undertaken.

A description of specific methodologies undertaken for each of the environmental parameters studied is included in Appendix A. Contact lists are provided in Appendix B and a List of References is provided in Appendix C.

2.1.2 Length of Project

In order to make predictions about the environmental conditions in the future, with or without the project, a definition of "project length" must be determined. Feasibility Studies concurrently being undertaken define their goal as to determine the wharf needs in the Year 2010 and most cargo projections were based on that date. However it is difficult, if not unrealistic, to attempt to make predictions regarding environmental conditions over 20 years, particularly in a rapidly developing area like General Santos City.

Consequently, predictions will be based on five year projections as recommended in the Environmental Management Bureau (EMB) annotated outline for the Environmental Impact Statement (EIS) Model.

2.1.3 Study Area

The study area for the description of existing environment and subsequent prediction of impacts is defined by the environmental parameters being described and their potential to be affected by or to affect the project.

For the purposes of describing the immediate environment of the project and the direct impacts, of the proposed improvements, the study area has been defined as the port area. This includes the two potential reclaimable areas, the existing port property and the water area 200 m off the wharf face. Figure 2-1 shows this defined study area. Detailed hydrographic and topographic surveys have been undertaken in this area. Marine habitat detailed surveys were also conducted within this study area.

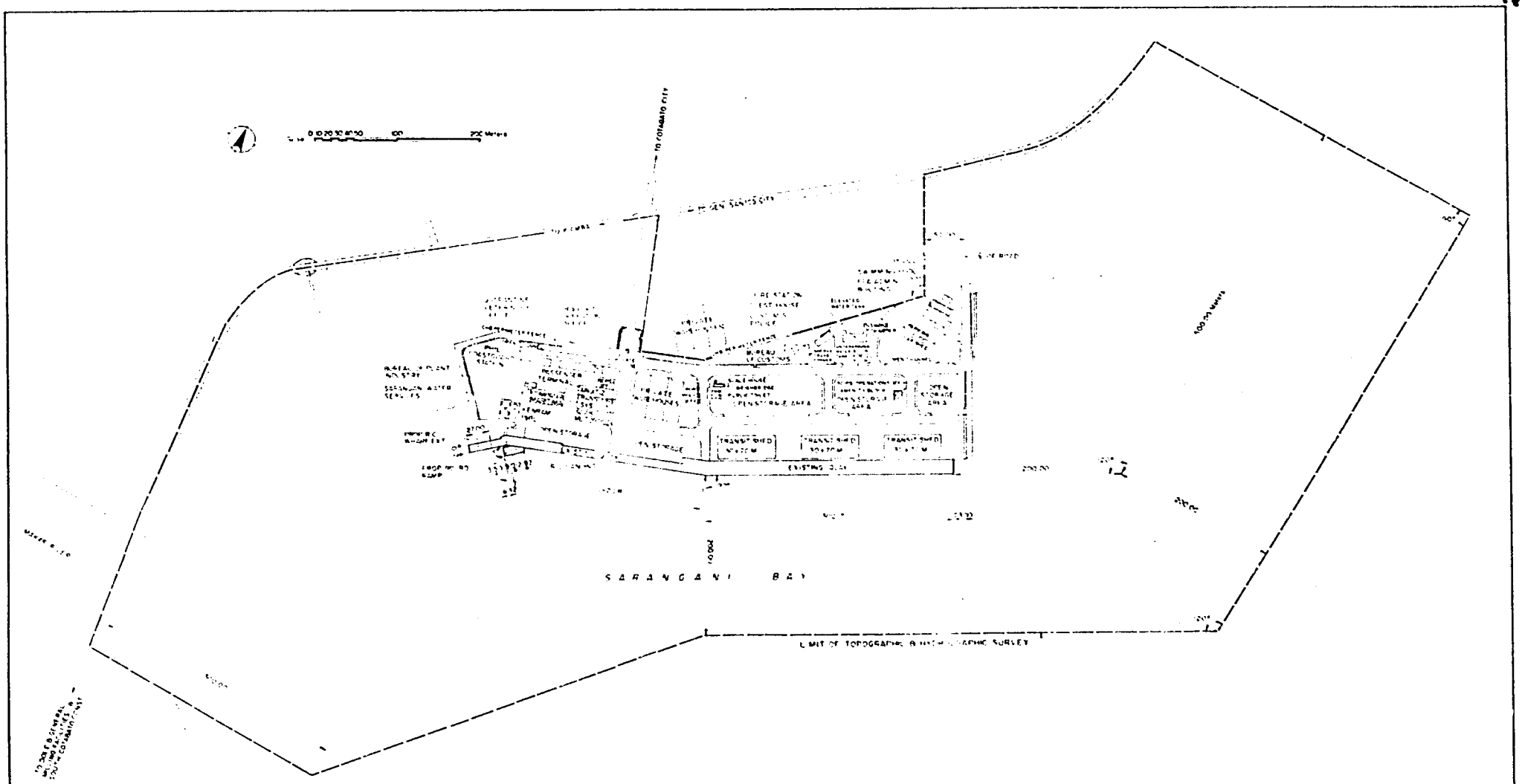
For the purposes of describing the existing environment at the Makar Wharf in the context of the overall environment of the area, the Makar River watershed has been used as a study area for soils, geology and topography. This also enabled the consultant to examine environmental factors that may, in turn, affect the Makar Wharf, such as soil erosion. This study area is shown in Figure 2-2. A smaller study area was used for describing the terrestrial habitat as the effects of the port expansion are expected to be directed on a limited area.

For the purposes of socio-economic discussions, the primary study area is encompassed by the wharf area including the port workers and the communities at either end of the port that would most likely be affected. As an additional level of information, background information for the municipality of General Santos City is included in order to place the preceding information in the context of the entire municipality.

For the purposes of describing oceanographic characteristics and fisheries, Sarangani Bay as a whole has been used as the study area. For water quality parameters, a one kilometer radius off the port has been identified. The extension of study areas from the immediate area of the wharf for these parameters is required to reflect the mobility of the fishing fleet, dispersion factors for water quality parameters and the continuous ecosystem which the bay represents. These study areas are illustrated within their sections on the existing environment.

2.2 LAND USE AND PLANNING

Labangal, the barangay in which Makar Port is situated, is considered an urban barangay of General Santos City. In 1991, Labangal was split into two barangays, Labangal and Calumpang. However, since most recent statistics available (1989 Socio-Economic Profile, General Santos City) refer to the barangay of Labangal, the discussions and illustrations on land use in this and subsequent chapters will refer to that barangay which combines both Calumpang and Labangal. Figure 2-3 illustrates Labangal and the neighbouring barangays of General Santos City, based



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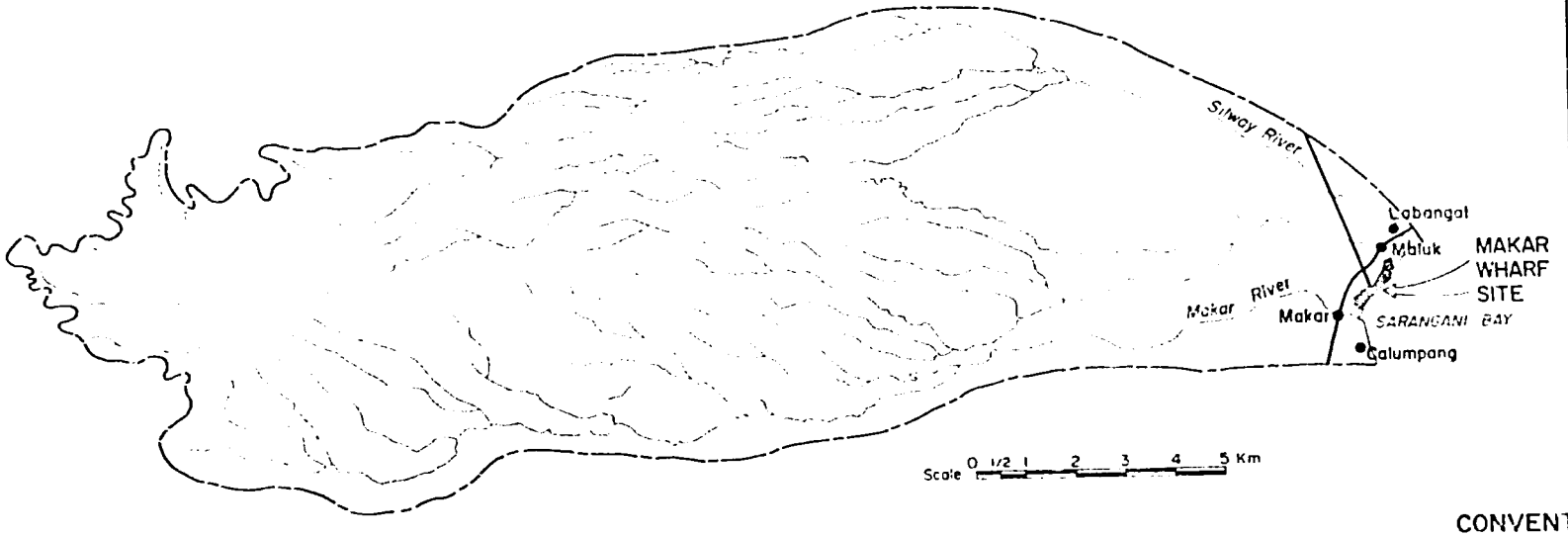
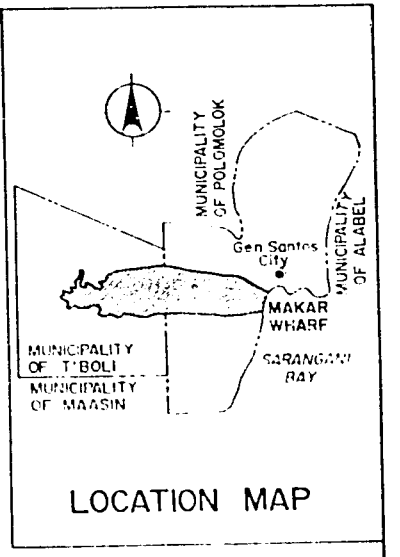
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

MAKAR WHARF STUDY AREA

FIGURE 2–1





CONVENTIONAL SIGN :

- Makar River Watershed Boundary
- Road
- River / Creeks
- Mapping Unit
- Barangay

SOURCES OF INFORMATION: AMS topographic map series scale 1:50,000 compiled in 1956 Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey team.
Map preparation & reproduction by the Agricultural Land Management & Evaluation Division

NOTE: All political boundaries are not authoritative.

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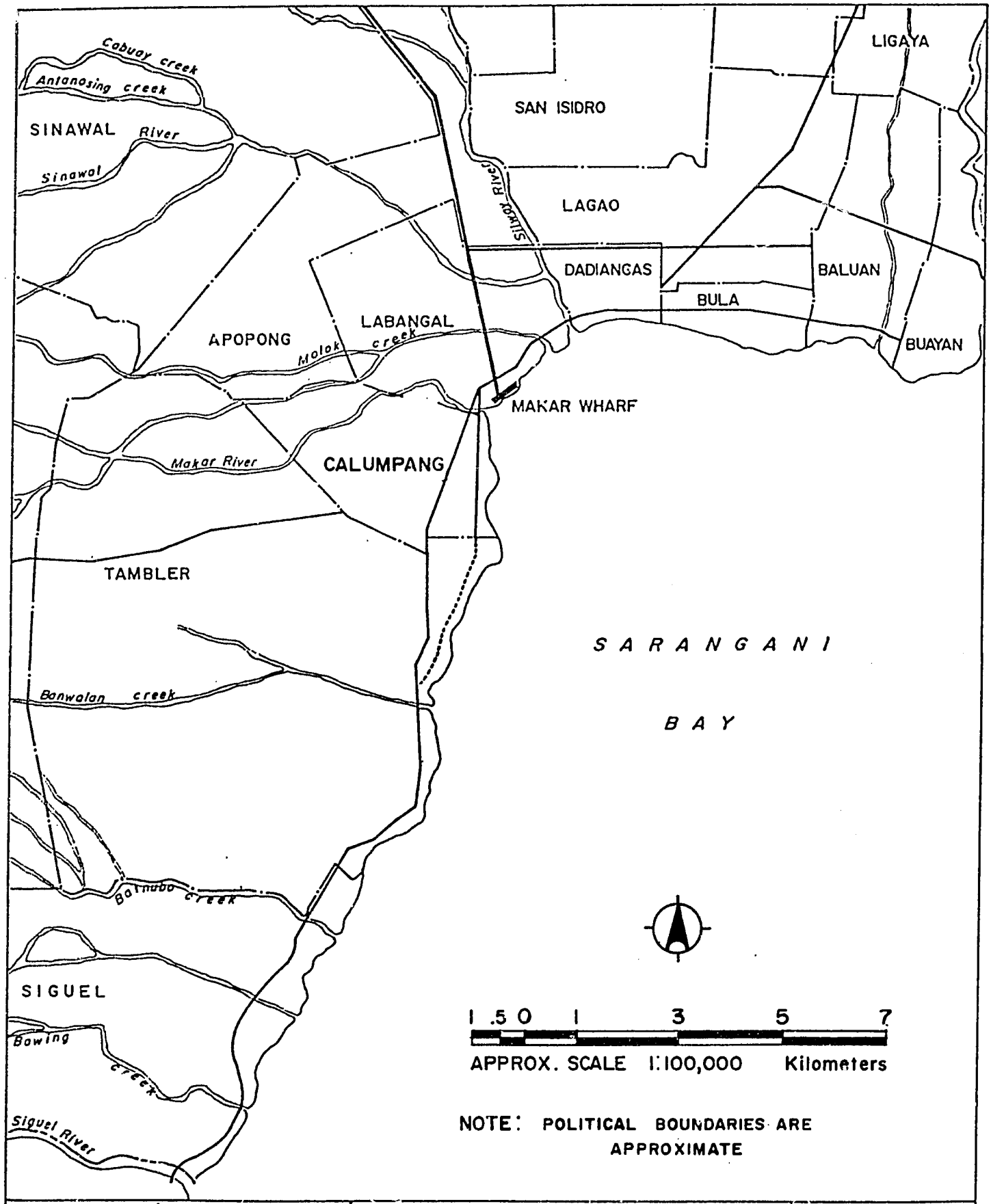
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

MAKAR RIVER WATERSHED STUDY AREA

FIGURE 2-2



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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LABANGAL AND NEIGHBORING BARANGAYS OF GENERAL SANTOS

FIGURE 2-3

32

on the General Santos City Consolidated Map obtained in 1991.

2.2.1 Existing Land Use in Labangal

Labangal has land area of approximately 2495 ha comprised of built-up areas, agricultural areas, open grassland, open space, transportation and utilities, and infrastructure. Table 2-1 shows the breakdown of land uses as classified by the General Santos City Planning and Development Office. Figure 2-4 shows the main land uses in barangay Labangal based on the General Santos City Consolidated Map and recent surveys of the area. Based on the comparison with the General Santos City overall figures, Labangal has a larger proportion of built-up area than the municipality as whole, and a larger proportion of grassland areas. However, compared to the other urban barangays, Labangal has a significantly lower percentage of built-up areas. (Table 2-2)

Of the built-up areas, 70% is comprised of residential areas, 24% industrial and 5% institutional, and 1% commercial. There is evidence of overcrowdimg and some urban blight in the urban barangays, including Labangal, which the city is, at present, trying to counter (Plate 2-1). Two of these densely populated squatter areas are found on either side of the current port site. These are referred to in subsequent sections as Lower Makar and the Badjao community (Figure 2-3).

Open grassland area comprises the greatest existing land use of Labangal, occupying 65% of the total area. Land use and vegetation information prepared by the Bureau of Soils determined that these areas are made up of 80% grassland and 20% shrublands.

Nearby, in barangay Tambler, a Civil Reservation area of 556 ha has been created in order to absorb some of the population growth from the urban core of Dadiangas. The upper Tambler relocation area is currently a growing urban commumity and the local government of General Santos City is attending to the provision of necessary community services.

2.2.2 Development Plans

The Philippine Assistance Program (PAP) aims to promote equitable and sustainable economic growth in the Philippines. The principal goal is to alleviate poverty in the countryside through production-oriented activities outside the National Capital Region. The program supports the Philippines' medium-term development plan for the period of 1987-1992. To be included in the PAP, projects should be located in one of the 16 "economic development zones", one of which is General Santos City and its hinterland.

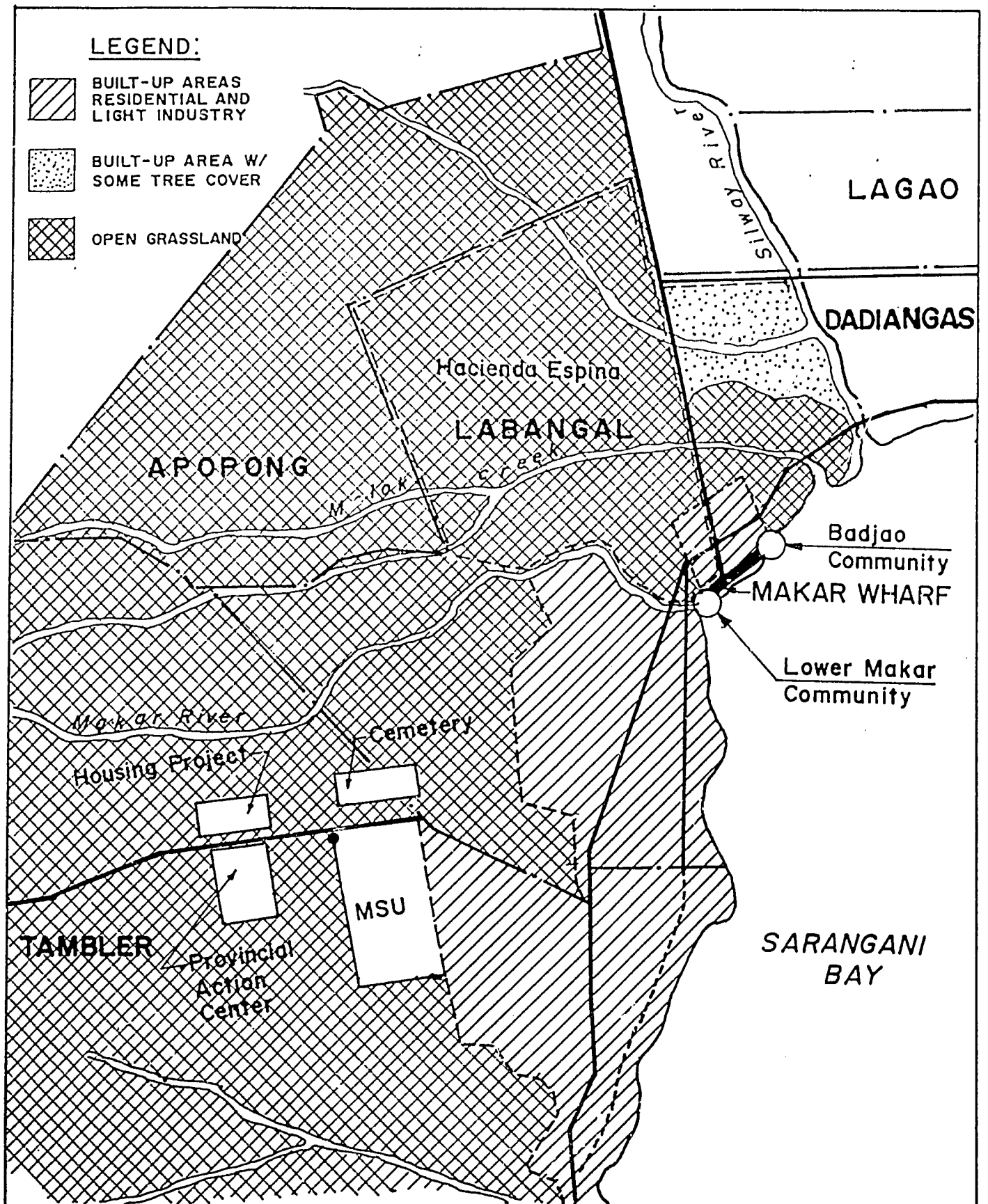
A major task in the PAP is that of identifying productive investment projects and undertaking the necessary studies required to effectively carry them out. Both the identification of cost-effective programs and detailed pre-implementation studies are essential if the Philippine Assistance Program is to be successfully implemented.

Table 2-1
LAND USES IN BARANGAY LABANGAL AND GENERAL SANTOS CITY (GSC)

	LABANGAL		G S C	
	ha	%	ha	%
Built-Up	448	18	3,161	6
Agriculture	212	8	23,161	43
Grassland	1,629	65	24,637	46
Open Space	27	1	94	> 1
Forest Reserve	0	0	200	> 1
Transport/Utilities	15	> 1	87	> 1
Infrastructure	164	7	2,071	4
Prawn/Fishpond	0	0	195	> 1
TOTAL	2,495		53,601	

Source: 1989 Socio-Economic Profile, General Santos City

34



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO.: 492-0452-C-00-0099-00

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

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LAND-USE IN BARANGAY LABANGAL AND VICINITY

FIGURE 2-4

Table 2-2
COMPARISON OF LAND USES IN LABANGAL AND OTHER URBAN BARANGAYS

	BUILT-UP		AGRICULTURE		GRASSLAND		OPEN SPACE		FOREST RESERVE		TRANSPORT UTILITIES		INFRASTRUCTURE		PRAWN/ FISHPONDS		TOTAL
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha
Labangal	448	18	212	8	1629	65	27	1	0	0	15	> 1	164	7	0	0	2495
Bula	141	44	75	23	0	0	2	> 1	0	0	0	0	25	8	80	25	323
Dadiangas	220	68	0	0	0	0	11	3	0	0	4	1	90	28	0	0	325
Lagao	669	35	1053	55	0	0	> 1	> 1	0	0	> 1	> 1	183	10	0	0	1906

Source: 1989 Socio-economic Profile, General Santos City.

PLATE 2-1 **View North from the existing Makar Wharf including portions of the Venil Badjao community, the Labangal coastline and Dadiangas (upper right hand corner).**

31

A number of potential projects have been identified in Mindanao which comprise the Mindanao Development Program.

The Mindanao Development Program is designed to concentrate USAID's limited funding and project management resources on an area where they will have a significant impact, quickly removing the constraints on marketing farm and fishery products and thus encouraging private sector investment.

The initial subprojects which have been identified for further study and potential funding include:

- Makar Wharf Improvement and/or Expansion, including improved grain shipping facilities
- Tambler Agro-Processing Center
- Tambler Fish Port
- General Santos Air Service Improvement Project
- Rural Infrastructure Fund Project, South Cotabato Roads
- Mindanao Telecommunications Improvement
- Grain Shipping Facilities for Other Mindanao Ports

The first four are located in the immediate environs of General Santos City, while the road improvement project concentrates on the rural hinterland. Improved rural roads are important in decreasing average cost of transportation of inputs and products and in permitting transport at all times -- a requirement for commercial production of highly perishable goods and a key factor in promoting production of less perishable crops such as corn and rice.

The telecommunications improvements cannot be targeted exclusively for the project area; rather, General Santos City is one of the beneficiaries of a larger, integrated effort to improve telecommunications in Mindanao. Lastly, improvements in grain shipping facilities are under consideration for other ports, including Cagayan de Oro and Davao City. Their chief impact on the Makar Wharf project is derived from the competition for cargo, with relative transport costs and quality of service acting to define the ports' respective hinterlands.

2.2.2.1 Agro-Processing Center at Tambler

Barangay Tambler is located along the Banwalan Creek SSW of the center of General Santos City. The proposed 32 ha project site is located on Sarangani Bay about 9 km by road to the south of Makar Wharf. The proposed complex includes components such as a corn oil

38

producing plant, a feed mill, a slaughterhouse and meat processing plant (abbatoir/cold storage), and processing facilities for agricultural and extractive products. The latter include cashew nuts, coconut shells for granulated charcoal, fruits and vegetables (mangos, bananas, papayas, guyabanos, asparagus, potatoes, sweet corn). The facilities would provide for juice extraction, canning, drying and making chips. Some of these products would be destined to other islands or countries and could be shipped out of Makar Wharf. Others would have a negative effect on certain types of traffic through Makar Wharf: the most obvious one is the corn oil production facility which competes directly for corn which might otherwise pass through the proposed bulk handling facility. In still other cases, competition may be quite complex. The abbatoir/cold storage facility could produce frozen meats. These could be containerized and shipped out through Makar Wharf, reducing the exports of live animals through Makar Wharf. The Wharf might also compete with the airport for the shipment of more select types of frozen fish.

2.2.2.2 Fish Port at Tambler

The proposed fishing port complex is located within the Agro-Processing Center at Tambler. It consists of three separate fish landings, a "hall" for auctions and marketing, cold storage, an ice plant, ice storage and support facilities.

The landings are subdivided in:

- a wet fishing landing quay to handle up to 20 boats of 3-15 gross tons each
- a tuna landing area for large boats handling mainly tuna -- a landing jetty for up to 15 boats of a maximum of 40 gross tons each
- a purse seiner landing wharf for up to 5 boats of 300-2,000 gross tons each.

The fishing port may offer an alternative work location for the fishing and gleaning families presently located at Makar Wharf who may have to be relocated if the wharf is extended in the near future. It is unclear at this point if the fish processed in the facilities behind the landings might be frozen and shipped out in containers from Makar Wharf, or flown out from the Buayan airport.

2.2.2.3 General Santos Air Service Improvement Project

The only airport in the province of South Cotabato is located in Buayan, in General Santos City. Currently, Buayan is capable of handling only prop aircraft, such as the Fokker series. Passenger service is available to Cebu and Manila, via connection with jet service in Cebu or, alternatively, in Davao City. The delays and inconvenient hours associated with such indirect service may discourage some businesses from locating in the province. It is likely, however, that the economic problems from limitations on air cargo are more severe than those from the

passenger service. The existing runways cannot accommodate larger, more economical carriers, such as the Boeing 737 or Airbus 300, without major new construction. A consulting firm is currently engaged in a feasibility study of the options for extending runway(s) at Buayan or constructing a major new airport at another site. A number of variations on these two basic options are involved, and the predicted net economic benefits are to be compared with the status quo. As mentioned earlier, fresh tuna is now being sent by truck to the larger Davao City airport, and other potential cargo may require either air transportation or efficient container operations at Makar Wharf if it is to be produced and marketed economically from South Cotabato.

2.3 SOCIO-ECONOMIC CONDITIONS

This section describes the sociocultural setting of the proposed project. In a limited sense, the project's immediate socioeconomic environment consists primarily of the communities on each side of the wharf--the "Badjao community" which forms part of purok Venil on the east and another settlement in purok Lower Makar on the west. Both puroks are part of Labangal, one of 26 barangays that comprise General Santos City (Figure 2-3).

The project, however, may also be viewed in its larger setting, for indeed the city as a whole benefits from the port and influences it as well, both directly and indirectly. To provide a perspective on the wider context, therefore, this section begins with an overview of the socio-economic conditions in General Santos City. It is followed by descriptions of Lower Makar and the Badjao community. Also briefly discussed is the workforce at the wharf itself.

2.3.1 General Santos City

2.3.1.1 Population

General Santos City is one of the fastest growing urban centers in the Philippines. Migrants continue to flock to the city in search of job opportunities. The 1980 population of 149,396 increased to 250,389 in 1990, marking on annual growth rate of 5.30 percent. Population density also increased from 279 persons per sq km in 1980 to 463 in 1989.

The city's population is relatively young, the median age as of 1989 being 17 years old. Forty-four percent belong to the age category of 14 years and below, 54 percent to the so-called economically active age group (15-64), and only 2 percent to the elderly population. Viewed differently, every group of 100 adult workers in the population supports 85 dependents, most of them below 15 years old. Males slightly outnumber females, there being 104 males for every 100 females.

A characteristic of General Santos City as an urban center is its mix of various ethnolinguistic groups--the Cebuano, Ilonggo, and Boholano from the Visayas (67 percent), the Tagalog and Ilocano migrants from Luzon (17 percent), and the Muslims of Mindanao (5 percent).

2.3.1.2 Housing, Utilities, and Community Infrastructure

Given its increasing population size and density, General Santos City is beginning to experience a shortage in housing. In 1987, the city's 37,123 households were sheltered in 35,935 dwelling units, thus suggesting that some houses are being shared by two or more households.

The typical or modal pattern in terms of housing indicates a single unit structure (90 percent) with an area of less than 30 sq m (54 percent), and owned by the occupant (57 percent; 1980 Census of Population and Housing). About one percent of the dwelling units are considered of the "barong-barong" type. In terms of tenure, 16 percent of the houses were established and are occupied by squatters.

The city has the basic infrastructure and system for water and electricity, although these are not yet widely accessible. In terms of water supply, General Santos City has six Level I (communal faucets serving several households) and 90 Level II (deep wells, shallow wells, free flowing, and spring) systems. Roughly 47 percent of households depend on tubed/piped deep wells, 45 percent on shallow wells, and only 5 percent on either a privately-owned or a public faucet (1980 Census of Population and Housing).

Power is provided to General Santos City by the National Power Corporation (NPC) through the South Cotabato Electric Cooperative II (SOCOTECO II). The power plant is connected to the Mindanao grid of the Maria Cristina Falls Hydro-Electric Plant in Iligan City. Standby diesel-powered generators serve as alternative power sources in cases of power failure.

About 42 percent of the households use electricity for lighting, and 56 percent use kerosene. Only two percent use electricity for cooking; the rest use wood or charcoal (62 percent), kerosene (18 percent), or liquefied petroleum gas (17 percent).

The city has no sewerage system. Septic tanks and leaching chambers are the only form of waste disposal. Storm drainage facilities do not exist either, although the City Engineer's office has managed to install a few on some major roads. Drainage inlets, open ditches and drainage pipes are the most visible structures.

Sixty-nine percent of households have a water-sealed toilet of one kind or another, 23 percent have a closed-pit toilet (antipolo), and seven percent an open pit (1980 Census of Population and Housing).

Refuse collection is undertaken by the Office of the City Engineer in the urban barangays and the Dadiangas Public Market. Refuse collection trucks dump at landfill sites in Apopong and Tambler.

-41

In terms of communication facilities and infrastructure, General Santos City has telephone and telegraph services, eight radio (AM & FM) and two TV stations, access to regional and national dailies, three strategically located post offices, and at least four courier companies.

2.3.1.3 Education, Health and Social Services

The city has ample opportunities for education, with its 54 elementary schools, 17 high schools, 5 vocational schools, and 4 colleges. The literacy rate is high (92 percent), and at least 49 percent of the household population aged seven years and above have had some elementary education.

In 1989-90, General Santos City had 42 public and 12 private elementary schools. Enrollment in both types of schools reached 43,754 with 91 percent of those students enrolled in public schools. Total enrollment had increased by 11 percent from the previous school year.

In the same year the five public secondary schools and 12 private secondary schools had a total enrollment of 15,416 with an additional 2,326 students enrolled in the secondary school of Mindanao State University (MSU). The private secondary schools accounted for 44 percent (or 7,726) of all high school students. Public school enrollment (56 percent) increased significantly from the previous year due to the implementation of free secondary education.

General Santos also has one state university and seven private institutions offering college degree courses (five schools offer purely technical courses). In 1989-90, a total of 14,696 students were enrolled in regular college courses, and 7,672 in vocational courses. By the end of that year, 2,553 college graduates were added to the labor force.

In terms of health services, General Santos City has adequate infrastructure, a sizeable health manpower (though still below national standards for manpower-to-population ratios), and a varied set of health programs.

The city has three primary clinics (10 beds or less), one secondary health center (25-50 beds) and three tertiary hospitals (70 beds or more), or a total hospital bed capacity of 305. In addition, 11 barangays, including Labangal, have a barangay health unit.

Based on 1989 statistics, General Santos City had 13 doctors, 23 nurses, 21 midwives and four dentists in the government service. Relative to national standards, however, General Santos City still "lacks 10 public health doctors, six public health nurses, 25 public health midwives, and 10 dentists. It has, however, a surplus of 3 sanitary inspectors" (GSC Socio-Economic Profile, 1989: 180).

In addition, a series of health programs are underway in General Santos City, among them: Community Health through Integrated Local Development (CHILD), a Primary Health Care Program, a Maternal and Child Health Program, an Immunization Program, an Environmental Sanitation Program, a Dental Health Services Program, and a Family Planning Program.

As for the health status of the population, a total of 13,462 morbidity cases were recorded for 1989. The three most common causes of morbidity were upper respiratory tract infections (5,776), diarrhea (2,146), and bronchitis (1,633; 1989 Socio-economic Profile, General Santos City). A total of 921 deaths were recorded, with pneumonia as the leading cause (253 cases). Social services are extended by the Department of Social Welfare and Development (DSWD) which served a total of 25,329 clients in 1988. Six types of services are offered to clients, namely: Self-Employment Assistance, Practical Skills Development and Job Placement, Day Care and Supplemental Feedings, Emergency Assistance, Family Planning Motivation/Population and Sex Education, and Special Social Services.

2.3.1.4 Employment and Income

In 1989, working age population of General Santos City reached 137,866, or 56 percent of the city's total population. However, 31 percent of this number were not in the labor force. Of the 95,447 in the labor force, 89.7 percent were employed and 10.3 percent were unemployed. Of those employed, a third are in the services, 20 percent each in agriculture and fishing and in commerce, and only 10 percent in manufacturing.

A 1990 Business Resource Center (BRC) survey report showed that 35 percent of the households in the city fall below the poverty line estimated at 3,000 pesos a month. Some 35 percent have monthly incomes ranging from 3,000 to 5,500 pesos, while 15 percent receive more than 6,500 pesos in income per month.

Differences in socio-economic status may also be shown, albeit indirectly, through other indicators. For example, 54 percent of households have houses with a floor area of less than 30 sq m, 29 percent between 30 and 49 sq m, 10 percent between 50 and 69 sq m, and 7 percent with more than 70 sq m. Also, 67 percent of households own a radio, and only 14 percent have a television set (1980 Census of Population and Housing).

2.3.2 Lower Makar

2.3.2.1 Area and Settlement History

Lower Makar, with a land area of 1.6 ha, is the settlement adjacent to the south western side of the present wharf. It is one of 17 puroks that now constitute the new barangay Labangal. In March 1991, fifteen other puroks that used to fall under Labangal were reclassified by the city government to constitute the new barangay Calumpang.

Accounts of old-time residents indicate that the first settlers in Lower Makar arrived from Iloilo in 1965. Later migrants subsequently came from Leyte, Bohol, Davao and various other places in Visayas and Mindanao. The lingua franca in the area, as in General Santos City, is Cebuano although Tagalog is widely understood.

43

2.3.2.2 Population

Purok officials estimate that the population of Lower Makar as of 1990 was 2,704. Fifty-two percent of the total are females, and 75 percent are below 17 years old. About one of every four residents is a qualified voter.

2.3.2.3 Housing and Community Infrastructure

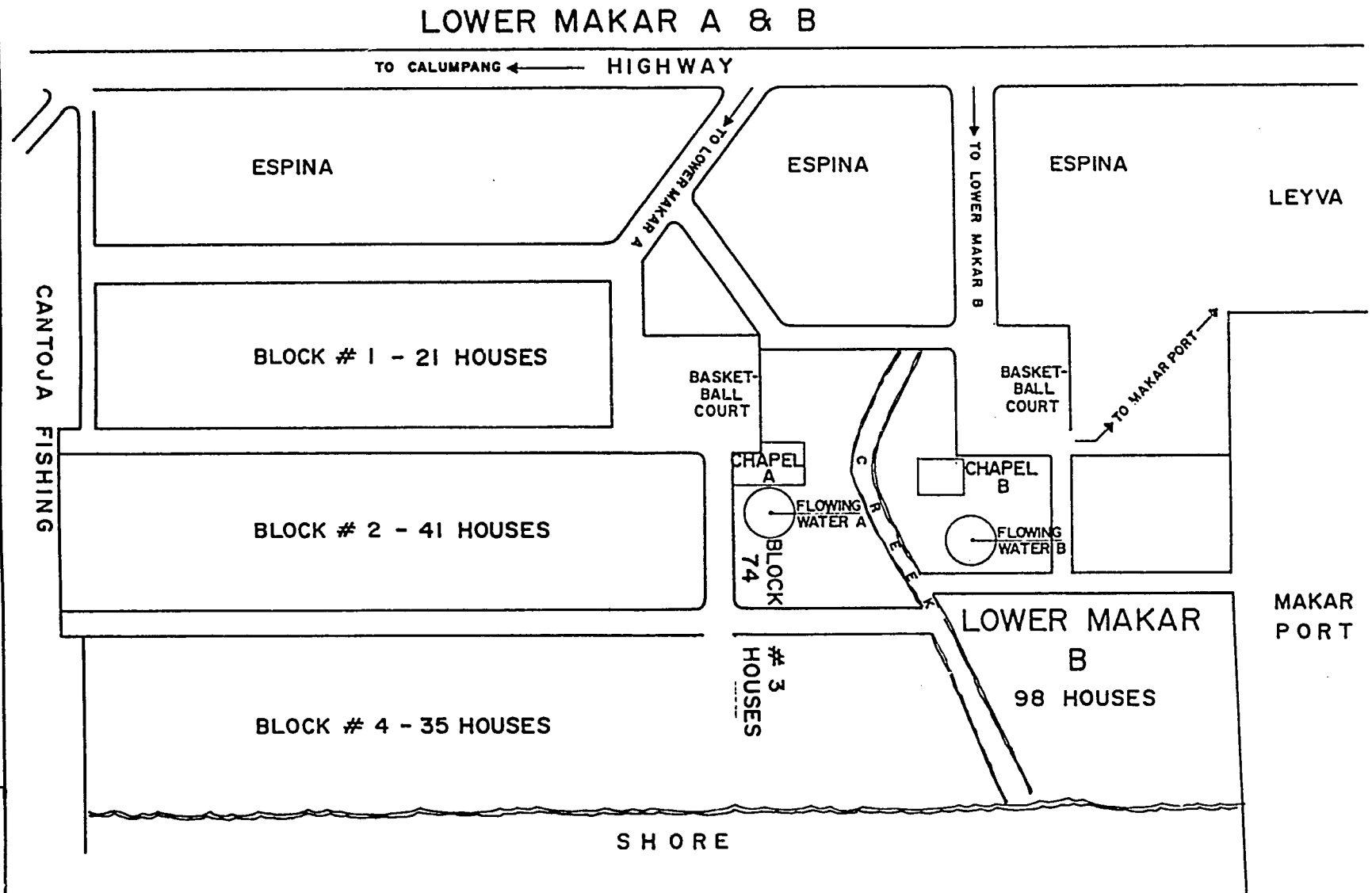
Informants recall that there were only about a dozen houses in 1969. As of March, 1991, the number had increased to 352 (data from Barangay Health Midwife; another count done by a community leader in April 1991 showed 269 houses; (Figure 2-5). The total number of families is 435, thus suggesting that some houses are shared by two or more families. Most families own their home, while others merely rent. Other units also have boarders and "bedspacers," mostly young women working in the nearby factories.

Houses are generally small (less than 30 sq m) and are built of mixed materials: wood for walls and either nipa shingles or galvanized iron sheets for roofing. The few economically better-off families have houses with concrete floors and walls (Plate 2-2).

The community in general has access to public utilities such as water and electricity. Although there is no piped water system, water is nonetheless available from two "flowing" sources and one pitcher pump situated within the community. Water from these sources is used for drinking, cooking, and washing. Eleven electric posts, each with a working street light, are spread out in the area. Households have electrical connections, although electricity is used mostly for lighting. Three of the 15 or so sari-sari stores have refrigerators in them, and at least 20 houses have a television antenna. Majority of the households use firewood and kerosene stoves for cooking.

Garbage is disposed of in four pits situated in an adjacent, privately owned lot north of the settlement. The community had also requested the government to have a public toilet built in this area where the ground is elevated. Unfortunately, the government was unable to build one because the owners of the lot objected to the plan. Only about four households have private toilets; the rest use the bushy areas in the adjacent lot.

Community infrastructure for religious worship and recreation are also found in Lower Makar. There are two chapels (used by its largely Catholic population) and two basketball courts (Plate 2-3). A Catholic mass is celebrated every first Wednesday of the month, in honor of the purok's patron, the Mother of Perpetual Help.



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO.: 492-0438-C-00-0098-00

LOUIS BERGER INTERNATIONAL, INC.
• LACKWOOD DIECKE ENT'L
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• ELMER OTTERS ENT'L CORP.
• TRANS-ASIA (PHIL.), INC.
• CONSULTANT MANAGEMENT SERVICES, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

SKETCH MAP OF LOWER MAKAR

FIGURE 2-5

PLATE 2-2 **Lower Makar Settlement Directly West of Makar Wharf.**

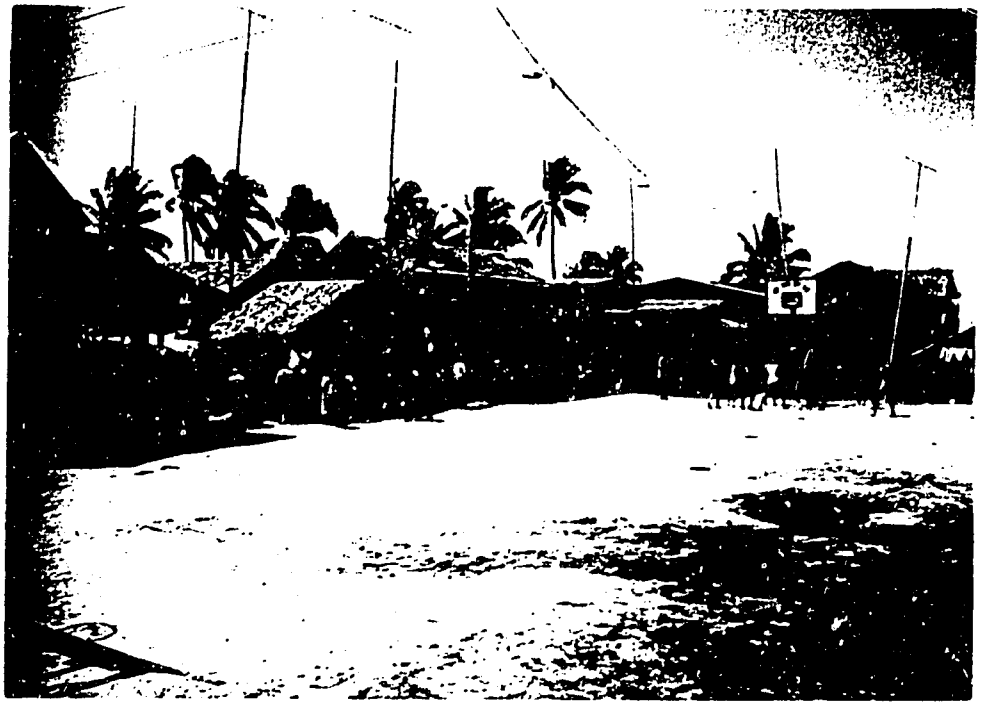


PLATE 2-3 **Basketball Court and Houses in Purok Lower Makar.**

46

Interestingly, public utilities, infrastructure, and services are perceived at once as the responsibility of the government and as special favors granted by political patrons. Thus, one flowing source of water is identified with a former local official, one chapel and the basketball courts with a candidate in the last elections, and the additional streetlights and the opportunity to acquire a homelot at the relocation site with an incumbent official.

2.3.2.4 Education, Health and Social Services

Makar's schoolchildren have access to two public elementary schools (Labangal Elementary School and Ramon Saavedra Elementary School) located close to the settlement. High school students, on the other hand, attend either the Ramon Magsaysay High School located about a kilometer away or the Mindanao State University High School in Dadiangas.

A survey of 180 household heads in the neighboring and relatively more developed fishing barangay of Calumpang showed that the average fisherman had at least completed sixth grade. Given the more depressed socio-economic status of Lower Makar families, it is likely that the heads of fishing households here have had even less years of schooling.

The educational status of the younger population, however, may be slightly better now, given the presence and proximity of schools in the area. Moreover, the younger members of the workforce may be encouraged to complete at least a high school education inasmuch as this is the minimum requirement for employment in most of the factories. Ironically, however, as one informant opines, the value of education is not fully utilized inasmuch as high school graduates end up merely cleaning bottles and cans for sardines and pineapple.

As a purok of barangay Labangal, Lower Makar is served by Labangal's barangay health center located in Upper Makar, just about a kilometer way. One of the four midwives assigned to barangay Labangal thus services Lower Makar.

Reports from the midwife indicate that the most common cases of morbidity in Lower Makar are similar to those reported in the city as a whole, namely, upper respiratory tract infections and diarrhea. For the period January to March 1991, for example, two cases each of bronchial pneumonia, gastroenteritis, and influenza were reported from Lower Makar.

2.3.2.5 Income and Livelihood

At least 80 percent of Lower Makar's labor force are dependent on fishing and fishing-related activities for their income. The rest either work at the Makar Wharf as contractual office employees, stevedores, food peddlers and stall operators, or are employed as daily wage workers in the nearby factories. Additional income is also gained from other activities such as duck-raising and mat-weaving.

47

Incomes from fishing, particularly tuna fishing which is the dominant livelihood activity in Lower Makar, vary depending upon the ownership of the means of production, and upon the supply of fish and the actual catch. A typical tuna fishing expedition requires a motorized pumpboat, an operator, and a crew of fishermen. These resources are mobilized by a financier who also takes care of what locals refer to as the "starting," that is the initial capital needed to pay for all the trip's requirements: ice, fuel, and food for the crew, including coffee and cigarettes. The financier may operate his own pumpboat, if he has one, or hire a pumpboat and an operator. The number of fishermen he takes depends upon the size of the boat and upon his capital. These fishermen-passengers are essentially shareworkers for they get only a percentage of the value of their tuna catch, leaving the rest to the financier.

Income from tuna fishing is reckoned primarily in terms of the sale of the total catch; the smaller kinds of fish which the worker catches in the process are usually considered bonus and are not subjected to further sharing. Shares are determined according to this scheme: the pumpboat owner gets 10 percent of the gross income; the fishermen-crew members receive from 20 to 25 percent of the value of their respective catch (depending upon the arrangement); the operator gets 10 percent of the net income; and the financier gets the rest.

Majority of the fishermen in Lower Makar actually work as members of fishing crews, or more properly, as passengers or shareworkers. Records at the Philippine Coast Guard, General Santos City station, show that although 200 registered pumpboats dock regularly at Lower Makar, only 22 of these are owned by Lower Makar residents.

A fisherman's income depends not only on his economic position and resources but also upon the supply of fish and his actual catch. Variations in the latter are usually explained as resulting from both seasonal changes and changes in one's good luck. Thus, one is lucky or "masuwerte" when one hits what is called a "jackpot"--a big haul of tuna. The former is governed by local sharing systems which have also changed over the years. Informants recall that in the late 70's, when the price of crude oil was much lower, fishermen received 50 percent as their share of the catch.

In contrast, most contractual employees at Makar Wharf and the workers at the factories receive fixed daily wages. These employees, however, have no job security inasmuch as companies hire them only for six months or less, partly to avoid the law which requires that permanency be given to workers employed for more than six months. Fluctuations in the supply of fish are also cited as reasons for the short-term work contracts in the factories. Consequently, workers move from job to job, from factory to factory.

2.3.2.6 Social and Political Organization

Lower Makar is organized as a political-administrative unit. It has a purok leader and six kagawads or representatives. These leaders look after the community's needs and represent the people in dealings with local officials.

48

Also found in Lower Makar is the Fishermen's Village Association (FVA), established only recently (April 1990) by the fisherfolk who comprise the majority of the population. The organization has around 300 members, only about 100 of whom are considered active in that they pay the monthly dues of 5 pesos. The FVA was formed partly to pursue the housing and land tenure concerns of the residents, particularly with their anticipated relocation. The organization, however, also plans to establish a cooperative, following the example of fishermen in Calumpang who were reportedly able to secure loans after their cooperative was formed.

Other organizations in the area are the Kabataang Barangay, representing the youth; the Mothers' Club coordinated by personnel of the Department of Health; and the Catholic Youth Movement.

As noted earlier, electoral politics is very much at work in the community. Kin-and-alliance groups identify openly with political candidates, with each group claiming the area as the "baluwarte" or bailiwick of this or that candidate.

2.3.2.7 Women

Women in Lower Makar carry out various roles. In addition to attending to their duties and responsibilities at home as wife, mother, and housekeeper, many of them augment the household's income by other means, e.g., managing a sari-sari store and helping sell fish. Younger female family members work at the nearby factories.

Women are also active in the political arena. Of the three community leaders assigned by the local government to enlist residents for a previous relocation program, two are women. These activities notwithstanding, however, women are unfortunately also more often portrayed--even by women informants themselves--as spending their time and money in card games and mahjong.

2.3.2.8 Community Problems

Purok officials consider unemployment as the primary problem in the community, followed by occasional problems of theft and the increasing incidence of drug addiction. Local leaders believe that unemployment in fact contributes to the latter problems. Specific to fishermen is the problem of piracy in the open seas.

Fishermen also generally recognize the problem of indiscriminate fishing which is understood to further cause the depletion of fishery resources. Two informants maintained, for example, that they had heard over the radio a Japanese technologist advocating controlled fishing. They believe, however, that unfortunately this advice cannot be heeded by small fishermen driven by dire economic need.

2.3.3 Badjao Community

2.3.3.1 Area and Settlement History

Immediately adjacent to Makar Wharf, on the eastern side, is a community of people referred to as the "Badjao". The community is part of Venil which, like Lower Makar, is one of 17 puroks that comprise the recently partitioned barangay of Labangal. The Badjao settlement has land area of 1.5 hectares. It is bounded on the north by a road connecting Makar and General Santos City, on the east by a privately owned land, and on the south by Sarangani Bay.

Together with other Badjaos found mostly in the Sulu Archipelago, they constitute one of about a dozen ethnolinguistic groups in the Philippines generally identified as the Muslim population. In addition to their Islamic Faith, the Badjao are reported to retain many of their non-Muslim religious beliefs and practices (Gowing, 1979).

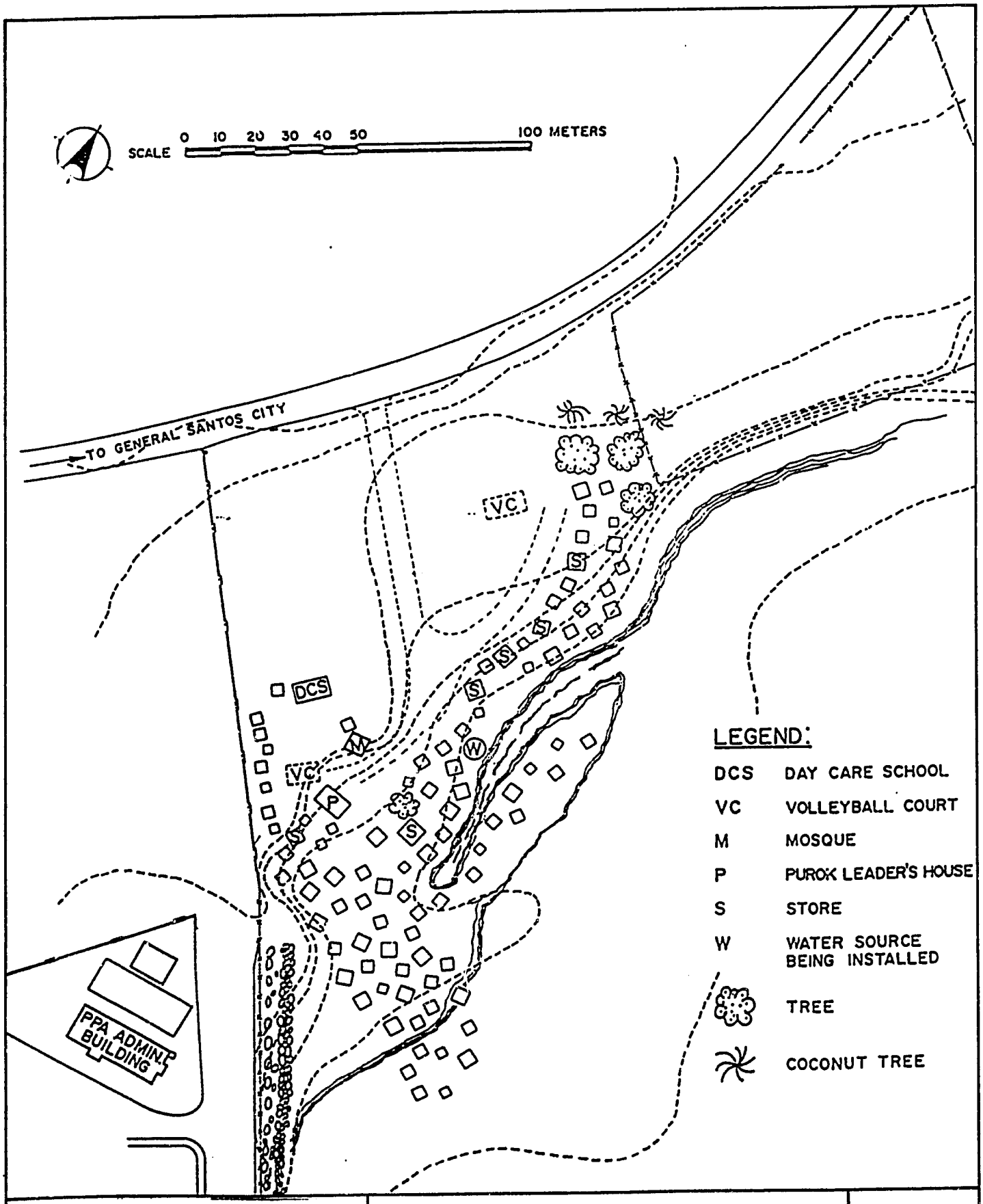
The Badjao are often mentioned in relation to the Samal and the Tausug, the two other dominant groups in the islands of Sulu. These three groups are usually differentiated, if not stratified, both by outsiders and by themselves, in terms of their subsistence activities and lifestyle. Thus, the Tausug are more inland-oriented, engaging in farming and business; the Samal live along the coast; while the Badjao live in small house-boats, being almost completely dependent upon the sea. For this reason, the Badjao are also often described as "sea-gypsies" or "sea nomads" or somewhat derisively as Samal-luwaan (outcasts) or Samal-laud or Pala-u (people of the ocean) by the Samal and the Tausug (Gowing, 1979; Teo, 1989).

The Badjao community adjacent to the wharf is homogeneous in many ways. Indeed, except for three Tausug families, everyone else is a Badjao. Moreover, all profess faith in Islam, save a family of three. Everyone speaks a dialect called "Siamal" by the Tausug or "Sinama" by the Samal.

The community is quite new. The first settlers, some 36 people led by the current purok chairman, established their houses only about four years ago in 1987. Since then, more migrants have settled in, mostly from Basilan, Jolo, and Siasi islands in Sulu and a few from Zamboanga. They left their previous places to seek better economic opportunities, and to avoid the internecine warfare between the government and the Muslim rebels. Contrary to popular belief, the migrants did not reach General Santos City in their small boats but travelled on commercial passenger ships. A schematic diagram of the community is shown in Figure 2-6.

2.3.3.2 Population

In July 1990, a complete enumeration survey conducted by students of the College of Nursing, Notre Dame of Dadiangas College (NDDC) showed that there were 102 houses and 112 families. The total population was 570, consisting of 259 males and 311 females (Table 2-3).



PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT 492-0432-C-00-0089-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-6
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L • ERNST & YOUNG INT'L • GLOBETROTTERS ENGR. CORP. • TRANS-ASIA PHILS. INC. • CONSULTANT MANAGEMENT SERVICES, INC	SKETCH MAP OF BADJAO COMMUNITY BASED ON A DRAWING BY A DEATH WORKER-VOLUNTEER FROM THE AREA	

51

By March 1991, the number of houses had increased to 116, and the population to 574.

Table 2-3
POPULATION DISTRIBUTION AMONG THE BADJAO,
BY AGE AND SEX, 1990

AGE	MALE	FEMALE	TOTAL	PERCENT
0 - 4	57	65	122	21
5 - 9	46	63	109	19
10 - 14	17	40	57	10
15 - 19	22	33	55	10
20 - 24	18	24	42	7
25 - 29	26	25	51	9
30 - 34	21	24	45	8
35 - 39	18	13	31	5
40 - 44	12	8	20	4
45 - 49	8	5	13	2
50 - 54	5	6	11	2
55 - 59	3	1	4	1
60 - 64	5	3	8	1
65 - 69	0	1	1	–
70+	1	–	1	–
	259	311	570	

Source: Business Resource Center, Notre Dame of Dadiangas College, General Santos City, based on community study done by student nurses, College of Nursing, July 1990

The Badjao population is relatively young. The median age is about 17 years; 31 percent are below 10 years old; and 67 percent are potential members of the labor force (10-59 years old).

2.3.3.3 Housing and Community Infrastructure

In terms of housing, public utilities, and community infrastructure, the Badjao community is characteristically poor. The typical Badjao house is a one-room structure measuring about three by three meters, or no more than 20 sq m. It is occupied by a family of about five members (the parents and three children), on the average. Supported by wooden stilts, the house is elevated about a meter from the ground. This structure keeps the house above the water level, provides ventilation from below and, during the long dry season, serves as a convenient storage space for the banca, fishing gear, firewood, and other things (Plate 2-4 and 2-5).

92

PLATE 2-4 **Typical Badjao Houses.**

PLATE 2-5 **Typical Badjao Houses.**

53'

The Badjao houses almost uniformly have roofs made of nipa shingles. The wall materials, on the other hand, show some variations which, together with the house's state of repair, possibly indicate subtle differences in socioeconomic status. Thus, one observes wooden boards in one house, neatly spread bamboo slats in a few units, nipa shingles in most others, and sawali mats, scrap boards and metal sheets in poorer ones.

Residents get their water from either of two privately-owned pitcher type pumps located some 200 meters away and outside the walled-in compound. The chore is not without risks: three Badjao children on their way to fetch water have reportedly died after being run over while crossing the busy road traversed by speeding trucks and jeepneys. And water is not for free: residents pay the pump owner 25 centavos and the water carrier two pesos for each 20-liter container. A family of two adults and three children ordinarily uses up eight 20-liter containers a day--or about 18 pesos--for drinking, cooking, washing and other chores. Residents hope the situation will soon change, however: in March 1991, pipes that may provide a "free-flowing" water source were being installed by the city government.

The community has no access to electricity, and there is no streetlamp within the area. Households use kerosene lamps for lighting and firewood for cooking.

Garbage is disposed of in an open pit situated just a few meters away from the houses but still within the compound. There are no public nor private toilets in the community.

For religious services, the Badjaos have a mosque, consisting of a small hut where prayers are held and led by the Imam. For recreation purposes, a playing space for volleyball is also found within the compound.

2.3.3.4 Education, Health and Social Services

The level of education among the Badjao is sordidly low. Of the 451 community members above seven years old, only 55 individuals (or 12 percent) have had some schooling. In other words, close to nine out of ten Badjaos have had no formal education at all.

Among those who have studied, two have had some college education, 11 reached high school, and 42 had some elementary schooling. However, more than half have stopped studying. Thus, among the Badjao only 20 elementary school children and four high school students are currently enrolled, the former in Labangal Elementary School and the latter in Mindanao State University High School.

Attempts to provide additional education to the community are underway. Three-hour class sessions for children are held daily by the Christian Missionary Alliance Church which has established a learning center within the settlement area. Some of the older members of the community also attend the adult education classes held every Saturday at the Labangal Elementary School.

Equally poor is the health and nutritional status of the Badjao. A survey (Operation Timbang) done last July 1990 by NDDC nursing students showed that on the basis of age and weight measures, 85 percent of children below seven years old are undernourished: 22 percent are severely underweight; 32 percent moderately underweight; and 31 percent mildly underweight.

The more common sicknesses among the children are diarrhea, measles, and intestinal worms. In 1990, at least ten children reportedly died from measles.

In response to these problems, NDDC's College of Nursing conducted an immunization program among the Badjao. The College has also began to train two female members of the community as health workers. One of them is a migrant from Iloilo who got married to a Tausug; she has had some college education.

2.2.3.5 Income and Livelihood

As a sea-dwelling people, the Badjao depend primarily on fishing for their income and livelihood. However, unlike the fishermen of Lower Makar engaged in tuna fishing in the open sea, the Badjao engage in small-scale fishing in the bay. Thus, the technologies they use--nets, lines, traps, and spears -- are relatively simple, with the possession of a motorized banca providing about the only competitive edge.

Informants maintain that income from fishing is highly variable. One fisherman recalled having a "jackpot" at one time--catching 15 bails (banyera) of bolinao, or anchovies, valued at 400 pesos per bail--and having no catch whatsover for more than a week at another time.

While most Badjaos concentrate on fishing, some of them engage primarily in fish trading (paglalako), that is, buying fish directly from small-scale fishermen and selling them directly to consumers. Thus, one informant reported buying 20 kg of fish at ₱ 25 per kg and selling it at ₱ 30 per kg, thereby getting a gross income of ₱ 100 on that transaction. After deducting the interest of ₱ 25 (at five percent or ₱ 5 per ₱ 100) on the amount he borrowed (₱ 500), he had a net income of ₱ 75.

In both fishing and fish marketing, in fact, the Badjaos have to borrow their initial capital or "starting," often from other members of the community and at other times from outside financiers. Others sometimes pool their resources as well. In these cases, either sharing arrangements or fixed interest rates are operational.

Other income-generating activities among the Badjao are boat- making, gathering seashells and corals, weaving mats made of pandan leaves, and operating a sari-sari store (of which there are ten in the area). Except for boat-making, these activities are done mostly by women, although women also assist directly in fishing. The wife of the purok leader reported spending ₱ 100 to make a "double-sided" 4x6 ft mat, working on it intermittently for about a month, and selling it for ₱ 250, thus gaining a net income of ₱ 150.

55

Perhaps indicative of increasing poverty among the Badjao is the emerging activity of begging for alms in the city streets, done mostly by Badjao women and children. This reality is not hidden nor denied; on one occasion, an informant pointed to four women and six children who had just arrived from begging.

2.3.3.6 Social and Political Organization

The Badjao community is in many ways still homogeneous and egalitarian: almost all households are of the same ethnic group and are uniformly engaged in subsistence fishing. Less apparent, however, are some underlying differences within the community.

Despite their very small, almost negligible number, the Tausug exercise some degree of power and influence in the Badjao community. The social prestige they carry by simply being Tausug (at least among the peoples of Sulu) is reinforced by their having more economic resources and more access to the outside world as it were. One Tausug provides credit to fishermen and owns a sari-sari store; another has a motorized banca and is one of the purok representatives; and both are married to the community's health workers, chosen partly because of their higher education and correlatively, their linguistic facility in dealing with outsiders.

Indicative of these ethnic differences is the view expressed by one informant that in future the allocation of space and even possibly of relocation sites should perhaps maintain these ethnic boundaries.

In terms of politics, the Badjao community is organized as a purok of barangay Labangal. It has a set of purok officials recommended by the people and appointed by the city mayor. Reflecting the convergence of socio-cultural and political-administrative structures, the purok chairman selected by the community was already the recognized leader of the settlement, having been the head of the first group of families that settled on the present site. Effectively, however, the purok chairman has carried out the more traditional function of mediating in conflicts within the community rather than representing the community in the wider society.

The task of mobilizing external resources seems to be performed more often by the other purok officials, perhaps by reason of their education and greater ease in dealing with non-Badjaos. These officials appear to have developed close links with the local government, four of them having received through a livelihood program a motorized banca and other fishing equipment each worth some ₱ 72,000.

Outside of these political-administrative functions, active participation in other formal organizations is limited. Although some Badjaos had enlisted as members of an organization called the Maguindanao-Badjao Muslim Fishermen's Association, the organization has not had any major activities.

56

2.3.4 The Workforce at the Wharf

No less important in the socioeconomic environment of the proposed project are the people with jobs on the wharf. As of April 1991, a total of 1,360 employees were working in the area. Arrastre workers and stevedores account for 73 percent (988) of the total. They are employed by the Southern Cotabato Integrated Port Services Incorporated (SCIPSI). The other employees work at the Philippine Ports Authority office (48), the various service organizations such as Customs and Coast Guard (101), and the different shipping lines (113). Of the total number of employees, only 77 are women, mostly administrative and clerical staff workers.

The typical worker at the port may be described as male (94 percent), 30 years old, married (53 percent), and with some elementary education (52 percent). The arrastre, stevedores, and keymen are members of the Sarangani Marine and General Workers' Union - Trade Unions of the Philippines and Allied Services (SAMAGEWU-TUPAS). Many of the dockworkers live in Lower Makar.

2.4 PHYSICAL ENVIRONMENT

2.4.1 Climate

The climate of the project site results from the composite effects of various climatic controls including: geography and topography, the relative positions of semi-permanent large-scale cyclones and anticyclones, the air streams and the occurrence of transient tropical disturbances. The positioning of large-scale cyclones and anticyclones is primarily responsible for the prevailing air streams that dominate the different parts of the country at various times of the year. The prevailing winds together with topography are mainly responsible in shaping the climate of the site.

The regional climate of General Santos City was characterized using secondary data obtained from the records of the PAGASA. Meteorological data, from 1949 to 1986, of the General Santos City synoptic weather station located near the City Hall Building were used mainly in this report.

The climate of General Santos City belongs to Type IV of Corona's classification of the Philippine climate, wherein rainfall is more or less evenly distributed throughout the year (Figure 2-7).

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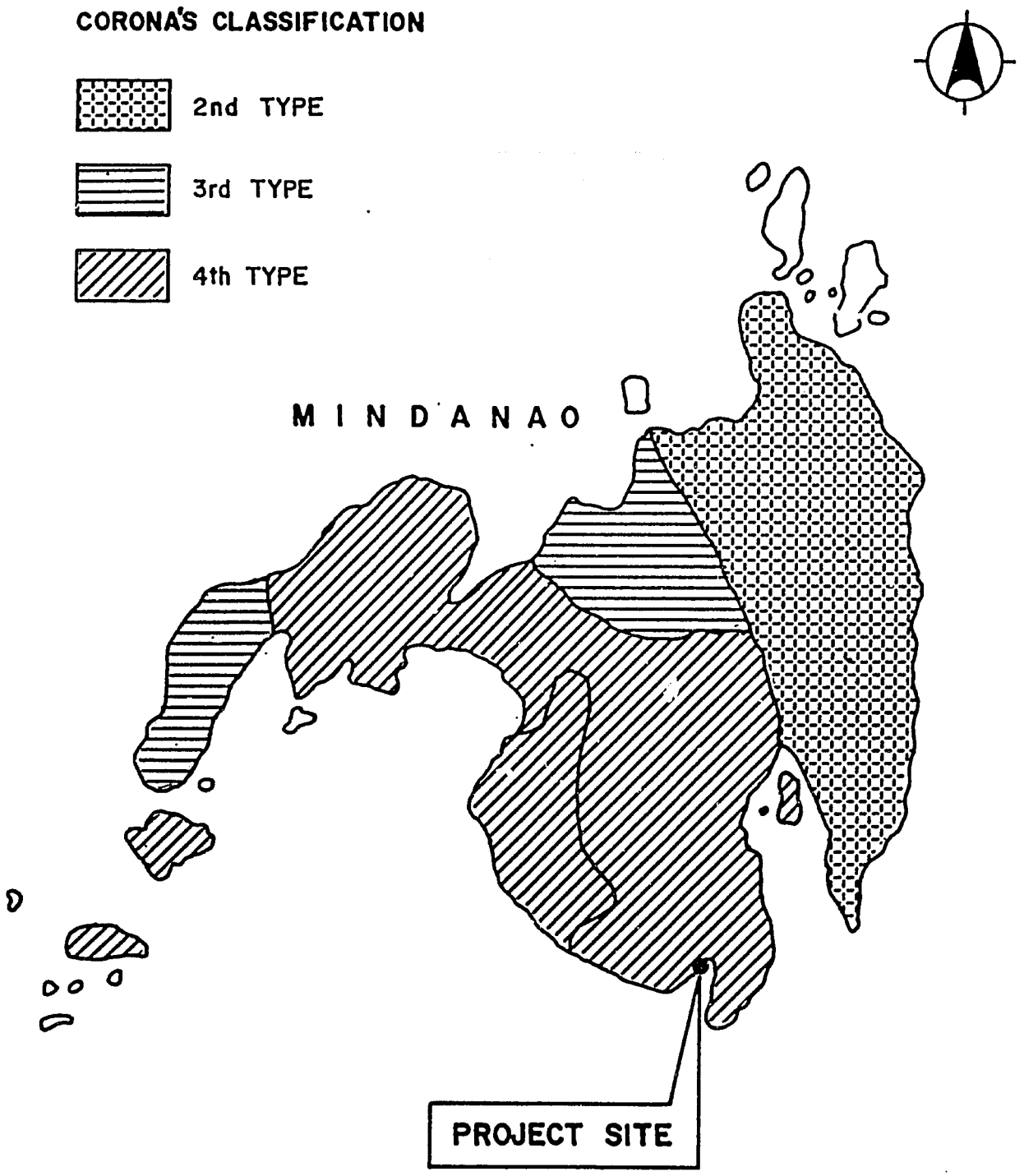


PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0453-C-00-0095-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-7
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • ERNST & YOUNG INT'L. • GLOBETROTTERS ENGG CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, N.C.	LOCAL CLIMATE ACCORDING TO CORONA'S CLASSIFICATION	

58

2.4.1.1 The Major Air Streams

The principal air streams which affect the project site are the Northeast Monsoon (amihan), the Southwest Monsoon (habagat) and the North Pacific Trades.

The Northwest Monsoon prevails during the months of October to March but exhibits highest intensity during January and February. This air stream originates from the intensely cold anticyclone that develops over the Asiatic continent during the northern hemispheric winter. This relatively cold and less humid air stream reaches the project site from the northeast after undergoing significant temperature modification.

The Southwest Monsoon dominates the area during summer or more specifically, from May or June until October. This warm and extremely humid air stream originates from the northern portion of the great Indian Ocean anticyclone during the southern hemispheric winter. It crosses the equator and moves in the general direction of the thermally-induced low pressure area over continental Asia before passing through the Philippines from a southwesterly direction.

The North Pacific Trades are generally dominant in the entire country during April and early May. They comes from variable directions ranging from the northeast to the southeast. This air mass is extremely warm and humid.

Because of its geographic location, General Santos City is relatively shielded from the direct effects of both the Northeast and the Southwest Monsoons.

2.4.1.2 Rainfall

Rainfall at the project site is brought about by various phenomena such as the intertropical convergence zone, easterly waves, local convective systems (such as thunderstorms) and, to a lesser extent, frontal systems associated with subtropical disturbances. Studies in the Philippines have shown that about 47 percent of the annual average rainfall is directly or indirectly related to the occurrence of tropical cyclones; 39 percent is attributed to the intertropical convergence zone, local convection, easterly waves and other small-scale systems; and the remaining 14 percent is due to the monsoons.

The monthly average rainfall at General Santos City is shown in Table 2-4 together with other relevant climatic parameters. Although the rainfall at the site is almost evenly distributed throughout the year, the maximum rain period occurs in June and July. Rainfall is minimum in March.

General Santos City ranks among the driest places in the country, accumulating an average annual rainfall of 954.9 mm.

Table 2-5 shows some climatological extreme values observed at General Santos City. As of 1986, the greatest 24-hour rainfall recorded was 309 mm, observed on July 9, 1983.

59

Table 2-4

MEAN VALUES OF CLIMATOLOGICAL NORMALS FOR GENERAL SANTOS CITY

(Period of Records: 1949-1986)

MONTH	RAINFALL (mm)	NO. RAINY DAYS	TEMPERATURE MAXIMUM	TEMPERATURE MINIMUM	TEMPERATURE MEAN	RH (%)	NO. THUNDERSTORM DAYS
Jan	64.1	9	32.6	21.5	27.0	76	1
Feb	73.2	8	32.9	21.6	27.2	76	2
Mar	39.5	7	33.6	21.8	27.7	75	2
Apr	50.5	8	33.7	22.4	28.0	77	4
May	87.5	12	32.7	22.7	27.7	80	6
Jun	112.5	14	31.4	22.3	26.8	82	4
Jul	104.3	13	31.0	22.0	26.5	83	4
Aug	87.2	13	31.0	21.9	26.4	83	4
Sep	80.6	12	31.4	21.9	26.4	82	4
Oct	94.4	12	31.8	22.0	26.9	81	4
Nov	87.0	12	32.4	21.9	27.1	81	4
Dec	74.1	11	32.5	21.7	27.1	79	3
Annual	954.9	11	32.3	22.0	27.1	80	3

Source: PAGASA

Table 2-5

CLIMATOLOGICAL EXTREME VALUES FOR GENERAL SANTOS CITY

(1949-1986)

MONTH	TEMPERATURE HIGH	YEAR	TEMPERATURE LOW	YEAR	GREATEST DAILY RAINFALL MAXIMUM AMOUNT	YEAR	HIGHEST WIND (mps) MAXIMUM SPD/DIR	YEAR
Jan	36.4	1964	17.1	1965	105.9	1966	20/S	1982
Feb	37.8	1983	17.2	1958	79.0	1982	16/NNE	1975
Mar	38.0	1983	16.9	1963	55.6	1949	18/SW	1983
Apr	38.0	1983	18.3	1951	60.0	1964	19/S	1971
May	38.0	1983	18.7	1951	86.1	1955	14/S	1972
Jun	36.8	1979	17.9	1961	142.0	1983	17/S	1972
Jul	36.1	1973	17.2	1985	309.0	1983	17/SSE	1972
Aug	36.1	1973	17.2	1985	126.0	1959	17/S	1972
Sep	36.8	1979	18.0	1985	189.5	1977	18/SSE	1972
Oct	37.0	1980	18.2	1961	101.0	1970	17/S	1972
Nov	37.0	1983	18.3	1951	102.1	1962	15/SE	1970
Dec	36.7	1982	18.0	1950	62.2	1964	14/SSW	1972
Annual	38.0	1983	16.9	1963	309.0	1983	20/S	1982

Source: PAGASA

60

2.4.1.3 Temperature

The annual mean temperature of General Santos City is a balmy 27.1°C (Table 2-4). The warmest month is April with a mean of 28°C. The mean annual maximum temperature is a warm 32.3°C with April registering 33.7°C. The lowest monthly mean minimum temperature occurs in January with 21.5°C. The mean diurnal range of temperature is 10.3°C. The maximum temperature recorded at the site is 38.0°C observed on March 19, April 20, and May 12, in 1983, while the lowest was 16.9°C in March 9, 1963.

2.4.1.4 Relative Humidity

The mean annual relative humidity at the site is 80 percent with April recording the lowest monthly mean at 77 percent and July and August, the high of 83 percent.

2.4.1.5 Prevailing Winds

The monthly prevailing surface winds recorded at General Santos City are presented in the form of wind rose diagrams shown in Figures 2-8 to 2-13. These rose diagrams were based on wind observations taken at three hour intervals, at the PAGASA weather station, averaged over the years 1951 to 1975.

On an annual basis (Fig. 2-14), southerly winds blows 19 percent of the time; northerly winds, 10 percent; and northeasterly winds, 12 percent. Calm conditions are observed most of the time (50 percent). These observations are also based on an average over the years 1951 to 1975.

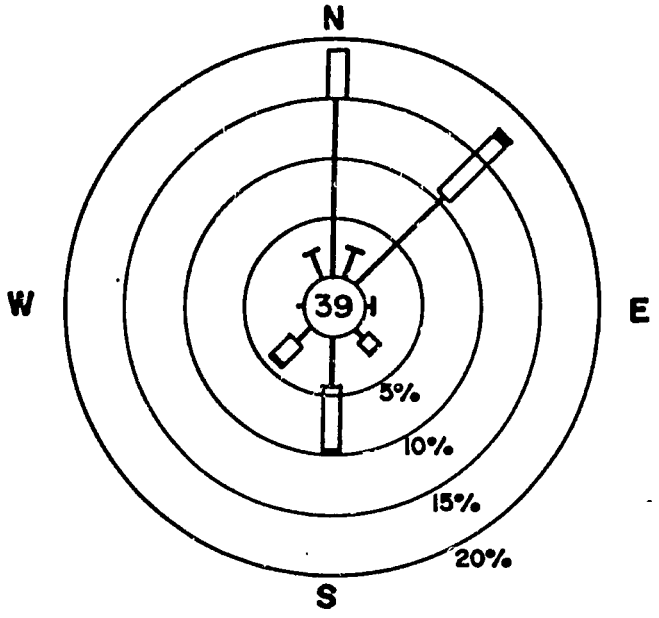
The prevalence of southerlies and northerlies in the area shows the dominant effect of sea and land breezes. Sea breeze usually prevails from 10 a.m. to about 6 p.m. while land breeze influence the wind patterns from 10 p.m. to about 3 a.m.. Calm conditions usually prevail between 4 a.m. and 8 a.m..

2.4.2 Air Quality

The existing air quality Makar Wharf typical of a rural environment. There are no significant industrial sources of air contaminants in proximity to the project site.

To assess the existing air quality of the project site, ambient total suspended particulate (TSP) concentrations and noise levels were measured over a limited period. TSP concentration and noise level measurements were conducted on March 18-21, 1991 at various measuring stations around and within the Makar Wharf complex. A high volume sampler was used for TSP monitoring while a MSA (Type 1) noise meter was used for noise level determinations. The locations of the various monitoring stations are shown in Figure 2-15. Because of regular

JANUARY



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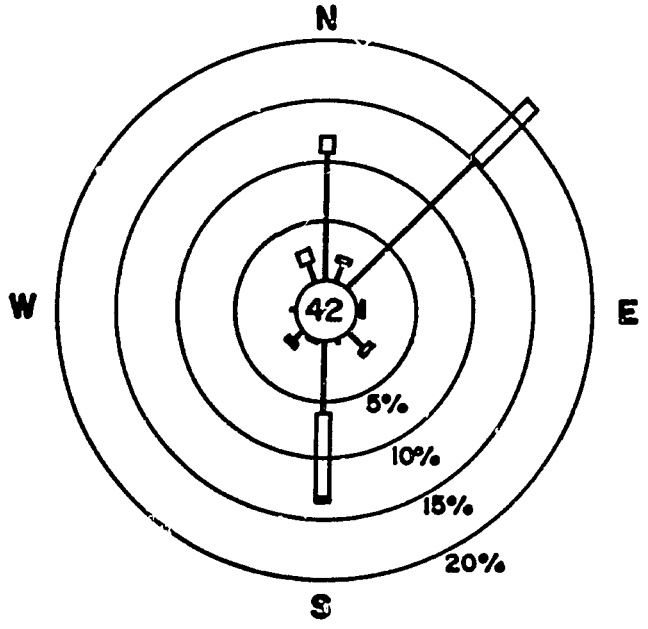

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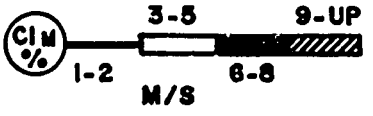

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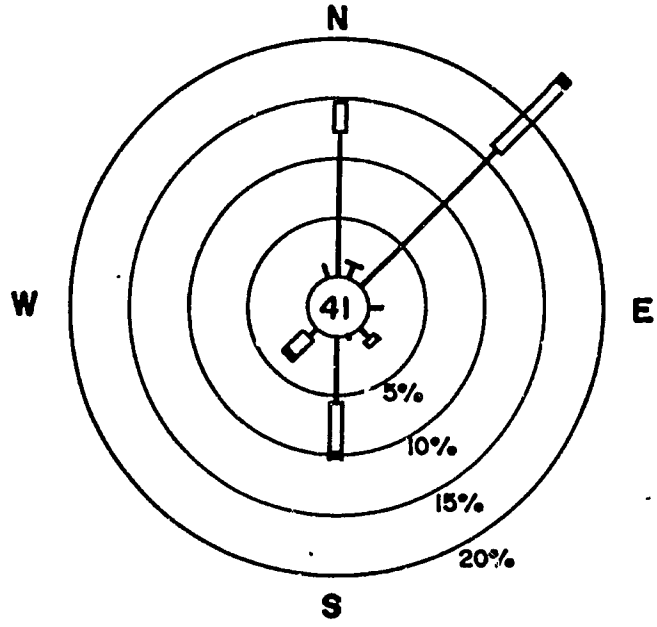
PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: [illegible]	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-8
LOUIS BERGER INTERNATIONAL, INC. •LACHMAN CHEMICAL ENT. •CHRIST & YOUNG ENT. •CONSULTING ENG CORP. •TRANS-ASIA (PHIL.), INC. •CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY JAN./FEB.	

-62-

MARCH



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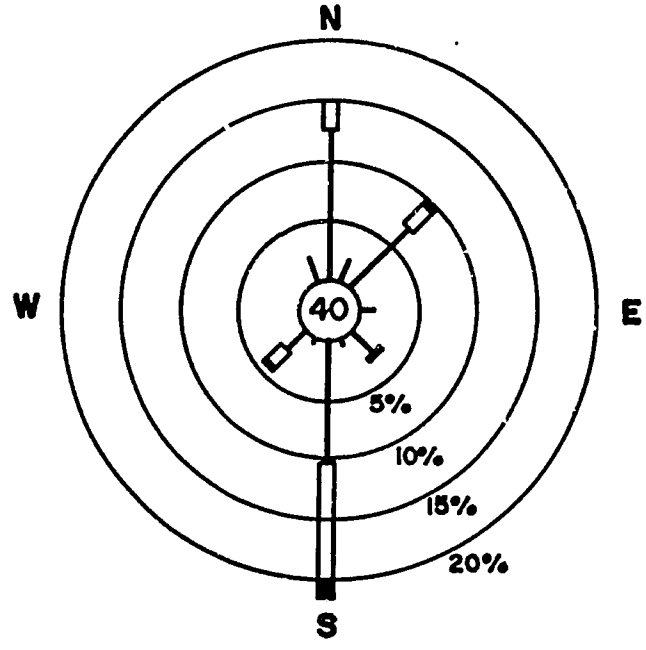

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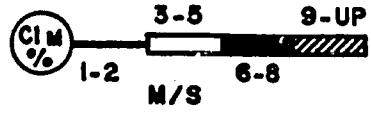

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PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: [illegible]	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-9
LOUIS BERGER INTERNATIONAL, INC. [illegible] • TRANS-ASIA (PHIL.), INC. • GEOSCIENTISTS INFO CORP. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY MAR./APR.	

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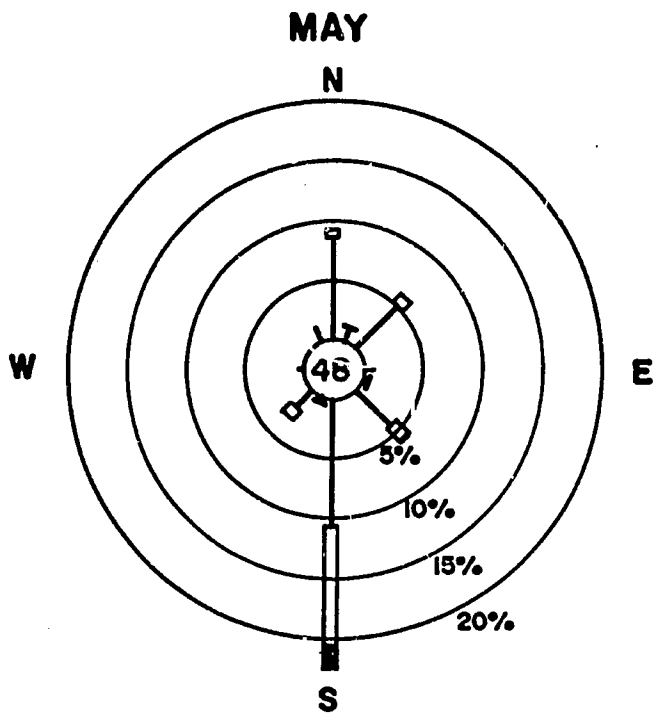

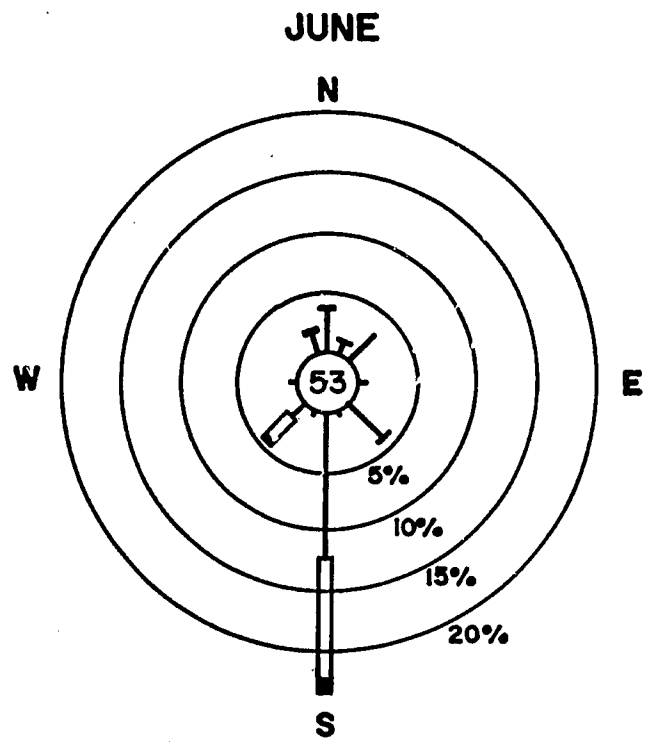

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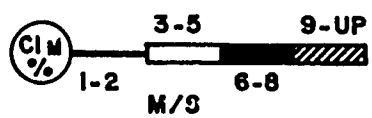

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PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0190-C-00-3009-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-10
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • GRANT & YOUNG INT'L. • GLOBETROTTERS INFO CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY MAY/JUNE	

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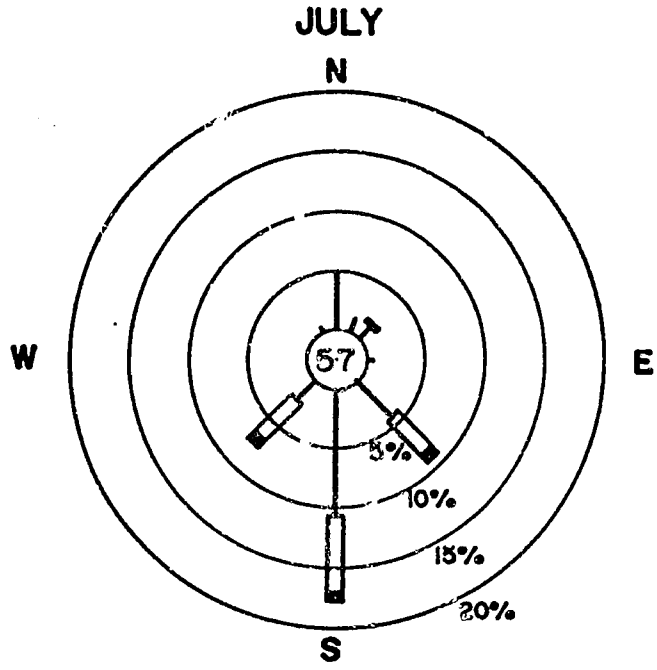

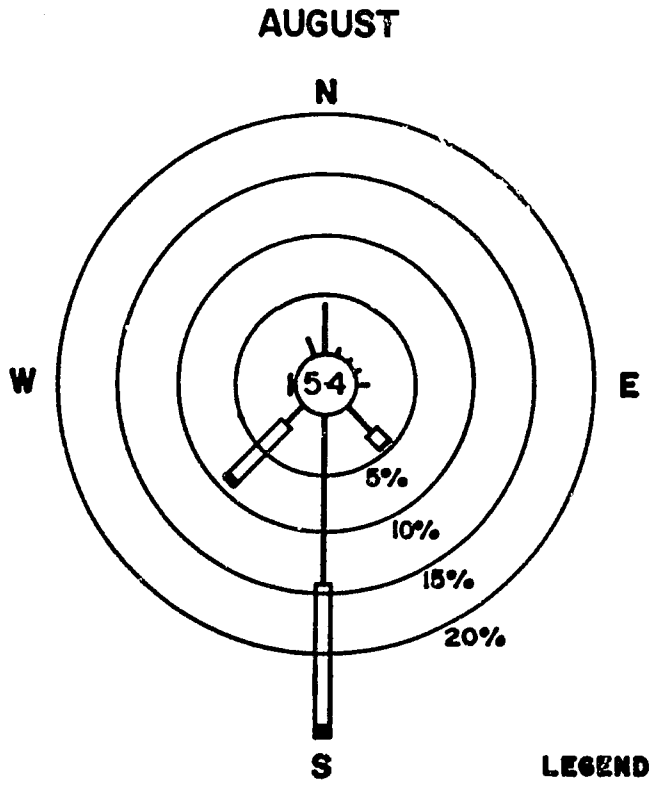

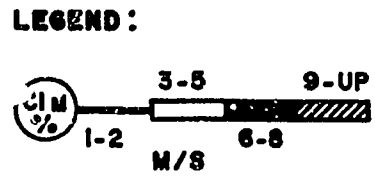

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PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0453-C-00-0000-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-11
LOUIS BERGER INTERNATIONAL, INC. • LOUIS BERGER PHILIPPINES INT'L. • ERECT & TURNER INT'L. • GLOBETROTTERS EMPLOYMENT • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY JULY/AUG.	

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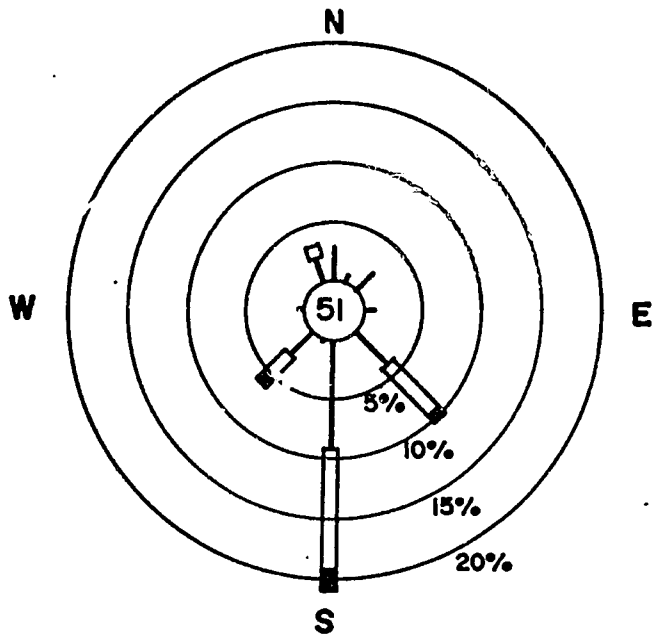
SEPTEMBER



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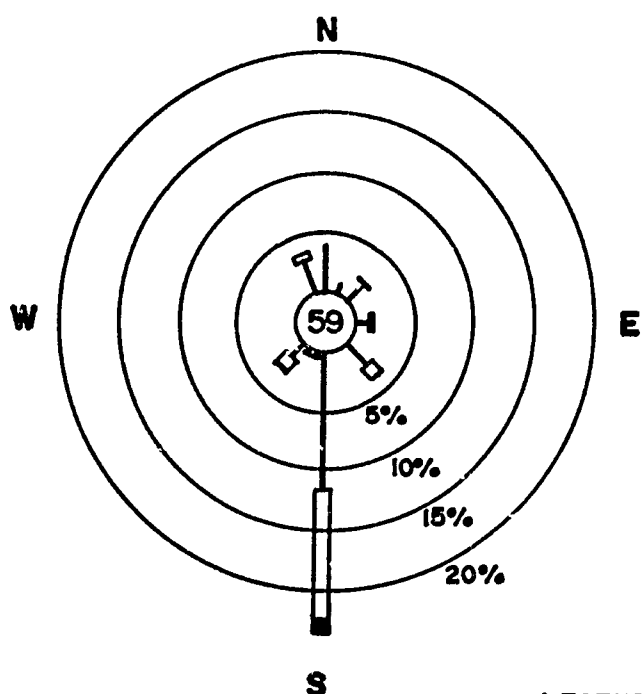

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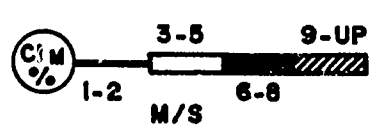

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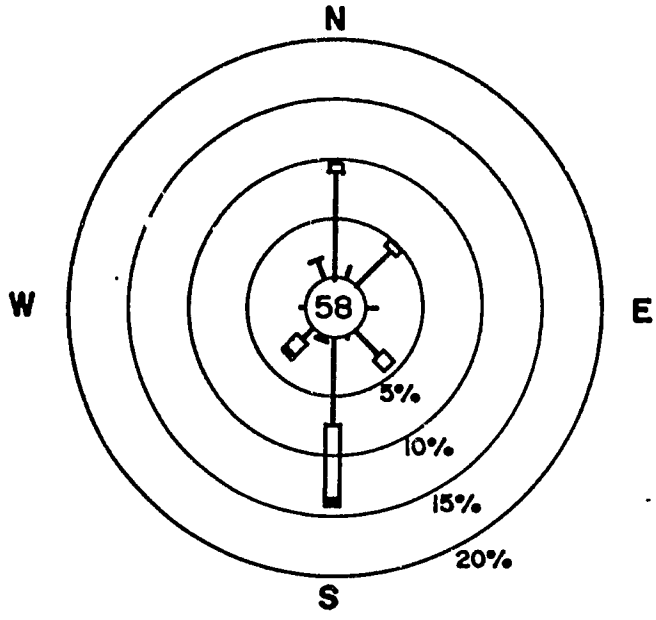
PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0483-C-00-4088-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-12
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • SENST & VINNE INT'L. • ELECTRICITIES DEV'T CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY SEPT./OCT.	

66

NOVEMBER



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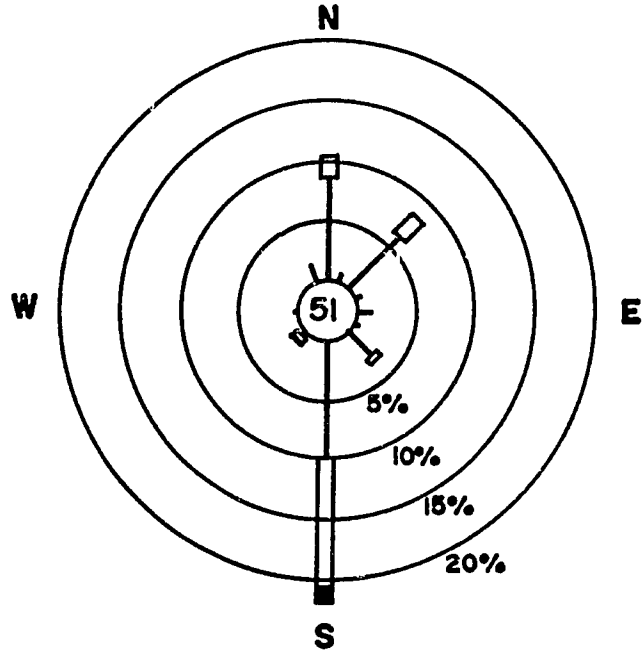

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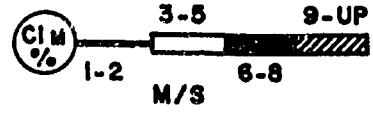

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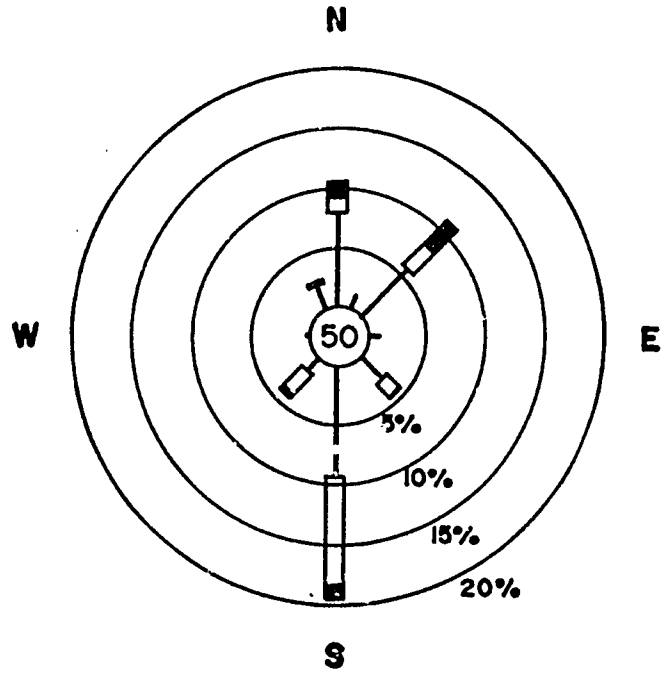
PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0458-C-00-0000-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-13
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • ERNST & YOUNG INT'L. • GLOBE-BETTERS ENPS CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY NOV./DEC.	

67

ANNUAL AVERAGE



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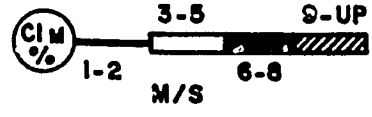

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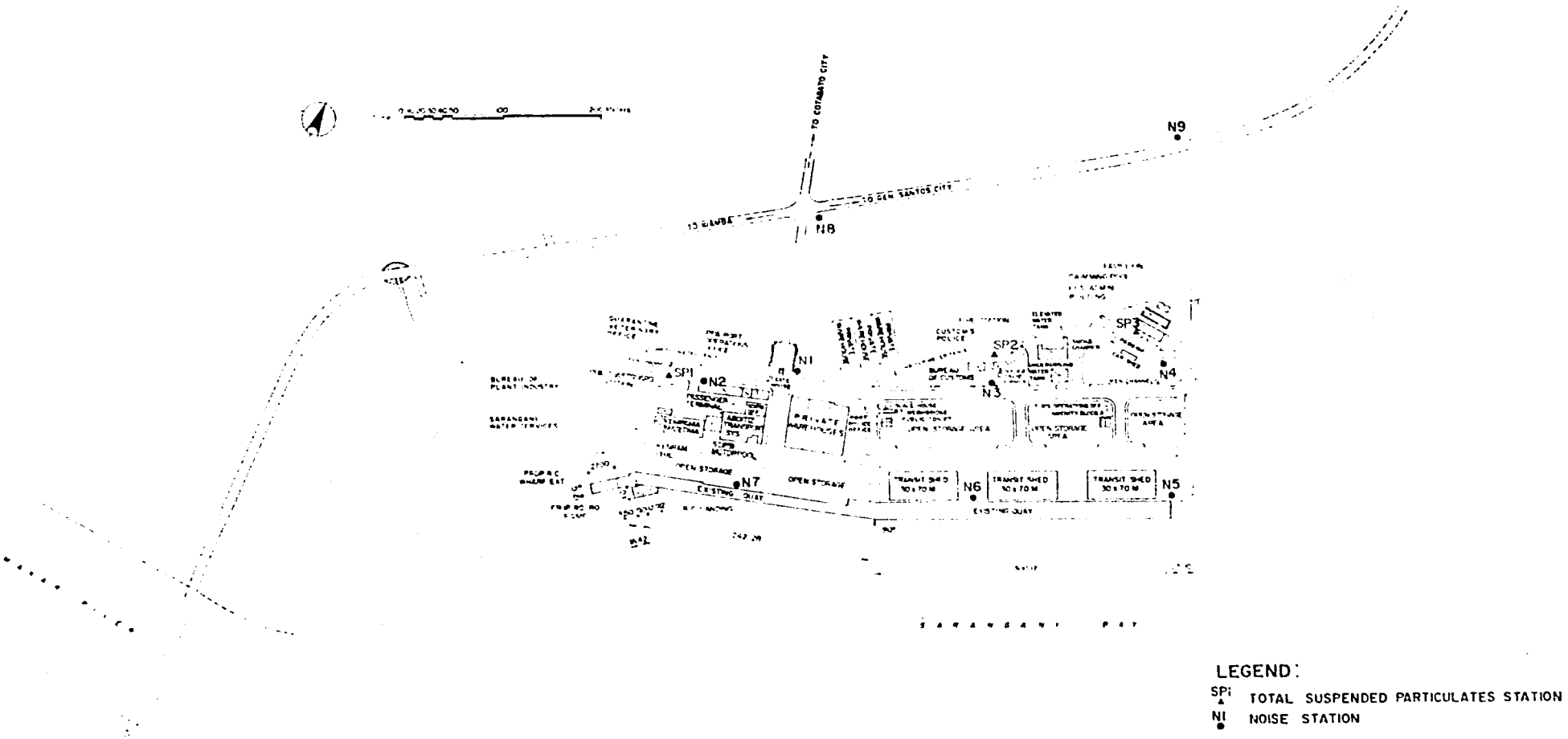
PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0488-C-00-0086-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-14
LOUIS BERGER INTERNATIONAL, INC. • LONGWOOD GREENE INT'L. • ERNST & YOUNG INT'L. • ELECTROTHERM EXPO CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	WIND ROSE FOR GENERAL SANTOS CITY ANNUAL AVERAGE	



PHILIPPINE ASSISTANCE PROGRAM SUPPORT

LOUIS BERGER INTERNATIONAL, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LOCATION OF AIR QUALITY SAMPLING STATIONS

FIGURE 2-15

power outages in the area from 6 a.m. to 12 noon, no TSP measurements were taken during the morning hours.

2.4.2.1 Total Suspended Particulates

A total of 14 TSP measurements were made over a total period of 36 hours as shown in Table 2-6. The weighed average hourly TSP concentration at the project site amounts to 93.9 ug/cu m. The highest concentration observed was in Station 1 at 188.6 ug/cu m while the least was recorded at Station 3 at 43.7 ug/cu m. The weighed average TSP concentration as well as all observed values at all stations were well within the national ambient standard for total suspended particulates which is 250 ug/cu m for hourly exposure.

2.4.2.2 Noise Levels

Table 2-7 shows the results of noise measurements at various points within and in the vicinity of the project site. The mean values of measured sound pressure levels within the Makar Wharf complex, i.e. for stations N1 to N7, ranged from a low of 45 dB (A) to a high of 58 dB (A). The maximum sound pressure level measured within the wharf area during the monitoring period was registered at Station N1 at 71 dB (A). Station N1 is located at the gate and the relatively high noise level was due to accelerating tricycles. The existing noise levels within the wharf area are well within the national ambient noise standards for light industrial areas of 70 dB (A) for daytime hours, 65 dB (A) for morning and evening hours, and 60 dB (A) for nighttime hours.

The noise levels measured along the national road (Stations NB and N9) were much higher, with averages ranging from 57 to 63 dB (A), and maximum values ranging from 69 to 72 dB (A). These noise levels are primarily due to passing vehicles, notably tricycles and jeepneys.

2.4.3 Water Resources and Water Quality

An assessment of the existing water quality and water resources was necessary in order to establish the baseline conditions in which the current port is operating and to identify those areas that may be most sensitive to the potential environmental consequences of the proposed improvements.

The zone of influence for studies on water quality and water resources was defined by the probable primary and direct impact of the proposed port improvements. This area was defined to include the area within a one kilometer radius of the existing wharf. Figure 2-16 shows the defined zone of influence of water quality parameters of the project site.

70

Table 2-6

AMBIENT TOTAL SUSPENDED PARTICULATE MATTER CONCENTRATIONS AT THE MAKAR WHARF COMPLEX

(ug/cu m)

SAMPLING STATION	DATE	TIME OF SAMPLING FROM	TO	CONCENTRATION (ug/cu m)
SP1	3-18-91	1350H	1450H	80.2
SP1	3-18-91	1500H	1600H	105.8
SP1	3-18-91	1610H	1710H	188.6
SP1	3-18-91	1730H	0600H	59.7
SP2	3-19-91	1230H	1330H	91.5
SP2	3-19-91	1340H	1440H	141.0
SP2	3-19-91	1445H	1545H	133.0
SP2	3-19-91	1555H	1655H	125.0
SP2	3-19-91	1710H	1810H	76.4
SP3	3-20-91	1245H	1345H	117.8
SP3	3-20-91	1355H	1455H	98.3
SP3	3-20-91	1530H	1630H	169.7
SP3	3-20-91	1640H	1740H	43.7
SP1	3-20-91	1830H	0600H	109.8
Total no. of hours of observations: 36				
Weighted hourly average concentration				93.9
Highest value observed				188.6
Lowest value observed				43.7

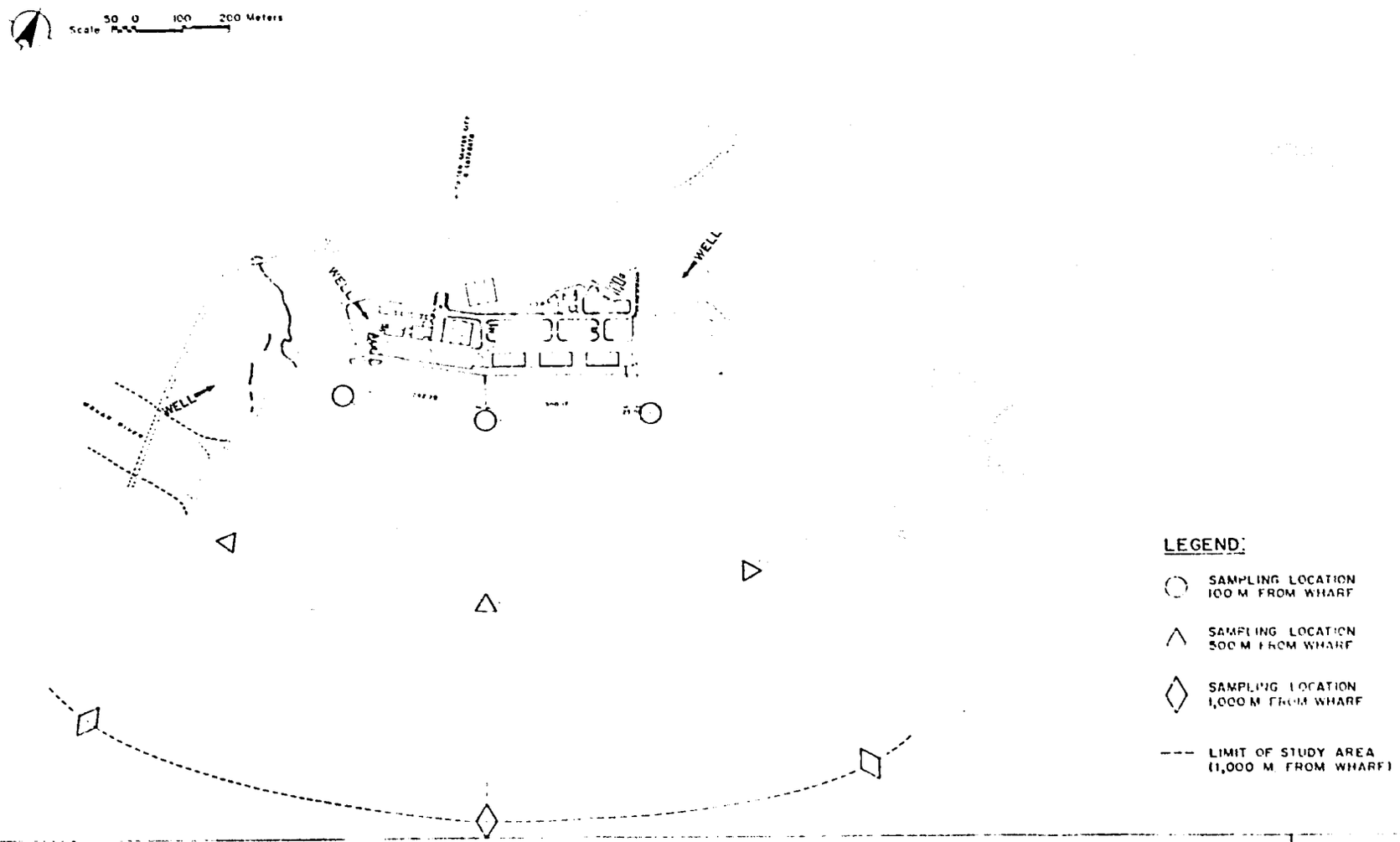
71

Table 2-7

OBSERVED NOISE LEVELS AT THE MAKAR WHARF COMPLEX

STATION	DATE	TIME	SOUND PRESSURE LEVEL, dB (A) MAXIMUM	MINIMUM	MEAN
N1	3-18-91	1400H	71	42	58
N1	3-18-91	1740H	67	48	55
N1	3-19-91	0730H	56	40	53
N1	3-20-91	1410H	68	49	56
N2	3-19-91	0755H	57	45	54
N2	3-19-91	1305H	64	54	57
N2	3-19-91	1730H	66	49	57
N2	3-20-91	1415H	65	50	54
N3	3-19-91	0805H	55	43	52
N3	3-19-91	1310H	62	51	54
N3	3-19-91	1740H	61	49	54
N3	3-20-91	1420H	60	49	55
N4	3-19-91	0810H	53	41	48
N4	3-19-91	1315H	58	46	51
N4	3-19-91	1745H	59	49	53
N4	3-20-91	1425H	58	47	50
N5	3-19-91	0820H	53	40	46
N5	3-19-91	1325H	54	43	48
N5	3-19-91	1755H	5o	50	52
N5	3-20-91	1430H	58	49	55
N6	3-19-91	0825H	53	41	45
N6	3-19-91	1330H	55	42	47
N7	3-19-91	0830H	53	44	48
N8	3-19-91	0835H	72	55	61
N8	3-20-91	1845H	69	52	57
N9	3-19-91	0840H	73	58	63
N9	3-20-91	1855H	70	51	58

72'



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO 492 0492-C-00-0049-00

LOUIS BERGER INTERNATIONAL, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

WATER QUALITY SAMPLING LOCATIONS

FIGURE 2–16

The defined perimeter is bounded by the Calumpang Road in the north and the Sarangani Bay in the south. The east is flanked by the area extending from the Wharf towards Saboay River. The Badjao community and Barrio Molok are located within this area. The west is bounded by the two fishing communities (A and B) extending from the Wharf towards the Makar River.

For the purpose of this study, the eastern region within the zone of influence will be referred to as Upper Makar, while the western region will be called Lower Makar.

2.4.3.1 Present Status of Water Resources and Use

- Coastal and Marine Water Resources

Sarangani Bay constitutes the principal waterbody within the zone of influence of the project site. Its watershed and coastal areas support multiple uses of the aquatic and land resources in the area. It supports the fishery and aquacultural operations, sustains agricultural and industrial activities, and promotes navigation, transport and tourism development in the region.

Sarangani Bay, Davao Gulf, and the Celebes Sea are major fishing grounds in the region. In General Santos City, the fish export in 1988 amounted to 2942 MT of processed and canned fish valued at $5 M and 1227 MT of frozen fish products valued at $1.8 M. The fish catch for that year amounted to about 300 MT daily with a total fish consumption amounting to 150 MT daily. Nearly 20,000 fishermen were registered for that year.

Prawn culture is a booming industry in General Santos City with a reported export of 31,755 MT for 1988. Its market includes Japan, United States, and Europe. Sarangani Bay provides for the marine water demand of the aquaculture sector. It also serves as repository of wastes and wastewater from prawn farms. Waters drained from prawn farms have been conservatively estimated at 75,000 m^3 per hectare per year.

Seaweed culture is currently being tested near Kiamba by Dole Philippines, Inc.

In 1988, about 4163 business establishments applied for license or were given permits to operate within the watershed of Sarangani Bay. A list of major investors in General Santos City is given in Table 2-8. The location and distribution of some of these major establishments are presented in Figure 2-17. The bay provides for the water needs of industrial and commercial establishments and serves as the ultimate receptor of manufacturing wastes and wastewater discharges.

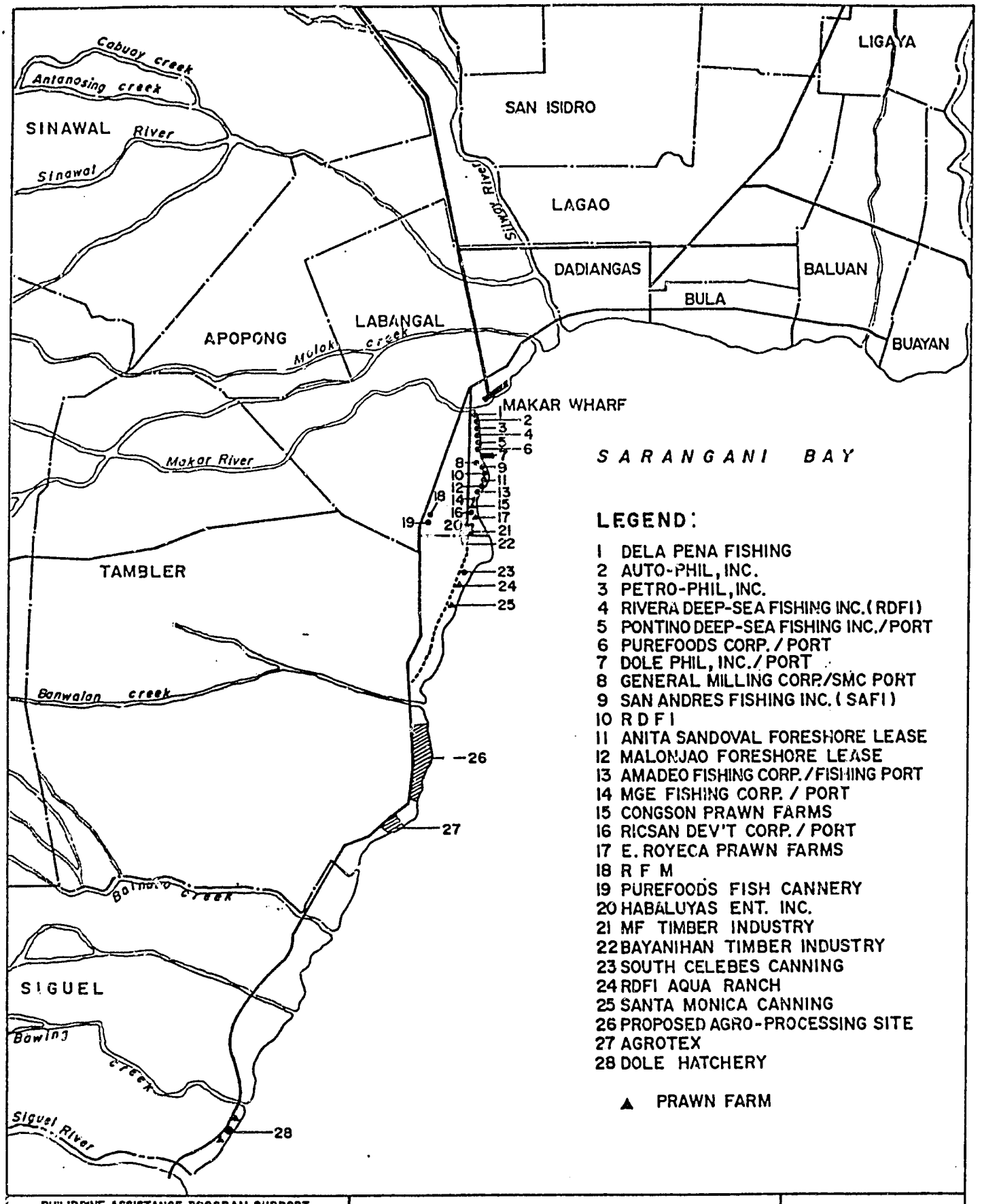
74

Table 2-8
MAJOR INVESTORS IN GENERAL SANTOS CITY, 1988

MULTI-NATIONAL CORPORATIONS	FISHING INDUSTRY	SERVICES AND TRADING ESTABLISHMENTS
* Dole Philippines, Inc.	Southern Fishing Industry	
Standard (Phil) Fruit Corporation (STANFILCO)	* San Andres Fishing Industry	General Santos Doctor's Hospital
Coca-Cola Bottlers Phil., Inc.	* R.D. Fishing Industry Corporation	St. Elizabeth Hospital
Caltex Philippines, Inc.	* Amadeo Fishing	Casa Luisa
* Petrophil Corporation	Sedgewick Trader Corporation	Dadiangas Sun Trading
* Santa Monica Canning Corporation (SANCANCO)	* Dole Philippines, Inc. Fish Port	Sarangani Security Agency
Pilipinas Shell Petroleum Corporation	QBRO Fishing Enterprises	Joan's Bake Shoppe
Pepsi-Cola Distributor	* Pontino Deep Sea Fishing Industries	Roland Goipeng Rice Mill
Nestle Philippines, Inc.	Philippine Orient	Gochay Ching Min Corn Mill
	Teodoro Fishing Industry	Carlos Hardware
AGRICULTURAL CORPORATIONS	Santo Domingo Fishing Corporation	Ecco Hardware
	Kaman Enterprises	Yap Mabuhay Enterprises
San Miguel Corporation (SMC)	Aqua Marine Ventures, Inc.	South Cotabato Integrated Services, Inc.
Ayala Agricultural Development Corporation	Aries Fishing Industry	Supreme Merchant Corporation
Philippine Cotton Corporation	Orient Marine	Ang Brothers Commercial Development Corporation
Mindanao Cotton Development Corporation	Lig Marine Products, Inc.	Eng Kim's Hardware
Philippines Asia Agro Industrial Corporation	Tagalog Agro - Industrial	Lim Brothers Hardware
* Agrotex	Astron Marine Corporation	Linda Enterprises
Pioneer Hybrid	San Pedro Celebes Fishing	Kimball Plaza
Southern Agro Export	Kapalaran International Fishing	White Gold City
* Congson Agro-Industrial Corporation	* De la Peña Fishing Industry	Zuellig Pharmaceutical
Bibiana Swine Farms	Tuna Agro - Industrial	Sulpicio Lines, Inc.
G.T.A. Progressive Stock Piggery	Damalerio fishing Industry	Lorenzo Shipping Corporation
Demontano Swine Farm	MGE Fishing Industry	Aboitiz Shipping Corporation
P.I. Stock Farm	Century Brokerage	William Lines, Inc.
Sun Bee Sen Food Producers	LT Fishing	
Checkered Farms, Inc.	Templado Fishing Industry	**INDUSTRIAL CORPORATIONS**
	Garaygay Fishing	
	Talaba Fishing	* Purefoods Corporation
	Suares Fishing	* General Milling Corporation
	Laguna Fishing	D.I.P. Steel Fabrication Co., Inc.
	SRS Fishing Industry	M.F. Timber Industry, Inc.
	Veneracion Fishing Industry	Davao Union Cement Corporation
	Lastimosa Fishing	Congson Ice Plant
	Cantoja Fishing Industry	Veneracion Ice Plant
	DJL Tuna Magnet Fishing Industry	Cebu Oxygen and Acetylene Company (COACO)
	Felipe Yu Fishing	
	Teodoro Ong Yu Fishing	
	Raphaida Fishing	
	Roel Fishing Industry	

* Those companies present along the western shore of Sarangani Bay. (Refer to Figure 2-17)

Source: Comprehensive opportunities for a moving economy at General Santos City. Volume 1, No. 1



PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0452-C-00-0099-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L. • ERNST & YOUNG INT'L. • BLOBETROTTERS ENG'G. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	LOCATION OF MAJOR INDUSTRIAL ESTABLISHMENTS ON THE WEST SIDE OF SARANGANI BAY	FIGURE 2-17

76

Sarangani Bay is part of the sea lane which provides for the transportation and navigation requirements of the region. In 1990, the Makar Wharf traffic involved 770 domestic and 73 foreign vessels. Domestic cargo volume for the same year involved 259,000 MT of inward cargo and 512,000 MT outward cargo. Foreign import cargo amounted to 60,000 MT and export cargo of 13,000 MT. Human traffic for that year were 46,000 disembarked and 62,000 embarked passengers.

Tourism has shown encouraging development in Sarangani Bay. As the number of hotel accommodations and beach resorts have increased in recent years.

The present, multiple uses of Sarangani Bay water resources pose important environmental and resource management considerations.

- Surface Freshwater Resources

Two riverbeds run near either side of the project site. On the west is the Makar River and on the east is the Saboay River. The Makar River is within the one kilometer perimeter of the zone of influence of the Wharf, while the Saboay River is just outside of it.

The Makar River headwaters originate some 35 km from Sarangani Bay. The discharge rate of Makar River recorded at Barrio San Jose, some 15 km upstream, ranged from 1354 to 1568 l/sec in 1982 and from 1121 to 1449 l/sec in 1989 (Golez, L. pers. comm., March 24, 1991).

At present, the section of the Makar River falling within the one kilometer perimeter has no residual flow and its silted riverbed is exposed. The drying up of the downstream section of the Makar River started some three to five years ago when the upstream stretches of the river were diverted to irrigate croplands in the area.

The downstream users of the river water did not protest against such action. Residents had already encroached into the area for settlement and for mooring and repair of their boats (Bacalao, P. pers. comm, March 28, 1991). Occasional monsoonal flashfloods of short duration inundate the dried up river bed.

- Underground Water Resources

General Santos City is believed to have an enormous underground water resources. The coastal areas in the vicinity of the Makar Wharf are characterized by alluvial plains which are known to have rich underground aquifers as evidenced by free flowing wells of relatively shallow depths.

77

The area extending from Upper Makar in the east to Lower Makar in the west have confirmed aquifers at depths ranging from 60 - 90 m. A recent well boring in Upper Makar reached a depth of 80 m and was anticipated to generate water of quality and volume adequate to satisfy the water demand of the growing Badjao community.

The information obtained from the interview of the well drillers in General Santos City indicated that groundwater is relatively shallow and is obtainable between a depth of 10 -80 m. It was also indicated that free flowing wells are obtained at the average depth of 80 m. There are at least two of these wells near the wharf.

In the Upper Makar area, the members of the Badjao community fetch water from the free flowing wells located in Molok or from a pitcher pump well across the street. (Pacardo F. pers. comm., March 30, 1991).

In the Lower Makar, three flowing wells service the water requirements of the residents. In Lower Makar B, the free flowing well has a much reduced flow. Recently the well experienced water fouling and a tainted fishy odor (Bacalo, P., pers. comm. March 30, 1991). This incident was attributed to a leak in the pipe system allowing seepage of decomposing plant material coming from an old abandoned log pond located in the vicinity of the well. The two free flowing wells located in Lower Makar A have a larger volume of discharge and no fouling incidences have been reported.

All the free flowing wells in Lower Makar form part of the donations given by mayoralty candidates during the last election.

In the port area, water service is provide by the Philippine Port Authority and by Sarangani Water Supply Services (now known as the C. Limjap Water Services). C. Limjap supplies seventy percent of the water demand of berthed ships and PPA services the remaining thirty percent of this requirement.

Hourly generation rates amount to 35,000 l with the PPA water service unit and 15,000 - 20,000 l for C. Limjap depending on the ship's location. In 1990, PPA supplied 35,577,000 l of water and at a 70:30 percent sharing a total of 118,590,000 l have been supplied by the two water systems.

C. Limjap charges 12.50 pesos per 1000 l of water while PPA charges 9.25 pesos per 1000 l. Unlike C. Limjap, PPA accommodates occasional requests from industries, institutions, and the general public for water supply.

The details of the water supply facilities of the two water service units at the Wharf are described in Section 1.2.5.

18

2.4.3.2 Present Status of Water Quality

The characterization of the present status of water quality of seawater and groundwater were achieved using standardized methods prescribed by the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR). These standardized methods for the analysis of physical, chemical, and biological parameters of water quality are listed in Appendix A-2.

For the purpose of this analysis, only water samples obtained from Sarangani Bay and flowing wells within the area of the project site were included. No water samples were obtained from the downstream stretch of the Makar River since it no longer flows into Sarangani Bay near the port site. Water sampling was conducted during the period of March 15-31, 1991, during the daylight hours at designated sampling sites. The location of water quality sampling sites are shown in Figure 2-16.

- Water Quality of Sarangani Bay

  Data describing the existing water quality of Sarangani Bay found within the zone of influence of the Makar Wharf are summarized in Table 2-9. The mean maximum values for water quality parameters measured are shown in Table 2-10. The distance and depth profiles for these parameters are shown in Table 2-11. The following observations are noted:

  1. The waters of Sarangani Bay within the zone of influence of the project site remained clear across the secchi-disc transparency depth of more than seven meters.

  2. Color values increased moderately towards the Lower Makar area and were generally higher at seven meters depth nearshore.

  3. Water temperature, pH, salinity and conductivity values were invariable across distance and depth.

  4. Dissolved Oxygen (DO) exceeded six mg/l while Biological Oxygen Demand (BOD) remained below the two mg/l mark. The COD (Chemical Oxygen Demand) values fluctuated widely with maximum level reaching 57 mg/l mark.

  5. Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) varied within narrow limits and did not exhibit any distance- nor depth-related pattern of change.

  6. NO_3-N (Nitrate-Nitrogen) and PO_4-P (Ortho Phosphate) were generally low and varied minimally across distance and depth.

19

Table 2-9

RESULTS OF WATER QUALITY ANALYSIS FOR COASTAL MARINE WATERS OF SARANGANI BAY

SAMPLING SITES		UPPER MAKAR						MAKAR WHARF						LOWER MAKAR					
DISTANCE FROM SHORE (m)		100		500		1000		100		500		1000		100		500		1000	
DEPTH LEVEL (m)		0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0
WATER QUALITY PARAMETERS	UNITS OF MEASURE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Color	PCU	2	(-)	5	(-)	2	(-)	2	(-)	2	(-)	5	(-)	5	(-)	5	(-)	8	(-)
		2	5	2	2	8	2	25	2	2	1	25	18	2	50	2	38	12	18
Temperature	°C	26	(-)	26	(-)	27	(-)	28	(-)	26	(-)	27	(-)	27	(-)	27	(-)	28	(-)
pH	units	7.94	(-)	8.03	(-)	7.85	(-)	7.96	(-)	8.10	(-)	7.99	(-)	7.99	(-)	7.98	(-)	7.97	(-)
Salinity	0/00	34	31	28.00	30	28.5	31.5	32	32.5	31	31.5	29.8	28.5	30	315	305	315	31	32
Conductivity x 10^3	$\frac{\text{umhos}}{\text{cm}}$	490	500	470	495	460	500	500	500	495	500	480	500	490	500	495	500	495	500
DO	mg/l	6.6	(-)	6.4	(-)	6.4	(-)	6.7	(-)	6.3	(-)	6.3	(-)	6.2	(-)	6.3	(-)	6.5	(-)
		2	(-)	1	(-)	2	(-)	2	(-)	1	(-)	1	(-)	1	(-)	2	(-)	2	(-)
BOD	mg/l	2	(-)	1	(-)	2	(-)	2	(-)	1	(-)	1	(-)	1	(-)	2	(-)	2	(-)
		1	1	1	1	1	1	1	2	1	2	2	2	1	1	1	1	1	1
		12	(-)	4	(-)	4	(-)	19	(-)	19	(-)	19	(-)	8	(-)	12	(-)	35	(-)
COD	mg/l	11	8	7	4	7	4	16	49	45	4	4	57	4	4	28	20	20	24
TSS	mg/l	25	(-)	37	(-)	23	(-)	29	(-)	21	(-)	26	(-)	11	(-)	26	(-)	34	(-)
		22	25	31	56	21	58	25	32	38	19	33	26	32	28	31	16	42	46
TDS	mg/l	34722	(-)	(-)	35891	(-)	34813	(-)	34906	(-)	35374	(-)	35851	(-)	34805	(-)	35082	(-)	34944
		33493	36116	32974	35163	31123	35189	33981	34646	33767	34876	32932	35002	34311	34668	35697	34482	35157	34304
NO_3 - N	mg/l	0.015	(-)	0.020	(-)	0.025	(-)	0.020	(-)	0.025	(-)	0.020	(-)	0.020	(-)	0.025	(-)	0.035	(-)
		0.0034	0.0024	0.0074	0.0024	0.0074	0.0014	0.0034	0.0030	0.0040	0.0024	0.0040	0.0010	0.0044	0.0034	0.0074	0.0034	0.0024	0.0014
PO_4 - P	mg/l	2.320	(-)	5.800	(-)	1.160	(-)	2.320	(-)	3.016	(-)	2.784	(-)	3.248	(-)	1.624	(-)	2.088	(-)
		0.336	0.448	0.112	0.448	0.448	0.672	0.336	0.672	0.560	0.112	8.960	0.224	0.224	0.448	0.336	0.560	2.840	0.448
Surfactants (MBAS) (a)	mg/l	1.3	(-)	2.6	(-)	1.3	(-)	1.3	(-)	2.6	(-)	1.3	(-)	2.6	(-)	1.3	(-)	1.3	(-)
		0.3	(-)	0.5	ND	ND	0.5	ND	1.4	ND	ND	ND	ND	ND	ND	ND	0.3	0.4	ND
Oil and Grease	mg/l	4.56	(-)	5.00	(-)	3.00	(-)	3.22	(-)	1.10	(-)	0.56	(-)	5.30	(-)	3.30	(-)	12.90	(-)
		0.50	1.40	0.60	2.30	1.80	2.20	2.50	1.00	3.60	2.80	1.00	1.30	3.30	3.20	1.40	0.60	2.10	4.40
Phenol (b)	mg/l	0.002	(-)	0.015	(-)	0.004	(-)	0.001	(-)	ND	(-)	0.002	(-)	ND	(-)	ND	(-)	0.008	(-)
		ND	0.002	ND	0.001	0.002	0.001	ND	ND	0.002	ND	ND	ND	ND	0.002	ND	ND	ND	ND

(continued)

Table 2-9 (Continued)

RESULTS OF WATER QUALITY ANALYSIS FOR COASTAL MARINE WATERS OF SARANGANI BAY

SAMPLING SITES		UPPER MAKAR						MAKAR WHARF						LOWER MAKAR					
DISTANCE FROM SHORE (m)		100		500		1000		100		500		1000		100		500		1000	
DEPTH LEVEL (m)		0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0	0.5	7.0
WATER QUALITY PARAMETERS	UNITS OF MEASURE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Arsenic (c)	mg/l	ND	(-)	ND	(-)	ND	(-)	ND	(-)	ND	(-)	ND	(-)	ND	(-)	ND	(-)	ND	(-)
Cadmium	mg/l	0.053	(-)	0.053	(-)	0.056	(-)	0.053	(-)	0.053	(-)	0.053	(-)	0.056	(-)	0.057	(-)	0.056	(-)
		0.060	(-)	0.057	0.060	0.054	0.054	0.070	0.070	0.074	0.067	0.070	0.077	0.050	0.070	0.093	0.070	0.067	0.074
Chromium VI (b)	mg/l	0.393	(-)	0.393	(-)	ND	(-)	3.440	(-)	3.930	(-)	0.442	(-)	0.393	(-)	0.393	(-)	0.442	(-)
		ND	(-)	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	0.001	ND	ND	ND	0.006	0.001
Copper	mg/l	0.073	(-)	0.069	(-)	0.067	(-)	0.067	(-)	0.085	(-)	0.073	(-)	0.085	(-)	0.067	(-)	0.067	(-)
Lead	mg/l	0.450	(-)	0.409	(-)	0.409	(-)	0.491	(-)	0.409	(-)	0.409	(-)	0.409	(-)	0.409	(-)	0.450	(-)
		0.353	(-)	0.372	0.484	0.353	0.335	0.353	0.465	0.428	0.465	0.298	0.298	0.391	0.353	0.298	0.446	0.335	0.298
Mercury	mg/l	0.0002	(-)	0.0001	(-)	0.0001	(-)	0.0002	(-)	0.0006	(-)	0.0003	(-)	0.0004	(-)	0.0002	(-)	0.0002	(-)
Zinc	mg/l	0.041	(-)	0.032	(-)	0.076	(-)	0.050	(-)	0.038	(-)	0.035	(-)	0.440	(-)	0.038	(-)	0.035	(-)
Total Coliform	MNP	>1600	(-)	900	(-)	1600	(-)	27	(-)	7	(-)	240	(-)	130	(-)	170	(-)	130	(-)
	100ml	17.00	(-)	240	7	900	23	300	30	2.2	(-)	4	4	1600	34	26	8	26	(-)
Fecal Coliform	MNP	500	(-)	300	(-)	900	(-)	80	(-)	4	(-)	27	(-)	130	(-)	130	(-)	80	(-)
	100ml	12	(-)	34	7	900	<2.2	2	17	<2.2	(-)	4	4	34	12	14	13	4	(-)

(a) ND < 0.00001 (b) ND < 0.001 (c) ND < 0.02 (-) not determined

Table 2-10
MEAN AND MINIMUM-MAXIMUM VALUES OF WATER QUALITY FOR COASTAL AND MARINE WATERS OF SARANGANI BAY

WATER QUALITY PARAMETERS	UNIT OF MEASURE	UPPER MAKAR	LOWER MAKAR	MAKAR WHARF	NSDW STANDARD
Color	PCU	3.3 (2-8)	9.1 (2-25)	15.5 (2-50)	5.0
Temperature	°C	26.3 (26-27)	27 (26-28)	27.3 (27-28)	3°C rise
pH	Units	7.94 (7.85-8.03)	8.02 (7.96-810)	7.90 (7.97-7.98)	6.0-8.5
Salinity	0/00	30.5 (28-34)	30.9 (28.5-32.5)	31.1 (30-32)	-
Conductivity $x10^3$	$\frac{\mu mhos}{cm}$	486 (460-500)	496 (480-500)	497 (490-500)	-
DO	mg/l	6.5 (6.4-6.6)	6.4 (6.3-6.7)	6.3 (6.2-6.5)	5
BOD	mg/l	1.2 (1-2)	1.5 (1-2)	1.2 (1-2)	7
COD	mg/l	6.8 (4-12)	25.8 (4-57)	17.2 (4-35)	-
Total SS	mg/l	33 (21-58)	27.7 (19-38)	29.5 (11-46)	30
Total DS	mg/l	34387 (31123-35891)	34593 (32932-35851)	34828 (34304-35697)	-
NO_3-N	mg/l	0.0091 (0.0014-0.034)	0.0092 (0.0024-0.0250)	0.0113 (0.0014-0.0350)	-
PO_4-P	mg/l	1.305 (0.112-5.800)	2.360 (0.116-8.960)	1.313 (0.224-3.248)	-
Surfactants	mg/l	0.67 (<0.1-2.6)	0.50 (<0.1-2.6)	0.7 (<0.1-2.6)	0.5
Oil and Grease	mg/l	2.37 (0.5-5.00)	2.45 (0.56-8.22)	4.05 (0.6-12.90)	3.0
Phenol	mg/l	0.003 0.001-0.015)	0.001 <0.001-0.002)	0.002 (<0.001-0.008)	-
Arsenic	mg/l	<0.01	<0.01	<0.01	0.05
Cadmium	mg/l	0.056 (0.053-0.060)	0.065 (0.053-0.077)	0.066 (0.050-0.093)	0.01
Chromium (VI)	mg/l	0.099 (<0.001-0.393)	0.132 (<0.001-0.442)	0.138 (0.001-0.442)	0.10
Copper	mg/l	0.070 (0.067-0.073)	0.075 (0.067-0.085)	0.073 (0.067-0.085)	0.05
Lead	mg/l	0.396 (0.335-0.484)	0.401 (0.298-0.491)	0.376 0.298-0.446)	0.05
Mercury	mg/l	0.0001 (0.0001-0.0002)	0.0002 (0.0006-0.0003)	0.0002 (0.0002-0.0004)	0.002
Zinc	mg/l	0.049 (0.032-0.076)	0.041 (0.035-0.050)	0.039 (0.035-0.0114)	-
Total Coliform	$\frac{MPN}{100\ ml}$	660.8 (7->1600)	76.8 (<2.2-300)	265.5 (8-1600)	1000
Fecal Coliform	$\frac{MPN}{100\ ml}$	331.9	17.5	52.1	-

* NSDW = National Standard for Drinking Water (DOH)
- No Water Quality Standard recommended

Table 2-11
DISTANCE AND DEPTH PROFILE OF WATER QUALITY OF COASTAL AND MARINE WATERS OF SARANGANI BAY

WATER QUALITY PARAMETERS	DISTANCE FROM SHORE			DEPTH LEVEL		DISTANCE VS DEPTH	WATER QUALITY CRITERIA
	100m	500m	1000m	0.5m	7.0m		
Color	1.05	6.5	10.8	6.4	15.1	9.3	5.0
Temperature °C	26.3	27.0	27.3	26.9	-	-	3°C rise
pH	7.94	8.02	7.98	7.97	-	-	6.0 - 8.5
Salinity 0/00	31.8	30.4	30.2	30.5	31.1	30.8	-
Conductivity $x10^4$	497	492	489	486	499	493	-
DO	6.5	6.3	6.4	6.4	-	-	5
BOD	1.3	1.2	1.4	1.3	1.3	1.3	7
COD	14.4	15.9	19.3	15.2	19.2	17.2	-
Total SS	25.4	30.5	34.3	29.8	43.3	30.1	30
Total DS	34627	34812	34924	34970	34832	34788	-
NO_3-N	0.008	0.013	0.011	0.014	0.002	0.011	-
PO_4-P	2.89	1.40	2.18	1.60	0.45	2.16	-
Surfactant x 10^{-4}	0.90	0.85	0.58	0.75	0.23	0.78	0.5
Oil and Grease (mg/l)	3.3	2.3	3.2	2.6	2.6	2.96	3.0
Phenols	0.0013	0.0027	0.0023	0.003	0.001	0.002	
Arsenic	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05
Cadmium	0.06	0.065	0.059	0.059	0.068	0.062	0.01
Chromium VI	0.142	0.132	0.149	0.149	0.001	0.0124	0.10
Copper	0.075	0.074	0.069	0.073	-	-	0.05
Lead	0.408	0.418	0.376	0.376	0.31	0.393	0.05
Mercury	0.0003	0.00006	0.0002	0.0002	-	-	0.002
Zinc	0.045	0.036	0.049	0.044	-	-	-
Total Coliform	467	170	114	438	18	333	1000
Fecal Coliform	98	63	274	185	9	139	-

Note: Mean values are reported for each parameter.
- No Water Quality Standards recommended.

7. The organic chemicals showed moderately elevated values with maximum values estimated at 2.6 mg/l surfactant, 12.90 mg/l oil and grease, and 0.008 mg/l phenols.

8. Among the trace elements analyzed, Cadmium (Cd), Chromium Hexavalent (Cr VI), Copper (Cu), and Lead (Pb) showed elevated values independent of distance and depth.

9. Total coliform counts tended to increase nearshore with peak counts of fecal coliforms recorded in the Upper Makar area.

- Water Quality Classification of Sarangani Bay

Sarangani Bay and its tributary rivers remained unclassified at present (Gonzales, E., Water Quality Division, EMB, pers.comm., April 3, 1991). With the implementation of the DENR Administrative Order No.34 (dated March 20, 1990) it is anticipated that water quality criteria will be established for the surface freshwater and coastal marine waters of southern Mindanao.

The Environmental Management and Protected Areas Service of the Regional DENR Office in Davao City is currently undertaking water quality monitoring of coastal marine waters in the region (Estrada, G.T., Regional Technical Director, DENR, pers. comm., March 15, 1991).

A USAID-assisted program on water quality monitoring of Sarangani Bay is expected to commence in May 1991 with participation of Dole Philippines Inc. and the Mindanao State University (Suazo, R. pers. comm. March 30, 1991, see Appendix D-12).

In the Feasibility Study undertaken for the Agro-Processing and Fish-Port Facilities undertaken by SINGCONSULT in 1990, it was recommended that water quality criteria for Class SB coastal marine waters be adopted for the water quality impact assessment of the proposed project. This water classification applies to waterbodies which are intended primary for contact recreation and fish spawning.

With the current multiple use of Sarangani Bay and the existing environmental condition of the project site, it seems logical to recommend the Class SC Classification criteria as bases for evaluating the significance of the water quality impact of the proposed port development at the Makar Wharf. Class SC coastal marine waters are intended for secondary contact recreation and for commercial and sustenance fishery.

The National Water Quality Criteria and Standards for Coastal Marine Waters (Section 68, of the Revised Water Usage and Classification/Water Quality Criteria) is presented in Appendix D-1.

84

Table 2-12

PERCENT EXCEEDANCES OF WATER QUALITY CRITERIA FOR COASTAL AND MARINE WATERS OF SARANGANI BAY

WATER QUALITY PARAMETERS	* WATER QUALITY CRITERIA	NO. OF SAMPLES	DATA OF EXCEEDING WATER QTY. CRITERIA	
			NO	%
Color (PCU)	>5	27	9	33
pH Units	6.0-8.5	9	0	0
DO	<5.0	9	0	0
BOD	7.0	27	0	0
Total SS	30	27	12	44
Surfactant	0.5	26	10	38
Oil and Grease	3.0	27	10	37
As	0.05	9	0	0
Cd	0.01	27	26	96
Chromium VI	0.1	26	8	31
Cu	0.05	9	9	100
Pb	0.05	26	26	100
Hg	0.002	9	0	0
Total Coliform	1000	26	3	12

* Source: Revised water usage and classification/water quality criteria.
DENR Administrative Order No. 37, March 20, 1990

85

An analysis of the percent proportion of the water quality data that exceeded the established criteria for the parameters investigated is presented in Table 2-12.

It is worthwhile to note that nearly 100 percent of the water samples analyzed contained the trace elements Cadmium (Cd), Copper (Cu), and Lead (Pb) at concentrations which exceeded the established maximum permissible limits for coastal marine waters. The elements Cd and Pb are known to cause toxic and deleterious physiological effects on aquatic life and humans.

Other water quality parameters which registered moderate exceedances of the established water quality criteria include color, TSS, surfactants, oil and grease, Cr (VI), and total coliforms.

- Water Pollution Problems of Sarangani Bay

There are no reported cases of pollution problems at the Makar Wharf (R. Cadiz, Terminal Operation Officer, PPA, Wharf, pers. comm. March 30, 1991).

Floodwaters and domestic sewage of undetermined volume can be handled by existing storm drains and sewers. These discharges are allowed to drain directly into the bay where natural dilution at sea provides the necessary treatment to reduce their pollution load.

Bilge waters and liquid wastes from vessels are normally disposed at high sea. There is no provision for the disposal of liquid waste in the port at present.

The volume of solid wastes generated from on-land facilities and from the vessels is unknown. However, garbage and refuse including livestock manure collected from the port or from cargo vessels are disposed at dump sites located outside the port area. Littering in the port and in cargo vessels is uncommon. Unconfirmed cases of sea dumping of garbage by cargo vessels calling at Makar Wharf was also reported. Floating debris litter the shoreline near the Makar Wharf.

Metal scraps, rust shavings, and construction wastes generated from the maintenance and repair of ships and vessels are contained and disposed of properly. There were no reported cases of accidental spills of chemicals and paints nor of intentional discard of refuse into the baywaters.

Cargoes containing toxic and hazardous chemicals such as fungicides, insecticides, fertilizers, veterinary products, and other chemical products and preparations are either kept in transit sheds or stored in private warehouses. Decomposable or perishable cargoes including agricultural commodities such as grains and cereals are also handled and stored in the port. However, there were no reported cases of spillage, fire, or explosion involving these type of cargoes. There is fire fighting equipment and fire hydrants located in strategic areas in the port.

86

Oil spills on land or at sea have not been reported in the vicinity of the Makar Wharf. No spillage was reported involving the palm oil depot on the west end of the port. At present there are no established provisions to handle oil spill contingencies at port or offshore.

It is evident that the present port operations at the Makar Wharf do not contribute significantly to the deterioration of water quality of Sarangani Bay. It is widely held that the current pollution problems in Sarangani Bay could be attributed largely to commercial, industrial, agricultural and aquacultural point sources of pollutants. These establishments are known to discharge large volumes of wastewaters containing high concentrations of decomposable organic matter and suspended solids.

Runoff of agricultural chemicals and top soil have been implicated in the pollution problems in Sarangani Bay. It is known that silt causes sedimentation of river beds and reabeds in the area. These have been commonly attributed to soil erosion resulting from land clearing, farming, and livestock raising in the watershed of Sarangani Bay and its tributary rivers.

- Water Quality of Makar Ground Water Supply

The results of the water quality of the free flowing wells within the zone of influence of the project site are summarized in Table 2-13. The location of the sampled wells is also indicated in Figure 2-16. Based on limited information generated from this water quality survey some important observations are made:

1. Well water was found to be generally clear, tasteless, with slight sulfurous odor. The high color value recorded for Lower Makar may be related to the recent case of water fouling reported.

2. The pH of well waters were within the range of neutrality.

3. Except for a slight increase in Pb, trace elements were so low as to cause no alarm.

4. Elevated levels of synthetic detergents and oil and grease were noted in all well waters analyzed.

5. Chloride and hardness values were relatively higher in the Upper Makar well waters.

6. Total and fecal coliform were generally low. Two samples obtained from the Wharf well gave higher counts exceeding 10 MPN/100 ml.

Table 2-13

RESULTS OF WATER QUALITY ANALYSIS FOR WELL WATER

SAMPLING SITES	UPPER MAKAR	LOWER MAKAR	MAKAR WHARF	NSDW STANDARD *
Color (PCU)	5	38	2	5
pH (Unit)	7.41	7.40	7.38	6.5 - 8.5
DO (mg/l)	1.80	1.75	2.40	-
BOD (mg/l)	1	1	1	-
COD (mg/l)	151	69	33	-
Total SS (mg/l)	3	2	2	-
Total DS (mg/l)	1321	494	422	-
Surfactants	ND-0.00039	ND-0.00039	ND-0.00039	0.5
Oil and Grease (mg/l)	5.90	0.20	5.40	nil
Phenol (mg/l)	0.002	ND	ND	0.001
NO3 - N (mg/l)	0.450	0.700	0.500	30
PO4 - P (mg/l)	6.032	5.104	4.176	-
Total Coliform	< 2.2	< 2.2	< 2.2	-
Fecal Coliform	< 2.2	< 2.2	< 2.2	-
Chloride as Cl (mg/l)	74.65	37.74	25.92	200
Copper (mg/l)	0.012	ND	ND	1.00
Arsenic (mg/l)	ND	ND	ND	0.05
Cadmium (mg/l)	ND	ND	ND	0.01
Chromium VI (mg/l)	ND	ND	ND	0.05
Lead (mg/l)	0.859	ND	ND	0.05
Total Mercury (mg/l)	0.0002	0.0001	0.0002	0.002
Zinc	0.028	0.025	ND	5.00

* National Standard for Drinking Water Quality,
Bureau of Research and Laboratories, Department of Health, Manila

\- No Water Quality Standard Recommended

- Water Quality Standards for Domestic Water Use

  Water intended for human consumption must be free from organisms and from concentrations of chemical substances that may be a hazard to health (WHO, 1971).

  To assess the suitability of well waters within the zone of influence of the project site, water quality data were compared with the National Standard for Drinking Water established by the Department of Health (Appendix D) and the International Standard for Domestic Water established by the WHO in 1971 (Appendix D).

- Water Usage Practices in Makar

  Based on site inspection and interviews held last March 30, 1991, the water use practices in the Makar communities found within the zone of influence of the project site were noted and are reported below.

  Expectedly, the poor sanitary conditions in the area (i.e., no toilet facilities in homes and communities) could promote fecal contamination of the water supply and increase the incidence of water-related illnesses including dysentery and parasitism in the area.

  Some residents believed that the unsanitary handling and storage of water (e.g. use of dirty collection bottles or jugs and uncovered storage jars) were more important in causing water-related diseases than fecal contamination of water supply.

  Boiling of water for infant's use was a common practice. Herbal medication was usually employed to relieve intestinal disorders. Hospitalization due to water-related diseases was rarely resorted to. Unconfirmed cases of death among children caused by drinking contaminated water were also reported.

  Water supplied to berthed ships in the Wharf does not receive any form of treatment. Disinfection of water is done by the water consumers themselves (e.g., chlorination of water in passenger-cargo vessels).

2.4.4 Oceanography

The oceanographic characterization of the project site is largely based on secondary information available for the site. Some information was obtained from the 1972 Feasibility Study for the expansion of the Makar Wharf made by Sir William Halcrow and Partners. More recently, Dames and Moore conducted some oceanographic studies near the site of the proposed agro-industrial complex at Tambler. The large- scale wind-driven surface circulation at the northern portion of Sarangani Bay was characterized using a mathematical model. The results of the simulation are consistent with some of the observed features.

2.2.4.1 Tides

The predicted tides at Sarangani Bay is based on the tide data of Legazpi port in Albay, Luzon according to the 1991 Predicted Tide and Current Tables published by the National Mapping and Resources Information Authority (NAMRIA), Department of Environment and Natural Resources. These are semi-diurnal in character with a mean tidal range is about 1.37 m and a diurnal range of about 1.62 m.

2.2.4.2 Currents

The current system of Sarangani Bay is not well known but may be assumed as a composite of tide-induced oscillatory motion and a primarily wind-driven surface circulation. During the rainy season, the coastal currents may be influenced also by fresh water discharges from the various rivers draining into the bay.

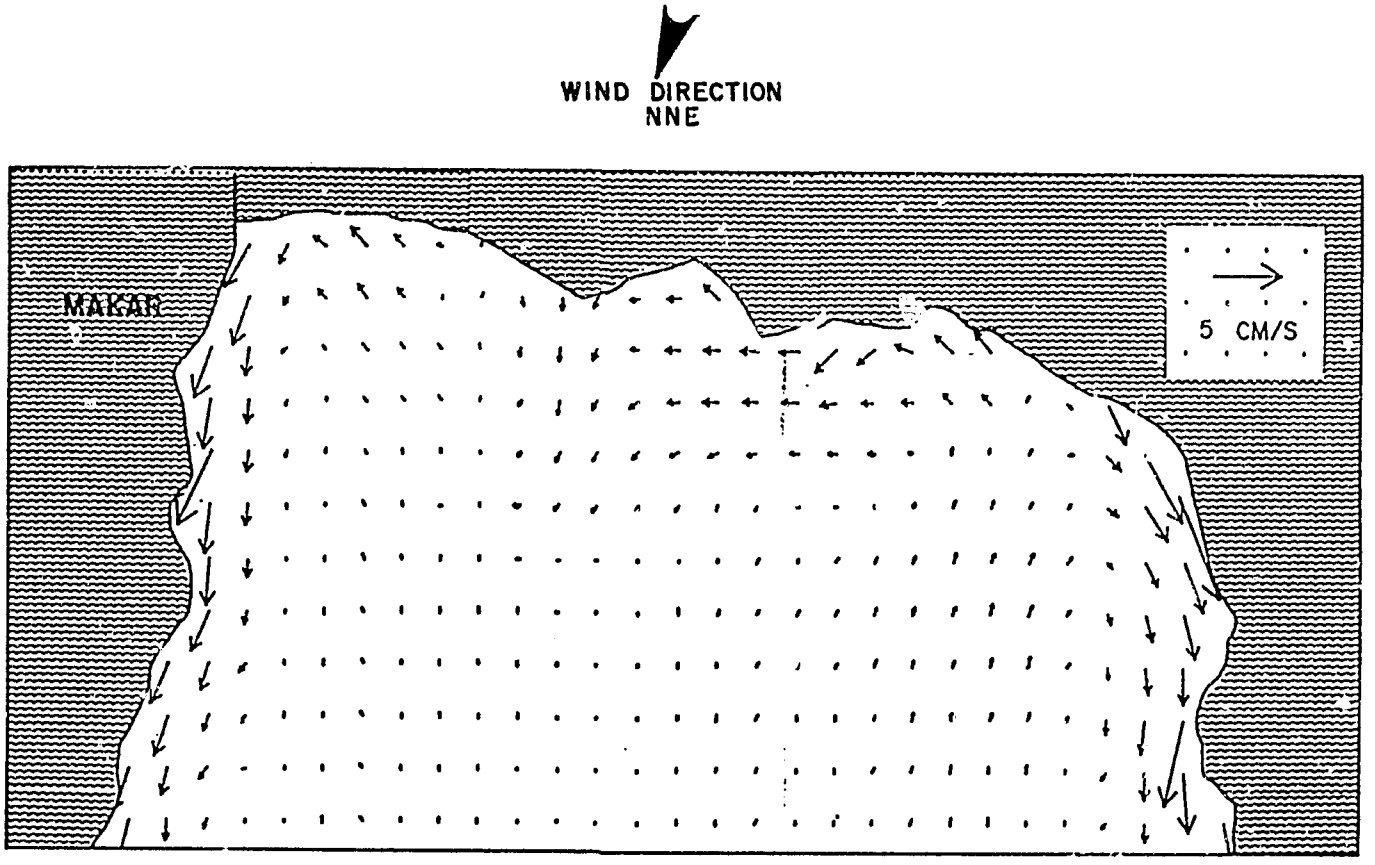
Information provided by fishermen, harbor pilots and ship masters suggest a northeastward flow during flood and a southwestward flow during ebb in the vicinity of Makar Wharf. This is consistent with the findings of Dames and Moore Ltd., which conducted an oceanographic survey for the proposed agro-processing center at Tambler, about 7 km south of Makar. Current speeds from near zero to about 100 cm/sec were observed near the reef flats at Tambler. Their observations also suggest tide currents of 60 to 75 cm/sec during ebb and 35 to 50 cm/sec during flood.

Aside from tidal influences, the surface waters of Sarangani Bay circulate in response to the tangential stress exerted by the wind at the sea surface. In order to characterize the large scale wind-driven surface circulation of northern Sarangani Bay, a depth- integrated mathematical model was applied using two prevailing wind scenarios. The results of the simulations are shown in Figure 2-18 for the NNE wind direction and Figure 2-19 for the SSW wind direction. The results showed that the wind-driven current components near the Makar Wharf generally follow the surface wind vector. The current speeds are greater in shallower areas where speeds are in the order of 5 cm/sec.

The large scale current system is generally perturbed by small scale eddies induced by the presence of coral reefs in the area. These perturbations are short-lived irregularities in current speeds and directions which are superimposed on the much larger wind-driven circulation. Observations conducted by Dames and Moore Ltd., showed the presence of these small scale eddies in the vicinity of the reef face at Tambler.

Longshore currents are also significant as far as sediment and pollution transport is concerned. At the Makar Wharf, the dominant longshore current is directed to the northeast since the wind waves in the area will be predominantly from the southeast.

90



WIND DIRECTION : N N E

WIND SPEED : 4.0 M/S

LEGEND :

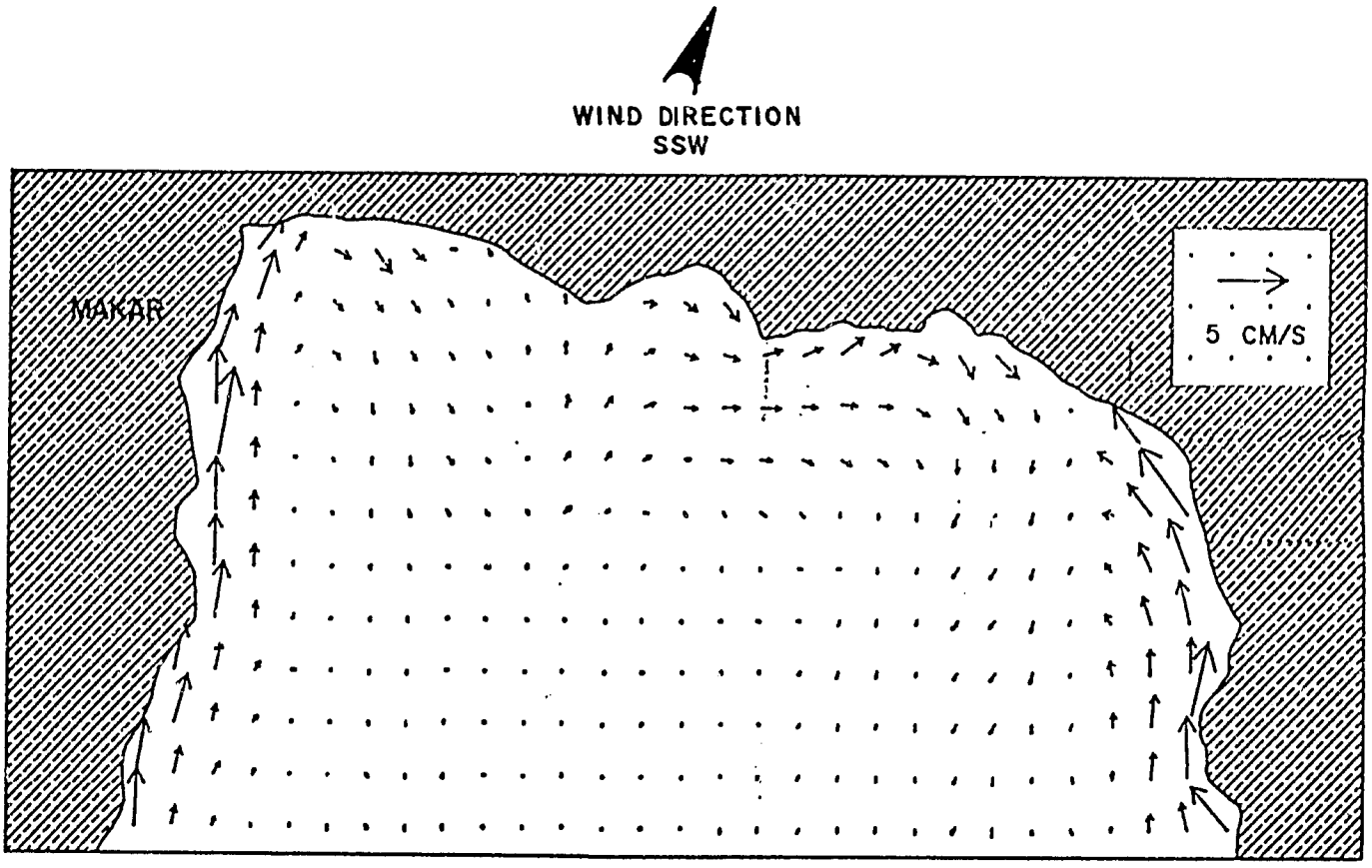
CURRENT DIRECTION

SEA (SARANGANI BAY)

LAND

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT 492-0452-C-00-0099-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-18
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L • ERNST & YOUNG INT'L • GLOBETROTTERS ENG'G. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC	CALCULATED DEPTH- AVERGED WIND-DRIVEN CURRENT SPEED (CM/S) AT SARANGANI BAY	

91



WIND DIRECTION : SSW

WIND SPEED : 4.0 M/S

LEGEND :

→ CURRENT DIRECTION

SEA (SARANGANI BAY)

LAND

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT 492-0452-C-00-0069-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-19
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L • ERNST & YOUNG INT'L • GLOBETROTTERS ENG'G. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC	CALCULATED DEPTH-AVERGED WIND-DRIVEN CURRENT SPEED (CM/S) AT SARANGANI BAY	

9V

2.4.4.3 Waves

A study of the wave condition at Makar Wharf was conducted by Sir William Halcrow and Partners for the port expansion feasibility study in 1972. This study established the probable maximum wave height that may result from a typical tropical cyclone located over Celebes Sea southwest of Sarangani Bay. The predicted significant wave height is 10.4 m with a corresponding period of 12.5 sec. This wave height reduces to 3.7 m, period of 7.4 sec at the entrance of Sarangani Bay. Due to wave diffraction around the Calumpang Point, the expected maximum wave height at the southwest end of the wharf is 0.6 m and 1.5 m at the northeast end of the wharf. However, because of its low latitude (about 5 deg N), the chance of occurrence of tropical cyclones in the Celebes Sea or in Sarangani Bay is extremely small.

The probability values for other significant wave heights are shown in graphs reproduced in Figure 2-20.

2.4.4.4 Sediment Transport

The 1972 and 1991 hydrographic maps of the Makar Wharf area were compared qualitatively to determine roughly the bathymetric changes in the sea bed during the period. Areas of accretion and erosion were identified in Figure 2-21.

It appears that the Makar River, which discharges only during heavy rainfall, was, nevertheless, a significant source of sediment. Sediment released by this river was transported northeastward along the existing quay probably by the littoral drift. Erosion seems to be taking place along the eastern end of the wharf. Eroded material in this area appeared to be transported seaward toward the deeper and steeper portion of the sea floor. This erosion probably resulted from the dredging operations that took place during the extension of the port in 1975.

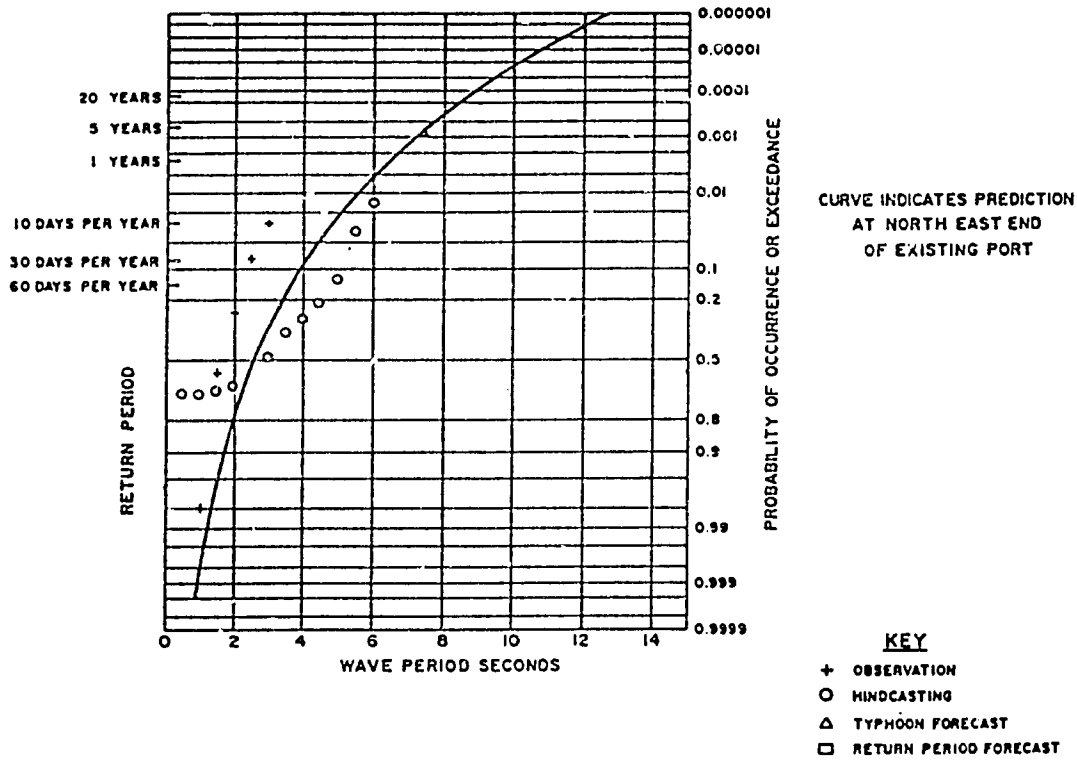
2.4.5 Geology, Soils and Topography

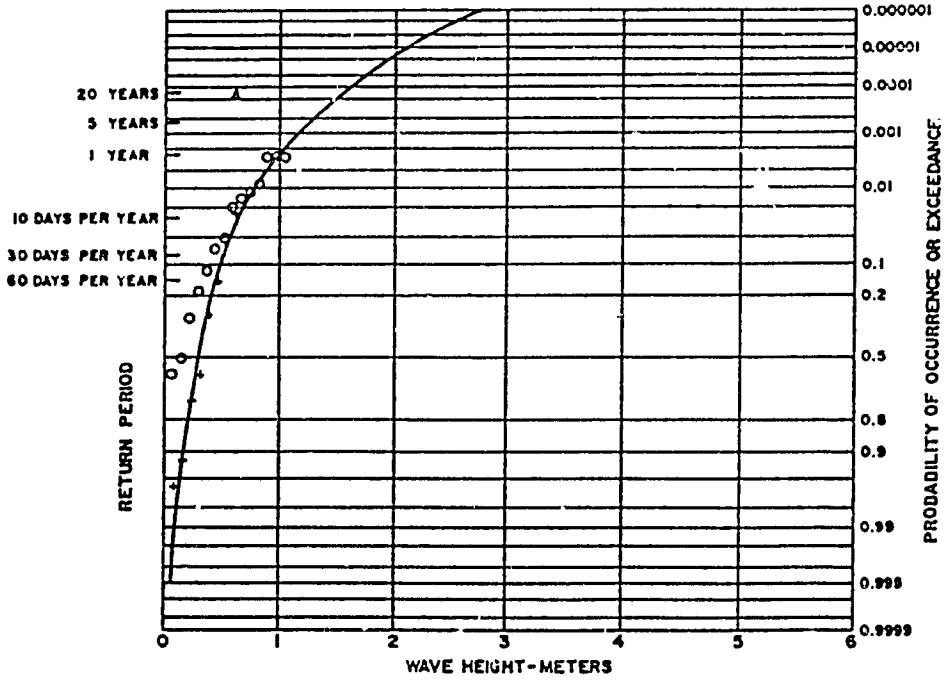
The geology, soils and topography component of the Makar Wharf Environmental Assessment deals primarily with the identification and assessment of the physical properties that affect the quality of the local and surrounding environments of the proposed Makar Wharf.

For the purposes of this report the zone of influence for geology, soils and topography is considered as the Makar River watershed area to provide the basis for the estimation of changes brought by natural processes (external factors) and by the Makar Wharf development project itself (site factors).

The total area of the watershed of the Makar River is approximately 17,928 hectares. The present Makar River have been diverted upstream for irrigation purposes and the river bed is dry adjacent to Makar Wharf.

97





Source: SIR WILLIAM HALCROW & PARTNERS-1971·General Santos Report·

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0453-C-00-0099-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-20
LOUIS BERGER INTERNATIONAL, INC. •LOCKWOOD GREENE INT'L. •ERNST & YOUNG INT'L •GLOBETROTTERS INFO CORP. •TRANS-ASIA (PHIL.), INC. •CONSULTANT MANAGEMENT SERVICES, INC.	WAVE PREDICTIONS	

94

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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

QUALITATIVE COMPARISON BETWEEN 1972 AND 1991 HYDROGRAPHIC SURVEY

FIGURE 2-21

2.4.5.1 Geology

The Makar Wharf project site is composed mainly of mixed unconsolidated sedimentary materials (recent alluvium) formed from sandstones, coralline limestones and volcanic fragments from the nearby volcanic mountains (Figure 2-22). These geological materials occupy an area of approximately 1,840 ha. In general, the upper layer of recent alluvium extends to a depth of 3 m, is formed of mostly coarse, non-plastic and non-sticky sandy loams and loamy sands. The underlying materials are coralline limestones which are relatively impervious in some places. Under the sand-coralline layers, are varying stratifications of loose clayey muds and volcanic materials.

The areas outside the Makar Wharf project site are composed of two major geologic formations - - the Banga Formation and the Pyroclastics (Figure 2-22). The Banga Formation, which comprises 5,312 ha of the watershed, is comprised of remnants of erosional landscapes and represents the elevated and dissected first level residual terraces of the watershed. The underlying materials are conglomerates intermixed with various sedimentaries such as siltstones, tuffaceous sandstones, and shales. This interbedding of sedimentaries and conglomerates are likewise intercalated with coralline limestones which occupy the seaward edge of the Banga Formation. The conglomerates are rounded and sub-rounded volcanic pebbles which are similar in composition to the volcanic materials obtained from the ejecta of Mount Matutum. When completely weathered these geological materials produce the finer sediments (silts and clays) to generally sandy materials found near the bay.

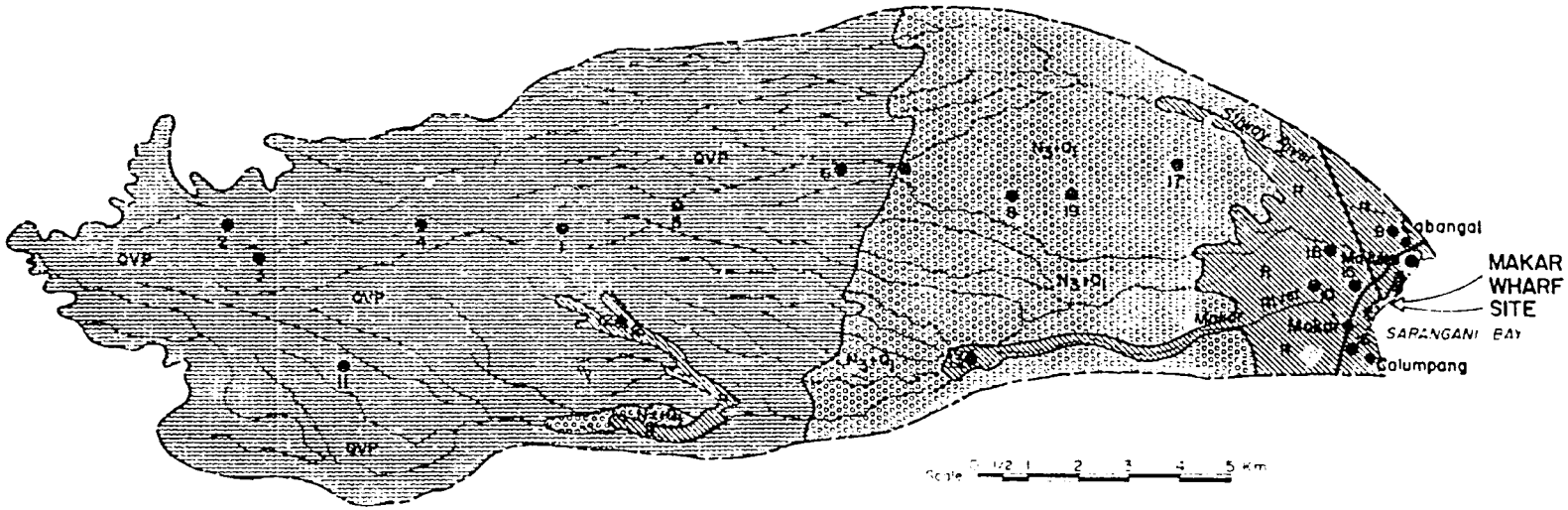
The Pyroclastics, which comprise 10,776 ha of the watershed, are the most extensive geologic materials in the watershed and are mainly composed of thick deposits of volcanic ejecta which form a continuous blanket covering the areas downslope of the volcano. The ejecta are composed of various materials such as ash, volcanic sands, cinders, tuff and other volcanic debris. This geologic materials give rise to well drained acid soils which are normally saturated with aluminum. Bureau of Soils and Water Management (BSWM) studies do not indicate the presence of any harmful heavy metals from the watershed. These volcanic soils exhibit fair to good soil fertility and are cultivated to various crops, mainly high yielding corn. The major input for this kind of soil is lime as well as phosphorous fertilizers.

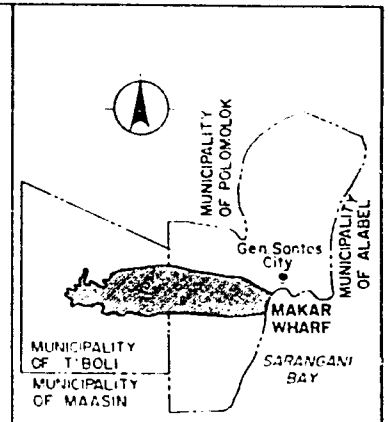
2.4.5.2 Soils and Landforms

The Makar Wharf is situated on landforms comprised of beach ridges and swales which are characterized by a dominance of sandy alluvial deposits underlain by thick and mixed strata of coraline limestone, tuffaceous shale, and volcanic debris.

The soils layers described by well drillers varied both in depth and in composition which include the sandy loam, clay, muds, coraline limestone,,and volcanic materials appearing at various thickness and depths. Clay muds vary in thickness, from one to two meters, while the volcanic sediments normally occur deep in the profile (30 m or more).

a6





LOCATION MAP

LEGEND:

GEOLOGIC FORMATION	GEOLOGIC TIME SCALE	ROCK TYPE	AREA (ha)	PERCENT (%)
RECENT ALLUVIUM (R)	Recent	Unsorted and Unconsolidated Sediments	1840	10.26
BANGA FORMATION (N_3+Q_1)	Pliocene - Pleistocene	Conglomerate	5312	29.63
PYROCLASTICS (QVP)	Pliocene - Quaternary	Pyroclastics	10776	60.11
TOTAL			17928	100%

AGE	SYMBOL	GEOLOGIC FORMATION	DESCRIPTION
A SEDIMENTARY ROCKS			
Recent	R	Recent Alluvium	Consist of fluviatile & paludal sediments (unsorted & unconsolidated clay, silt, sand, gravel, boulders & beach deposits) found in floodplains, stream beds & banks, flat areas, meander cut-offs & beach ridges; fringes of colluvium of the foot of hills, fault scarp detritus & alluvial fans composed of reworked pyroclastics & basalt fragments.
Pliocene - Pleistocene	N_3+Q_1	Banga Formation	Marine clastics consisting of tuffaceous sandstone, siltstone & shale interbedded w/ few lenses of micro & macro conglomerates. Reef limestone lenses intercalates w/in the formation.
B IGNEOUS ROCKS			
Pliocene Quarternary	QVP	Pyroclastics	Thick deposits of volcanic ejecta made up of volcanic sand, ash, cinder mixed w/ bombs & fine materials, tuff & other volcanic debris

CONVENTIONAL SIGN :

- Makar River Watershed Boundary
- Road
- River / Creeks
- QVP, R, N_3+Q_1 — Mapping Unit
- Barangay

SOURCES OF INFORMATION AMS topographic map series scale 1:50,000 compiled in 1956 Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey team.

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1 - Soil observation site.

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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

GEOLOGICAL MAP AND LOCATIONS OF SOIL OBSERVATIONS

FIGURE 2-22

Soils borings done by the BSWM indicate that the non-plastic sandy layers may extend anywhere between one to three meters, mixed with fragments of coralline limestones. The field pH values tend to become alkaline with greater soil depth indicating the influence of coralline limestones and possibly brackish water in the subsoils (see Soil Boring numbers 14 and 16, Appendix D-7). The locations of the soil borings done in the study area by BSWM are shown in Figure 2-22.

The physical and environmental properties observed for the soils and landforms in the entire Makar River watershed areas are summarized in Table 2-14. The individual soil descriptions observed at the BSWM soil boring sites are presented in Appendix D of this report.

The soils and their geomorphological properties are mapped as the Land Management Units (LMU) which are landscape units that have similar management properties (Figure 2-23). Each LMU has a similar set of soils, slope, land uses, and geological materials.

The lowland soil areas (LMU 08, 09HD, 12HD, and 16D) represent about 8.3 percent of the watershed. Except for minor differences in soil depth, slope and topographic positions, all of these lowland soils have coarse soils, of mainly loamy sands and sandy soil textures. These soils are also well drained and uneroded. Soil observations done to three meters, showed that most soil profiles are dominated by non-sticky and non-plastic, very permeable, sandy materials. It is on these types of soils that the existing Makar Wharf was built.
The upland soils (LMU 44, 51EF, 53D, and 53DO) are likewise deep, gently sloping and undulating (8-18 percent slopes), well drained and slightly eroded. These soil units occupy the base of the mountain slopes (footslopes) and represent approximately 30.5 percent of the Makar River watershed.

The hilly soils (LMU 114 and 116) are primarily sloping lands underlain by pyroclastic materials. The slopes exceeding 18 percent, are located in areas with more than 100 m of elevation and represent about 23.3 percent of the watershed. These units are subjected to various degrees of soil erosion and are devoted to agricultural use or dominated by grass and brush vegetation.

The mountain soils (LMU 157,164, and 170) are a combination of steeply sloping pyroclastics, andesites, and volcanic cone landscapes. Soils in these landscapes are highly eroded and are grown to various vegetation and marginal land uses. These soil units represent about 36.9 percent of the watershed.

2.4.5.3 Soil Erosion

Soil erosion is very evident in the hilly and mountainous portions of the watershed. This is to be expected due to the very low organic matter and the types of land uses that dominate the landscape. The Consultant also observed that practically all of the river systems in the areas adjoining the project are braided and sandbars are evident in the nearshore areas along Sarangani Bay.

Table 2-14
AREA (ha) DISTRIBUTION OF SLOPE, EROSION, LAND USE AND GEOLOGY BY LAND MANAGEMENT UNITS (LMU)

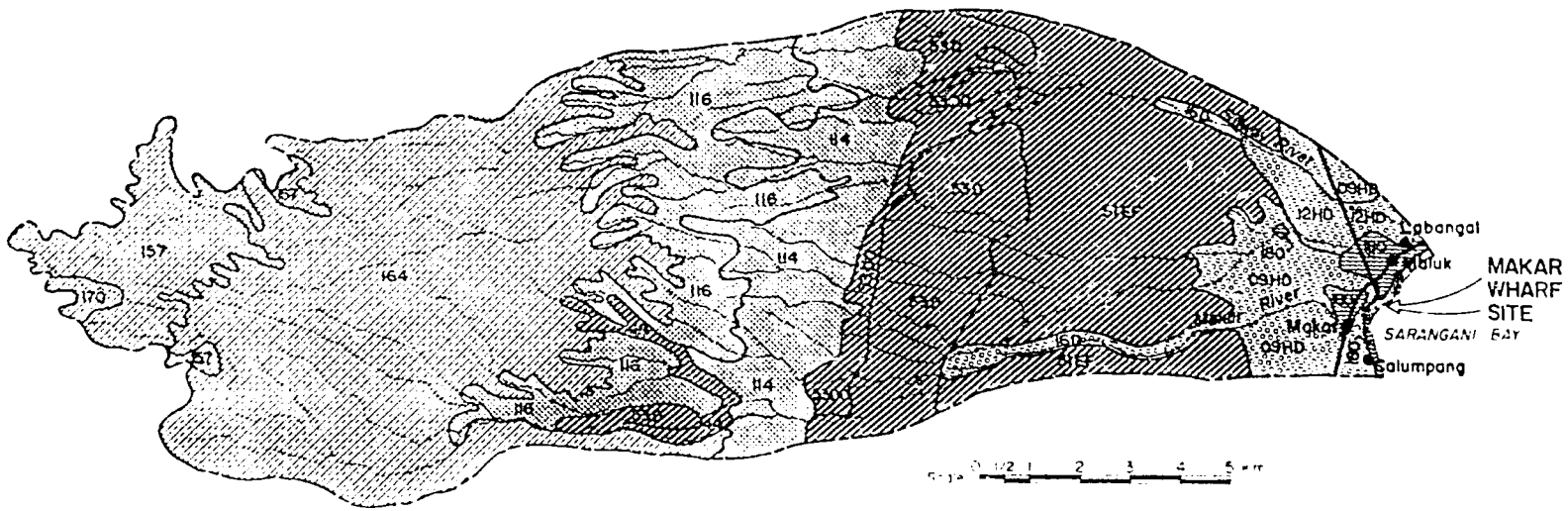
LMU	DESCRIPTION	AREA (ha)	SLOPE	AREA (ha)	EROSION	AREA (ha)	LAND USE	AREA (ha)	GEOLOGY	AREA (ha)
08	Beach ridges and swales	12	M	12	EO	12	Beach Sand	12	R (Recent Alluvium)	12
180	Built-up	188			Eu	188	Built-up	188	R (Recent Alluvium)	
09 HD	Broad alluvial plains (width > 500 m) well drained, light textured soil	960	M	960	EO	960	Coconut	162	R (Recent Alluvium)	960
							Corn	26		
							Banana	96		
							Grass	528		
							Shrubs	134		
							Cotton	1		
							Pasture	13		
12 HD	Lower river terraces, well drained, light textured soil	300	M	300	EO	300	Grass	109	R (Recent Alluvium)	300
							Coconut	106		
							Pasture	34		
							Shrubs	31		
							Corn	18		
							Cotton	2		
16 D	Infilled/Localized valleys, light texture soil (<100 m elevation, <8% slope)	216	M	176	E1	36	Corn	80	R (Recent Alluvium)	216
			N	40	EO	180	Grass	61		
							Pasture	48		
							Shrubs	20		
							Cotton	7		
44	Infilled/Localized valleys (>100 m elevation, <8% slope)	164	N	32	E1	40	Grass	99	R (Recent Alluvium)	164
			O	44	E3	124	Shrubs	49		
			P	80			Corn	16		
			Q	8						
51 EF	Lower footslopes (volcanic hills and mountains), medium to heavy textured soil	3,112	M	2,668	EO	2,692	Pasture	1,387	N3 + Q1 (Bangs Formation)	3,112
			N	444	E1	324	Corn	796		
					E3	96	Grass	434		
							Shrubs	239		
							Cotton	156		
							Banana	88		
							Coconut	12		

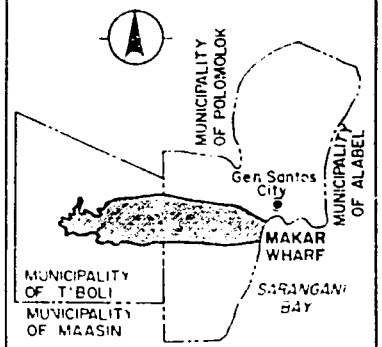
99

Table 2-14 (continued)
AREA (ha) DISTRIBUTION OF SLOPE, EROSION, LAND USE AND GEOLOGY
BY LAND MANAGEMENT UNITS (LMU)

LMU	DESCRIPTION	AREA (ha)	SLOPE	AREA (ha)	EROSION	AREA (ha)	LAND USE	AREA (ha)	GEOLOGY	AREA (ha)
53 D	Upper footslopes (volcanic hills or mountains), light textured soil	1,684	M	444	EO	452	Corn	1,440	N3 + Q1 (Banga Formation)	1,684
			N	1,220	E1	1,172	Grass	107		
			O	20	E3	60	Shrubs	69		
							Pasture	64		
							Cotton	4		
53 DO	Upper footslopes (volcanic hills or mountains), light textured soil, moderately sloping to rolling	516	O	476	E1	20	Corn	462	N3 + Q1 (Banga Formation)	516
			P	40	E3	496	Grass	16		
							Vegetable	16		
							Shrubs	10		
							Coconut	10		
							Melon	2		
114	High Pyroclastic hills	1,920	N	212	EO	32	Corn	1,269	QVP (Pyroclastics)	1,920
			O	1,192	E1	252	Grass	306		
			P	516	E3	1,636	Vegetable	197		
							Shrubs	124		
							Coconut	21		
							Melon	3		
116	High Andesitic hills	2,248	N	12	E1	20	Grass	1,217	QVP (Pyroclastics)	2,248
			O	1,604	E3	2,228	Shrubs	538		
			P	584			Corn	397		
			Q	48			Coconut	96		
164	Andesitic mountains	5,464	O	908	E1	168	Grass	3,379	QVP (Pyroclastics)	5,464
			P	3,692	E3	5,296	Corn	1,011		
			Q	864			Shrubs	979		
							Forest	95		
157	Pyroclastics mountains	1,604	P	316	E1	460	Shrubs	508	QVP (Pyroclastics)	1,064
			Q	748	E3	604	Grass	256		
							Forest	235		
							Corn	65		
170	Volcanic cones, non active	80	P	20	E1	68	Shrubs	43	QVP (Pyroclastics)	80
			Q	60	E3	12	Grass	21		
							Forest	10		
							Corn	6		

100





LOCATION MAP

LEGEND:

MAPPING SYMBOL	DESCRIPTION	AREA (Ha)	PERCENT (%)
08	BEACH RIDGES AND SWALES	12	0.07
09 HD	BROAD ALLUVIAL PLAINS (WIDTH > 500 M.) WELL DRAINED, LIGHT TEXTURED SOIL	960	5.36
12 HD	LOWER RIVER TERRACES, WELL DRAINED, LIGHT TEXTURED SOIL	300	1.67
160	INFILLED/LOCALIZED VALLEYS, LIGHT TEXTURED SOIL (<100 M ELEVATION, <8% SLOPE)	216	1.20
4a	INFILLED/LOCALIZED VALLEYS (>100 M ELEVATION, <8 % SLOPE)	164	0.91
51EF	LOWER FOOTSLOPES (VOLCANIC HILLS & MOUNTAINS) MEDIUM TO HEAVY TEXTURED SOIL	3112	17.36
53D	UPPER FOOTSLOPES (VOLCANIC HILLS OR MOUNTAINS) LIGHT TEXTURED SOIL	1684	9.39
53DD	UPPER FOOTSLOPES (VOLCANIC HILLS OR MOUNTAINS) LIGHT TEXTURED SOIL, MODERATELY SLOPING TO ROLLING	516	2.88

LEGEND:

MAPPING SYMBOL	DESCRIPTION	AREA (Ha.)	PERCENT (%)
114	HIGH PYROCLASTIC HILLS	1920	10.71
116	HIGH ANDESITIC HILLS	2248	12.54
157	PYROCLASTIC MOUNTAINS	1064	5.93
164	ANDESITIC HILLS	5464	30.48
170	VOLCANIC CONES, NON ACTIVE	80	0.45
180	BUILT-UP AREAS / URBAN LANDS	188	1.05
TOTAL		17,928	100.00

CONVENTIONAL SIGN :

- Makar River Watershed Boundary
- Road
- River / Creeks
- 09HD - 12HD / 180 — Mapping Unit
- ● Barangay

SOURCES OF INFORMATION: AMS topographic map series scale 1:50,000 compiled in 1956. Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey Team.

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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LAND MANAGEMENT UNIT MAP

FIGURE 2-23

The Erosion Map (Figure 2-24) provided in this report shows that the majority of the watershed (59 percent) is severely eroded. All of the eroded areas are located in the steep areas of the hilly and mountainous landscapes.

The areas with no apparent erosion comprise about 26 percent of the watershed and are located mainly in lowland plain areas. About 14.3 percent of the watershed is identified as slightly eroded and is located mainly in the hilly areas.

2.4.5.4 Topography

The Makar River watershed lies on the eastern slopes of the Parker Volcano, uppermost portions originating in the steep slopes while the lower portions are found in flat to gently sloping terrain. Figure 2-25 shows the slope classifications of the Makar watershed.

About 37 percent of the watershed is located in the alluvial plains: 27 percent having slopes of 0-3 percent and the remainder having slope of 3-8 percent. The Makar Wharf site is included in the 0-3 percent slope category.

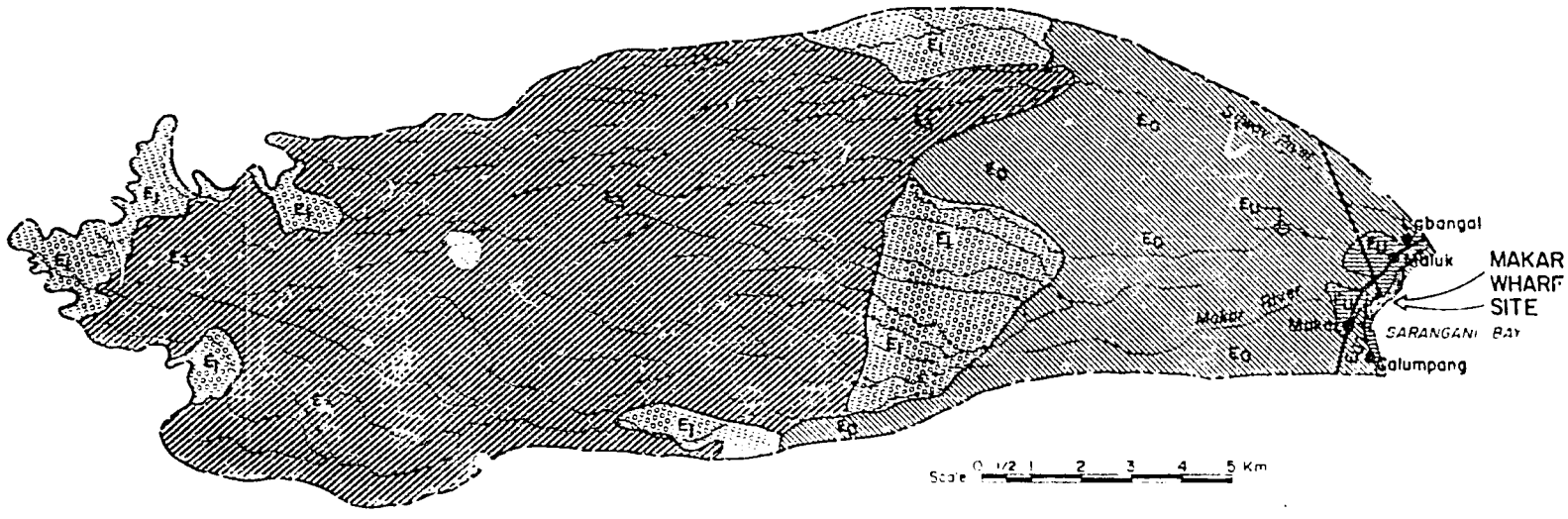
The intermediate uplands have 8-18 percent slopes and occupy approximately 24 percent of the watershed. The remaining 38 percent of lands are classified as steep to very steep and are very susceptible to soil erosion when the surface soils are exposed to heavy rains.

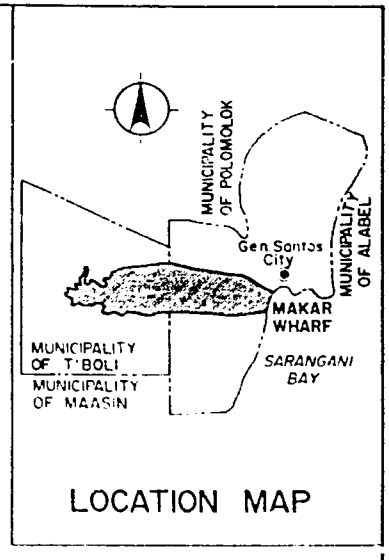
2.4.5.5 Present Land Use and Vegetation

Present land use and vegetation information is included to establish the influence of land utilization types on the stability of the soil surface, their ultimate effect on the quality of the soils and stability of the watershed.

The Land Use Map (Figure 2-26) shows that the most dominant agricultural use of the soils in the watershed is corn cultivation. It will be noted that corn cultivation is carried out on steep hills which explains the extensive soil erosion reported. Table 2-15 summarizes the present land use and vegetation types in the various landscapes of the Makar River watershed.

Extensive cultivation of corn in the steep hills and mountains demonstrates the importance of corn crops in the area and likewise explains the magnitude of land degradation in the upper portions of the Makar River watershed. The significant areas devoted to generally overgrazed grasslands further accentuates the degradation problems of the upland. Significant areas of the watershed are also deforested, contributing to the degradation of the soil.





LOCATION MAP

LEGEND:

MAPPING SYMBOLS	DESCRIPTION	AREA (ha.)	PERCENT (%)
Eo	no apparent erosion	4628	25.81
E1	slightly eroded	2560	14.28
E3	severely eroded	10552	58.86
Eu	miscellaneous/unclassified	188	1.05
TOTAL		17928	100%

CONVENTIONAL SIGN:

- Makar River Watershed Boundary
- Road
- River / Creeks
- Eo - E1 Eu Mapping Unit
- Barangay

SOURCES OF INFORMATION: AMS topographic map series scale 1:50,000 compiled in 1956. Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey team.

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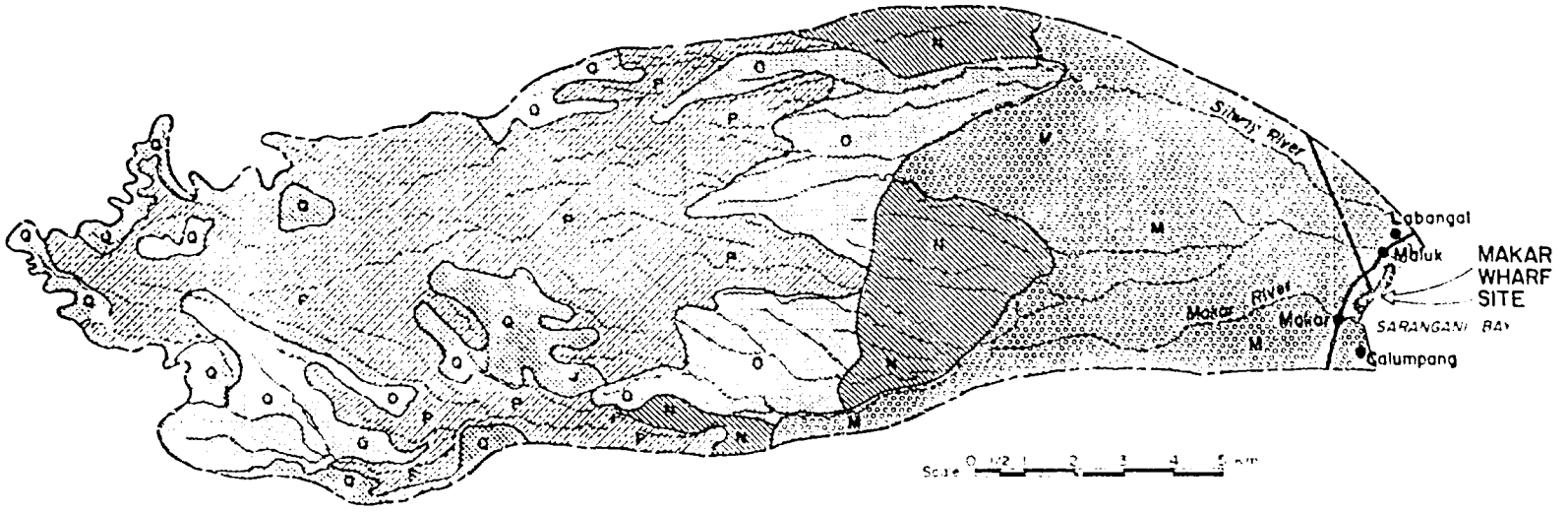
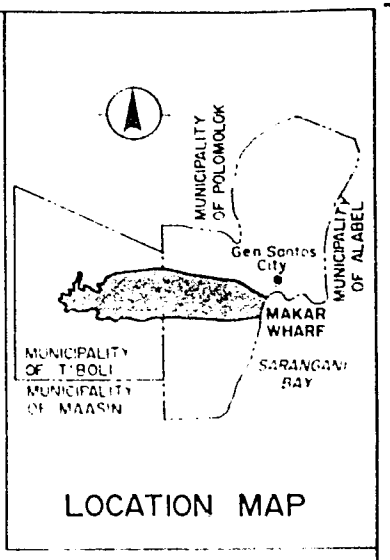
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

EROSION MAP

FIGURE 2-24





LOCATION MAP

CONVENTIONAL SIGN :

- Makar River Watershed Boundary
- Road
- River / Creeks
- M P N Mapping Unit
- Barangay

SOURCES OF INFORMATION AMS topographic map series scale 1:50,000 compiled in 1956 Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey team

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NOTE All political boundaries are not authoritative

LEGEND

MAPPING SYMBOL	PERCENT SLOPE	DESCRIPTION	AREA	PERCENT
M	0 - 3	LEVEL TO VERY GENTLY SLOPING	4748	26 50
N	3 - 8	GENTLY SLOPING TO UNDULATING	1960	10 90
O	8 - 18	MODERATELY SLOPING TO ROLLING	4244	23 70
P	18 - 30	ROLLING TO HILLY	5248	29 30
Q	30 - 50	STEEP HILLS AND MOUNTAINS	1728	9 60
TOTAL			17,928	100 00

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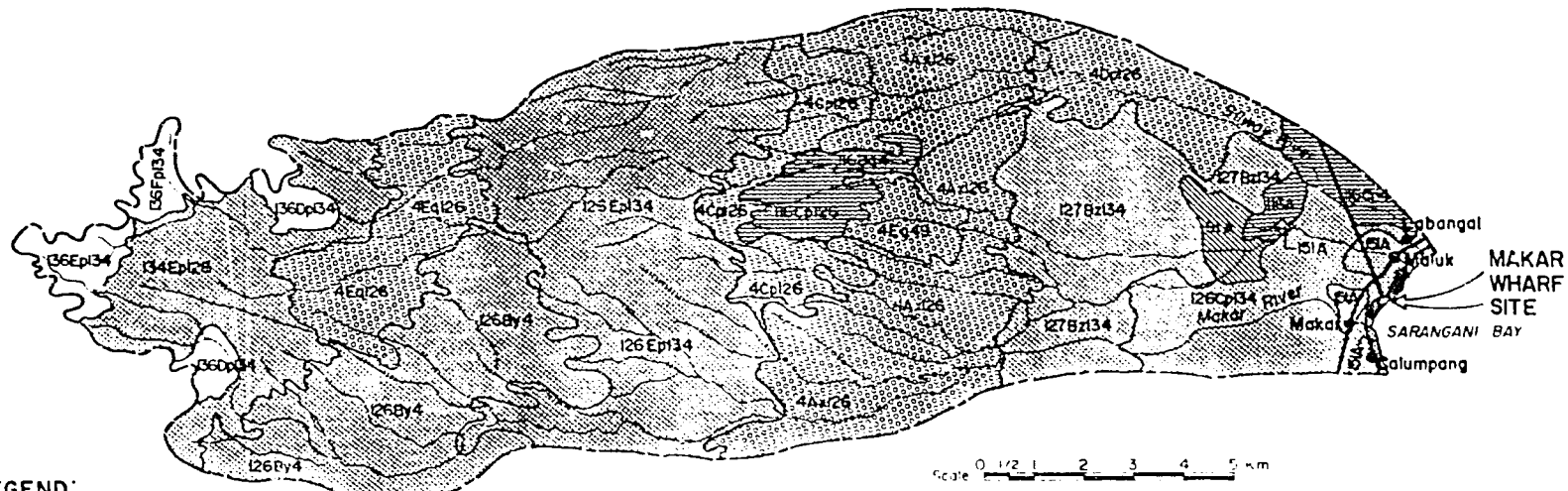
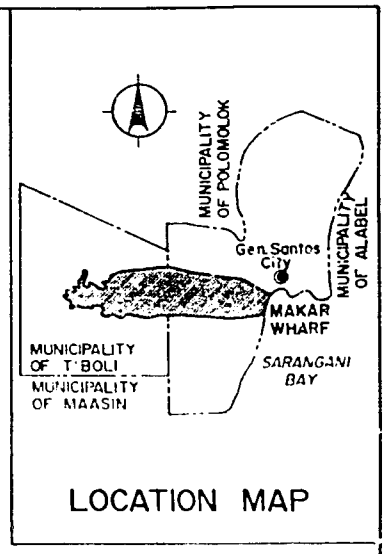
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

SLOPE MAP

FIGURE 2-25





LOCATION MAP

LEGEND:

MAPPING SYMBOLS	DOMINANT LAND USE	PERCENT (%)	AREA (Ha.)	ASSOCIATED LAND USE	PERCENT (%)	AREA (Ha.)	LESS EXTENSIVE LAND USE	PERCENT (%)	AREA (Ha.)	TOTAL AREA (Ha.)	PERCENT (%)
4Ax126	Cn	95	2999.20	Gr	3.00	94.68	Sh	2.00	63.12	3156	17.60
4Cp126	Cn	75	582.00	Gr	20.00	155.20	Sh	5.00	38.80	776	4.33
4Dp126	Cn	70	548.80	Gr	20.00	156.80	Ct	10.00	78.40	784	4.37
4Eq49	Cn	60	62.40	Veg.	35.00	36.40	Mt	5.00	5.20	104	0.58
4Eq126	Cn	60	559.20	Gr	40.00	372.80	-	-	-	932	5.20
51A	Bn	100	184.00	-	-	-	-	-	-	184	1.03
116A	Co	100	104.00	-	-	-	-	-	-	104	0.58
116Cp4	Co	80	176.00	Cn	20.00	44.00	-	-	-	220	1.23
116Cp126	Co	75	231.00	Gr	20.00	61.60	Sh	5.00	15.40	308	1.72
116Dq4	Co	60	72.00	Cn	40.00	48.00	-	-	-	120	0.67
126By4	Gr	90	2098.80	Cn	10.00	233.20	-	-	-	2332	13.01
126Cp134	Gr	80	966.40	Sh	20.00	241.60	-	-	-	1208	6.74
126Ep134	Gr	60	2047.20	Sh	30.00	1023.60	Cn	10.00	341.20	3412	19.03
127Bz134	Pasture	85	1547.00	Sh	10.00	182.00	Ct	5.00	91.00	1820	10.15
134Ep126	Sh	60	1022.40	Gr	30.00	511.20	Cn	10.00	170.40	1704	9.50
136Dp134	Fo	70	72.80	Sh	20.00	20.80	Gr	10.00	10.40	104	0.58
136Dq134	Fo	70	84.00	Sh	30.00	36.00	-	-	-	120	0.67
136Ep134	Fo	60	120.00	Sh	30.00	60.00	Gr	10.00	20.00	200	1.11
136Fp134	Fo	45	63.00	Sh	30.00	42.00	Gr	25.00	35.00	140	0.78
151A	Built-up	100	188.00	-	-	-	-	-	-	188	1.05
152A	Beach sand	100	12.00	-	-	-	-	-	-	12	0.07
TOTAL										17928	100.00

LAND USE / VEGETATION SYMBOL	DESCRIPTION
4	CORN
49	VEGETABLES (NOT SPECIFIED)
91	BANANA
116	COCONUT
126	GRASSLAND
127	PASTURE
134	SHRUBS
136	FOREST
151 A	BUILT - UP
152 A	BEACH SAND

NOTE: Ct - COTTON Mt - MELON

CLASSES & PERCENT DISTRIBUTION

DOMINANT LAND USE CLASSES	PERCENT	DOMINANT LAND USE CLASSES	PERCENT	ASSOCIATED LAND USE CLASSES	PERCENT
A	90-100	D	60-70	x	< 5
B	80-90	E	50-60	y	5-10
C	70-80	F	40-50	z	10-20
				p	20-30
				q	>= 30

MAPPING SYMBOL SPECIFICATION

4 C p 126
- 126 — MOST EXTENSIVE ASSOCIATED LAND USE
- p — PERCENT DISTRIBUTION OF THE MOST EXTENSIVE ASSOCIATED LAND USE
- C — PERCENT DISTRIBUTION OF DOMINANT LAND USE
- 4 — DOMINANT LAND USE

CONVENTIONAL SIGN :

- Makar River Watershed Boundary
- Road
- River / Creeks
- 152A, 51A, 116A — Mapping Unit
- Barangay

SOURCES OF INFORMATION: ANS topographic map series scale 1:50,000 compiled in 1956. Land Resources Data provided by the Bureau of Soils & Water Management, Department of Agriculture, Region XI Survey team.

Map preparation & reproduction by the Agricultural Land Management & Evaluation Division.

NOTE: All political boundaries are not authoritative.

PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO. 492-0432-C-00-0099-00

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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

PRESENT LAND USE/VEGETATION MAP

FIGURE 2-26

Table 2-15

SUMMARY OF PRESENT LAND USE AND VEGETATION IN MAKAR RIVER WATERSHED

LAND USE/VEGETATION	LOWLAND	UPLAND	HILLY/LAND	MOUNTAIN	TOTAL
Agriculture	510	2,514	1,983	1,082	6,089
Coconut	268	22	117	0	407
Corn	136	2,226	1,666	1,082	5,110
Banana	96	88	0	0	184
Cotton	10	160	0	0	170
Vegetables	0	18	200	0	218
Pasture	95	1,451	0	0	1,546
Grassland	797	557	1,523	3,636	6,513
Shrubland	234	318	668	1,530	2,750
Forest	0	0	200	340	540
Built-up	108	0	0	0	108
Beach-sand	12	0	0	0	12
Total	1,756	4,840	4,374	6,588	17,558

106

2.5 BIOLOGICAL ENVIRONMENT

2.5.1 Marine

2.5.1.1 Fisheries

- Marine Fisheries of General Santos City

Secondary data specific to the marine fisheries of Sarangani Bay is not available. The collection and production of statistics on catch production are undertaken for General Santos City or for the province of South Cotabato as a whole. The recorded catch, moreover, is not categorized by source whether at the provincial, municipal or barangay levels or by fishing areas. Fish production data for Sarangani Bay is invariably lumped with the total fish production figure of General Santos City. Substantial, if not full information of the fish production of General Santos City is generally included in fish production reports since this city is prominently known as the "tuna capital of the Philippines." Over a hundred tons of adult tuna are landed daily in this city, exceeding that of any other fish port or even the entire tuna landings recorded for all other fish ports combined (Plate 2-6). The Mindanao marine waters, including southern Sulu Sea, Moro Gulf and the adjacent Celebes Sea, are the centers of tuna abundance in the Philippine Exclusive Economic Zone (EEZ). Because of the proximity to these fishing grounds and its strategic location for transporting tuna to various markets for export or local consumption, General Santos City is the preferred landing location for the tuna and small pelagic fishing fleets of southern Mindanao.

- Fishing Boat Licensing System

For licensing purposes, fishing boats are classified as either commercial or municipal. Commercial fishing boats are over three gross tons and are allowed to operate in waters beyond seven kilometers from the shoreline. Municipal fishing boats are classified as those that are three gross tons or less, with or without motors and include manual fishing operations without the use of boats for subsistence purposes. Waters within the seven kilometer radius from the shoreline are reserved for municipal fishermen. Manual fishing operations, without the use of boats, for subsistence purposes, are also allowed in municipal fishing waters. This system of classification started in the 1950's and has no biological or technological basis. Wherever convenient and advantageous, fishing boat owners circumvent the system. Often, smaller commercial fishing boats are licensed as municipal and are allowed to fish in municipal waters during peak seasons. On the other hand, the larger municipal fishing boats, whenever capable, operate commercial fishing gears. Some fishing companies own both

PLATE 2-6 **Adult tuna weighed at the General Santos City fish market at Lion's Beach.**

168

commercial and municipal fishing boats. The commercial fishing boats not allowed in municipal waters serve as carrier vessels. Fishery resources, fishing gears, and other aspects of Philippine fisheries are uniformly classified as either commercial or municipal based on the definition of municipal and commercial boats.

- Catch Statistics and Catch/Effort Estimates Constraints

Accurate and reliable catch and catch per unit of effort (CPUE) statistics which are vital parameters in evaluating the state of exploitation of a particular fishing area are difficult to derive. While the Bureau of Fisheries and Aquatic Resources (BFAR) annually publishes the fisheries statistics of the Philippines which include fish or fish groups classified according to the International Statistical Standard Classification of Aquatic Animals and Plants (ISSCAP), number and tonnage of vessels, number and types of fishing gear and catch figures by fishing grounds and political regions, the manner of data reporting is not adequate to relate fishing effort to production in any particular fishery. At best, published CPUE estimates are inferential. From the 1950's to 1976, published fish production statistics covered only the commercial fisheries and were based on a voluntary declarations of catch which were invariably understated. In 1977, the catch statistics system for the municipal fisheries was established and published for the first time. However, inspite of improvements in the fishery production monitoring systems, there are still many missing values in establishing a historical pattern for determining the state of exploitation of fisheries. This is true even for the tuna fishery, the largest finfish fishery in the country today. Since the downgrading of the BFAR from a line bureau to a staff bureau, the above system of gathering fishery statistics has been abolished and recording as of 1988 is limited only to production.

- Commercial Fishing Fleet and Fish Production

The commercial fishing fleet of General Santos City consists of 80 purse seiners[1] operated by about 20 companies. In 1988, a daily average of 19 commercial fishing landed their catch in General Santos City. According to the Philippine Coast Guard office in General Santos City, only three purse seiners are registered in General Santos City. However, in 1988, the purse seine fleet, manned by over 5000 fishermen, is very mobile and is capable of fishing in the entire Philippine EEZ and in international waters outside of national jurisdiction. The catch of this fleet consists largely of juvenile tunas and small pelagics which are caught

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1 A purse seiner is a commercial fishing boat using a purse seine, a long rectangular enclosing net at least 700 meters long and over a hundred meters deep. A purse seiner unit consists of a catcher or mother vessel, or the purse seiner, a scout boat for locating tuna aggregations, one or more light boats and one or two carrier vessels. A large catcher boat carries from 40 to 50 fishermen. Smaller purse seiners are operated by 20 to 30, while carriers and palakayas are manned by 5.

indiscriminately in this nonselective fishing operation. A number of purse seiners are fishing under license in Papua New Guinea and Micronesia but it is not certain whether these boats land their catch in General Santos City.

In 1988 and 1989, commercial fishing boats landed a daily average of 212 and 214 mt of fish respectively in General Santos City (Table 2-16 and Table 2-17). These commercial fishing boats are largely purse seiners and the main catch are juvenile tunas and small pelagics. In 1989, these commercial boats accounted for 87 percent of fish production in General Santos City (Table 2-16).

The fish production of commercial tuna fleet is supported by an increasing number of municipal motorized pumpboats weighing under three gross tons and locally known as "palakaya". A palakaya is an enlarged, motorized boat with double outriggers and generally powered by a 135 hp automotive diesel engine. The hull of a typical "palakaya" is 16 to 18 m long and 1.5 m wide. Newly built "palakayas" are equipped with large ice boxes with on-board refrigeration which efficiently preserve the freshness of the catch. There are now over 6,000 "palakayas" landing their catch in General Santos City. Although weighing less than three gross tons and classified as municipal, the "palakayas" are used for long distance fishing in waters up to 2,000 m deep where adult tunas are aggregated using bamboo or cylindrical welded steel floating rafts locally called "payaos". Once the tunas are aggregated, the fishermen catch adult yellowfins weighing from 30 to 100 kg by hook and line from depths of 250 to 300 m.

- Municipal Fishing Fleet and Fish Production

In 1985, there were over 7000 municipal fishing boats reported in General Santos City. Some 5000 boat owners, however, have since joined the "palakaya" tuna fleet of the commercial fisheries sector. Today, there is an estimated 2000 non-motorized banca operators who concentrate in nearshore waters. In 1988, an average of 91 municipal boats landed per day.

In 1988 and 1989, landed averages 35 and 30 mt a day of a variety of fishes (Table 2-16 and 2-17). In 1989, municipal boats accounted for only 12 percent of the recorded fish production in General Santos City.

A breakdown of municipal fisheries production is shown in Table 2-18.

Table 2-16
NUMBER OF FISHING BOATS LANDING IN
GENERAL SANTOS CITY, 1988

	NUMBER OF FISHING BOATS					
	Municipal		Commercial		Total	
	Monthly	Average per day	Monthly	Average per day	Monthly	Average per day
January*						
February*						
March	2,074	67	387	12	2,461	79
April	2,739	91	506	17	3,245	108
May	3,127	101	545	18	3,672	119
June	2,261	75	446	15	2,707	90
July	2,599	84	517	17	3,116	101
August	2,446	79	645	21	3,092	100
September	3,098	103	786	26	3,884	129
October	2,584	83	647	21	3,231	104
November	3,073	102	728	24	3,801	126
December	3,176	121	587	19	3,763	140
Total	27,177	906	5,795	190	32,972	1,096
Average	2,718	91	580	19	3,297	110

Source: Philippine Fisheries Development Authority
General Santos City

* No data available

Table 2-17
FISH PRODUCTION IN METRIC TONS
GENERAL SANTOS CITY, 1989

MONTH	1988 PRODUCTION (METRIC TONS)				1989 PRODUCTION (METRIC TONS)			
	COMMERCIAL	MUNICIPAL	INLAND	TOTAL	COMMERCIAL	MUNICIPAL	INLAND	TOTAL
January	5,583.50	635.40	--	6,218.90	6,023.60	979.06	40.00	7,042.66
February	5,407.60	1,181.00	--	6,588.60	6,289.10	540.09	42.00	6,871.19
March	3,859.80	751.30	--	4,611.10	6,740.00	701.82	28.00	7,469.82
April	7,084.30	1,220.80	39.30	8,344.40	4,400.48	788.40	5.00	5,193.88
May	7,136.10	1,462.70	23.70	8,622.50	5,583.20	830.12	5.00	6,418.32
June	4,628.70	815.50	25.90	5,470.10	5,607.30	758.57	1.00	6,366.87
July	4,442.70	830.60	38.70	5,312.00	4,985.86	916.52	2.00	5,904.38
August	6,946.30	922.70	45.20	7,914.20	7,302.71	755.00	3.00	8,060.71
September	7,784.30	1,449.60	50.80	9,284.70	8,120.57	1,107.20	5.00	9,232.77
October	8,014.20	1,051.80	42.00	9,108.00	10,190.05	1,146.91	8.00	11,344.96
November	9,439.50	1,205.10	39.90	10,684.50	6,104.31	901.83	7.00	7,013.14
December	7,378.10	1,377.40	39.20	8,794.70	6,905.56	1,435.08	9.00	8,349.64
TOTAL	77,705.10	12,903.90	344.70	90,953.70	78,252.76	10,860.64	155.00	89,268.34

Source: Philippine Fisheries Development Authority (PFDA)
General Santos City

112

Table 2-18
MUNICIPAL FISHERIES PRODUCTION OF GENERAL SANTOS CITY, 1989 (IN KG.)

	BARILES *	SAMBAGON **	CARAO ***	MARANG	TULAY ***	PERIT ***	BILONG-BILONG	BANGUS	BANGSI	BOROT	PANDAWAN	CARABALLAS	OTHERS	TOTAL
January	662,215	44,177	36,051	18,661	25,954	27,988	18,132	33,108	12,415	11,278	6,491	6,436	76,168	979,074
February	279,134	44,275	38,796	19,419	17,868	28,536	12,973	34,024	7,539	8,591	6,465	10,647	74,314	582,581
March	451,368	52,452	40,721	22,894	15,410	14,435	5,932	23,530	7,895	7,270	14,055	10,144	64,279	730,415
April	470,854	105,849	57,624	34,203	21,493	19,949	4,670	4,904	14,830	20,169	2,559	4,332	26,977	788,413
May	416,918	114,198	100,716	50,290	8,333	43,365	2,255	5,038	14,818	25,959	2,442	1,753	44,037	830,122
June	459,449	70,091	57,491	42,579	6,346	47,038	1,547	1,275	11,508	34,227	1,132	609	25,281	758,573
July	480,219	112,137	91,196	37,760	7,012	71,721	1,463	2,000	13,266	72,655	946	651	23,495	914,521
August	260,840	106,291	102,578	23,589	12,537	90,920	5,595	3,100	11,711	102,665	1,039	4,519	29,621	755,005
September	577,375	125,278	109,127	30,889	14,150	105,693	6,829	4,940	13,340	90,903	935	2,375	25,344	1,107,178
October	568,602	134,035	115,389	31,842	13,247	120,162	4,660	8,230	8,305	109,369	916	5,445	26,716	1,146,918
November	532,004	85,892	70,869	20,512	4,210	70,270	3,675	5,375	8,655	78,010	479	1,965	19,919	901,835
December	920,363	121,499	105,357	45,892	9,835	95,789	2,195	8,620	12,148	82,696	585	2,895	27,657	1,435,531
	6,079,341	1,116,174	925,915	378,530	156,425	735,866	69,926	134,144	136,430	643,792	38,044	51,771	463,808	10,930,166

* Adult yellowfin
** Adult skipjack
*** Juvenile yellowfin

Refer to Table 2-18 for the English names of the other fish groups.
Source: Philippine Fisheries Development Authority, General Santos City

113

- Major Fish Groups[2]

The Philippine fishery is typical of the multi-species tropical fisheries where there is a great variety of species but only a few fish groups are caught at a commercial scale. There are over a hundred species of fish landed daily in General Santos City but only a few fish groups form the basis of the fishing industry (Table 2-19) In the order of their abundance the fish groups traded are: 1) tuna, 2) round scad, 3) bill fishes, 4) flying fish and milkfishes, 5) moonfish, and 6) dolphin fish. The reef fishes collectively called isdang bato or "stone fishes" since they are mainly captured among the stony coral reef areas, consists mostly of caesios (dalagang bukid), parrot fishes, siganids, goat fishes, crevalles, surgeon fishes, balistids, groupers, snappers, theraponids and a variety of grunts, wrasses, and breams typical of the fish fauna of coral reefs (Plate 2-7). Refer to Appendix D-8 for the proper fish nomenclature.

There is an apparent developing fishery for the dolphin fish locally called "dorado" or "pandawang". Wholesalers claim they export the adult pandawang, up to a meter long, to Hawaii where they are called "mahe-mahe" and are considered a delicacy. There are daily incidental catches of large adult marlins, swordfish and spanish mackerel but big catches of these species are rare.

- Fisheries of Sarangani Bay

As mentioned previously, there is no complete documentation of the fishery resources and industry of Sarangani Bay. To ascertain the status of the fishery that may be affected by the proposed extension of the Makar Wharf, a survey was conducted using a questionnaire (Appendix A-4) in random interviews with fishermen groups. There are currently 26 barangays in General Santos City but only six are considered fishing barangays having a predominance of fishing households. These are Tambler, Silway, Calumpang, Labangal, Bula and Buayan (Figure 2-3). Fishermen from these barangays are considered to be the group most affected by the Project (Plate 2-8).

A total of 70 fishermen were interviewed. Fishery students of Mindanao State University, Tambler, assisted in the survey. However, perhaps due to the

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2 The local fish nomenclature, especially of tuna, is quite confusing and may contribute to unreliable catch production data. This may be attributed to the inadequate knowledge of the early juvenile stages of fishes by local biologists and fishermen. For example, the yellowfin tuna (*Thunnus albacares*) and the big eye tuna (*T. obesus*) have separate local names for each of the developmental stages. They are 1) called hariles or tambakol when at adult sizes of 100 cm and above at which size they are caught by hook and line. 2) carao when at about 45 cm in length at which they are caught by surface nets, and 3) pirit a size smaller than the carao. In the case of skipjack (*Katsuwonus pelamis*), the adult sizes of 45 cm and above are referred to as sambangon and sizes under 45 cm are called pirit along with the yellowfin and big eye juveniles of similar sizes. The term pirit is also applied to the juveniles of similar size of the frigate tuna (*Auxis Thazard*), bullet tuna (*Auxis rochei*) and the eastern little tuna or oceanic bonito (*Euthynnus affinis*). All tuna of smaller sizes up to 20 cm are collectively called aloy, the Visayan term used for tuna in the Visayas and Mindanao.

114

Table 2-19
PERCENTAGE RELATIVE ABUNDANCE OF FISHES LANDED BY THE MUNICIPAL FISHERIES IN 1989 (IN KG) IN GENERAL SANTOS CITY

		VOLUME	%
Tunas		8,277,955	75.0
Adult yellowfin (Bariles)	6,079,341		
Juvenile yellowfin (Carao)	925,915		
Juvenile yellowfin and Skipjack (Pirit, Tulay)	378,530		
Adult Skipjack (Sambangon)	1,116,174		
Roundscad (Borot)		643,792	5.8
Billfishes (Marang, Atsi, Malasugui)		378,530	3.4
Flying fish (Bangsi)		134,144	1.2
Milkfish (Bangos)		136,430	1.2
Moonfish (Bilong-bilong)		69,926	0.6
Dolphin fish (Pandawan)		38,044	0.3
Jacks (Caraballas)		51,771	0.4
Incidental catch (reef fishes)		463,808	4.2
TOTAL		10,930,166	100.0

Source: Philippine Fisheries Development Authority, General Santos City

115

PLATE 2-7 A typical catch of "Stonefishes" by small banca fishermen. Stonefishes are captured in coral reefs in shallow Bay waters. On the upper left are juvenile anchovies taken by screen nets.

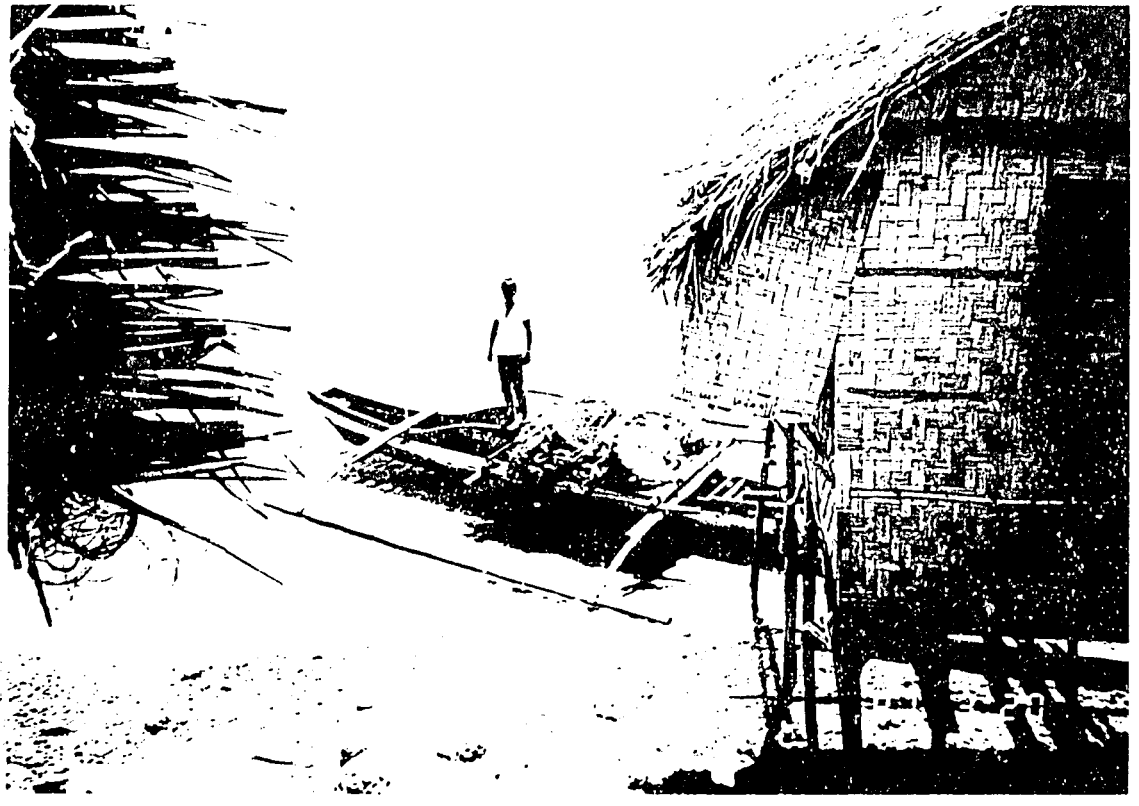

PLATE 2-8 **A Badjao small banca fisherman with his boat and fishing net. His bamboo and nipa hut stands on the beach, a part of the Project site.**

116

different dialects used by respondents in which the surveyors were not very proficient, some of the figures gathered were vague while others were superfluous.[3] These were not considered in the analysis. About 60 percent of the questionnaires provided meaningful information.

Formal dialogues with officials of provincial government offices concerned with fisheries such as the Bureau of Fisheries and Aquatic Resources and the Philippine Fisheries Development Authority (which are both under the Department of Agriculture), the Philippine Coast Guard, fish traders, and the academe, including faculty members of Mindanao State University, Tambler and Notre Dame of Dadiangas College were also undertaken.

There are no commercial fishing boats operating in Sarangani Bay regularly as the Bay's fishing grounds are no longer productive for large scale purse seine fishing. As mentioned previously, commercial fishing boats operate in South Sulu Sea, Moro Gulf and Celebes Sea and land their catch in General Santos City.

In 1985, of the over 7,000 listed municipal fishing boats, 5,000 have joined the "palakaya" fleet of the commercial tuna operators. Today, there is an estimated 2,000 non-motorized banca operators or municipal fishermen in Sarangani Bay and adjacent waters. Of these, only 745 or 38 percent are based in the six barangays with Labangal and Silway having the most number of fishermen (Table 2-20). Fishing gears used include gill net, hook and line, cast net, screen net, beach seine, fish corral, ring net, spears and fish traps. Fishermen generally fish from 6 to 12 hours daily. All fishing boats operate at depths of up to a thousand meters in almost all areas in Sarangani Bay and adjacent waters depending on the peak season of the targeted species. Notable fishing areas are the waters off Siquil, Glan, Lun and Maasin. Each fishing boat is operated by three to four fishermen on a pre-arranged sharing basis. Daily catch ranges from zero to 300 kg. The catch consists of a variety of species including juvenile tunas, small pelagic or surface dwelling species such as sardines, flying fishes, crevalles, half beaks, moonfish and reef fishes. Each fishermen grosses from zero to a thousand pesos a day depending on the volume of catch. A typical small banca fisherman from the Badjao community located adjacent to the port, is shown in Plate 2-8.

There are a small number of municipal fishermen operating motorized boats that have not joined the "palakaya" fleet of commercial tuna fishing boat operators. In the survey area, about 20 have motorized boats and enjoy a comparative advantage of shorter fishing time in more productive fishing grounds, using more efficient fishing gears.

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[3] In General Santos City, at least four major dialects are spoken including Tagalog, Visayan, Ilocano, and Muslim and two or more variations of each. The Visayan dialect has four variations namely, Ilongo, Cebuano, Hiligeynon, and Kwaray-a.

117

Table 2-20
MUNICIPAL FISHING BOATS AND FISHERMEN
IN SIX FISHING BARANGAYS OF GENERAL SANTOS CITY

BARANGAY	NO. OF NON-MOTORIZED BANCAS	NO. OF FISHERMEN
Calumpang	20	30
Bula	125	300
Buayan	100	200
Labangal	200	600
Silway	200	600
Tambler	100	300
Total	**745**	**2,000**

2.5.1.2 Marine Habitat

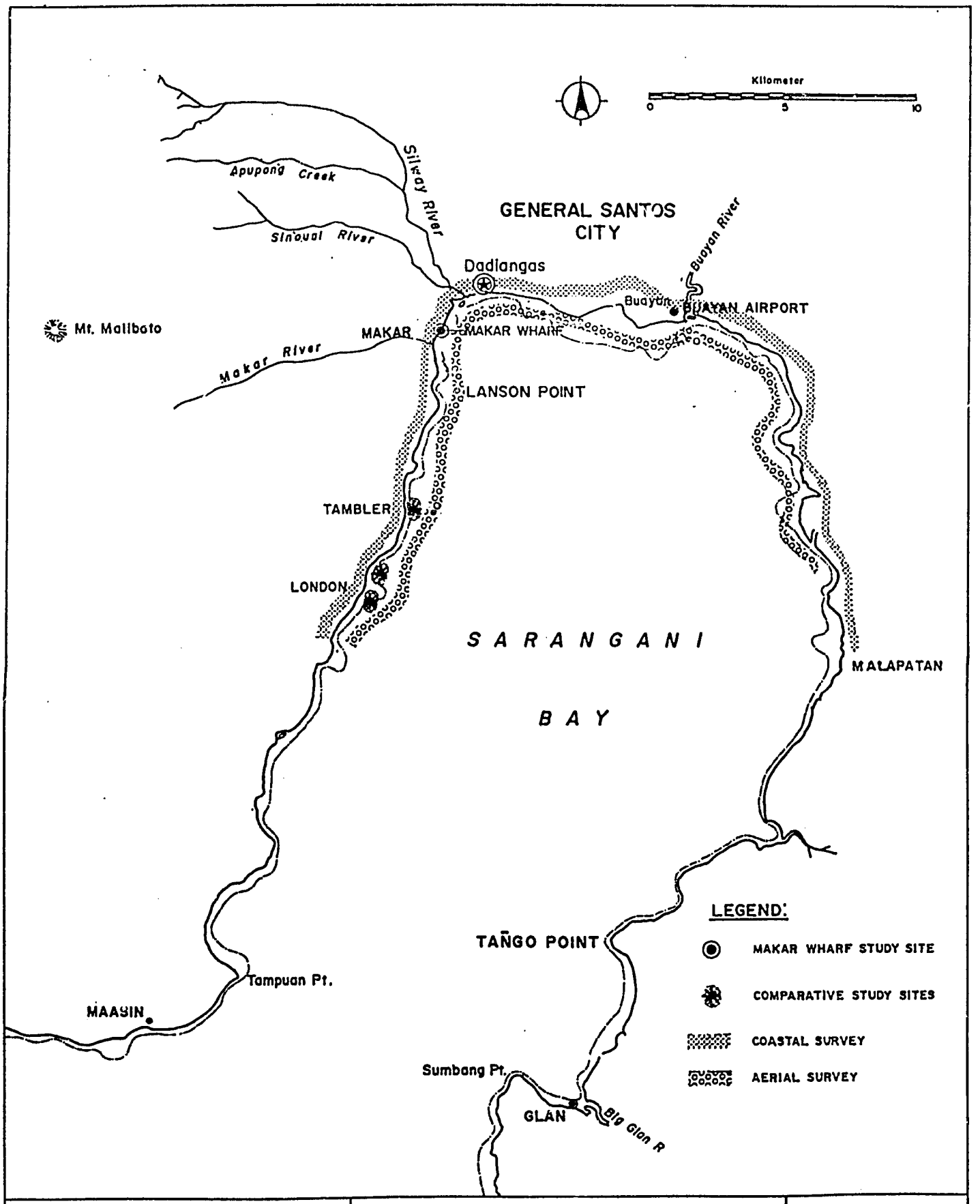
The coastline of Sarangani Bay, approximately 125 km in length, consists of a narrow border of fringing reef platforms and steep, sandy slopes. As a component of the environmental studies conducted for the proposed expansion of Makar Wharf, marine surveys were conducted for the nearshore, coastal zone of the project site and northern Sarangani Bay (Appendix A-6). Information available from the recent environmental studies of the proposed General Santos Agro-Processing Center (Dames and Moore) and the Airport Improvement Study (Wilbur/Smith) was incorporated to extend the scope and context of this study.

In addition to extensive sand slopes that are common to the coastline of northern Sarangani Bay, these studies identified three principal marine habitats directly influenced by coastal development due to their proximity and sensitive environmental requirements, namely:

- coral, including the distinctive groups of hard (scleractinian) and soft (alcyonacean) corals
- seagrass
- mangrove

These marine habitats were found primarily along the coastline of central and southern Sarangani Bay in contrast to the high level of coastal development and marine habitat displacement along the shores of northern Sarangani Bay. Specific examples of development-related, coastal impacts observed along the northern Sarangani Bay include:

118



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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

MARINE SURVEY SITES

FIGURE 2-27

119

- Extensive conversion of intertidal mangrove areas, along the coast from Tambler to Buayan, to prawn farms, commercial fish landings and canneries. Based on the 1988 socio-economic profile, only 8.3 ha, or 0.02 percent of the total land area of General Santos City, remains classified as marshland or mangrove areas.

- Intensive siltation of reef environments adjacent to local river systems. The corals in reef structures north of the Banwalan River, as well as in the vicinity of the Buayan River, were reported as mostly dead, as a result of excessive siltation, by the respective studies of Dames and Moore, Ltd. and Wilbur/Smith Associates, Inc.

- Reclamation of former tidal basins and reef platforms along the Calumpang and Labangal coast for commercial shipping and cannery facilities.

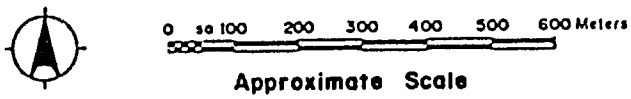
A 1989 study, published by the Business Resource Center of General Santos City, highlights the diminishing marine life and fisheries of Sarangani Bay. The destruction of coral reefs and mangroves, and pollution from fast developing General Santos City are identified as serious threats to the productivity of aquatic resources by the Sarangani Bay Marine and Inland Resource Conservation Project. This project, co-funded by USAID and Dolefil, Inc., was also initiated in 1989, and involves a three year program of community organization, water quality monitoring, artificial reef construction and mangrove reforestation.

The Port of General Santos City, Makar Wharf, is representative of the physical impact of coastal zone development. In 1972, a feasibility study was conducted by the consultant group of Sir William Halcrow and Partners, for an expansion of the previous Makar Wharf facility. In Section 2.1 of their Final Report, they noted:

> "The Port of General Santos, at Makar, is situated in the NW corner of the Bay, south of a low headland known as Dumpao Point off which lies a coral reef and north of another coral reef known as Calumpang Point ..."
>
> "Makar is a small village, the nearest town of any size being Dadiangas ..."

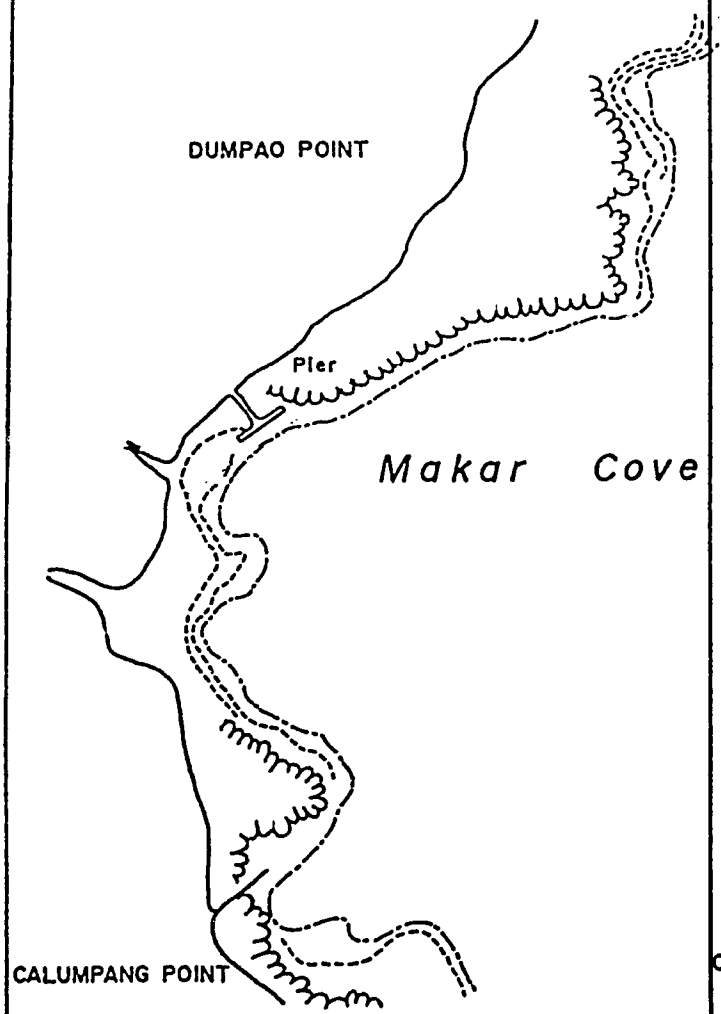
Makar Wharf was expanded, to the northeast, by some 300 m and paralleling the growth of General Santos City, Makar is no longer a small village. Extension of the wharf structure, including foreshore dredging to a reported depth of 8.5 m and reclamation of intertidal areas, replaced a significant portion of the Dumpao reef. Based on comparison of nautical charts, hydrographic reports of the 1972 Halcrow Study and hydrographic findings of the present study (Figure 2-21, and Section 2.4.4.4), these construction activities as well as extensive development of the Makar area, directly displaced or impacted the shallow marine habitat of the reef platforms adjacent Dumpao Point and Calumpang Point (Figure 2-28). The 1972 Halcrow Study reported, for example, that the rock bunds retaining the Makar Wharf reclamation were constructed of coral, hand excavated from Calumpang Point. Marine surveys conducted for this environmental assessment indicate that the remnant reef platform off Dumpao Point retains the

120



LEGEND:

- REEF PLATFORMS EXPOSED AT LOW TIDE
- MAKAR WHARF RECLAMATION TO DATE
- MAKAR WHARF DREDGING TO DATE
- PRIVATE WHARF RECLAMATION



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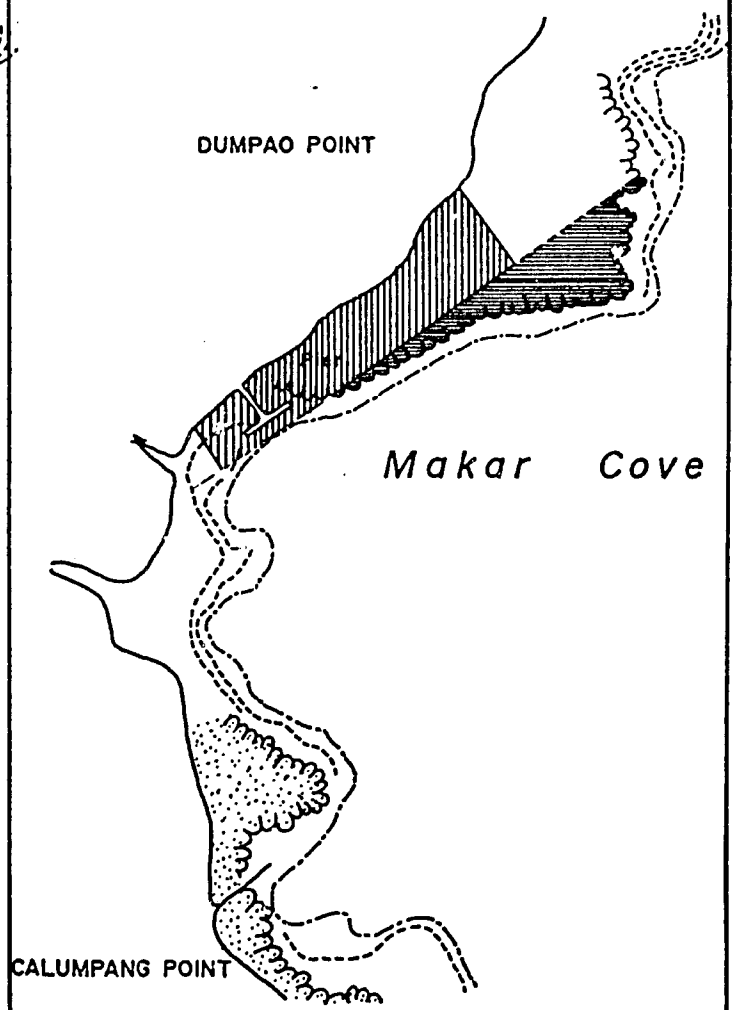
SURVEYS TO 1952



OBSERVATIONS OF MARINE AND
HYDROGRAPHIC SURVEYS, 1991

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT NO.: 492-0458-C-00-0099-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE 2-28
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L • ERNST & YOUNG INT'L • SLOBETROTTERS ENV'S. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC.	DEVELOPMENT OF MAKAR COVE REEF PLATFORMS	

121

most substantial marine habitat within the project study area. Figures 2-29 and 2-30 illustrate the distribution, or zonation, of recorded ecological communities and substrates of the Dumpao Point reef area.

A seaward transition is described from an intertidal reef flat, (Plate 2-9) to a shallow seagrass back reef area and a slightly deeper, soft coral dominated reef crest. A highly variable reef slope, extending from approximately two to seven meters of depth, appears to be an artifact of previous dredging activities. For example, the nearly vertical reef cut represented in Cross Section AA, Figure 2-30 is composed entirely of unconsolidated branched coral rubble, consisting primarily of Montipora, Anacropora and Acropora pieces. Below seven to ten meters of depth, the reef slope "cut" reaches a more gradual, fore reef slope of silty sand. Representative species and observations recorded during the marine survey of Dumpao Point and the adjacent subtidal piling structures of Makar Wharf are included in Appendix D-9.

Coral rubble, primarily of branched Acropora varieties, is a common substrate throughout the surveyed Dumpao reef platform, indicating an abundance and diversity of scleractinian, or hard corals no longer found at the site. Presently, hard coral presence at the project study site consists mostly of juvenile stages of pioneer type species often associated with disturbed environments. Available silt-free substrates of coralline rock displayed high levels and diversity of recent scleratinian settlement which may represent a periodic pattern of spat recruitment and subsequent mortality due to environmental stress. During the period of the marine surveys, March/April, 1991, water quality was notably turbid. Underwater visibility was estimated at only two to three meters, with the substrate generally silted. These marine surveys were conducted during the period of a regional drought and presumably high water quality with respect to river-borne siltation. Following a slight evening rain on March 13, underwater visibility was greatly reduced, with a muddy, freshwater lens overlaying the study area. Aerial surveys conducted at this time distinguished a coastal plume of brown, silty water originating from the Silway and Buayan Rivers and extending, coastwise, from Tambler to Malapatan (Plate 10). The watersheds of the Makar and Silway Rivers include extensive upland areas prone to, and in the process of, high levels of erosion. Based on local observation and all recent reports, the Makar River has not been active in years due to diversion for upland irrigation use. The 1972 Halcrow Study, for example, reported that the Makar River only flows during rare periods of floods.

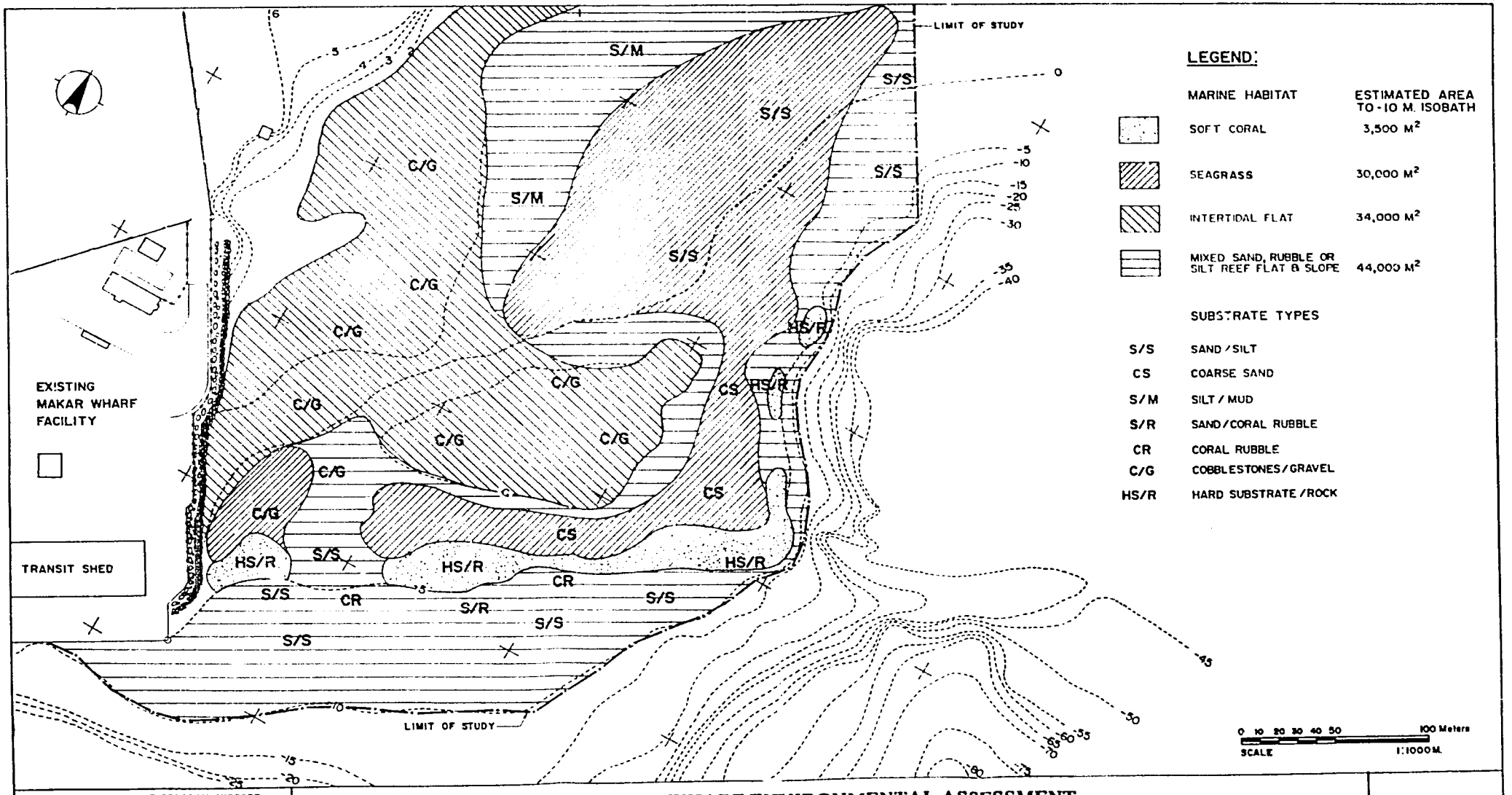
The abundance of coral rubble, and limited diversity of hard corals in the project study area is attributed to this periodic inundation by river silt and past dredging. Predominance of mature soft corals and seagrass at the site suggests a higher level of environmental tolerance, though their distribution and diversity is relatively limited. The colonized pilings of Makar Wharf maintain a distinctive community of shade tolerant, encrusting species including gorgonians (sea fans), sponges and scallops.

The status or absence of commonly occurring species was also noted in the marine surveys to gauge the ecological health of the study reef. In addition to the described abundance of coral rubble, the disturbed condition of the reef community is apparent in the near absence of marine organisms considered edible in local diets. The fish and invertebrate population of the reef is

122

PLATE 2-9 **Dumpao Point intertidal area at low tide, including a portion of the Venil Badjao community. View towards Northeast from existing Makar Wharf facility.**

123



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO.: 492-0432-0-00-0089-00

LOUIS BERGER INTERNATIONAL, INC.
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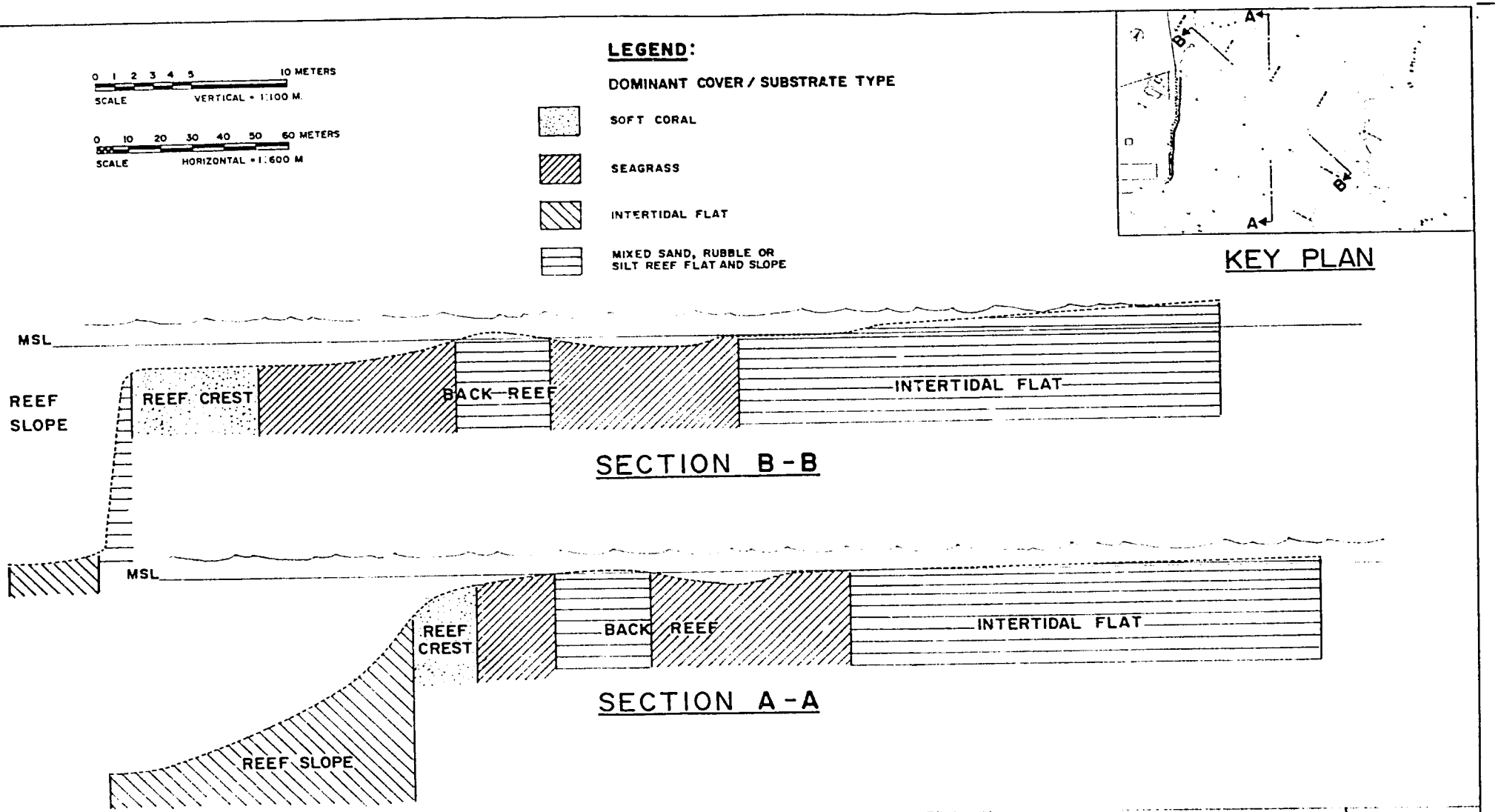
• CONSULTANT MANAGEMENT SERVICES, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

SCHEMATIC DISTRIBUTION OF MARINE HABITATS AND SUBSTRATE TYPES OF THE DUMPAO POINT REEF PLATFORM

FIGURE 2-29



PHILIPPINE ASSISTANCE PROGRAM SUPPORT
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
CONTRACT NO. 492-0452-C-00-0099-00

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

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

SCHEMATIC CROSS-SECTIONS OF THE DUMPAO POINT REEF PLATFORM

FIGURE 2-30

PLATE 2-10 **Discharge of the Silway River (3/14/91). Makar Wharf is to upper right hand corner of plate.**

126

minimal, or limited to a few juvenile individuals. Fishlife, in general, was most abundant in the sheltered water column of the wharf pilings.

Daily observations and interviews with the adjacent Badjao community of Venil, Makar, support the marine survey observations that extreme subsistence fishing pressure is present at the study site. Observed fishing activities at the site included:

- beach seine
- gill nets
- spear fishing
- hand lines
- gleaning

It was of interest to note that hard corals, typically varieties of Pocillopora and Fungia, are collected for the souvenir trade as a minor livelihood activity of the Badjao community. These corals are reportedly collected from less disturbed reefs adjoining the Tambler and Tampuan Point areas. The use of dynamite or cyanide for fishing was not reported or observed in the area.

For the purpose of comparison, secondary underwater surveys were conducted at three sites south of the Makar area (Figure 2-27). These sites, accessible from the coastal road, included:

- Lawis, Bawing
- London (Family Beach Resort)
- Tambler (GSC Agro-Processing Center Site)

The surveyed Lawis, Bawing site is a few hundred meters south of the Bawing artificial reef area, established as a component of the resource conservation project co-funded by USAID and Dolefil, Inc. The site is characterized as a gentle sand shelf to a distance approximately 40 m from shore where a steeper, sandy reef slope begins at a depth of about 10 m. The sandy substrate is greyish in color and clean, basically free of silt. Under water visibility was very clear and estimated at 15 m. The surveyed area was barren with exception of a light coverage of Halophila ovalis, a type of seagrass.

Similar to the Lawis, Bawing site, the London area opposite the Family Beach Resort maintains a mostly sandy shelf to 40-50 m from shore, where a sandy reef slope of 15°-20° begins. A lush seaward transition of seagrass was noted and included, Halodule uninervis, Syringodium spp., Enhalus acoroides and Halophila ovalis. The brown algae, Padina sp. occurs in

127

conjunction with Halodule uninervis. Patch reefs, of exposed hard substrate, occupy an estimated one to three percent of surveyed area. While limited in area, these patch reefs are highly diverse, micro habitats, including representatives of common shallow reef species, of corals, fish and invertebrates. The solitary corals Trachyphyllia and Catalaphyllia are common on the sandy slope. Local residents reported that Badjao divers occasionally collect corals from this area for sale as souvenirs. Underwater visibility was relatively clear and estimated at five meters. Observed silt load was minimal though floating trash and debris were common throughout the site.

Marine habitats of the Tambler Agro-Processing Center site are described in detail in the environmental assessment prepared for the proposed project by Dames and Moore. In their study, they described the fringing north and south coral reefs adjoining a central steeply sloping sandy cove of the property. Our comparative survey was limited to the sandy cove which slopes at about 45° only 10 m offshore. Patch reefs and spurs outcrop from this steep sand slope and comprise approximately 10 percent of the substrate. Hard coral cover on this exposed hard substrate was moderate and visually estimated at 20 to 30 percent. In contrast to the surveyed Dumpao reef platform, soft corals are less common at the Tambler site while reef fish population is more abundant. Similar to the London site, solid wastes and floating debris are prevalent throughout the reef area. Underwater visibility was a cloudy five to seven meters, with a silty freshwater lens offshore of the flowing springs of the Tambler site. The adjacent shoreline includes a few specimens of mature Sonneratia mangrove.

The collection of milkfish fry (Chanos chanos; bangus) was observed at all three secondary survey sites. Local fishermen use traditional push nets to collect the fry from shallow coastal waters of these sites, reportedly on a daily basis. According to these fishermen, the common practice of a designated milkfish fry concession area, usually awarded by municipal, or regional, bidding, does not exist along this coast. Collected fry are sorted and sold in General Santos City, typically to Taiwanese buyers. The Dames and Moore study noted that milkfish fry used to be gathered in large quantities from the Tambler project site beach. The decline of fry collection, described in their report as now almost non-existent, was attributed by local residents to the change in ambient water quality since the establishment of prawn farms and other processing facilities in the near by coastal areas.

2.5.2 Terrestrial

Terrestrial information was gathered through existing literature, contacts with local academics and DENR staff knowledgeable of the area, and through field verification.

The extent and diversity terrestrial ecosystems within the Makar Wharf study area are limited due to the level of development of the area. The study area encompassed by a one kilometer radius of the project site is built-up and vacant lots are interspersed with natural growing grasses and sparse tree cover. This limited diversity of habitat also limits the diversity of species found in the area. No rare or endangered species are known to occur in the Makar Wharf study area.

The following descriptions provide an overview of species present in the larger area encompassing Makar Wharf for which information was available. This takes into account the lower Makar watershed and adjoining lowland areas.

2.5.2.1 Wildlife

- Mammals

About 12 species of mammals have been reported in technical reports and anecdotally in the area of Makar and its immediate vicinities. These species are classified as common/abundant because of their wide distribution.

Most of these mammals can thrive well even in disturbed areas such as in human settlements, urban areas and agricultural lands/open spaces. A list of species and their ecological status is provided in Appendix D-10.

- Reptiles

About 15 species of reptiles have been reported (personal communication and technical reports) inhabiting the area. These species are classified as common and endemic. Their distribution is relatively widespread because they can easily be found especially in their well known habitats.

Most of these reptiles can thrive well even in disturbed areas such as human settlements and urban areas, open spaces and in thickets. A list of species and their ecological status is provided in Appendix D-10.

- Amphibians

There are about five well known species of amphibians that can be found in the area of Makar Wharf and its immediate vicinities. Most of these species can be seen in cultivated areas, ditches, ponds, streambanks and in near settled areas and are classified as common with a wide distribution. A list of species and their ecological status is provided in Appendix D-10.

- Water Bugs and Mites

Some twenty-five species of water bugs and mites are reported for the general area of Makar Wharf. Most of these species thrive well in agricultural areas planted to coconuts, bananas and citrus plants while others can be found along shorelines of streams and ponds. A list of species and their ecological status is provided in Appendix D-10.

129

- Birds

About 12 species of birds have been reported (personal communication and technical reports) in the general area of Makar, General Santos City. Most of these birds are common and resident of the area. They are usually seen in the shore areas of the Makar Cove and grassland areas where their food source and shelter are available. A list of species and their ecological status are provided in Appendix D-10.

- Insects

Based on the types of vegetation and the observed microhabitats of the general area of the Makar Wharf, the insect fauna that can be expected to be present will include about 15 taxonomic orders of insects. Most of these insects may be considered as common, though their distribution, especially the apterygotes, can be very limited or restricted. Their host-specific nature can limit distribution to microhabitat levels. The lists of insects are provided in Figure D-10.

2.5.2.2 Vegetation

The vegetation of the lower extent of the Makar Wharf watershed is dominated by natural growing grasses, some agricultural crops and limited tree cover. Other vegetation that can be found in the area are shrubs, bamboos, palms, ferns and some non- dipterocarp trees.

- Non-Dipterocarp Trees

Some 39 species of non-dipterocarp trees can be found in the general area, of which seven are classified as indeterminate, 10 depleted, and about 22 are considered as common and abundant. Most of these non-dipterocarp trees grow well in low to medium altitudes near coastal areas, in open thickets and dry areas. A list of species that is provided in Appendix D-11.

- Economic Ferns

About 10 species of ferns are identified in the general area of General Santos City which are all common and abundant. Most of these ferns are used in handicraft, as ornament, and as sources of food and medicine. They grow well in open places at low to medium altitudes, along stream banks and canals. Species of ferns in the area and their ecological status are listed in Appendix D-11.

- Bamboo

Two species of bamboo are found to be abundant in the area. These are mostly seen in cultivated and settled areas. The species of bamboo are Bambusa tulda

130

and Dendrocalamus merrillianus. They can be used as construction and handicraft materials. Refer to Appendix D-11 for their ecological status.

- Palms

  About four species of palms are found in the Makar area. These species grow well in low to medium altitude areas, especially in cultivated and settled lands. These species and their ecological status is provided in Appendix D-11.

- Grasses

  The dominant vegetation in the Makar area and its immediate vicinities are grasses. Some 17 species of grasses are found to be abundant and widespread in distribution. The species and their ecological status are provided in Appendix D-11.

2.6 CULTURAL ENVIRONMENT

2.6.1 Archaeological and Historical Sites

Little existing information is available regarding the existing archaeological data in the area around Sarangani Bay. Some data exists for what was previously known as Cotabato, however, most of the sites identified are well inland.

Beyer(1947) identified two sites near Sarangani Bay. The first were burial sites on Sarangani and Balut Islands, at the entrance of Sarangani Bay, on the east side. The second was seven or eight kilometers inland from the Celebes Plantation office on the southwest coast fronting the Celebes Sea (outside of Sarangani Bay).

Solheim II et al.(1979) made a survey of the coastline of the Davao Gulf and Sarangani Bay. Three sites were identified along the western shore of Sarangani Bay and of these three, two were partially excavated. The site nearest to the Makar Wharf study area is in Calumpang, on the grounds of the Holy Cross Monastery. Solheim did a small excavation on the monastery grounds and recovered pot sherds. The sherds were found between 40 and 52 cm depths. Below 52 cm, no more sherds were found. The presence of a few fragments of iron at this site suggested to Solheim II that the site probably dated pre-Sung and during the first millennium A.D. when iron was probably present in the area.

The next site was a rock shelter found in Tinoto Bay. This shelter had been occupied by a T'boli family until approximately 1967. At the time of Solheim's investigations, it was still being used for several weeks at a time by T'boli people when they came down from the mountains for shellfish gathering and salt making. No excavations were made at this site.

131

Another rock shelter was found near Tampat Point, approximately 50 m back from the beach, and it is now known as the T'boli Rock Shelter. This shelter was known to be used occasionally by T'boli people up until 1960 and contained recent furnishings. Two small test pits excavated by Solheim revealed pot sherds to a depth of 30 cm. Solheim concluded that there was a reasonable possibility of two separate pottery complexes at this site and recommended further exploration of the site.

Recently, another six sites have been identified at the future site of the Agro-Processing Center, approximately seven kilometers south of the Makar Wharf. These sites revealed earthenware sherds typical of the Metal Age Period (500 B.C. - 200 A.D.) as well of the sherds of trade ceramics attributed to the Late Ming period (16th - 17th centuries A.D.). Two test pits dug at the site indicated no evidence of direct association of trade ceramics and the researchers concluded that it was premature to establish the dating of the sites. Interestingly, some of the sherds found on these sites were similar to those found by Solheim II at the Calumpang Site in 1972 (Dames and Moore, 1991)

The Makar Wharf study area is already a highly disturbed area. The original and subsequent construction of the wharf necessitated extensive dredging of adjoining coastal areas and reef platforms. Most of the port area itself is created from reclaimed land. Small, relatively undisturbed areas exist outside the port area proper, in one area where few building are in place. The remainder of the surrounding area is built up with residential and business properties, many of which service the port. The site itself could have been a likely area for settlement given its location on the sea and between two rivers. Fresh water would have been abundant as well as the bounty of the sea. However, subsequent development has disturbed this area significantly.

2.6.2 Cultural or Religious Groups

The only cultural or religious group found in the area is the Badjao community located to the northeast of the port site. This community is extensively described in the Section 2.3.3 of this report.

132

CHAPTER 3

PREDICTED ENVIRONMENTAL CONDITIONS WITHOUT PROJECT

3.1 LAND USE AND PLANNING

The planning department of General Santos City expects an average annual growth rate in population of 5.8% in the next 10 years, giving a population of 461,000 by the year 2000 (GSC Socio-Economic Profile, 1989). Based on a current breakdown of land uses in the urban barangays of General Santos City and Labangal's proximity to the central core of General Santos City, it is expected that the land use trends in Labangal will move towards those proportions reflected in other urban barangays (Table 2-2).

Labangal currently only has 18% of its land area classified as built-up, which is significantly less than the other urban barangays. This will undoubtedly change in future with the implementation of a Department of Trade and Industry initiative designed to develop an "industrial estate" on what is now Hacienda Espina (see Figure 2-4). This would change over 900 ha from grassland to other classifications such as built-up, infrastructure and transport, and utilities. It would also be expected that with further development of light industry, additional residential development will occur adjacent to the industrial estate to accommodate workers.

Without the port expansion, there will still be a need for additional container storage area in the vicinity of the port since the forecasted trend is for the increased use of containers (Makar Wharf Feasibility Studies, 1991). This will alienate additional undeveloped lands to be used as storage areas, that might be put to other uses.

3.2 SOCIO-ECONOMIC CONDITIONS

3.2.1 Population

In General Santos City, current trends and forecasts indicate that population growth and density are likely to continue. The population growth rate for the city was 10.29 percent from 1975 to 1980, and 5.30 percent from 1980 to 1990. In fact, General Santos City is said to be the fourth fastest urban growth center in the country. Correspondingly, population density has been on the rise--from 160 persons per km^2 in 1970, and 279 in 1980, to 463 in 1990.

133

Corresponding increases in population growth are also likely to occur in both Lower Makar and Venil, although probably at a slower pace due to limited land area available for additional residential settlement.

3.2.2 Housing and Community Infrastructure

With population growth, housing density in both communities is also likely to increase, as it has in the last decade. In the Badjao community, for instance, the number of houses increased from 102 to 116 in less than a year. In terms of the quality of housing, improvements will depend upon the economic status of the population. Unless dramatic improvements are seen in their sources of income, the housing situation will remain the same.

Residents are not likely to assume ownership of their homelots as the foreshore areas are publicly owned and are being planned for development as an industrial estate by the current administration. Only if future administrations take a radically different stance is this likely to change.

Public utilities such as water and power systems will continue to be available, as they have been in Lower Makar. The water source in the Badjao community that was being constructed last April 1991 should be completed and operational soon. Electric power, however, is less likely to be made available because of the expenses involved and the limited affordability of electric power among the Badjao households. Nonetheless, with the national and local elections scheduled for 1992, it is likely that other community facilities will be introduced or existing ones renovated by political candidates.

In the long term, further improvements on utilities will ultimately depend upon the resources and priorities of the local and national governments.

3.2.3 Education, Health, and Social Services

Existing educational and health facilities are likely to be maintained and open to the communities. However, the quality of these facilities and services will depend upon the government's resources and management effectiveness.

Actual access to and utilization of these resources will depend upon the economic status and socio-cultural values and motivations of the communities. On the one hand, the Badjao will continue to have few students among them if poverty prevents them from being in school. Education will also remain unattractive to them if programs are not designed to meet their needs.

On the other hand, Lower Makar residents will have greater motivation to avail themselves of educational opportunities. The requirement of industries that workers have at least a high school education will serve as a necessary push. The availability of employment opportunities requiring

134

such educational attainment may fluctuate and, in the short-term, push people especially the young to fishing. However, the depletion of fisheries resources is also likely to turn them away from this economic activity.

Some improvements in health, e.g., disease prevention, may also be attained as health projects of the government and the private sector and more exposure to materials on health education will help increase people's awareness of health and sanitation practices. However, the people's economic situation will similarly constrain access to resources which could considerably improve their nutritional status.

3.2.4 Income and Livelihood

Dependence on fishing as a primary source of income is likely to continue among both the Badjao and Lower Makar residents. Unfortunately, at the level of intensity of current fishing pressure, fishing resources will in the long run be increasingly depleted, and will result in increasingly limited catches and incomes.

Employment in the factories will also continue among Lower Makar households, although full time work will be rare given the hiring policies of most industries which encourage only short-term (six months at most) contracts. In the long term, work in fishing-based factories may also be affected by the depletion of local fishing resources.

Without significant changes in the Badjaos' livelihood and without appropriate social services, the practice of begging by some of the women and children in their community will continue and, unfortunately, will cast further stigma on their culture.

3.2.5 Social and Political Life

Socio-economic differences among households along with the corresponding variations in access to resources are likely to remain in both communities.

The elections in 1992 are likely to be accompanied by increased political activities in the area, including community organizing and distribution of goods and resources. Consequently, political affiliations and divisions within the community will be accentuated, though perhaps only temporarily.

Although community organizations are already present in Lower Makar, their active participation and functioning will depend on the support of outside groups. Thus the feasibility of the fishermen's association becoming a cooperative will require the support and encouragement of external organizations.

On the socio-cultural side, changes in Badjao lifeways are likely to occur due to increasing contacts with and influence of the non- Badjao majority through the local government, public and private schools, religious groups, the private sector, and mass media. Some changes will also result from or at least be facilitated by outsiders marrying into the community. Consequently, a very gradual trend toward heterogeneity and differentiation is likely to occur.

3.3 PHYSICAL ENVIRONMENT

3.3.1 Air Quality

3.3.1.1 Total Suspended Particulates

Without the Makar Wharf Project, the average concentration of total suspended particulates (TSP) in the area is expected to increase slightly mainly because if the projected increase of vehicular traffic assumed to be at 3% (Makar Wharf Feasibility Studies, 1991). Of course, this prediction is based on the assumption that there would be no major improvement in the road conditions in the area. Therefore, by 1995, the average TSP concentration at the site is projected to increase to about 100 ug/m^3 from its present value of 93 ug/m^3. Thus, the ambient suspended particulate concentration is predicted to remain within the national ambient standard of 250 ug/m^3 up to 1995.

3.3.1.2 Noise Levels

Even without the Makar Wharf Project, the noise level in the area is expected to increase slightly because of the predicted natural increase in vehicular traffic. A mathematical model was used to project the expected noise level at 10 m, 20 m, and 30 m from the centerline near the junction of the Makar-Kiamba Road and the GSC/Makar-Marbel Road. It was assumed that the percentage distribution of vehicle types remains unchanged without the project and that the average daily traffic volume increases at an annual rate of 3%. The average speed of traffic was assumed as 35 kph. The predicted average noise levels due to vehicular traffic is shown in Table 3-1.

The average noise level value of 63.6 dB (A) predicted by the model for 1991 at a distance of 10 m from the road centerline compares very well with the measured average noise level value of 63 dB (A) at station N9 (Table 2-7).

Within the port area, the existing average noise levels of 45 - 56 dB (A) shall be maintained up to 1995 without the development of the Makar Wharf.

Table 3-1
PREDICTED* AVERAGE NOISE LEVELS ALONG THE MAIN ROAD WITHOUT THE PROJECT

PARAMETERS	1991	1995	2000	2005
No. of light vehicles/day	12,103	14,030	16,265	18,856
No. of heavy vehicles/day	1,606	1,832	2,159	2,503
Total no. of vehicles/day	13,709	15,892	18,424	21,359
Ave. no. of vehicles/hr	571	662	768	890
Fraction of light vehicles	0.88	0.88	0.88	0.88
Fraction of heavy vehicles	0.12	0.12	0.12	0.12
Predicted Noise Levels, dB (A) at				
10 m from road centerline	63.6	64.5	65.3	66.3
20 m from road centerline	61.6	62.3	62.9	63.7
30 m from road centerline	60.0	60.6	61.2	61.9

*Equation for predicting average noise levels:

$$L_a = L_w - 8 - 20 \log_{10} x + 10 \log_{10} C$$

where L_a = average noise level, dB (A)
L_w = $86 + 0.2\,V + 10 \log_{10} (a_1 + 8a_2)$, average sound power level of each vehicle
C = $3.14159\,(x/d) \tanh 6.28318\,(x/d)$
a_1 = fraction of small vehicles
a_2 = fraction of large vehicles
x = distance of receptor from road centerline, m
d = average vehicle spacing = 1000 V/N, m
V = average speed, 35 kph
N = average traffic volume, no. of vehicles/hr

3.3.2 Water Resources and Water Quality

This section deals with the description of the future conditions of the water resources and water quality characteristics in the next five years should the proposed port development in the Maker Wharf not take place.

3.3.2.1 Water Supply and Demand Scenarios

- Port Operation

The water supply and demand for port operations are unlikely to deviate markedly from their current levels in the next few years. The present generating capacity of the existing water supply sources at the wharf is adequate to meet any impending increase in water demand. With the replacement of the two worn-out uptake pumps of the PPA water service and the repair of the damaged pipelines of C. Limjap water service facilities, it is projected that the current generating capacity of the water sources can be increased further.

137

The supply capacity of the water source at the wharf is large. Based on water loading of 5 - 10 tons per vessel and at a rate of 2 - 4 vessels serviced per week, approximately 500 - 720 vessels can be serviced every month by the water service units at the Wharf. Considering that the combined capacity of the two water service units is estimated at 15,000 - 25,000 tons per month, approximately 6,000 - 8,400 vessels can be serviced at the wharf within a year. At a rate of 770 domestic vessels and 73 foreign vessels serviced at Makar Wharf in 1990, the supply potential of the existing water service units is exceedingly large.

In view of this, the water surplus of existing port operation can still allow the water service units at the wharf to accommodate requests of industrial establishments, institutions, and the general public for supplementary supply of water.

- For Domestic Use

It is unlikely that General Santos City will have pipe water supply system in the next five years. The area will continue to rely on underground water sources for its domestic supply. The abundance of springs and free flowing wells will most likely delay positive action on any proposal involving pipe water supply development in the area.

Total water demand will increase with rise in population density and traffic volume in the port area of General Santos City. The lure of job opportunities and better amenities is expected to stimulate influx of migrant workers and transient settlers into the city. This situation will continue to exert pressure on basic services including water supply in the area in the years to come.

- For Agricultural and Industrial Uses

The volume of water consumed by the industrial and commercial sectors in the Sarangani Bay area is enormous. Commercial establishments are estimated to consume three gallons per day per m^2 area while the meat and fish processing plants will require from 20 to 30 gpd per m^2 (SINGCONSULT, 1990).

In the fish processing industry the maximum percentage of water used for fluming of whole fish, fillets or offal amount to 50 - 60 percent of the total water demand. Fish washing, scaling, filleting, skinning, clean up of plant, etc., use about 37 - 43 percent of the total water intake. Thus these two operations alone consume more than 90 percent of the water used in a fish processing plant. In contrast, fish meal plants use only 2 - 4 percent of the total water demand (UN ESCAP, 1982).

On the other hand, five percent of the total water consumed in the slaughter of animals is used during shower and bath, 80 percent during the cleaning of offal, and 15 percent during the washing of carcasses. It has been estimated that at least 10 liters of water is consumed for every kilogram liveweight of slaughtered animal (APBPTC-BAI, 1989).

- For Aquacultural Uses

The expansion of the prawn culture industry in the coastal areas of Sarangani Bay will continue in the next few years. The prawn contract growing program initiated by Dole Philippines will stimulate activity in this sector. It is estimated that 2200 ha of the Sarangani Bay will be converted to prawn ponds within this period.

It was conservatively estimated that approximately 75,000 m^3/ha of spent water will be drained from prawn farms every year (Suazo, 1989). It is commonly held that complete water replacement is desirable in order to achieve and maintain good water quality for pond culture of prawns. Such practices will entail annual water consumption of nearly the same amount that is lost during pond drainage. With the projected 2200 ha of prawn farm development, as much as 165 million m^3 of water will be required every year to meet the increased demands.

With the installation of high powered pumps by an increasing number of prawn farms in the Sarangani Bay area, the problem of receeding water table levels and of increasing saline intrusion into underground aquifers would manifest themselves more significantly in the near future unless an appropriate water management program is instituted.

3.3.2.2 Water Quality and Water Pollution Without the Project

- Port-related Pollution Problems

The probability of pollution problems arising from port activities is minimal considering the kind and volume of cargoes handled and stored in the port area at present.

However, the chance of pollution problems occurring within the next five years will increase if the present port administration fails to formulate, improve or implement programs designed to regulate the use of existing water supply sources and to prevent the occurrence of water pollution problems within its area of responsibility.

It should be recognized that there are several potential point sources of pollution in the port area. The significance of their probable environmental impacts will vary with the kind and volume of pollutive materials released and the nature and extent of damage inflicted on lives and properties.

Categorically, the point sources of pollutants generated from on-land facilities and berthed ships and cargo vessels in the port are: 1) solid wastes and animal manure; 2) perishable fruits, vegetables and agricultural crops and by-products; 3) sewage and bilge water; 4) chemical leaks or spills, fires, and explosions, and 5) airborne particulates and odors.

- Solid Wastes

(a) Garbage and Refuse

There are no records of the amount and composition of solid wastes generated from on-land facilities and cargo vessels of Makar Wharf.

In a study of Batangas Port, it was estimated that two tons of solid wastes will be generated daily by the year 2005. About 65 percent of this solid wastes come from the on-land facilities and the remaining 35 percent from cargo vessels and ro-ro ships. Waste generation rates were estimated at 0.10 - 0.25 kg from individual persons and 20 kg for every cargo vessel (Batangas Port Development Project - EIS, Feb. 1991).

At present, Makar Wharf area does not have its own garbage collection and disposal service unit. It relies on the owners of the cargo vessels docked at the wharf to handle the disposal of their respective wastes into undetermined dump sites outside the port area. This practice is anticipated to continue in the next few years. The impact of leachaetes from waste disposal sites should be assessed in order to protect underground water sources from contamination with fecal and toxic substances.

The port administrators expressed the need to rehabilitate the existing solid waste management in General Santos City. It was also recognized that the city government should augment the fleet of hauling vehicles and establish additional dump sites in order to improve its capability to handle the demand of increasing waste generation in General Santos City and its environs.

140

Sea dumping of solid wastes is believed to be an uncommon practice in the bay area. However, the accumulation of floating sea debris on the shoreline of Lower Makar and other coastal areas of Sarangani Bay suggests that garbage disposal at sea and nearshore does take place in the area.

(b) Animal Manure

Livestock cargo generates a large volume of solid wastes. A hog yields an estimated 1.2 kgs of manure, while a larger animal yields 3.0 kgs (APBTC-BAI, 1988). Based on the 1989 statistic reported by the Philippine Ports Authority, a total of 29,534 live animals were handled in Makar Wharf. At an average of 2 kg fecal matter produced per head, approximately 60,000 kg of manure could have been generated at the wharf for that year.

When left uncollected, animal manure emits foul odors, presents potential hazards for transmission of disease, and acts as a potential input of organic pollutants into Sarangani Bay.

Holding facilities for livestock are unavailable or inadequate. Similarly there are no provisions for the collection, storage, and disposal of liquid and solid wastes while livestock are awaiting transport. It is a common practice for cargo owners to handle the collection and disposal of livestock wastes generated in the port. Dumping of manure in the wharf area is strictly prohibited by the port administration. These practices are expected to continue in the next few years.

(c) Perishable and Decomposable Products

Poor handling and storage of perishable farm produce can cause accumulation of decomposable waste materials at the wharf if not disposed of properly.

Handling of grain and cereal cargoes may result in unwanted spills on the ground or release of suspended particulates or dust into the air. When left uncollected these materials may be ultimately blown or swept into the baywater, increasing the organic loading of coastal waters.

(d) Agricultural Chemicals

Chemical products (e.g., potassium chloride, ammonium sulphate and perosulphate), agricultural chemical preparations (e.g., insecticides, fungicides, fertilizers, veterinary) and pharmaceutical products are handled at the wharf. These cargoes are potentially pollutive and their release into

at the wharf. These cargoes are potentially pollutive and their release into the environment resulting from mishandling or accidental spills, fires, or explosions should be prevented. There should be provisions to protect laborers from unnecessary risks of occupational exposure to toxic and hazardous chemicals.

- Liquid Wastes

(a) Bilge Water

There are no records of bilge water disposal by berthed ships or vessels at the wharf area. It is common maritime practice that bilge water is disposed while a vessel is at high sea. This disposal practice is likely to continue.

(b) Effluent and Stormwater

The volume and characteristics of port effluents generated from buildings and amenities have not been determined. It is assumed that the impact of this effluent is minimized by natural dilution rates of the voluminous Sarangani Bay. With the adequacy of natural treatment of organic effluents at present it is unlikely that additional storage and disposal/treatment facilities will be necessary to build in the port area within the next five years.

Storm events are rare in the project area. Generally, no flooding occurs in the wharf area. Storm water is allowed to drain into reinforced concrete pipes (490-910 mm diameter) and is conveyed into a lined trapezoidal ditch which then empties to the sea.

Wash waters from street scrubbing, warehouse cleaning, and equipment repairs in the port are allowed to drain into storm drain system to discharge to sea.

The wharf sewerage and storm drain system is likely to contain agricultural chemicals, oils, crop by-products when accidental spills occur in the port. There are no provisions to contain such spills nor to treat and dispose these spillage.

- Oil Spills

Since the port does not have provisions to store and supply fuel oil to berthed vessels and ships, the potential for an occurrence of oil spill in the Wharf is minimal. Nevertheless, accidental spills from vessels may occur in the bay or at

142

high sea. The quantity of spent oil washed from the port facilities is limited and is considered to have insignificant effects.

- Pollution Problems Associated with Non-port Activities

Outside of the wharf sources of point discharges of wastes and wastewaters are the numerous commercial, industrial, agricultural, developments in the area. These point source pollutants may include organic substances or toxic, inorganic contaminants. Organic pollutants possess characteristics which enable them to induce oxygen depletion and/or to stimulate excessive plant growth in the receiving water bodies. On the other hand, toxic contaminants include a wide variety of pollutants which are capable of exerting lethal or deleterious effects to sensitive living organisms including humans.

- Organic Pollution in the Bay Area

Organic pollution is commonly assessed in terms of biochemical oxygen demand. (BOD) provides an indication of the organic load of wastewaters or ambient aquatic environment. As a water quality parameter, it measures the amount of oxygen required for the bacterial decomposition of organic wastes and wastewaters. In effect a high BOD-containing wastewater has the potential to cause deoxygenation of receiving water bodies as a result of increasing consumption of oxygen by decomposing bacteria.

The depletion of the oxygen supply in water bodies creates respiratory stress. When subjected to such hypoxic conditions sensitive aquatic organisms may die of asphyxiation.

Since organic pollutants consist principally of carbohydrates, proteins,and fats their decomposition causes the release of plant nutrients (e.g., nitrogen and phosphorous). In a chemically enriched water body the absorption of sunlight initiates photosynthesis and stimulates plant production. The decomposition of accumulated plant materials often accelerates deoxygenation of water bodies.

The change in water quality as a consequence of nutrient enrichment and deoxygenation creates a stressful environment for aquatic life. Algal blooms and fish kills are indicators of deteriorating water quality resulting from organic pollution-induced eutrophication of the aquatic environment.

In a recent report, it was revealed that organic loadings in surface and coastal marine waters of southern Mindanao are comparatively lower than those recorded for central Visayas and Metro Manila (United Nations Environmental Program, UNDP, 1989). A summary of data on organic loadings in these areas is presented in Table 3-2.

Table 3-2
SUMMARY OF POLLUTANTS DISCHARGED INTO THE AQUATIC ENVIRONMENT (MT/yr)

LOCATION	BOD	SS	NITROGEN	PHOSPHORUS
Sea disposal				
Metro Manila	22,550	30,660	4,471	1,277
Central Visayas	1,171	6,880	875	250
Southern Mindanao	1,630	1,330	842	73
River disposal				
Metro Manila	64,298	81,931	10,786	1,081
Central Visayas	35,515	38,262	5,247	1,499
Southern Mindanao	13,754	11,623	7,210	620

Source: United Nations Environment Programme (UNDP), 1989

Water quality data described in Table 3-3 revealed that organic loading within the zone of influence of the project site is minimal.

BOD values were generally low (<2 mg/L) and were below the maximum permissible limit of 7 mg/1 established for Class SC coastal marine waters of the Philippines. Estimated DO levels of > 6.0 mg/1 exceeded the minimum permissible limit of 5 mg/1 considered adequate to support aquatic life.

Stimulation of excessive plant production in the nearshore waters of the project site was not evident. The estimated levels of nitrogen and phosphorus were within the acceptable limits of 0.3 - 5 mg/1. It was noted that the estimated values of nitrate and orthophosphate in surface water (0.5 m depth) were approximately ten-fold higher for the March 15 water samples than those recorded for the March 30 samples. The observed discrepancy in these estimates may be attributed partly to the release of nitrate and phosphate as a result of chemical oxidation of organic matter in the overlying water. It was found that most of the water samples analyzed had relatively higher concentrations of oil and grease, phenols, and surfactants; and the rise in COD levels would suggest the probability of organic oxidation taking place in the water column. The accompanying increase in total coliform counts in most of the March 15 samples would indicate the possible involvement of microbial decomposition in demineralization process.

Estimates of primary production (GPP) and community respiration (R) were comparable between the Upper Makar and Lower Makar stations. Similarly, the heterotrophic bacterial counts (THC) were invariable between the two stations.

144

Table 3-3
ORGANIC POLLUTION OF SARANGANI BAY

PARAMETERS TESTED	UNITS OF MEASURE	UPPER MAKAR	MAKAR WHARF	LOWER MAKAR	CLASS SC CRITERIA
DO	mg/l	6.4 - 6.6	6.3 - 6.7	6.2 - 6.5	≥ 5.0
BOD	mg/l	1 - 2	1 - 2	1 - 2	< 7
SS	mg/l	33	27.7	29.5	≤ 30
NO_3-N	mg/l	0.0091	0.0092	0.0113	-
PO_4-P	mg/l	1.305	2.360	1.313	-
THC	CFU/ml	7 - 104	19 - 273	32 - 277	-
GPP	$mgO_2/m^3/hr$	216.7	-	285.7	-
R	$mgO_2/m^3/hr$	150.0	-	171.4	-

- No water quality standard recommended

Areas outside the zone of influence of the project site are assumed to experience increasing incidences of elevated organic loadings.

In the fish processing and canning industry, the wastewater outputs reached 80-120 gal/min (2400 m^3/day) at RFM to 15 m^3/day at Purefoods. BOD loadings were 410 - 3000 mg/1 at Purefoods and 760 - 3400 mg/1 at Santa Monica Canning Corporation. Wastewater were variably treated via lagoon and pond holding systems prior to surface disposal into the bay.

The effluents generated from prawn farms contains an undetermined quantity of organic matter contributed by pond biomass, fecal matter, and non-utilized feeds. The BOD load of prawn farm effluent is likely to approximate more than 3000 mg/l. The Sarangani Aqua Resources, Inc. (SARI) prawn farm in Buayan, the spent water is conveyed to milkfish pond prior to sea disposal. The enriching properties of the wastewater provides auxiliary nutrient source needed to stimulate natural fish algae production in the pond and at the same time achieve BOD reduction and SS removal.

The level of organic inputs into the Bay is expected to increase with the operation of the abattoir, meat processing, fish processing and canning, fish meal production, tannery, fruit and vegetable processing, among others, in the proposed General Santos Agro-Processing Center. Table 3-4 presents the range of values of BOD and suspended solids (SS) in wastewaters generated from similar establishments.

145

Table 3-4
BOD and SS VALUES (in mg/l) IN WASTEWATERS OF AGRO-BASED INDUSTRIES

ESTABLISHMENTS	BOD	SS	REFERENCES
Fish Processing	275 - 540	200 - 500	ESCAP, 1982
Fish Meal Production	100,000	10,000	ESCAP, 1982
Abattoir	1,000 - 4,500	1,050	ABPTC, 1990
Meat Processing	1,800	2,500	ABPTC, 1990
Fruit and Vegetable Processing	495	300	Diaz, 1987

- Toxic Contaminants in Sarangani Bay

By definition, toxic wastes are residuals which contain substances which can be lethal to living organisms. Toxic substances frequently cause severe impact at relatively low concentrations. Their physico-chemical properties allow them to adsorb easily to suspended and bottom sediments. Many are transformed into chemicals which are also toxic; others bioconcentrate or resist degradation.

The toxic contaminants included in the water quality assessment undertaken for this study are the trace elements of Arsenic, Cadmium, Chromium, Copper, Lead, Mercury and Zinc (As, Cd, Cr, Cu, Pb, Hg, Zn) and organics (phenols, surfactants, oil and grease).

- Toxic Metals

The water quality data presented in Table 3-5 revealed that more than 96% of the water samples contained Cd, Pb, and Cu in quantities exceeding the criteria for Class SC coastal marine waters; and about 30% contained Cr(VI) at concentrations which exceeded the same criteria. The high concentrations of Cd, Cr, Cu, and Pb in water samples obtained within the zone of influence of the project site may suggest possible heavy metal contamination in Sarangani Bay.

146

Table 3-5
DETECTED AVERAGE CONCENTRATIONS (in mg/l) OF TOXIC METALS IN SARANGANI BAY

TOXIC METALS	NO. OF SAMPLES	AVERAGE CONC.	CLASS SC CRITERIA	SAMPLES EXCEEDING CRITERIA (%)
As	9	<0.01	0.05	0
Cd	27	0.062	0.01	96
Cr	26	0.123	0.10	31
Cu	9	0.073	0.05	100
Pb	26	0.278	0.05	100
Hg	9	0.0001	0.002	0
Zn	9	0.043	0.05	0

There are several potential point and non-point sources of metal contamination in Sarangani Bay. Food and food by-product processing wastes and wastewaters contain varying amount of metals (Klein et at., 1974). Similarly release of oil and petroleum products, effluents from waste treatment facilities, sewage from domestic sources, and runoff from urban areas contain metals (US EPA, 1986). Table 3-6 presents average concentrations of metal contaminants that are present in discharges or effluents generated by industrial, commercial, and domestic establishments those similar to operating in Sarangani Bay.

Table 3-6
AVERAGE CONCENTRATIONS (in mg/l) OF TOXIC METALS FROM POINT AND NON-POINT SOURCES

SOURCES	As	Cd	Cr	Cu	Pb	Hg
Fish Processing	-	0.014	0.23	0.24	-	-
Meat Processing	-	0.011	0.15	0.15	-	-
Misc. Foods	0.004	0.098	0.120	0.191	0.059	0.005
Oil/Petroleum Products	-	0.673	2.52	1.283	0.708	-
Waste Treatment Disposal	0.009	0.117	0.696	0.569	1.577	0.100
Domestic Sewage	0.072	0.082	0.759	0.255	0.217	-
Urban runoff	-	3.4	211	104	1,810	-

Sources: Klein et al., 1974; US EPA, 1986.

147

Depending upon their physico-chemical characteristics and the physico-chemical dynamics of the receiving water body, toxic metals may interact with or be absorbed by aquatic organisms.

In aquatic biota, toxic metals may behave differently and exert varying toxicities. Short exposure to high concentrations of metals may lethally disrupt respiratory surfaces, whereas at lower concentrations and longer exposure, lethality may occur by accumulation in internal organs.

Table 3-7 compares the acute lethality of some toxic metals to marine organisms. Relative toxicity is commonly expressed as estimates of metal concentration likely to cause 50 per cent of test organisms dying within a definite period of exposure (e.g., 96 hours). This estimate represents the median lethal concentration of a toxicant or its LC50.

Table 3-7
LETHAL TOXICITY OF METALS TO MARINE ORGANISMS AS 96-hr LC50 (mg/l)

TOXIC METALS	FISH	CRUSTACEANS	MOLLUSKS	POLYCHAETES
Cd	22 - 55	0.015 - 47	2.2 - 3.5	2.5 - 12.1
Cr	91	10	14 - 105	2.0 - >50
Cu	2.5	0.17 - 100	0.14	0.16 - 0.5
Hg	0.23	0.05 - 0.5	0.058 - 32	0.02 - 0.09
Pb	188	-	-	7.7 - 20
Zn	60	0.4 - 50	10 - 50	1.8 - 55

Sources: Jackim et al. 1970; Bryan 1976

The limited information on toxic metals in the waters of Sarangani Bay suggests that detected average concentrations were still generally below the estimated LC50's required to bring about acute lethal effects on marine organisms. However, the secondary data on metal loadings of wastewaters from similar industrial and commercial activities in Sarangani Bay raise concern for potential toxic metal inputs into the baywaters from these sources.

It should be recognized that chronic exposure to low levels of toxic metal can also induce sub-lethal effects to marine organisms. These sub-lethal effects have been observed in changes in: (1) body forms and structures (2) basal activities related to normal growth, development, swimming performance, respiration, circulation; (3) biochemical functions of blood and body fluids, enzyme and hormone activities; (4) behavioral responses and communication and (5) reproduction (Alabaster and Lloyd, 1980).

activities; (4) behavioral responses and communication and (5) reproduction (Alabaster and Lloyd, 1980).

Significant to severe modifications in aquatic community structures can involve reduction in numbers of species, including complete exclusion of sensitive species. A reduction in the number of individuals of surviving species occurs with the amount of reduction related to the metal present (Connel and Miller, 1984).

- Toxic Organics

Phenols, surfactants, oils and grease constitute the toxic organics analyzed in baywaters collected within the zone of influence of the project site.

A little more than one third (> 38 percent) of the 26 water samples analyzed for surfactants and oil and grease exceeded the criteria for Class SC coastal marine waters. None of the water samples gave phenol values which exceeded 5 mg/l, the concentration considered sufficient to cause fish tainting (Connel and Miller, 1989).

There was a noticeable concentration of oil and grease in all stations; values reached 12.9 mg/l in the Lower Makar samples and exceeded the maximum permissible limit of 3 mg/l.

Increasing concentrations of oil and grease in the water samples may be attributed to discharges coming from the cleaning of machinery, runoff from roads, and inadvertent loss from boat engines. The presence of oil depots (Caltex Philippines, Petrophil Corporation, and Pilipinas Shell Petroleum Corporation) in Sarangani Bay provides potential sources of oil and grease contamination of the bay waters.

When present in large quantities, oil and grease can have adverse effects on the aquatic environment and biota. Oil and grease form a thin layer over water interfering with gas diffusion at the surface. Oil slicks smother shorelines and seabeds killing aquatic birds, coral reefs, intertidal fauna; and damage shellfish and finfish industry and bathing beaches.

Although problems with oil pollution in Sarangani Bay have not been reported to date, the port authority is aware of the need for oil pollution contingency measures. At present there are no facilities or equipment at the wharf to respond to such exigencies arising in the near future.

The headquarters of the 8th Coast Guard District, located on the Sasa Wharf in Davao City house the regional center of the National Operation for the Control

149

of Oil Pollution (NOCOP). It has the capability to respond to oil pollution exigencies in marine waters of southern Philippines. Capt. E.A. Erolin, PN, Commander of the Coast Guard District recommends the establishment of an oil pollution contingency facility in the Makar Wharf in anticipation of the proposed port development (pers. comm. March 15,1991).

Another toxic organic examined in the bay water was surfactants or detergents. Water samples obtained from the three sampling sites did not differ in their mean surfactant values (0.5 - 0.7 mg/l) with peak values recorded at 2.6 mg/l. The maximum permissible limit for surfactants in Class SC coastal marine water is 5 mg/l. A little more than 30 percent of the water samples exceeded this limit.

Synthetic detergents have been increasingly used to replace soap as surfactant. Detergents or surfactants enter waterways through treated or untreated sewage containing domestic or industrial waste water and urban runoff.

Surfactants exert toxic and deleterious effects on aquatic organisms. Acute lethal concentrations (expressed as 96-hr. LC50 ranged from 4.5 - 23 mg/l in freshwater fishes and 1 - 10 mg/l in marine fishes (Connel and Miller, 1984)). In general, surfactant toxicity arises from inhibition of enzymes or the surface transmission of ions through membranes.

Sublethal effects take a wide variety of different forms. Surfactants have been found to cause inhibition of growth, destruction of respiratory epithelium of fish gills, and damage to sensitive external sensory organs, e.g., for food searching.

- Groundwater Pollution in Makar Area

In general, groundwater pollution is limited within the zone of influence of the project site. Well waters were found to be bacteriologically safe and are uncontaminated with toxic metals and organics.

The slight increase in detected levels of lead, synthetic detergents, oil and grease in about 30 percent of the water samples analyzed are considered of insignificant concentration to cause any alarm. Nevertheless, consistent monitoring of these parameters should be done to assure that these constituents do not pose real health hazards to the residents in the area.

The slight increase in chloride and hardness values in the well waters of the Upper Makar reflects more the geological features of the area than ensuing salt intrusion into the underground aquifers.

It is anticipated that population density and business activities in the port area will increase at a slow pace in the next five years. The existing pattern of water used

150

in and out of the port area is unlikely to impose additional demands on present water supply sources. Water quality of well waters is expected to remain within acceptable range of health and safety in the next few years.

3.3.3 Oceanography

Without the Makar Wharf expansion project, there will be no significant changes in the oceanographic conditions currently prevailing at the site. Makar River shall continue to be the main source of sediment in the area but no excessive sediment build-up is anticipated in the foreseeable future unless the Makar River is no longer diverted for agricultural purposes.

3.3.4 Geology, Soils and Topography

Environmental impact processes identified in Section 2.4.5 for geology, soils and topography of the Makar River watershed include:

- Previous diversion of the Makar River for irrigation purposes
- Prevalence of erosion due to soil types and slopes, compounded by traditional agricultural practices
- Braiding of river beds and sand bar development in coastal areas as a result of erosion
- Lost of soil fertility as a result of agricultural practices, over grazing and deforestation.

Without implementation of the project, these general processes are predicted to continue to operate within the watershed area. Proposed, or forecasted development of the coastal zone, such as the 973 ha Labangal Industrial Estate on the site of the Hacienda Espina, will tend to accentuate disruptive land use activities in upland, higher slope areas.

151

3.4 BIOLOGICAL ENVIRONMENT

3.4.1 Marine

3.4.1.1 Fisheries

While General Santos City is referred to as the "Tuna Capital of the Philippines", available statistics and field surveys indicate that fisheries production is concentrated in waters outside of Sarangani Bay, including the southern Sulu Sea, Moro Gulf and adjacent Celebes Sea. The deep water, distant nature of these principal fishing grounds effectively insulates these fishery resources from direct impacts associated with the implementation, or non-implementation, of the proposed Makar Wharf expansion. Without the project, indirect impacts of the population growth and development forecasted for General Santos and the South Cotabato region are predicted to continue in the form of marine habitat and water quality degradation primarily of northern Sarangani Bay. Degradation of the coastal marine environment, in combination with overfishing, could severely strain the viability of municipal and subsistence fisheries.

3.4.1.2 Marine Habitat

The coastline of Makar Cove and northern Sarangani Bay is extensively developed and is undergoing a rapid process of urbanization and industrial growth. At present, for example, 18 fishports and tuna factories, as well as commercial wharf facilities (Makar, Dolefil, General Milling, Caltex and Agri-Tex) crowd the coasts of Labangal, Tambler and Siguel (Figure 2-17). The sandy stretch of Bula and Lions Beach is a major fish landing and improvised wet market, while the Buayan area is characterized by prawn farms and silted reefs. A 973 ha area adjoining the present Makar Wharf, the former Hacienda Espina is designated by the municipal and national governments as the future Labangal Industrial Estate.

In addition to the physical development, reclamation or dredging of the coastal area, the primary environmental threats identified for the Dumpao Point reef are siltation, overfishing and pollution.[1] These primary threats operate, for the most part, independently of present or forecasted Makar Wharf operations, and will foreseeably continue and increase in proportion to development and population growth of General Santos City and the South Cotabato Region. In the absence of concerted coastal resource management, the no action alternative of not expanding the Makar Wharf will not significantly alter the process of marine habitat degradation in the northern Sarangani Bay.

[1]For example, the Santa Monica tuna cannery (Sancanco), located in Calumpang, was recently closed by the municipal government due to violation of water pollution regulations. The cannery was allowed to resume operations only after initiating a waste treatment program.

152

3.4.2 Terrestrial

Continued developmental activities in Makar and adjacent areas will result in reduction in available habitat. Modification of the terrestrial environment of General Santos City will continue with the on-going process of industrialization, urbanization and settlement area expansion. The economic boom of General Santos City will trigger the steady transmigration of people due to perceived employment prospects and opportunities in the area.

Land use conversions will alter the remaining habitats of floral and faunal species that exist in the available agricultural types of vegetation of the low lying coastal areas.

3.5 CULTURAL ENVIRONMENT

3.5.1 Archaeological or Historical Sites

Based on the ongoing development of the area, the coastline of Sarangani Bay is likely to become more densely populated. Therefore, disturbances of any potential sites are likely. The area in the immediate vicinity of Makar Wharf is already relatively densely populated and is comprised of built-up areas (see Section 2.1). Therefore, the conditions for potential archaeological finds are not expected to be high now or in the future.

3.5.2 Tribal or Religious Groups

The Badjao community adjoining the Makar Wharf site is the only tribal or religious group that is present in the study area. The future prospects for this community are discussed in Section 3.2.

CHAPTER 4

ASSESSMENT OF ENVIRONMENTAL IMPACTS

4.1 EFFECTS ON LAND USE

Current plans for the area in and around Makar Wharf include the creation of a 973 ha industrial estate on what is now Hacienda Espina (Figure 2-4). The development of this estate will be in keeping with the trend of land use along the coast.

The operation of the wharf after expansion will not require any substantial addition to the existing work force. Endeavors to amalgamate port needs, such as container storage areas within the port, will free-up land areas outside the port area for other developments which could take advantage of the port expansion or the proximity of the proposed industrial estate.

There is no indication that the proposed port expansion would significantly change current land use trends in the vicinity of the port, specifically barangay Labangal. Developments that are anticipated as a result of the port would be in keeping with the existing and planned development for the area (i.e.- light industry).

4.2 EFFECTS ON SOCIO-ECONOMIC CONDITIONS

The proposed rehabilitation and expansion of Makar Wharf will have its attendant benefits and costs, for both the communities immediately adjacent to the wharf and for General Santos City in general.

In the short-term, the project will provide income and employment opportunities to the surrounding population, particularly of Lower Makar, as jobs will be generated during the construction phase.

In the long run, the expansion of the wharf may increase the volume of traffic in the port. Such an increase will in turn create more demand for goods and services. Increased cargo, for example, may require additional arrastres and stevedores, especially if port operations remain labor-intensive. Similarly, increased economic activity particularly in the tertiary sector and most especially in the informal market is likely to result as more goods and passengers flow in and out of the city. Jeepney and tricycle drivers may have more trips, while local stores, restaurants or food stall vendors, and street hawkers may have more buyers. Thus new food

stalls may be added to the 65 stores along the road to the port and the 28 stalls in the market located near the wharf.

Consequently, municipal and national governments stand to benefit from the income and taxes generated from the increased volume of traffic and the increase in wharf-related businesses. An expanded and more modern wharf may further stimulate growth in agriculture and commerce.

The project's social costs, on the other hand, consists primarily in the dislocation of the Badjao community and its consequences on their lives. The relocation of the Badjao will evidently affect almost all aspects of their lives, and some aspects more adversely than others.

4.2.1 Housing and Community Infrastructure

To begin with, relocation will require the physical transfer of some houses and the possible demolition of others, particularly those in disrepair. Transferring the entire house would be no less cumbersome and would involve major costs as well. Boards, nails, and other materials for holding the houses together while being transported will be needed.

To be sure, the Badjaos currently do not have access to a public water and power system. Thus, it could be said that relocation cannot be any worse in terms of access to these utilities. Yet, difficult as it may be, the Badjao nonetheless have secured access to a private water source. In the absence of an appropriate site with an alternative water source, therefore, relocation would understandably be perceived as a step backwards.

4.2.2 Education, Health, and Social Services

Given the fact that almost all lands along the bay, and especially the coastal areas near the city, are already privately-claimed or owned, it is highly likely that the relocation site will be much farther from the city proper. Consequently, access to education, health, and social services even in terms of mere physical distance will be constrained.

While it is likely that there will be a nearby barangay elementary school that can accommodate the 20 Badjao pupils, the four Badjao students studying at MSU High School may be saddled with the problem of having to travel longer and farther. The additional transport costs involved may even result in their withdrawing from school altogether.

Public health and social services may be available in whichever barangay the Badjao are relocated. Still, it is also possible that the delivery of these services may be less frequent and regular, given the distance health service providers will have to travel. Even the assistance which the private sector (e.g., NDDC College of Nursing) is providing will be affected by the additional time, money, and effort to be incurred.

4.2.3 Income and Livelihood

Relocation may also adversely affect the Badjaos' income and livelihood. Although the move might in fact bring the Badjao fishermen closer to better fishing grounds, it will also take them farther away from the market and from their consumers. Even the meager income from begging will be reduced further as transportation costs also increase.

Involving as it does the relocation of a whole community, the proposed project clearly requires the development and implementation of appropriate programs and strategies. These measures should directly address the Badjao community's needs for better housing and public utilities, greater access to health, education, and social services, and increased income and employment opportunities.

4.2.4 Community Perceptions toward Relocation

To determine the community's perceptions, particularly in regard to the wharf's extension, in-depth key-informant interviews and informal group discussions were conducted among residents of Lower Makar and among the Badjao. A sample survey was no longer felt necessary as preliminary field visits showed that each community was highly homogeneous and therefore was not likely to indicate much variability in the responses. Indeed, all the informants recognized the right of the government to have the adjacent communities relocated. Therefore, more qualitative investigation of the residents' views and attitudes was deemed most appropriate.

4.2.4.1 Lower Makar

In Lower Makar, the informants interviewed included two barangay officials, the barangay health midwife, the purok head, one community leader, an official and two members of the fishermen's association, two other community residents, and a young adult fisherman.

By and large the community recognizes the fact that the foreshore area where they now reside is public land. If possible, the residents prefer that they be given the first option to purchase the land. But should relocation be really necessary due to the wharf's expansion, then the community will agree to leave. They will do so on the assumption that indeed only public infrastructure such as a wharf will be built on the land. However, if the government's plan is to actually transfer ownership of the area to private hands, or to allow other settlers to move in once the current residents are relocated, then the community will strongly oppose the move.

While recognizing the government's rights over the land, the community also hopes that relocation is at least made bearable and humane. Essentially, residents propose the following: 1) some compensation scheme is adopted; 2) the relocation site is close to the sea; 3) the on-site infrastructure, amenities, and services are already in place prior to relocation; 4) the payment terms are reasonable; and 5) other benefits are provided.

Residents suggest that inasmuch as relocation will incur various costs such as food and materials for transferring and renovating the house, the government should provide some financial assistance to the relocatees. Members of the community are well aware of previous relocation programs of the city government wherein people did receive some compensation for the move, in addition to the opportunity to own a homelot. Consequently, some twenty households in Lower Makar have had their houses officially assessed in anticipation of this possibility.

With majority of the settlement's population dependent on fishing, the community further considers it important that the relocation site should be close to the bay. Otherwise, fishermen expect problems of commuting to and from the site especially when their boats dock late at night. Others also mentioned the problem of securing their fishing equipment from theft if left unattended. For this reason, not many people are pleased with the prospect of moving to Tambler, one of the current relocation sites located four kilometers from Makar. Fishermen now living there spend three pesos for a jeepney fare to Calumpang or five pesos to Makar. To be sure, some households have adjusted to the move and have seen some benefits too. One fisherman-household head, for example, says he now pays only forty-eight pesos a month for renting a house in Tambler, instead of the ₱ 240 monthly rental in Calumpang.

Another proposal from the community is for the government to ensure that at the very least the facilities, services, and infrastructure already available in Lower Makar--flowing water, electricity, a chapel, a basketball court, among others--are also made available or operational at the relocation site by the time the residents move. Reinforcing this position is the belief shared by many that the present relocation areas, including Tambler, are found wanting in terms of on-site services and infrastructure. This, of course, is not entirely valid--the initial relocation area in Tambler has access to electricity and water; and a complete elementary school is operational. It is only in the new, expansion areas that facilities are still being completed. Nonetheless, the belief serves to justify the people's reluctance to move.

Informants further suggest that the terms and conditions for eventual ownership of the homelots in the relocation site should be made easier and reasonable. As a reference point, informants cite a previous relocation effort which allegedly stipulated that the homelot is to be forfeited if no house is built after three months. Informants hope that greater flexibility is adopted on this issue in the future.

Other benefits, services, and concerns have also been proposed by the community. For one, residents hope that transportation to and from the relocation area is improved, with better roads and more vehicles plying the route. Attention should also be paid to reducing, if not removing, occasions for conflict between Muslim and non-Muslim settlers. One leader recounted that when homelots were being allocated in Tambler, she was anxious that the common practice among non-Muslims of raising pigs in the backyard would be highly offensive to Muslims. She therefore suggested that Muslim and non-Muslim groups not be placed in adjacent lots or blocks. The physical layout and allocation of lots in future relocation sites, therefore, should similarly take these religious differences into account.

4.2.4.2 Badjao Community

Informal group discussions among the Badjao included the purok chairman, the Imam (religious leader), the purok secretary who is also one of the health workers, two other officials, and about ten other members of the community, both young and old. Subsequent interviews were made with another prominent community leader and the other health worker.

The Badjao readily admit that the land on which their houses are built is publicly owned. They have recognized this fact ever since they approached the PPA requesting permission to set up their houses on the site, however temporarily. In effect, the community is resigned to the possibility of their being relocated. "If we really have to go, then we have to go," as one informant remarked.

However, because of their dependence on subsistence fishing, the Badjao hope that they can be relocated to an area along the coast. One informant suggested the foreshore areas of barangays Bula and Tambler as their preferred sites, although he did not know if lots were still available there.

For most residents, a relocation site such as sitio Uhaw in barangay Tambler is much too far. Moreover, they find as unsafe and impractical the idea of leaving their bancas and fishing equipment on the shore, having someone watch over them, and commuting to and from their homelots farther inland.

Unlike Lower Makar's residents, the Badjao did not specify other preferred terms and conditions of relocation besides the site's proximity to the sea. One of their leaders said that he had been informed by a city official about the strong likelihood of their being relocated and about the government's intent to help find them an alternative site. At the same time, he mentioned that the Christian Missionary Alliance Church had also expressed its intention to help provide homelots for the Badjao community.

4.3 EFFECTS ON THE PHYSICAL ENVIRONMENT

4.3.1 Air Quality

4.3.1.1 Total Suspended Particulates During Construction

There shall be a very slight increase in the total suspended particulates (TSP) concentration in the project site during construction. This short-term negative impact on air quality shall be very minimal. Pile driving and reclamation works for the expansion of the new port facilities, which

158

account for a great portion of the construction activities, are not expected to have any impact on the concentration of TSP in the area.

4.3.1.2 Total Suspended Particulates During Operation

The normal operation of the expanded port facilities is not expected to contribute to the TSP concentration in the area. However, there may be a slight increase in dust concentration within the port area if the proposed bulk corn silo and handling facilities are constructed within the port area. Dust mitigation for this structure is addressed in the feasibility study report for this facility.

Despite these predicted increases in TSP concentration during construction and operation of the project, it is believed that the national ambient standard for TSP, which is 250 ug/cm^3 will not be exceeded.

4.3.1.3 Noise Impacts from Construction

During the construction phase, a variety of equipment will be operated at one time or another at the Makar Wharf site. A list of typical construction equipment and their corresponding sound pressure levels at 15 m from the source is shown in Table 4-1. Based on the theory of geometric attenuation of sound, the predicted sound pressure levels at various distances from the equipment are presented in Table 4-2.

Since noise-generating equipment are typically operated intermittently, the typically exposure times of a receptor (a typical construction worker) to these equipment will be, generally less than 8 hours a day. Furthermore, considering the temporary duration of the construction phase, the values given in Table 4-2 are tolerable when compared to the 80 dB (A) threshold value for an 8-hour exposure. Exceptions to this are the areas near the pile driver and jackhammer where workers may be required to wear ear plugs. Noise levels at the periphery of the project site is not expected to exceed the national ambient noise standard for industrial areas. The existing allowable noise levels for various land uses are shown in Table 4-3.

4.3.1.4 Noise Impacts from Operation

The operation of an expanded Makar Wharf would tend to increase the amount of cargo that will pass through its facilities. This would tend to increase the number of heavy vehicles (cargo trucks and trailers) that would pass through the road leading to the port, hence, the noise level along this road would also tend to increase. The increase in the number of heavy vehicles may be assumed to be proportional to the anticipated increase in cargoes handled by the Wharf. The predicted annual growth rates (mid-forecast) of cargoes at the Wharf are 7.6% within the period 1990-1995, 4.4% for 1995-2000, 1.3% for 2000-2005, and a decrease of -1.7% in the period

159

Table 4-1

TYPICAL NOISE EMMISSIONS OF CONSTRUCTION EQUIPMENT

EQUIPMENT	TYPICAL SOUND PRESSURE LEVELS IN dB (A) (AT 15 m FROM THE SOURCE)
Air Compressor	75 - 87
Backhoe	71 - 92
Compactor	72
Concrete Mixer	75 - 88
Concrete Pump	82
Cranes	76 - 88
Front Loader	72 - 81
Generator	72 - 82
Grader	80 - 93
Jack Hammer	81 - 97
Paver	87 - 88
Pile Driver	95 - 105
Pumps	70 - 90
Tractors, Bulldozers	78 - 95
Trucks	83 - 93
Vibrators	68 - 81

Source: Canter, Larry W., 1977: Environmental Impact Assessment, McGraw Hill, New York, 331 pp.

Table 4-2

PREDICTED ATTENUATED NOISE LEVELS IN dB (A) AT VARIOUS DISTANCES FROM THE CONSTRUCTION EQUIPMENT

EQUIPMENT	DISTANCE (m) 30	60	120	240
Air Compressor	69 - 81	63 - 75	57 - 69	51 - 63
Backhoe	65 - 87	59 - 81	53 - 75	47 - 69
Compactor	66	60	54	48
Concrete Mixer	69 - 82	63 - 76	57 - 70	51 - 64
Concrete Pump	76	70	64	58
Cranes	70 - 80	64 - 74	58 - 68	52 - 62
Front Loader	66 - 75	60 - 69	54 - 63	48 - 57
Generator	66 - 76	60 - 70	54 - 64	48 - 58
Grader	74 - 87	68 - 81	62 - 75	56 - 69
Jack Hammer	75 - 91	69 - 85	63 - 79	57 - 73
Paver	81 - 82	75 - 76	69 - 70	63 - 64
Pile Driver	89 - 99	83 - 93	77 - 87	71 - 81
Pumps	64 - 84	56 - 78	50 - 72	44 - 66
Tractors, Bulldozers	72 - 89	66 - 83	60 - 77	54 - 71
Trucks	77 - 87	71 - 81	65 - 75	59 - 69
Vibrators	62 - 75	56 - 69	50 - 63	44 - 57

Table 4-3
ENVIRONMENTAL QUALITY STANDARDS FOR NOISE

CLASS	AREA	MAXIMUM ALLOWABLE NOISE LEVEL, dB (A)		
		DAY	MORN/EVE	NIGHT
AA	Hospital, School	50	45	40
A	Residential	55	50	45
B	Commercial	65	60	55
C	Light Idustrial	70	65	60
D	Heavy Industrial	75	70	65

Note:

The divisions of the 24-hour period shall be as follows:

Morning	5:00 AM	-	9:00 AM
Daytime	9:00 AM	-	6:00 PM
Evening	6:00 PM	-	10:00 PM
Nightime	10:00 PM	-	5:00 AM

Source: National Pollution Control Commission (1978).
"Rules and Regulations of the National Pollution Control Commission".
Official Gazette, No. 23, Vol. 74.

Table 4-4
PREDICTED AVERAGE NOISE LEVELS ALONG THE MAIN ROAD WITH THE PROJECT

PARAMETERS	1995	2000	2005	2010
No. of light vehicles/day	14030	16265	18856	21859
No. of heavy vehicles/day	2788	3368	4177	4189
Total no. of vehicles/day	16785	19633	23033	26048
Ave. no. of vehicles/hr	699	8181	960	1085
Fraction of light vehicles	0.84	0.83	0.82	0.84
Fraction of heavy vehicles	0.16	0.17	0.18	0.16
Predicted Noise Levels, dB (A) at				
10 m from road centerline	65.5	66.6	67.6	68.0
20 m from road centerline	63.2	64.0	64.9	65.2
30 m from road centerline	61.5	62.3	63.1	63.5

2005-2010. (Makar Wharf Feasibility Study, 1991) However, the lighter vehicles are assumed to have a constant growth rate of 3% from 1900-2010. The results of the simulation is shown in Table 4-4.

As the results show, the predicted noise levels that would result from the operation of the expanded wharf would still satisfy the national ambient noise standard for light industrial areas (see Table 4-3). Hence, the long term noise impact of the project is very minimal.

4.3.2 Water Resources and Water Quality

This section deals with the assessment of the probable changes on the aquatic environment as a result of the proposed improvements of the facilities of the Makar Wharf.

The proposed wharf improvements involve two phases. Phase I involves the reconstruction of the open area north of the transit shed to serve as container yard and a number of management and operational improvements while Phase II involves the dredging and reclamation of a 150 m by 380 m area at the northeast end of the existing port where a new berth will be added and a container facility constructed. The berth areas will be dredged up to a depth of -15 m. A livestock terminal will also be constructed to the northeast of the existing facility.

4.3.2 Water Resources and Water Quality

4.3.2.1 Phase I

- Construction

  The construction aspects of Phase I are unlikely to significantly affect water resources or water quality within the project site. The labour required for such construction activity will, for the most part, be readily available from within General Santos City. Those specialists that may be required from elsewhere will be in small enough numbers to be housed within existing facilities in General Santos City. Existing water supplies at the port will be adequate to supply the needs of additional workers. There may be some additional requirements for sanitary facilities during the construction activity.

- Operation

  The impacts of the operation of the port will mainly be of a positive nature. As this phase incorporates a number of improvements to existing systems, the net impact will be a positive one.

The addition of navigational aids and communication equipment will lessen the probability of vessel accidents, in an already low risk area.

4.3.2.2 Phase II

- Construction

Dredging works involve cutting into the seabed. During this activity a solution of earth materials and sea water will be generated. The earth material constitutes at least 10 percent of the total volume of the dredged spoil dumpings. The muddy water may contain varying amounts of inert particles, such as clay and silt (i.e., high SS), high concentration of organic detritus (i.e., high BOD) and possibly industrial pollutants (i.e., heavy metals, pesticides, and other toxic organics).

Based on geotechnical surveys, most of the dredgeate at the site is expected to consist of sand and gravel, while the deepest dredge materials will include clay materials. The sand and gravel will be used, as fill in the reclamation area. However, suitable methods of disposal must be found for the clay materials.

The dredging, reclamation and disposal of clay materials will produce some impact on the surrounding water quality.

The possible adverse effects of dredging on the receiving water body include the following:

(a) Increased turbidity due to suspended solids

The proportion of silt and clay in the muddy water will determine the quantity of particles suspended in the water column. Fine clay particles of about 0.020 mm in size remain in suspension in water and gradually settle out at a rate of 0.0002 m/sec. Baseline conditions for turbidity are not ideal and based on marine surveys, the area has already been subject to some siltation. Current data in the area indicates that any suspended solids generation would be very localized.

Increased turbidity due to suspended particles is perhaps the most significant adverse environmental effect that may result from construction activities in the port area. Some of the deleterious effects of increased turbidity on aquatic life are:

163

(i) Fish tend to avoid turbid water due to feeding inhibition and difficulty in seeking shelter. Turbidity reduces activity and may interfere with behavioral and migratory patterns.

(ii) The settling out of suspended matter blankets benthic plants and invertebrates resulting in high mortalities and disruption of benthic settlement and recruitment patterns by substrate alteration.

(iii) The harmful effects on fish, zooplankton, and other organisms includes the clogging of the respiratory surfaces and gills with particles resulting in asphyxiation.

(iv) Suspended particulates cause mortalities to benthic eggs due to smothering, and to non-benthic eggs by adsorption onto the egg surface. Both result in a reduction of water flow and dissolved oxygen to the egg.

(v) Restricted light penetration due to turbidity interferes with the energy input to aquatic ecosystems. Thus, biomass, diversity and species distribution in the system could be correspondingly reduced.

Additionally, sediment deposition in bathing beaches and water fouling due to increased sediment suspension contribute to reduction in the enjoyment of the recreation and aesthetic benefits of these beaches. However, no bathing beaches exist in the immediate vicinity of the port.

It should also be recognized that the duration of impacts associated with increased turbidity will be short-lived and restricted to the immediate vicinity of the project site. This condition is dependent upon the volume of dredged spoil dumpings generated, the disposal methods employed, the disposal sites established, and the physical condition in the receiving water body. Given the existing degraded condition of the marine habitat in this area, the net effects of dredging on turbidity, with appropriate mitigation, will be minimal.

(b) Increased deoxygenation and eutrophication due to high BOD load of sediment.

It is assumed that the organic input in the project area is practically nil. Geotechnical surveys indicate that no organic materials are present in the substrate to be dredged. Effluent from normal port operation effluent is

164

low in organic content. Human excreta and solid wastes are minimal considering the low population density in the Badjao community. Surface runoff is non-existent due to the diversion of the Makar River. Industrial point sources of organic wastes are not present in the project site. Effluent discharge from industries located outside the zone of influence of the project site may be subjected to the dispersal and dilution action of the baywater reducing its potential to accumulate in the vicinity of the project site. These conditions suggest the area is unlikely to contain large amounts of accumulated organic materials to bring about pollution problems at the port site.

The low BOD values estimated for seawater within the zone of influence of the project site seemed to suggest that organic loading derived from point sources and sediment compartment were minimal. At most, mild but localized and short-lived water pollution problems may result from port construction. Appropriate mitigation measures can be designed to alleviate those impacts.

(c) Increased metal contamination

The trace metal analysis revealed that, at baseline conditions, Pb, Cd, Cu, and Cr exceeded the maximum permissible limits established for the Class SC coastal and marine waters. However, their estimated average concentrations were too low to cause significant lethal effects on marine life. The source of these metal concentrations are unknown and sampling error can not be ruled out. If unusual metal concentrations are inherent in the local soils, the scouring of metal-contaminated sediment in the dredge area may increase the ambient concentrations of toxic elements in the water.

Deleterious and physiological toxic effects on sensitive marine species are attributed to the presence of toxic contaminants derived from industrial wastes. Elevated levels of toxic metals in sediment, for instance, could be contributed by addition of industrial effluents into Sarangani Bay. However, the toxic effects of these contaminants are influenced by their physico-chemical properties and the biochemical characteristics of aquatic organisms. Toxic metals tend to be effectively absorbed onto sediment particulates rendering them unavailable for uptake and assimilation by aquatic biota. Detoxification mechanisms are also available in some aquatic species which enable them to render harmless potentially toxic chemical substances found in water.

165

Therefore, the release of toxic amounts of trace metals is unlikely to cause significant effects during port construction. However, long-term effects due to chronic exposure to sublethal concentrations of heavy metals cannot be totally discounted.

- Operations

The types of impacts that can be expected from the expansion and expected increase in activities at the port are: increase in solid and liquid wastes, increased likelihood of spills of either oil or contaminants.

(a) Solid wastes

Phase II will include the construction of a livestock terminal and an appropriate sanitary treatment facility to dispose of animal wastes produced at the facility. Because live animal cargoes were projected to increase regardless of the expansion of the port, this terminal and treatment facilities will have a net positive impact on water quality.

Other solid wastes may increase with the expansion of the port such as spoiled fruits and vegetables and used packaging materials. This is not expected to cause a significant impact on water quality as current laws (Presidential Decree no. 600) prohibit the dumping of solid wastes into Philippine navigable waters. The hauling and disposal of these solid wastes into off-site dumps will continue to be the responsibility of the cargo owner.

(b) Liquid wastes

With the new port facilities at Makar, it is projected that the volume of cargo and passengers will increase somewhat. In 1990 alone, there were 770 domestic vessels and 73 foreign vessels which called in at the Makar Wharf. The number of vessels is not expected to increase significantly, however, (Section 1.3.3.3) since there is a trend towards more containerships and there is also a trend for increase in size in containerships, the net result will be an insignificant increase in the number of ships, if any at all.

With any increase in vessel traffic, the volume of ballast and bilge water disposed into the sea is expected to increase proportionately. However, the current practice of depositing of bilge at open sea will preclude significant impacts on Sarangani Bay water quality.

166

- Potential for toxic chemical or oil spills

Expansion of containerized cargo service may increase the volume of chemical cargoes, such as fertilizer, handled at the port. Potentially toxic and hazardous chemicals are contained in many types of agricultural chemicals and pharmaceutical products which are likely to be handled in the container shipyard in the port of Makar.

The improper handling, storage, and transport of potentially toxic and hazardous chemical cargoes in the port could increase the probability of accidental release, explosion, or fire and the damaging consequences on the lives and properties of laborers and passengers in the port.

No records exists of oil spills near the Makar Port in Sarangani Bay (Philippine Coast Guard, 1989). The configuration of Sarangani Bay, with its wide entrance, wide channel and great depths, contributes greatly to the navigational safety of the area. The addition of new navigational aids in Phase I will enhance the inherent safety of the port. Also, the current practice for experienced pilots to berth ships virtually eliminates risks on docking.

No oil tanker traffic presently exists at the port, nor is any expected as a result of the port expansion. While cargo traffic is expected to increase, this does not necessarily mean an increase in vessel traffic. As the trend is toward more containers, and container ships are becoming larger, vessel traffic may not change significantly.

Based on all these factors, the increased risk for oil or fuel spills as a result of vessel collision is expected to be minimal.

4.3.3 Oceanography

4.3.3.1 Nearshore Currents.

Phase II of the wharf expansion program calls for the reclamation of a 150 m by 380 m area that shall be developed as the wharf expansion. It will require the dredging of the seabed to -15 m. The area to be reclaimed is very small (5.7 ha) and the proposed alignment of the quay is such that it is almost parallel to the natural bathymetric contours. Hence, the proposed geometry of the proposed wharf expansion is not expected to affect the natural flow of the nearshore current system. Moreover, the reclamation shall be made on the coral reef area where it is very shallow and where there is no appreciable water current.

167

The dredging of the sea bed to -15 m shall affect a very small area adjacent to the extended port. While the deepening of sea bed shall tend to decrease the magnitude of the wind-driven surface current, this effect is so minimal in the project site that it is not expected to disrupt the present surface transport characteristics of the nearshore waters at Makar.

Future possible expansions of the wharf could include further reclamation and dredging to -20 m. Even with this amount of dredging, the area that shall be affected remains to be very small compared to the total dimension of the wharf. Hence, no significant impact on the nearshore current system is anticipated.

4.3.3.2 Changes in Local Sediment Transport and Beach Stability.

The eastward extension of the quay is not expected to disturb the natural transport of sediment from the Makar River during the rainy season. Beach stability near the wharf is not likely to be affected by the reclamation and the extension of the quay since the beach areas in Makar are adequately protected from erosion by the fringing coral reefs.

4.3.4 Geology, Soils and Topography

The project is predicted to have limited direct terrestrial impact as the proposed expansion primarily concerns reclamation of a tidal basin area. Fill requirements of the reclamation will be largely satisfied by dredged spoils of the fore reef slope. The additional requirements of fill and armour rock, described in Section 1.3.2 of this report, will be sourced from existing borrow sites at the Silway, Sinawal and Buayan Rivers. These river borrow sites are traditional sources of fill and aggregate in the area.

4.4 EFFECTS ON THE BIOLOGICAL ENVIRONMENT

4.4.1 Marine Environment

4.4.1.1 Fisheries

The construction and operation of the 150 m extension of the Makar Wharf will directly impact marginal fisheries habitat at the site (Section 4.4.1.2). However, environmental degradation of fisheries habitat as a direct result of the proposed expansion is minimal compared to the larger biological and ecological impacts that have occurred along the coasts of northern Sarangani Bay.

168

The effects on fisheries will be insignificant as the adjacent fishing grounds that will be affected, especially those within the three-kilometer radius, are not major fishing grounds. The nearshore waters of the Makar area are apparently overfished and depleted, hence municipal fishermen currently look for more productive areas particularly near the entrance of the Sarangani Bay.

Many of the Badjao fishermen interviewed were more disturbed with the imminent relocation of their dwellings rather than with the expected damages to the fishing ground in the immediate vicinity of the project site.

4.4.1.2 Marine Habitat

The proposed, staged expansion of the Makar Wharf to the northeast will effectively eliminate the remnant marine habitat described as the Dumpao reef platform. The proposed dredging and reclamation for the wharf expansion will directly and indirectly displace an estimated:

- 3.4 ha of intertidal reef flat
- 3.0 ha of seagrass dominated habitat
- 0.35 ha of soft coral dominated habitat
- 4.4 ha of mixed reef flat and sandy fore reef slope
- Subsistence fisheries associated with these marine habitats.

This reef area is described, in Sections 2.5.1.2 and 3.4.1.2, as environmentally disturbed and stressed by a complex of development impacts, including siltation, pollution and overfishing. Continued stress on this limited reef habitat, coupled with forecasted population growth and industrialization is predicted to result in the displacement of these habitats and associated subsistence fisheries.

Along with displacement of the subsistence fisheries of the Dumpao reef platform, the proposed expansion will displace the Badjao community of Venil. Social soundness surveys and scoping sessions conducted as part of this assessment identified the importance of a coastal relocation site for the Badjao community. In the absence of alternative livelihood opportunities or mitigating efforts, such as the conservation educational programs incorporated in the USAID-Dolefil co-funded Sarangani Bay Marine and Inland Resource Conservation Project, it is anticipated that marine habitats accessible to their relocation site will be subjected to similarly intensive, subsistence fishing pressure as described, in Section 2.5.1.2, for the Dumpao Point reef.

If construction of the expansion is implemented, a primary concern is the proposed dredging to a depth of 15 m, along the face of the new quay extension. Substrate borings conducted during the concurrent Feasibility Study identified samples of clay material at this depth. From an

environmental concern, dredging and disposal of an extensive clay faction could disperse significant silt into the immediate and adjoining coastal waters, compounding the pre-existing condition of high levels of coastal siltation. While the marine surveys for this environmental assessment were limited to shallow marine habitats (above 10 to 15 m of depth), deeper habitats and species understandably exist and may be directly or indirectly affected by the potential plume of dredging wastes. As recommended in the Feasibility Study, additional boring samples are warranted to determine the relative extent of clay substrate prior to initiating the detailed design of the facility.

In the Scope Of Work of the Makar Wharf Environmental Assessment, the use of coral as landfill material was identified as a potentially significant environmental issue. Use of coral as construction material of fill is restricted by GOP Presidential Degree 1219 (1977). Based on marine surveys, living (hard) coral reefs are not a substantial feature of northern Sarangani Bay. Preliminary estimates incorporated in the Feasibility Study indicate that fill requirements of proposed reclamation areas will be adequately supplied by dredging spoils, land sourced fill and armour rock. Local observations and interviews do not support the reported use of coral as fill material on a commercial scale.

Eventual operation of the expanded wharf facility is not anticipated to directly impact outlying marine habitat areas, with the noted exception of increased risk of spills and objectionable discharge which are discussed in Section 4.3.2. The recommendation of installing navigational aids, while providing additional berth space for public safety vessels and warehouse space for oil containment equipment should adequately compensate the operational threats of any forecasted traffic increases.

4.4.2 Terrestrial

No significant impacts are expected to occur given the minimum amount of land area to be used in the port expansion. The limited area that would be included in the reclamation, livestock terminal and new port entrance are situated in previously disturbed open grassland areas. This habitat type is typical of the lower Makar River watershed and does not contain any reported sensitive or endangered species of flora and fauna.

4.5 CULTURAL ENVIRONMENT

4.5.1 Archeological or Historical Sites

Based on the limited archeological data available for the western coast of Sarangani Bay, it is impossible to make a definitive assessment of the potential for cultural artifacts in the port area. However, since the present wharf is the result of different construction periods which included

disturbance of the marine environment by dredging, it is unlikely that artifacts would be found in the marine environment. Also for that portion of the port that is existing the likelihood of artifacts is extremely remote, as the port site is primarily a reclaimed area constructed in 1975-76.

However, the location of the Makar Wharf on the coastline and near the mouths of two rivers would indicate an ideal historic settlement site. Some undisturbed areas remain near the wharf, which with port development may become built up. Also, sources of fill material for the reclaimed areas are potential sources of artifacts since these fill sources are located in river beds.

4.5.2 Tribal or Religious Groups

A discussion of the effects on the Badjao community is included in Section 4.2

4.6 AESTHETIC EFFECTS

4.6.1 Land

The most significant change in land form/pattern which will be produced by the project is the reclamation of the foreshore areas. Some vegetation will be disturbed as a result of landfilling activities during the construction phase of the project. This will be a temporary and insignificant amount of disturbance.

4.6.2 Atmosphere

Dust generation will increase during the construction phase of the project (Section 4.3.1) but this increase is expected to be minimal. Generated dust particles will settle in the course of time and are not expected to be significant during normal wharf operation.

Additional construction activities, such as concrete cement production, operation of pile drivers, dredging and related traffic, will produce some additional noise and emissions during construction but as the magnitude of the construction is not large, and the recommended staged-implementation of the project, the duration will be relatively short and effects temporary.

Operation of the port will be improved as part of Phase I and while there is a projected increased in traffic, the proposed improvements are expected to streamline the operational process of cargo handling.

171

4.6.3 Water

Turbidity of the Sarangani Bay near Makar Wharf will increase as a direct result of construction activities including proposed dredging, pile driving and filling. However, this condition will be shortlived and ambient conditions are predicted to return after construction. Use of a silt curtain, such as plastic sheets, to encircle the dredging site, would further restrict dispersal of dredged sediments and limit increases in local turbidity. The natural bluish-green color of the coastals waters will return after the construction period.

4.7 POTENTIAL FOR CUMULATIVE EFFECTS WITH OTHER PROJECTS

Given the development plans provided in Section 2.2.2 of this report, General Santos City and environs will be undergoing considerable growth and change if these plans are undertaken.

The development of the Agro-Processing Center, roads, airport and the expansion of the Makar Wharf, are all projects that will have some impact on the surrounding environment. The combination of all of this development and the ancillary growth it is expected to precipitate could have an overall significant impact.

The Consultant is not in a position to determine specific potential impacts of other projects and leaves that to the environmental assessments that are prepared for each project to delineate. However, some general statements can be made that identify common areas that may be the most greatly effected.

Of particular concern is the water quality of Sarangani Bay. As mentioned in Section 2.4.3 of this report, Sarangani Bay already acts as the receptor for domestic and industrial wastes, as well as run-off from the vast agricultural area encompassed by the numerous watersheds that flow into Sarangani Bay. In addition, upland degradation results in heavy silt loads flowing into the bay during seasonal rains.

Anecdotal information indicates that fisheries in Sarangani Bay have diminished significantly although the offshore commercial fishery continues to thrive. Mangrove destruction around the bay is in evidence due to preparation of aquaculture ponds. In addition, the ongoing development around the Bay will continue to require fresh continuous water supplies, often in large quantities.

The other primary area of impact of ongoing development will undoubtedly occur in the socio-economic area. On one hand, the process of development will provide opportunities for work and upgrade the community as a whole. However, unplanned development can also dislocate individuals and communities and unless appropriate accommodation is made early, this problem will continue to grow.

172

General Santos City and all the municipalities around Sarangani Bay have a unique opportunity as most of the proposed developments are currently in the planning stages. Therefore, there is time to plan development in an orderly and cohesive manner. The Sarangani Bay area needs, to undertake a comprehensive plan to identify resources, needs and limiting factors and to establish a system whereby benefits to all users are maximized. This, in essence, would be a program of sustainable development.

CHAPTER 5

MITIGATIVE MEASURES

5.1 MITIGATION FOR THE SOCIO-ECONOMIC EFFECTS

As explained in the preceding chapter, the proposed rehabilitation and expansion of the wharf will result in the relocation of the entire Badjao community of 570 people. As much as possible, therefore, mitigation should be aimed at reducing the costs and inconveniences of relocation, and at improving the Badjaos' quality of life in the relocation site.

In general, mitigation may focus on these key concerns: (1) community information campaign and consultative meetings; (2) compensation and security of tenure; (3) site selection and development; (4) community organizing and development; and (5) monitoring.

5.1.1 Community Information Campaign and Consultative Meetings

It is proposed that the city government, and the project proponent, Philippine Ports Authority, hold meetings with the leaders and members of the Badjao community not only to provide them with full information about the project but also to solicit their suggestions. These meetings will serve to make the community aware of the need to expand the wharf and the government's knowledge of the costs and benefits involved. In turn, through these gatherings, the government can determine the specific needs and concerns of the community and communicate its intent to help them meet these needs. Representatives from the Urban Poor Council, civic and community organizations concerned with Badjao welfare may be invited to these meetings to ensure that the community's interests are safeguarded.

5.1.2 Compensation and Security of Tenure

An important mitigation measure is to ensure that the terms and conditions for relocation are clear and acceptable to the Badjao. As much as possible, the project should provide a just and fair compensation scheme for the Badjao and assist them in acquiring security of tenure over the relocation site.

The specific content of the compensation scheme will have to be worked out with the Badjao community. Among the elements which may be considered, however, are the following: the value of the house should it be demolished; the cost of materials needed for preparing the houses to be transferred and for renovating them; the cost of labor, including expenses for food and other items; and opportunity costs.

For this purpose, the experience of previous relocation programs can be reviewed. For example, the construction of an highway in General Santos City some years back reportedly dislocated 33 families who were subsequently given ₱ 3,000 each in compensation. In addition, each family was relocated to a homelot which was to be amortized for a period of five years at ₱ 48 a month.

Indeed, an important component of the relocation plan should be the opportunity for the Badjao to own a homelot. To be sure, some reservations have been expressed by some sectors regarding this alternative. The Badjaos' state of poverty and their supposedly migratory or "gypsy-like" nature have raised doubts regarding not only their ability to pay for a homelot, and even their desire to own one.

Rather than be constrained by these fears, the relocation plan should instead include innovative ways by which the Badjao can, as a community, work together to eventually own their homelot. To prevent the unwarranted selling of individual lots, for example, a type of community stewardship could be followed instead. At the same time, private groups and organizations could be tapped to provide initial financing for the homelots.

5.1.3 Site Selection and Development

The social and economic dislocation of the Badjao may indeed result if the relocation plan fails to consider the community's dependence on subsistence fishing and its need for public utilities and services.

Given the community's continued dependence on subsistence fishing, the project should, as a mitigating measure, select a relocation site which is as close to the sea as possible. This alternative is currently being strongly pursued by the city government with the assistance of the Urban Poor Council. One of the sites being considered is an area about a hundred meters from the shore, in the vicinity of "Dupalco Beach" in barangay Tambler. The site has an area of 5.8 ha and can accommodate 400 families at 100 to 150 sq m per family. As of April 1991, the land was valued at ₱ 150 per sq m.

Equally important is not just the location of the site that is selected but also the very process of selection itself. It is suggested that Badjao representatives be made to participate in the selection process--setting the parameters of the possible sites, conducting on-site visits or field inspections, assessing the relative costs and benefits of alternative places, and deciding on the area.

In addition to site selection, the project should ensure the development of the relocation area. For one, the services and infrastructure which the Badjao already had access to prior to relocation--a water source, a place of worship, and a recreation area, and access to education and health services--should also be ready and available at the resettlement area, preferably by the time the move is actually made. In addition, public sanitation facilities can be installed and

175

access to electricity made possible.

5.1.4 Community organizing and development

For the Badjao community to participate effectively in its own development, it is important to strengthen its organizational capabilities. Through an active community organization, the Badjao can better articulate their demands, secure the resources they need, and design and implement action plans. To this end, the project should help organize the community by providing training in organizational skills development. With this foundation in place, the community can subsequently be assisted in exploring the possibility of establishing a cooperative which could help them secure loans or market their products.

Other training and assistance programs can be initiated to provide the Badjao additional sources of income, if not alternative livelihood activities. For example, the Badjaos' creative skills can be tapped for cottage industries such as mat- weaving, woodcraft (e.g., carving miniature boats) and shellcraft production. In fact, the development efforts for the community can be geared towards building a "Badjao village" which could showcase Badjao arts and crafts, while helping maintain the group's culture, identity, and lifestyle. However, in doing so, steps should be taken to ensure that the Badjao remain in control of their lives and are not commercially exploited.

5.1.5 Monitoring

Essential to the successful implementation of the mitigating measures is a monitoring system that would check compliance with the relocation plan. The monitoring system will verify the presence and assess the quality of public utilities and infrastructure in the relocation area and the community's access to education, health, and social services. Similarly, monitoring activities will periodically determine the progress of efforts to provide security of tenure to the Badjao and to help them establish a viable community organization. Moreover, studies should be conducted to determine improvements in the Badjaos' economic status and in the quality of their life in general.

5.1.6 Timetable

Although the proposed project is not expected to be initiated as soon as possible, the full details of the proposed mitigating measures can be worked out and implemented immediately. The government, in close coordination and consultation with the community leaders, will need to decide on the relocation site and on the terms and conditions of relocation. Once the site is determined, the basic utilities (especially a water system) may be installed. Access to education and health services should also be ensured.

In the meantime, the government and the private sector can initiate the necessary training programs for the Badjao community. Moreover, a system should be designed and implemented to ensure that no additional migrants, particularly those who wish to take advantage of the relocation program, move into the area. The Badjao community may assume the responsibility for carrying out this task.

5.2 MITIGATION FOR EFFECTS ON PHYSICAL ENVIRONMENT

5.2.1 Air Quality

5.2.1.1 Total Suspended Particulates

Without the proposed bulk corn facilities, the impact on total suspended particulates of the construction and operation of the wharf would be very minimal. The national standard for TSP concentration of 250 ug/m^3 is not expected to be exceeded. In view of this, no extraordinary mitigative measures are recommended except that construction activities should strictly adhere to good engineering practices to avoid excessive generation of dust.

If the bulk corn facility will be constructed within the port area, an assessment of the proposed facility with respect to its dust generating potential should be made. Engineering measures should be included in the plan in order to prevent dust from being emitted into the free air during loading and unloading operations.

5.2.1.2 Noise Impacts

The impact of noise during the construction and operation of the project is expected to be minimal except in the vicinity of the pile driver and jackhammer as they are operating during construction. Workers near these equipment should be advised to wear ear plugs while working in the vicinity of these equipment to avoid undue exposure to loud sound. It is also recommended that pile driving and other activities likely to generate excessive noise be limited to daylight hours.

The noise generated by the expected increase in vehicular traffic is not likely to exceed the national standard for light industrial areas. Hence, no extraordinary mitigative measures are being recommended.

177

5.2.2 Water Quality and Water Resources

The probable adverse environmental effects of port improvements on water quality and water use within the zone of influence of the project site necessitate the formulation and implementation of appropriate mitigation measures and waste management strategies in order to minimize the undesirable consequences of port construction and operation.

This section suggests mitigation measures and waste management strategies for potential impacts identified in Section 4.3.2 whether impacts were considered significant or insignificant.

5.2.2.1 Mitigation of Impacts of Port Construction

The most significant impact that is expected is the increased turbidity and sedimentation as a result of the proposed dredging. While the area that is expected to be effected is already a degraded marine habitat and turbidity in the water quality study area occasionally exceeds the water quality criteria(Section 2.4.3), it is, nevertheless incumbent on the proponent to provide appropriate measures to ensure that their project does not further degrade the existing environment.

Because dredging will be a short term operation, the duration of which is estimated at three months, a number of measures can be taken to minimize the effects of that activity. Associated with dredging will be the filling of a 150 by 380 m area and the disposal of any clay dredgeate that cannot be used for fill. The consultant proposes the following mitigation measures:

(a) In order to minimize sedimentation as a result of filling activities, a coffer dam of rip-rap will first be constructed around the area to be filled. The material which the dam is constructed of should allow for liquid flow-through in order to accommodate tidal movements, but should be of fine enough grade material to act as a sediment trap.

(b) For engineering feasibility, a clamshell dredge is the preferred dredge operation, in order to allow for the separation of the upper layers of dredge materials(i.e. those suitable for fill) and the lower layer (clay which must be disposed of). The clamshell is also preferable from an environmental standpoint, particularly if the heavy metal concentrations found in the water column are the result of natural contamination by soils. The clamshell would then provide more control of the operation and again, would allow for separation of the possibly contaminated clay layer.

(c) It is recommended that prior to dredging, during geotechnical surveys, samples of the proposed dredgeate be analyzed for heavy metal content (specifically Pb, Cd, Cu, Cr) in order to determine if the source of these concentrations is the soil. If not, then a hydraulic dredge would also be considered suitable, if necessary,

178

for dredging operations.

(d) There are four options for disposal of the dredgeate. If the laboratory analysis determines that there are no heavy metals in the clay deposits, these dredge materials could be recycled for use as water retentive lining material for prawn ponds or irrigation canals.

A second option is the disposal offshore by bottom dumping from a barge. The weight of a barge load of dredgeate acts as a deterrent to surface dispersal and dispersal does not take place till well below the surface. This option can only be used if a clamshell dredge is used. The selection of an offshore dumpsite should be done in conjunction with DENR and PCG.

The third option is a dry land disposal site. This should only be considered if there is no heavy metal concentrations in the clay materials. The selection of the site should be done in conjunction with local representatives of DENR, PPA and city officials. A landfill should be constructed that could also accommodate solid wastes from the port.

The fourth option may be used if a hydraulic dredge is used. The slurry should be piped offshore and directed downward in a rigid pipe to a depth of -25 m. This will avoid surface dispersal and allow the slurry into a deeper part of the water column where dispersal is faster.

The preferred option is to use on offshore dump site.

(e) During the dredging operation, water quality monitoring should be undertaken. A water quality monitoring program for construction and operation is included in Appendix G, Environmental Action Plan.

Because the organic contents and toxic contaminants could be intimately associated with the sediment fractions of the dredging spoil, the mitigation for their potential adverse effects is similar to those proposed for suspended particulates.

In addition to the options proposed for the mitigation of suspended particulates, the removal of decomposable organics and toxicants can be achieved by the addition of chemical flocculants. The flocs can be easily settled and the organics and toxicants increasingly removed from the dredging slurry. The clarified effluent may undergo further reduction of pollution load through the natural processes of dispersion and dilution at sea. This would only be necessary if high heavy metal concentrations were a problem.

5.2.2.2 Mitigation of Impacts of Port Operation

It has been determined that proposed improvements to the port will in fact increase the environmental soundness of port operations. These measures are outlined briefly below. While other impacts were determined to be improbable, other mitigation measures are provided below that would mitigate against potential, but unlikely impacts.

(a) Construct and operate treatment facilities designed to handle highly organic wastes, specifically animal manure. This facility has been provided for at the livestock terminal.

(b) Provide litter receptacles for on-land and shipboard collection of solid wastes to facilitate to storage, transport, and disposal of solid wastes.

(c) Incorporate an anti-littering public education campaign for all port employees and workers to ensure the continued clean operation of the port.

(d) Impose charges on the use of waste handling and disposal services provided in the port.

(e) Provide storage area for PCG oil spill equipment and prepare an oil spill/toxic materials contingency plan for the port and Sarangani Bay. This should be a cooperative effort between PPA and PCG.

(f) Ensure workers are aware of proper handling procedures for toxic materials and are provided gloves and breathing filters when necessary.

An ongoing water quality monitoring program is also proposed in order to ensure that mitigation measures are effective. This program is presented in Appendix G, Environmental Management Plan.

5.2.3 Oceanography

Since no significant adverse impacts resulting from the construction and operation of the project are expected on the various physical oceanographic parameters, no mitigative measures are recommended.

180

5.3 MITIGATION FOR EFFECTS ON BIOLOGICAL ENVIRONMENT

5.3.1 Marine

5.3.1.1 Fisheries

The fisheries habitats most likely to be damaged are the adjacent reef areas. Artificial fisheries habitats, whether in the form of benthic artificial reefs or floated fish aggregating devices, have been proven to be very effective in building fish communities in otherwise barren areas. Since the Dolefil-USAID already has programs of this sort, it would be efficient and cost-effective to dovetail additional reef rehabilitation projects with their organization (Appendix D-12).

The eventual relocation site of the Badjao community would be a recommended priority area for additional fisheries rehabilitation efforts, such as described for the USAID-Dolefil Project, subject to a positive cost/benefit evaluation.

5.3.1.2 Marine Habitat

The environmental impact of the proposed expansion of the Makar Wharf on the local marine habitat can be described in terms of physical displacement of the Dumpao reef platform, including an estimated:

- 3.4 ha of intertidal reef flat
- 3.0 ha of seagrass dominated habitat
- 0.35 ha of soft coral dominated habitat
- 4.4 ha of mixed reef flat and sandy fore reef slope
- Subsistence fisheries associated with these marine habitats.

Quantitative surveys of these areas indicate high levels of past disturbance, as well as present and predicted stress related to intensive development of the adjoining coastline. These surveys suggest, and subsequent discussions with researchers of the Marine Science Institute of the University of the Philippines support the possibility of transplanting the relatively unique soft coral component of this reef habitat. These soft corals, including mature colonies of Lobophytum, Sarcophytum and Sinularia, are attached mostly to loose rocks and rubble which could forseeably be transferred intact to a designated reef area. The transplanted soft corals could be incorporated into tourism developments along the London coastline of central Sarangani Bay and serve as a nucleus of a local marine sanctuary, or park.

181

In addition to reclamation of the remaining Dumpao reef platform, the effect of dredging to a depth of 15 m, into an identified layer of clay , was discussed with a recommendation for additional bore samplings to completed prior to detailed design to clarify this problem. The indirect impact of increased shipping traffic to the expanded Makar Wharf facility was addressed through provision of navigational aids, dedicated accommodation of public safety vessels and spill containment equipment, and management reforms of port operations, sanitation and waste treatment. Enforcement of existing Philippine maritime rules and regulations prohibiting the dumping of wastes and spillage of oil in harbors such as the Sarangani Bay is assumed.

Degradation of marine habitats is widespread throughout northern Sarangani Bay. Environmental costs associated in this assessment with the benefits of rapid social and economic growth of the General Santos area include:

- Extensive soil erosion and river borne siltation;
- Pollution and declines in the water quality of coastal zones;
- Displacement of nearshore marine habitats;
- Resultant loss of fisheries productivity.

An environmental limit to sustainable social and economic growth is recognized by the concerned government and non-government organizations operating in the area (see Scoping Session Report, Makar Wharf Environmental Assessment). The critical need to strengthen the long term management of coastal and upland natural resources is illustrated in two projects recently initiated and co-funded by USAID and Dolefil, Inc., in cooperation with DENR. These two projects, the Sarangani Bay Marine and Inland Resources Conservation Project and the Mt. Matutum Reforestation and Soil Conservation Project (see Appendix D-12), utilize a community organization approach to install environmental consciousness on the contact, user level.

A similar approach of community level organization and supportive livelihood development programs, could be effectively incorporated in the relocation of the Badjao community of Venil, Makar to minimize the environmental impact on the marine habitats while maximizing socio-economic benefits of the relocation site.

5.3.2 Terrestrial Environment

To encourage the habitation of wildlife in the area, a landscape greenbelt zone could be established along the perimeter of the wharf. Such a greenbelt zone should be planted with fruit and forest trees to serve as habitats of some wildlife species in the area and to serve as a buffer zone to incremental noise and other flow resource pollution due to the expected increase in the volume of vehicular traffic along present and planned transportation routes. The species

recommended for the greenbelt zone are: narra (Pterocarpus indicus), mahogany (Swietenia mahogany), talisay (Terminalia catappa), auri (Auri coliformis), niyog (Cocus nucifera) and sago (Metroxylon sagu).

5.4 MITIGATION FOR EFFECTS ON THE CULTURAL ENVIRONMENT

In order to mitigate for the future loss or disturbance of cultural artifacts as a direct or indirect result of port expansion, it is recommended that prior to any new construction on relatively undisturbed areas, the Archaeology Division of the National Museum of the Philippines be provided the opportunity to examine the area.

In addition, Presidential Decree No. 347 (1974), amending certain sections of Republic Act No. 4846, otherwise known as "The Cultural Properties Preservation and Protection Act", contains mandatory procedures for chance funds during construction projects whereby:

"When excavators shall strike upon any buried cultural property, the excavation shall be suspended and the matter reported immediately to the director of the National Museum who shall take appropriate steps to have the discovery investigated and to insure the proper and safe removal thereof, with the knowledge and consent of the owner. The suspension shall not be lifted until the Director of the National Museum shall allow it."

5.5 MITIGATION FOR AESTHETIC EFFECTS

The establishment of a greenbelt zone, along the perimeter of the wharf will provide lush green scenery and shade trees.

5.6 MITIGATION FOR CUMULATIVE IMPACTS

Many semi-enclosed bays and coastal waters in the Philippines are in varying states of ecological degradation due to increasing developmental activities, rapid population growth and industrialization. At present, the coastal zone of the Sarangani Bay is relatively undeveloped and water quality is not yet a serious issue. However, the importance of applying the principals of Ecology to the process of economic development is recognized.

In order to harness development in the area for the benefit of all, and to ensure a continued resource base for continued sustainable development, the local governments should undertake the establishment of an interagency planning body similar to the Laguna de Bay Development Authority. This body would consist of representatives of agencies concerned with Bay activities such as the Department of Environment and Natural Resources, Department of Tourism, Department of Public Works and Highways, Department of Trade and Industry, Philippine Coast Guard, Philippine Ports Authority, National Housing Authority and the local municipal governments.

Some of the initial programs that would be required would be the identification of land based pollution sources, valuable ecological areas (mangroves, reefs), and the identification of numbers of fishermen that are dependent or partially dependent on fisheries resources in the bay. The goals of the planning body would have to be clearly defined and programs designed to meet those goals.

A study of land based pollution sources in two bays in Thailand (Kositratana and Kajornatiyudh, 1988) identified a number of programs that could be implemented to improve water quality in the bays. These could apply to Sarangani Bay and include: strengthening law enforcement, Land Use Development Plan implementation, environmental awareness education, development of community sanitation, environmental monitoring, and application of zoning restrictions for industrial areas.

Already existing programs in Sarangani Bay such as the Sarangani Bay Marine and Inland Resources Conservation Project, a USAID-Dolefil program, could serve as a starting point. Also, by incorporating an overall resource management plan, this existing program would be further strengthened. Components of this program, such as artificial reef building, could be enhanced through added public education about fisheries resources and development of a fisheries management program to allow for the sustainability of marine resources. In this way, artificial reefs could become starting points in fisheries rehabilitation, rather than an endpoint -- simply temporary unmanaged fishing areas.

Other programs that have been undertaken in the Philippines such as the Central Visayas Regional Project(CVRP) and the Coastal Resources Management Project (CRMP) in the Lingayen Gulf could be used as a basis for such a plan in Sarangani Bay. These projects use a community-based approach which draws on local organizations rather than creating new ones.

An important component in any type of overall plan that is undertaken will be that of education. Communities, fishermen's organizations and others all must believe in the value of the programs they are undertaking before they will become active and continuing participants. An overall program on how resources must be managed in order to be sustained for continued use must be undertaken. Only when participants become "believers" will these types of programs be effective. An example of this is found in Bantayan Island, in Cebu, where a rich crab fishery now supplies a crab processing plant that exports canned crab meat to Europe and the United States. Biologists in the area have ingrained in local fishermen the wisdom of throwing back

184

"berried" crabs (those that are carrying eggs). The processing plant also rejects crabs that are "berried" and those with a carapace length of less than four inches. (a management technique for crab fishery is restriction in crab carapace size)

While it is not within the purview of this particular Environmental Assessment, the overall environmental quality of the coastal area of Sarangani Bay will continue to play an important role in the sustained development of this area. Therefore, this section has been included as a possible beginning point for discussion for those agencies and governments that will be orchestrating this future development.

APPENDIX A

METHODOLOGIES

APPENDIX A-1

WATER QUALITY SAMPLING AND ANALYSIS

Appendix A-1
WATER QUALITY SAMPLING AND ANALYSIS

For seawater, samples were obtained from three locations fronting the Makar Wharf, the Lower Makar, and the Upper Makar. For each location, three sampling sites were marked at 100, 500, 1000 meter distance from shore. At each sampling site two depth points were established within the 7 meter light compensation point - surface (0.5 m) and subsurface (<7 m). There are eighteen samples (3 x 3 x 2 = 18) obtained in one sampling day (0800 - 1700) for three sampling days within the period March 14-31, 1991. A motorized outriggered banca was used in collecting water samples at sea.

Samples were collected and stored in polyethylene containers with volume capacity of two liters (samples were treated with sulfuric acid to pH 2.0 for nutrient and trace metal analyses) to four liters (unacidified samples for other chemical tests). Sterile 100 ml glass bottles used for collection and storage of well water were similar to those used for seawater samples. Water samples were allowed to trickle into the container to avoid unnecessary aeration of water.

Well water samples were obtained from three locations - Makar Wharf, Upper Makar (Molok Flowing Well) and Lower Makar. Sample containers used for collection and storage of well water were similar to those used for seawater samples. Water samples were allowed to trickle into the containers to avoid unnecessary aeration of water.

No water samples were obtained from Makar River since at the wharf, it is dry and remains so throughout the year with the exception of seasonal flash floods.

Water samples were submitted for the required water quality to Ostrea Mineral Laboratory in Manila and the Chemistry Laboratory of Mindanao State University at General Santos City.

APPENDIX A-2

APPROVED METHODS OF ANALYSIS

Appendix A-2
APPROVED METHODS OF ANALYSIS

	PARAMETER	METHOD OF ANALYSIS
1	COLOR	Visual Comparison Method (Platinum Cobalt Scale)
2	TEMPERATURE	Use of Mercury-Filled Thermometer
3	pH	Glass Electrode Method
4	DISSOLVED OXYGEN	Azide Modification (Winkler Method), Membrane Electrode (DO meter)
5	BOD_5	Azide Modification (Dilution Technique)
6	TOTAL SUSPENDED SOLIDS	Gravimetric Method
7	NITRATE AS NITROGEN	Bruccine Method for Saline Waters, specific Ion Electrode Meter for Fresh Water
8	PHOSPHATE AS PHOSPORUS	Stannous Chloride Method
9	SURFACTANTS (MBAS)	Methylene Blue Method (Colorimetric)
10	OIL AND GREASE	Gravimetric Method (Petroleum Ether Extraction)
11	PHENOLIC SUBSTANCES	Chloroform Extraction Method
12	ARSENIC	Silver Diethyldithiocarbamate Method (Colorimetric)
13	CADMIUM	Atomic Absorption Spectrophotometry (Wet ashing with concentration HNO_3 + HCl)
14	CHROMIUM	Diphenyl Carbazide Colorimetric Method
15	LEAD	Atomic Absorption Spectrophotometry
16	TOTAL MERCURY	Cold Vapor Technique, (Mercury Analyzer, AAS)
17	TOTAL COLIFORMS	Multi-Tube Fermentation Technique or Membrane Filter
18	FECAL COLIFORMS	Multi-Tube Fermentation Technique or Membrane Filter

Note: Other methods found in the Philippine Standard Methods for Air and Water Analysis, the "Standard Methods for the Examination of Water and Waste Waters", published jointly by American Public Health Association (APHA), the American Waterworks Association and the Water Pollution Control Federation of the U.S. or in accordance with such other method of analyses as the DENR may prescribe.

Source: Revised Water Usage and Classification/Water Quality Criteria DENR Administrative Order No. 34 Series of 1990, March 20, 1990.

190

APPENDIX A-3

GEOLOGY, SOILS AND TOPOGRAPHY METHODOLOGY

Appendix A-3
GEOLOGY, SOILS AND TOPOGRAPHY METHODOLOGY

Geological, soils and other biophysical information was obtained from Bureau of Soils and Water Management land resources study which included 300 cm auger soil boring sites located in the Makar watershed. Additional information was obtained through soil borings conducted for the Feasibility Study on the Makar Wharf project.

Interviews with local well drillers from General Santos City were conducted in order to gather information on the possible subsoil layers and status of groundwater in the vicinity of the project site. Information gained from these interviews included: soil textural grades at various soil depths, thickness of textural grades and depth of groundwater.

Maps illustrating geological characteristics, erosion potential, slope, and present land use and vegetation were completed for the Makar watershed.

APPENDIX A-4

MUNICIPAL FISHER FOLK QUESTIONNAIRE
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

Appendix A-4
MUNICIPAL FISHER FOLK QUESTIONNAIRE
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

1. Fishing Grounds

   a. Do you fish in Sarangani Bay? _____

   b. How much of your time do you spend fishing in Sarangani Bay? _____%

   c. What areas do you fish in Sarangani Bay?

   _____

   _____

   d. At what depth do you usually fish? _____

2. Type of Boat/Gear

   a. What kind of boat do you fish with?

   Length? Size? _____
   Type of Power? _____

   b. What types of gear do you use for fishing?

   _____

   _____

   c. What gears are operated from the boat?

   _____

   d. What gear do you use the most and why?

   _____

   _____

3. Timing

a. When is your peak season?

_____

_____

b. During your peak season, how many fishing days do you have per month? _____

c. During your off season, how many fishing days do you have per month? _____

d. On average, how many hours per day do you fish? _____

4. Catch Composition

a. How many species do you catch? _____

b. What species do you usually catch? _____

List the order of abundance of species you catch and their relative abundance in your catch.

Abundance _____% 1. _____
_____% 2. _____
_____% 3. _____
_____% 4. _____
_____% Other_____

5. Fishery Production

a. During your peak season, what is your average catch per boat per day in kilograms? _____

b. During your off season, what is your average catch per boat per day in kilograms?

_____

c. On an average day, what would be the composition of the following table?

SPECIES	KILOGRAM	PRICE PER KILOGRAM	TOTAL VALUE	NO. OF PIECES PER KILOGRAM

APPENDIX A-5

MARINE HABITAT METHODOLOGY

Appendix A-5
MARINE HABITAT METHODOLOGY

Methodology applied to assess the marine habitat impact of expansion of the Makar Wharf included:

- Marine underwater surveys involving the use of scuba and free diving
- Coastal surveys by road and sea transportation
- Aerial survey
- Local and institutional - level interviews and discussions
- Literature review

The emphasis of these surveys was to investigate and qualitatively describe on a habitat, key species level, the existing marine environment and predicted net impact of the proposed project. For the purpose of this assessment, the zone of influence includes the nearshore coastal border of the project site and northern Sarangani Bay. The primary habitats investigated included significant distributions of coral, seagrass and mangrove. A summary of surveys performed is included in Appendix A-6.

Underwater surveys were conducted to a depth of 10 to 15 meters, the limit of proposed dredging or notable marine habitat. Based on preliminary observations, local interviews and review of the proposed project design, underwater surveys focused on the remnant reef platform of Dumpao Point. Schematic distribution of recorded marine habitats and substrate types was referenced to the hydrographic chart developed for the Feasibility Study. Recommendations for the mitigation of predicted environmental impacts incorporate on-going projects in the General Santos area.

APPENDIX A-6

SUMMARY OF MARINE HABITAT SURVEYS

Appendix A-6
SUMMARY OF MARINE HABITAT SURVEYS

DATE	DESCRIPTION	LOCATION
March 12 (am)	Coastal Survey, by boat	Makar to Tambler
March 13 (am)	Underwater Survey, freediving	Dumpao Point reef platform
March 13 (pm)	Aerial Survey, by land	GSC to Lot, Malapatan
March 14 (am)	Fish Landing Survey, by land	Bula, Lion's Beach
March 14 (am)	Underwater Survey, freediving	Dumpao Point reef platform
March 14 (pm)	Aerial Survey, by land	London, Tambler to Malapatan
April 16 (am)	Underwater Survey, scuba	Dumpao Point reef platform
April 17 (am)	Underwater Survey, scuba	Dumpao Point reef platform
April 18 (am)	Comparative Underwater Surveys	Bawing, London, Tambler
April 18 (pm)	Coastal Survey, by land	GSC to London, Tambler

APPENDIX B

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Appendix B
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206

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20

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APPENDIX D

TECHNICAL INFORMATION

APPENDIX D-1

WATER QUALITY CRITERIA
FOR COASTAL AND MARINE WATERS

Appendix D-1
WATER QUALITY CRITERIA
FOR COASTAL AND MARINE WATERS

PARAMETER	UNIT	CLASS SA	CLASS SB	CLASS SC	CLASS SD
Color	PCU	(c)	(c)	(c)	(c)
Temperature[d] (max. rise in degree Celsius)	°C rise	3	3	3	3
pH (range)		6.5-8.5	6.0-8.5	6.0-8.5	6.0-9.0
Dissolved Oxygen[e] (Minimum)	% satn	70	70	70	70
	mg/L	5.0	5.0	5.0	2.0
5-Day 20°C BOD	mg/L	3	5	7(10)	--
Total Suspended Solids	mg/L	(f)	(g)	(g)	(h)
Surfactants (MBAS)	mg/L	0.2	0.3	0.5	--
Oil/Grease (Petroleum Ether Extract)	mg/L	1	2	3	5
Phenolic Susbstances as Phenols	mg/L	nil	0.01	(1)	--
Total Coliforms	MPN/100mL	70[m]	1,000[m]	1,000[m]	--
Fecal Coliforms	MPN/100mL	nil	200[m]	--	--
Copper	mg/L	--	0.02[n] [o]	0.05[o]	--
Arsenic[i]	mg/L	0.05	0.05	0.05	--
Cadmium[i]	mg/L	0.01	0.01	0.01	--
Chromium[i] (hexavalent)	mg/L	0.05	0.1	0.1	--
Cyanide	mg/L	0.05	0.05	0.05	--
Lead[i]	mg/L	0.05	0.05	0.05	--
Total Mercury[i]	mg/L	0.002	0.002	0.002	--
Organophosphate	mg/L	nil	nil	nil	--
Aldrin	mg/L	0.001	--	--	--
DDT	mg/L	0.05	--	--	--
Dieldrin	mg/L	0.001	--	--	--
Heptachlor	mg/L	nil	--	--	--
Lindane	mg/L	0.004	--	--	--
Toxaphane	mg/L	0.005	--	--	--
Methoxychlor	mg/L	0.10	--	--	--
Chlordane	mg/L	0.003	--	--	--
Endrin	mg/L	nil	--	--	--
PCB	mg/L	0.001	--	--	--

Note: 1. Limiting values of organophosphates and organochlorines may in the meantime serve as guidelines in the interim period pending the procurement and availability of necessary laboratory equipment. For Barium, Cobalt, Fluoride, Iron, Lithium, Manganese, Nickel, Selenium, Silver and Vanadium, the 1978 NPCC Rules and Regulations, Section 69 may be considered.

Source: Revised Water Usage and Classification/Water Quality Criteria.
DENR Admnistrative Order No. 34. Series of 1990, March 20, 1990.

217

Footnotes for Appendix D-1

(a) - Except as otherwise indicated, the numerical limits in Table 1 and 3 are yearly average values. Values enclosed in parentheses are maximum values.

(b) - For irrigation purposes, SAR should have a minimum value of 8 and a maximum value not to exceed 18. Boron should not exceed 0.75 mg/l.

(c) - No abnormal discoloration from unnatural causes.

(d) - The allowable temperature increase over the average ambient temperature for each month. This rise shall be based on the average of the maximum daily temperature readings recorded at the site but upstream of the mixing zone over a period of one (1) month.

(e) - Sampling taken between 9:00 AM and 4:00 PM.

(f) - Not more than 30 mg/L increase.

(h) - Not more than 60 mg/L increase.

(i) - Do not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.

(j) - Applicable only to lakes, resevoirs, and similarly impounded water.

(k) - When applied to lakes or resevoirs, the Phosphate as P concentration should not exceed an average of 0.05 mg/L nor a maximum of 0.1 mg/L.

(l) - Not present in concentrations to affect fish flavor/taste.

(m) - These values refer to the geometric mean of the most probable number of coliform organism during a 3-month period and that the limit indicated shall not exceeded in 20 percent of the samples taken during the same period.

(n) - For spawning areas for "Chanos chanos" and other similar species.

(o) - Limit is in terms of dissolved copper.

nil - Extremely low concentration and not detectable by existing equipment.

-- - Mean the standard of these substances are not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources.

nr - Means No Recommendation made.

218

APPENDIX D-2

EFFLUENT STANDARDS
CONVENTIONAL AND OTHER POLLUTANTS

Appendix D-2
EFFLUENT STANDARDS: CONVENTIONAL AND OTHER POLLUTANTS (IN INLAND WATERS CLASS D, COASTAL WATERS CLASS SC AND SD AND OTHER COASTAL WATERS NOT YET CLASSIFIED)

PARAMETER	UNIT	INLAND WATERS (CLASS D)		COASTAL WATERS (CLASS SC)		CLASS SD & OTHER COASTAL WATERS NOT CLASSIFIED	
		OEI	NPI	OEI	NPI	OEI	NPI
Color	PCU	--	--	(c)	(c)	(c)	(c)
Temperature (max. rise in degree Celsius in RBW)	°C rise	3	3	3	3	3	3
pH (range)		5.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	5.0-9.0	5.0-9.0
COD	mg/L	250	200	250	200	300	200
5-Day 20°C BOD	mg/L	150[d]	120	120[d]	100	150[d]	120
Total Suspended Solids	mg/L	200	150	200	150	(g)	(f)
Total Dissolved Solids	mg/L	2,000[h]	1,500[h]	--	--	--	--
Surfactants (MBAS)	mg/L	--	--	15	10	--	--
Oil/Grease (Petroleum Ether Extract)	mg/L	--	--	15	10	15	15
* Phenolic Susbstances as Phenols	mg/L	--	--	1.0[i]	0.5[i]	5.0	1.0
Total Coliforms	MPN/100mL	(j)	(j)	--	--	--	--

NOTES:

1. In cases where the background level of Total Dissolved Solids (TDS) in freshwater rivers, lakes, reserviors and similar bodies of water is higher than the Water Quality Criteria, the discharge should not increase the level of TDS in the receiving body of water by more than ten percent of the background level.
2. The COD limits in Tables 2A and 2B generally apply to domestic wastewater treatment plant effluent. For industrial discharges, the effluent standards for COD should be on a case to case basis considering the COD - BOD ratio after treatment. In the interim period that this ratio is not yet established by each discharger, the BOD requirement shall be enforced.
3. There are no effluent standards for chloride except for industries using brine and discharging into inland waters, in which case the chloride content should not exceed 500 mg/L.
4. The effluent standards apply to industrial manufacturing plants and municipal treatment plants discharging more than thrity (30) cubic meters per day.

Source: Revised Water Usage and Classification/Water Quality Criteria.
DENR Administrative Order No. 34. Series of 1990, March 20, 1990.

APPENDIX D-3

EFFLUENT STANDARDS
TOXIC AND OTHER DELETERIOUS SUBSTANCE

Appendix D-3
EFFLUENT STANDARDS: TOXIC AND OTHER DELETERIOUS SUBSTANCE
(Maximum Limits for the protection of Public) Health[a]

PARAMETER	UNIT	PROTECTED WATERS CATEGORY I (CLASS AA & SA)		PROTECTED WATERS CATEGORY I (CLASS AA & SA)		INLAND WATERS CLASS C		MARINE WATERS CLASS SC		MARINE WATERS CLASS SD	
		OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI
Arsenic	mg/L	(b)	(b)	0.2	0.1	0.5	0.2	1.0	0.5	1.0	0.5
Cadmium	mg/L	(b)	(b)	0.05	0.02	0.1	0.05	0.02	0.1	0.5	0.2
Chromium (hexavalent)	mg/L	(b)	(b)	0.1	0.05	0.2	0.1	0.5	0.2	1.0	0.5
Cyanide	mg/L	(b)	(b)	0.2	0.1	0.3	0.2	0.5	0.2	--	--
Lead	mg/L	(b)	(b)	0.2	0.1	0.5	0.3	1.0	0.5	--	--
Total Mercury	mg/L	(b)	(b)	0.005	0.005	0.005	0.005	0.005	0.005	0.05	0.01
PCB	mg/L	(b)	(b)	0.003	0.003	0.003	0.003	0.003	0.003	--	--
Formaldehyde	mg/L	(b)	(b)	2.0	1.0	0.2	1.0	2.0	1.0	--	--

Note:

(a) Except as otherwise indicated, all limiting values in Table 1 (Section 4) are maximum and therefore that shall not be exceeded.

(b) Discharge of sewage and/or trade effluents are prohibited or not allowed.

NOTES:

1. In cases where the background level of Total Dissolved Solids (TDS) in freshwater rivers, lakes, reserviors and similar bodies of water is higher than the Water Quality Criteris, the discharge should not increase the level of TDS in the receiving body of water by more than ten percent of the background level.
2. The COD limits in Tables 2A and 2B generally apply to domestic wastewater treatment plant effluent. For industrial discharges, the effluent standards for COD should be on a case to case basis considering the COD - BOD ratio after treatment. In the interim period that this ratio is not yet established by each discharger, the BOD requirement shall be enforced.
3. There are no effluent standrads for chloride except for industries using brine and discharging inland waters, in which case the chloride content should not exceed 500 mg/L.
4. The effluent standards apply to industrial manufacturing plants and municipal treatment plants discharging more than thrity (30) cubic meters per day.

Source: Revised Effluent Regulations of 1990.
DENR Administrative Order No. 35. Series of 1990, March 20, 1990.

LEGEND for Appendix D-2 and D-3

(a) - Except as otherwise indicated, all limiting values in Tables 2A and 2B are 90th percentile values. This is applicable only when the discharger undertakes daily monitoring of its effleunt quality, otherwise, the numerical values in the tables represent maximum values not to be exceeded once a year.

(b) - Discharging of sewage and/or trade effluents is prohibited or not allowed.

(c) - Discharge shall not cause abnormal discoloration in the receiving waters outside of the mixing zone.

(d) - For wastewaters with initial BOD concentration over 1,000 mg/L but less than 3,000 mg/L, the limit may be exceeded up to a maximum of 200 mg/L or a treatment reduction of ninety (90) percent, whichever is more strict. Applicable to both old and new industries.

(e) - The parameters Total Suspended Solids (TSS) should not increase the TSS of the receiving water by more than thirty (30) percent during the dry season.

(f) - Not more than 30 mg/L increase (dry season)

(g) - Not more than 60 mg/L increase (dry season)

(h) - If effluent is the sole source of supply for irrigation, the maximum limits are 1,500 mg/L and 1,000 mg/L, respectively, for old industries and new industries.

(i) - Not present in concentration to affect fish flavor or taste or tainting.

(j) - If effleunt is used to irrigate vegetable and fruit crops which may be eaten raw, Fecal Coliforms should be less than 500 MPN/100 mL.

APPENDIX D-4

NATIONAL STANDARDS FOR DRINKING WATER

Appendix D-4
NATIONAL STANDARDS FOR DRINKING WATER

PARAMETER	MAXIMUM PERMISSIBLE LEVEL
* Turbidity	5 units
Color	5 units (s) **
Odor	Unobjectionable
Threshold odor number	Not more than 3
Taste	Unobjectionable
* Total Solids	500 (s)
* pH	6.5 - 8.5
Phenolic Substances	0.001
Radioactive Substances	
Gross Alpha	3 pCi/l
Gross Beta	30 pCi/l
Trace Elements	
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Copper	1.0
Cyanide	0.05
Fluoride	0.6
Iron	1.0 (s)
Lead	0.05
Manganese	0.5 (s)
Mercury	0.002
Selenium	0.01
* Zinc	5.0 (s)
Organic Chemicals	
Synthetic	
Detergents (MBAS)	0.5
Oil and Grease	Nil

Appendix D-4 (continued)
NATIONAL STANDARDS FOR DRINKING WATER

PARAMETER	MAXIMUM PERMISSIBLE LEVEL
Persistent Pesticides	
Aldrin	0.001
DDT	0.05
Dieldrin	0.001
Chlordane	0.003
Endrin	0.0002
Heptachlor	0.0001
Lindane	0.004
Toxaphane	0.005
Methoxychlor	0.1
2, 4-D	0.1
2,4,5-T	0.01
PCB	Nil
Other Chemicals	
Calcium	75
Chloride	200 (s)
Magnesium	50 (s)
Nitrate (NO3)	30
Sulfate	200 (s)
Hydrogen Sulfide	0.05 (s)

- All units are in mg/l, unless otherwise stated.
- (s) - Secondary standards; compliance with the standard and analysis are not obligatory.

Source: Bureau of Research and Laboratories, Department of Health, Manila.

APPENDIX D-5

INTERNATIONAL STANDARDS FOR DRINKING WATER (WHO, 1971)

Appendix D-5
INTERNATIONAL STANDARDS FOR DRINKING WATER (WHO, 1971)

SUBSTANCE OR CHARACTERISTICS	UNDESIRABLE EFFECT THAT MAY BE PRODUCED	HIGHEST DESIRABLE LEVEL	MAXIMUM PERMISSIBLE LEVEL
Substances causing discoloration	Discoloration	5 units[a]	50 units[a]
Substances causing odors	Odors	Unobjectionable	Unobjectionable
Substances causing tastes	Tastes	Unobjectionable	Unobjectionable
Suspended matter	Turbidity Possibly gastrointestinal irritation	5 units[b]	25 units[b]
Total solids	Taste Gastrointestinal irritation	1,500 mg/l	5000 mg/l
pH range	Taste Corrosion	7.0 to 8.5	6.5 to 9.2
Anionic detergents[c]	Taste and foaming	0.2 mg/l	1.0 mg/l
Mineral Oil	Taste and odor after chlorination	0.01 mg/l	0.30 mg/l
Phenolic compounds (as phenol)	Taste, particularly in chlorinated water	0.001 mg/l	0.002 mg/l
Total hardness	Excessive scale formation	2mEq/l[e] (100 mg/l $CaCO_3$)	10mEq/l (500 mg/l $CaCO_3$)
Calcium (as Ca)	Excessive scale formation	75 mg/l	200 mg/l
Chloride (as Cl)	Taste; corrosion in hot-water systems	200 mg/l	600 mg/l
Copper (as Cu)	Astringent taste; discoloration and corrosion of pipes, fittings and utensils	0.05 mg/l	1.5 mg/l

228

Appendix D-5 (continued)
INTERNATIONAL STANDARDS FOR DRINKING WATER (WHO, 1971)

SUBSTANCE OR CHARACTERISTICS	UNDESIRABLE EFFECT THAT MAY BE PRODUCED	HIGHEST DESIRABLE LEVEL	MAXIMUM PERMISSIBLE LEVEL
Iron (total as Fe)	Taste; discoloration; deposits and growth of iron bacteria; turbidity	0.1 mg/l	1.0 mg/l
Magnesium (as Mg)	Hardness; taste; gastrointestinal irritation in the presence of sulfate	Not more than 30 mg/l if there are 250 mg/l of sulfate; if there is less sulfate, magnesium up to 150 mg/l may be allowed	150 mg/l
Manganese (as Mn)	Taste; discoloration; deposits in pipes; Turbidity	0.05 mg/l	0.5 mg/l
Sulfate (as SO_4)	Gastrointestinal irritation when magnesium or sodium are present	200 mg/l	400 mg/l
Zinc (as Zn)	Astringent taste; opalescence and sand-like deposits	5.0 mg/l	15 mg/l

Legend for Appendix D-5

a. On the platinum - cobalt scale

b. Turbidity Units

c. Different substances are used in different countries

d. If the hardness is much less than this, other undesirable effects may be caused, for example, heavy metals may be dissolved out of pipes.

e. 1mEq/l of hardness-producing ion = 50 mg $CaCO_3$/l = 5.0 French degrees of hardness = 2.8 (approx.) German degrees of hardness = 3.5 (approx.) English degrees.

APPENDIX D-6

COPIES OF CERTIFICATES OF ANALYSIS FOR WATER QUALITY PARAMETERS ANALYZED FOR MAKAR WHARF

OSTREA MINERAL LABORATORIES, INC.
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P.O. Box EA 451, Ermita, Manila
Tel. Nos. 59-19-10, 59-15-24, 50-02-61
Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 15, 1991
CLIENT REF. NO.
R.A. NO. 91-04-040
CERT. NO.. 91-280
INVOICE NO. SI No. 6338
SHEET NO. 1 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Center 500S	Makar Well	Badjao Well	Makar 500S
I. TOTAL COLIFORM TEST				
a. Presumptive Test	Negative	Negative	Negative	Positive
b. Confirmatory Test	Negative	Negative	Negative	Positive
M P N / 100 ml	∠ 2.2	∠ 2.2	∠ 2.2	26
II. FECAL COLIFORM TEST	Negative	Negative	Negative	Positive
M P N / 100 ml	∠ 2.2	∠ 2.2	∠ 2.2	14
III. STANDARD PLATE COUNT/ml				
Heterotrophic Plate Count-CFU/ml	98	28	18	141

***** O V E R *****

ANALYTICAL METHOD/REMARKS

Fermentation Tube Process.

TOTAL SAMPLES 20 TOTAL ANALYSIS 86

N. D. = Element is not detected by the method employed.

CERTIFIED BY:

LORNA G. SY
Manager, Analytical Services

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SHEET NO. 2 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Makar 100S	Center 1000, 7m	Badjao 100S	Makar 500,7m
I. TOTAL COLIFORM TEST				
a. Presumptive Test	Positive	Positive	Positive	Positive
b. Confirmatory Test	Positive	Positive	Positive	Positive
M P N / 100 ml.	1,600	4	17	8
II. FECAL COLIFORM TEST	Positive	Positive	Positive	Positive
M P N / 100 ml.	34	4	12	13
III. STANDARD PLATE COUNT				
Heterotrophic Plate Count-CFU/ml	277	70	94	37

***** O V E R *****

ANALYTICAL METHOD/REMARKS

Fermentation Tube Process.

TOTAL SAMPLES 20 TOTAL ANALYSIS 80

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CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Badjao 1000S	Wharf Well	Badjao 500,7m	Makar Well
I. TOTAL COLIFORM TEST				
a. Presumptive Test	Positive	Positive	Positive	Negative
b. Confirmatory Test	Positive	Positive	Positive	Negative
M P N / 100 ml.	900	33	7	< 2.2
II. FECAL COLIFORM TEST	Positive	Positive	Positive	Negative
M P N / 100 ml.	900	17	7	< 2.2
III. STANDARD PLATE COUNT				
Heterotrophic Plate Count-CFU/ml	67	18	21	42

***** O V E R *****

ANALYTICAL METHOD/REMARKS

Fermentation Tube Process.

TOTAL SAMPLES 10 TOTAL ANALYSIS 80

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CERT. NO.. 91-280
INVOICE NO. SI # 6338
SHEET NO. 4 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Makar 100,7m	Badjao 1000,7m	Badjao 500S	Center 100,7m
I. TOTAL COLIFORM TEST				
a. Presumptive Test	Positive	Positive	Positive	Positive
b. Confirmatory Test	Positive	Positive	Positive	Positive
M P N / 100 ml.	34	23	240	30
II. FECAL COLIFORM TEST	Positive	Negative	Positive	Positive
M P N / 100 ml.	12	∠ 2.2	34	17
III. STANDARD PLATE COUNT				
Hererotrophic Plate Count-CFU/ml	125	7	40	237

***** O V E R *****

ANALYTICAL METHOD/REMARKS

Fermentation Tube Process.

TOTAL SAMPLES 20 TOTAL ANALYSIS 80

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R.A. NO. 91-04-040
CERT. NO.. 91-280
INVOICE NO. SI # 6338
SHEET NO. 5 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Center 1000S	Center 100S	Makar 100S 1000S ?
I. TOTAL COLIFORM TEST			
a. Presumptive Test	Positive	Positive	Positive
b. Confirmatory Test	Positive	Positive	Positive
M P N / 100 ml.	4	300	26
II. FECAL COLIFORM TEST	Positive	Positive	Positive
M P N / 100 ml.	4	2	4
III. STANDARD PLATE COUNT			
Heterotrophic Plate Count-CFU/ml	41	68	62

***** O V E R *****

ANALYTICAL METHOD/REMARKS
Fermentation Tube Process.

TOTAL SAMPLES 20 TOTAL ANALYSIS 80

N. D. = Element is not detected by the method employed.

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CERT. NO.. 91-280
INVOICE NO. SI # 6338
SHEET NO. 6 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		Pb, ppm	Cd, ppm	Cr (hexavalent), ppm	MBAS, mg/L
BADJAO	100S-Unfixed	0.353	0.060	ND ∠0.001	0.00003
	500S- "	0.372	0.057	ND	0.00005
	500-7m "	0.484	0.060	ND	ND∠ 0.00001
	1000S "	0.353	0.054	ND	ND∠ 0.00001
	1000-7m "	0.335	0.054	ND	0.00005
MAKAR	100S "	0.391	0.050	0.001	ND
	500S "	0.298	0.057	ND	ND
	500-7m "	0.446	0.070	ND	0.00003
	100-7m "	0.353	0.070	ND	ND
	1000-7m "	0.298	0.074	0.001	ND
	1000S "	0.335	0.067	0.006	0.00004
CENTER	500-7m "	0.465	0.067	ND	ND
	1000S "	0.298	0.070	ND	ND
	500S "	0.428	0.074	ND	ND
	1000-7m "	0.298	0.077	ND	ND
	100-7m "	0.465	0.070	0.001	0.00014
	100S "	0.353	0.070	ND	ND
WHARF WELL		0.167	0.003	ND	ND
MAKAR WELL		0.056	0.003	ND	ND
BADJAO WELL		0.037	0.003	ND	ND

***** O V E R *****

ANALYTICAL METHOD/REMARKS

TOTAL SAMPLES 20 TOTAL ANALYSIS 86

N. D. = Element is not detected by the method employed.

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DATE. April 15, 1991
CLIENT REF. NO.
R.A. NO. 91-04-040
CERT. NO.. 91=280
INVOICE NO. SI # 6338
SHEET NO. 7 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Hardness, mg/L $CaCO_3$	Cl, mg/L
WHARF WELL	192.05	52.28
MAKAR WELL	255.15	46.45
BADJAO WELL	650.84	90.42

***** NOTHING FOLLOWS *****

ANALYTICAL METHOD/REMARKS

TOTAL SAMPLES 20 TOTAL ANALYSIS 86

N. D. = Element is not detected by the method employed.

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Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 22, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI # 6338
SHEET NO. 1 OF 1 PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		Cr (Hexavalent), ppm
CENTER	100S	ND /0.001
	500S	ND
	1000S	ND
BADJAO	100S	ND
	500S	ND
	1000S	ND
	WELL	ND
MAKAR	100S	ND
	500S	ND
	1000S	ND
	WELL	ND
WHARF WELL		ND
MOSQUE 1000S		ND

***** NOTHING FOLLOWS *****

NOTE:
Above are follow-up results for CHROMIUM (HEXAVALENT) for samples which were released APRIL 3, 1991 under Cert. No. 91-252.

ANALYTICAL METHOD/REMARKS

TOTAL SAMPLES 12 TOTAL ANALYSIS 12

N. D. = Element is not detected by the method employed.

CERTIFIED BY:

for LORNA G. SY
Manager, Analytical Services

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Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 15, 1991
CLIENT REF. NO.
R.A. NO. 91-04-040
CERT. NO.. 91-280-A
INVOICE NO. SI # 6338
SHEET NO. 1 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		BOD,mg/L	COD,mg/L	Cl,mg/L	P,mg/L	Phenols,mg/L
BADJAO	100-S Unfixed	1	11	18372.77	0.336	ND /0.001
	500-S "	1	7	17485.16	0.112	ND
	500-7m "	1	4	18950.98	0.448	0.001
	1000-S "	1	7	16961.65	0.448	0.002
	100-7m "	1	8	19055.69	0.448	0.002
	1000-7m "	1	4	19003.33	0.672	0.001
MAKAR	100-S "	1	4	18322.77	0.224	ND
	500-S "	1	28	19108.04	0.336	ND
	500-7m "	1	20	19160.39	0.560	ND
	100-7m "	1	4	19055.69	0.448	0.002
	1000-7m "	1	20	18950.98	0.448	ND
	1000-S "	1	24	19212.74	2.840	ND
CENTER	500-7m "	2	4	19108.04	0.112	ND
	1000-S "	2	8	18113.37	8.960	ND
	500-S "	1	45	18322.77	0.560	0.002
	1000-7m "	2	57	18950.98	0.224	ND
	100-7m "	2	49	19003.33	0.672	ND
	100-S "	1	16	18832.18	0.336	ND

***** O V E R *****

Active Substance used for MBAS is Sodium Lauryl Sulfate.
Analysis done using DENR prescribed methods.
Reference: Standard Methods for the Examination of H_2O & Wastewater, 15th Editio

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

LORNA G. SY
Manager, Analytical Services

TOTAL SAMPLES 18 TOTAL ANALYSIS 180

N. D. = Element is not detected by the method employed.

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PHILIPPINE SOCIETY FOR QUALITY CONTROL, INC.

AMERICAN SOCIETY FOR TESTING MATERIALS

AMERICAN COUNCIL OF INDEPENDENT LABORATORIES, INC.

OSTREA MINERAL LABORATORIES, INC.
assaying and testing specialists
1264 Pres. Quirino Ave. Cor. Penzfrancia St.
Paco, Metro Manila, 1007
P.O. Box EA 451, Ermita, Manila
Tel. Nos. 59-19-10, 59-15-24, 50-02-61
Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 15, 1991
CLIENT REF. NO.
R.A. NO. 91-04-040
CERT. NO.. 91-280-A
INVOICE NO. SI # 6338
SHEET NO. 2 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		TSS, mg/L	TDS, mg/L	Color
BADJAO	100-S Unfixed	22	33493	2
	500-S "	31	32974	2
	500-7m "	56	35163	2
	1000-S "	21	31123	8
	1000-7m "	58	35189	2
	100-7m "	25	36116	5
MAKAR	100-S "	32	34311	2
	500-S "	31	35697	2
	500-7m "	16	34482	38
	100-7m "	28	34668	50
	1000-7m "	42	34304	18
	1000-S "	46	35157	12
CENTER	500-7m "	19	34876	1
	1000-S "	33	32932	25
	500-S "	38	33767	2
	1000-7m "	26	35002	18
	100-7m "	25	34646	25
	100-S "	32	33981	2

Active Substance used for MBAS is Sodium Lauryl Sulfate.
Analysis done using DENR prescribed methods.
Reference: Standard Methods for the Examination of H_2O & Wastewater, 15h Edition.

ANALYTICAL METHOD/REMARKS

TOTAL SAMPLES 18 TOTAL ANALYSIS 180

N. D. = Element is not detected by the method employed.

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Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 1 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	Hg, ppm	As, ppm	Cu, ppm	Pb, ppm	Zn, ppm
ENTER 100S	0.0002	ND <0.01	0.067	0.491	0.050
500S	0.00006	ND	0.085	0.409	0.038
1000S	0.0003	ND	0.073	0.409	0.035
ADJAO 100S	0.0002	ND	0.073	0.450	0.041
500S	0.0001	ND	0.069	0.409	0.032
WELL	0.0002	ND	0.012	0.859	0.028
AKAR 100S	0.0004	ND	0.085	0.409	0.044
500S	0.00002	ND	0.067	0.409	0.038
1000S	0.0002	ND	0.067	0.450	0.035
WELL	0.0001	ND	ND	ND	0.025
HARP WELL	0.0002	ND	ND	ND	ND
OSQUE 1000S	0.0001	ND	0.067	0.409	0.076

***** O V E R *****

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 2 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		Cd, ppm	Cr(Total), ppm	NO_3-N, mg/L	P, mg/L
CENTER	100S	0.053	0.344	0.020	2.320
	500S	0.053	0.393	0.025	3.016
	1000S	0.053	0.442	0.020	2.784
BADJAO	100S	0.053	0.393	0.015	2.320
	500S	0.053	0.393	0.020	5.800
	WELL	ND	ND	0.450	6.032
MAKAR	100S	0.056	0.393	0.020	3.248
	500S	0.056	0.393	0.025	1.624
	1000S	0.056	0.442	0.035	2.088
	WELL	ND	ND	0.700	5.104
WHARF WELL		ND	ND	0.500	4.176
MOSQUE	1000S	0.056	0.442	0.025	1.160

***** OVER *****

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 3 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

BACTERIOLOGICAL TEST

	CENTER 1000S	MOSQUE 1000S	CENTER 100S	BADJAO 500S
I. Total Coliform Test				
a. Presumptive Test	Positive	Positive	Positive	Positive
b. Confirmatory Test	Positive	Positive	Positive	Positive
M P N / 100 ml.	240	1,600	27	900
II. Fecal Coliform Test	Positive	Positive	Positive	Positive
MPN / 100 ml.	27	900	80	300
III. Standard Plate Count/ml.	112	65	24	104

	BADJAO WELL	WHARF WELL	MAKAR 100S	MAKAR 1000S
I. Total Coliform Test	Negative	Negative	Positive	Positive
a. Presumptive Test				
b. Confirmatory Test	Negative	Negative	Positive	Positive
M P N / 100 ml.	/2.2	/2.2	130	130

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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Manager, Analytical Services

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LOUIS BERGER INTERNATIONAL, INC.

DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 4 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION	BADJAO WELL	WHARF WELL	MAKAR 100S	MAKAR 1000S
II. Fecal Coliform Test	Negative	Negative	Positive	Positive
MPN / 100 ml.	<2.2	<2.2	130	80
III. Standard Plate Count/ml.	22	36	35	32

	BADJAO 100S	CENTER 500S	MAKAR 500S	MAKAR WELL
I. Total Coliform Test				
a. Presumptive Test	Positive	Positive	Positive	Negative
b. Confirmatory Test	Positive	Positive	Positive	Negative
M P N / 100 ml.	≥ 1,600	7	170	<2.2
II. Fecal Coliform Test	Positive	Positive	Positive	Negative
M P N / 100 ml.	500	4	130	<2.2
III. Standard Plate Count/ml.	38	19	41	62

***** O V E R *****

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 5 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		BOD, mg/L	COD, mg/L	Phenol, mg/L	TSS, mg/L
CENTER	100S	2	19	0.001	29
	500S	1	19	ND /0.001	21
	1000S	1	19	0.002	26
BADJAO	100S	2	12	0.002	25
	500S	1	4	0.015	37
	WELL	1	151	0.002	3
MAKAR	100S	1	8	ND	11
	500S	2	12	ND	26
	1000S	2	35	0.008	34
	WELL	1	69	ND	2
WHARF WELL		1	33	ND	2
MOSQUE	1000S	2	4	0.004	23

***** OVER *****

ANALYTICAL METHOD/REMARKS

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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DATE. April 3, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 6 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		TDS, mg/L	Oil & Grease, mg/L	Cl, mg/L	Color
CENTER	100S	34906	8.22	18855.855	2
	500S	35374	1.10	18760.795	2
	1000S	35851	0.56	18616.851	5
BADJAO	100S	34722	4.56	18855.855	2
	500S	35891	5.00	18952.722	5
	WELL	1321	5.90	74.658	5
MAKAR	100S	34805	5.30	18616.851	5
	500S	35082	3.30	18616.851	5
	1000S	34944	12.90	18520.887	8
	WELL	494	0.20	37.744	38
WHARF WELL		422	5.40	25.923	2
MOSQUE	1000S	34813	3.00	18157.490	2

***** O V E R *****

NOTE: Surfactants result to follow.

ANALYTICAL METHOD/REMARKS

CERTIFIED BY:

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

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Telex No. (745 or 742) 40405 ICS No. 593

LOUIS BERGER INTERNATIONAL, INC.

DATE. April 19, 1991
CLIENT REF. NO.
R.A. NO. 91-04-040
CERT. NO.. 91-280 A
INVOICE NO. SI # 6338
SHEET NO. 1 OF 1 PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

		NO_3-N, mg/L	Oil & Grease, mg/L
BADJAO	100-S Unfixed	0.0034	0.5
	500-S "	0.0074	0.6
	500-7m "	0.0024	2.3
	1000-S "	0.0074	1.8
	1000-7m "	0.0014	2.2
	100-7m "	0.0024	1.4
MAKAR	100-S "	0.0044	3.3
	500-S "	0.0074	1.4
	500-7m "	0.0024	0.6
	100-7m "	0.0034	3.2
	1000-7m "	0.0014	4.4
	1000-S "	0.0024	2.1
CENTER	500-7m "	0.0024	2.8
	1000-S "	0.0040	1.0
	500-S "	0.0004	3.6
	1000-7m "	0.0010	1.3
	100-7m "	0.0030	1.0
	100-S "	0.0034	2.5

******* NOTHING FOLLOWS *******

N. B.
1) Typographical error of Certificate No. 91-280 Sheet No. 5 which was submitted April 15, 1991 for the Total Coliform Test instead of MAKAR 100S it should be MAKAR 1000S.

ANALYTICAL METHOD/REMARKS
2) Phosphorus in mg/L reported under Cert. No. 91-280-A released April 15, 1991 is for Orthophosphates.

TOTAL SAMPLES 18 TOTAL ANALYSIS 36

N. D. = Element is not detected by the method employed.

CERTIFIED BY:

LORNA G. [illegible]Y
Manager, Analytical Services

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LOUIS BERGER INTERNATIONAL, INC.

DATE. April 15, 1991
CLIENT REF. NO.
R.A. NO. 91-03-054
CERT. NO.. 91-252
INVOICE NO. SI No. 6338
SHEET NO. 7 OF ____ PAGES

CERTIFICATE OF ANALYSIS

SAMPLE DESCRIPTION

	MBAS, mg/L	Cr, hex mg/L
CENTER 100S	0.00013	ND <0.001
500S	0.00026	ND
1000S	0.00013	ND
BADJAO 100S	0.00013	ND
500S	0.00026	ND
WELL	0.00039	ND
MAKAR 100S	0.00026	ND
500S	0.00013	ND
1000S	0.00013	ND
WELL	0.00039	ND
WHARF WELL	0.00039	ND
MOSQUE 1000S	0.00013	ND

****** NOTHING FOLLOWS ******

ANALYTICAL METHOD/REMARKS
Results completed.

TOTAL SAMPLES 12 TOTAL ANALYSIS 216

N. D. = Element is not detected by the method employed.

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APPENDIX D-7

DETAILED SOIL AND LAND USE DESCRIPTIONS

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	1	Soil Depth to (cm)	:	20 cm
Location	:	Brgy. San Jose, Bagong Silang, T'Boli	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	164 Andesitic Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 111	Surface Texture	:	Sandy Loam
Longitude	:	125 0' 22"	Surface Impediments	:	NE
Latitude	:	6 6' 22"	Observed Rooting Depth	:	20 cm
Surface Landform	:	High Relief	Elevation (m)	:	600 cm
Vegetation/Land Use	:	Grasses/Corn	Flooding	:	None
Slope Average	:	18 - 30	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topograpgy	:	Hilly
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 10	Very Dark Grayish Brown (10YR 3/2) Moist, Sandy Loam, Few Distinct clear brownish yellow (10YR 6/6) mottles, of few small soft and hard limestone fragments, (0.5 to 2.0 cm. Diameter) many fine to medium roots, pH (7.2).
B1	10 - 20	Yellowish brown (10YR 5/4) moist, sandy loam, non-sticky, non-plastic, loose, presence of few small soft and hard limestone fragments (1.0 to 3.0 cm. Diameter), few fine roots, pH (6.8).
B2	20 - 60	Light yellowish brown (10YR 6/4) moist, fine sandy loam, non-sticky, non-plastic, very loose, presence of few soft and hard limestone fragments (1.0 to 3.0 cm. Diameter), pH (6.4).
C1	60 - 113	Brown to dark brown (10YR 4/3) moist, fine sandy loam, non-sticky, non-plastic, very friable, presence of hard mixed fragments (1.0 to 5.0 cm. Diameter), pH (6.8).
C2	113 Below	Brown (10YR 5/3) moist, fine sandy loam, non-sticky, non-plastic, very friable, presence of hard mixed fragments (1.0 to 5.0 cm. Diameter), pH (6.8).

250

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	2	Soil Depth to (cm)	:	120 cm
Location	:	Brgy. San Jose, Bulol Kalan, T'Boli	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	157 Pyroclastics Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	3938 - 11	Surface Texture	:	Sandy Loam
Longitude	:	124 56' 46"	Surface Impediments	:	NE
Latitude	:	6 6' 25"	Observed Rooting Depth	:	50 cm
Surface Landform	:	Hills (High Relief)	Elevation (m)	:	1000 cm
Vegetation/Land Use	:	Shrub/Grasses/Corn	Flooding	:	None
Slope Average	:	18 - 30 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Rolling to Hilly
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 05	Very Dark Grayish Brown (10YR 2/2) moist, sandy loam, non-sticky, non-plastic, few soft and hard fragments (1.0 to 2.0 cm. Diameter), many fine to medium roots, pH (7.2).
A2	5 - 25	Dark yellowish brown (10YR 3/4) moist, sandy loam, non-sticky, non-plastic, presence of small hard fragments (1.0 to 2.0 cm. Diameter), very few fine roots, pH (6.8).
B1	25 - 50	Brownish yellow (10YR 6/6), moist fine sandy loam, non-sticky, non-plastic, very loose, few fine distinct clear, strong brown (7.5YR 5/8) mottles, pH (6.4) Diameter), very few fine roots, pH (6.8).
B2	50 - 80	Brownish yellow (10YR 5/4), moist, very fine sandy loam, non-sticky, non-plastic, loose, few fine distinct clear, yellowish red (5YR 4/6) mottles, pH (6.4).
C1	113 Below	Yellowish brown (10YR 5/4) moist, fine sandy loam, non-sticky, non-plastic, very loose, presence of small mixed fragments (0.5 to 1.0 cm. Diameter), pH (6.4).

25

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	3	Soil Depth to (cm)	:	110 cm
Location	:	Brgy. San Jose, Bulol Kalan, T'Boli	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	157 Pyroclastics Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	3938 - 11	Surface Texture	:	Sandy Loam
Longitude	:	124 57' 07"	Surface Impediments	:	None
Latitude	:	6 6' 04"	Observed Rooting Depth	:	50 cm
Surface Landform	:	Hills (High Relief)	Elevation (m)	:	1000 cm
Vegetation/Land Use	:	Shrub/Grasses/Corn	Flooding	:	None
Slope Average	:	18 - 30 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Rolling to Hilly
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 10	Very dark grayish brown (10YR 2/2) moist, sandy loam, non-sticky, non-plastic, few soft and hard mixed fragments (1.0 to 2.0 cm. diameter), many fine to medium roots, pH (6.8).
A2	10 - 25	Dark yellowish brown (10YR 3/4) moist, sandy loam, non-sticky, non-plastic, presence of small hard mixed fragments (1.0 to 2.0 cm. diameter), very few fine roots, pH (5.8).
B1	25 - 50	Brownish yellow (10YR 6/6), moist fine sandy loam, non-sticky, non-plastic, very loose, few fine distinct clear, strong brown (7.5YR 5/8) mottles, pH (5.8).
B2	50 - 70	Brownish yellow (10YR 6/8), moist, fine sandy loam, non-sticky, non-plastic, loose, few fine distinct clear, yellowish red (5YR 4/6) mottles, pH (6.8).
C	70 - 100	Yellowish brown (10YR 5/4), moist, fine sandy loam, non-sticky, non-plastic, very loose, presence of small mixed fragments (0.5 to 1.0 cm. diameter), pH (6.8).
R	113 Below	Unpenetrable due to hard rock.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	4	Soil Depth to (cm)	:	120 cm
Location	:	Brgy. San Jose, T'Boli	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	164 Andesitic Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	3938 - 11	Surface Texture	:	Fine Sandy Loam
Longitude	:	124 58' 53"	Surface Impediments	:	NE
Latitude	:	6 06' 28"	Observed Rooting Depth	:	60 cm
Surface Landform	:	Hills (High Relief)	Elevation (m)	:	680 cm
Vegetation/Land Use	:	Corn/Grasses	Flooding	:	None
Slope Average	:	18 - 30 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Rolling to Hilly
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Very dark grayish brown (10YR 3/2), moist, fine sandy loam, non-sticky, non-plastic, loose, many fine roots, pH (6.0).
A2	20 - 45	Very dark gray (10YR 3/1), moist, sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (6.0)
B1	45 - 60	Yellowish brown (10YR 5/4), moist, sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (6.8).
B2	60 - 90	Brownish yellow (10YR 6/6), moist, fine sandy loam, non-sticky, non-plastic, loose, pH (6.8).
C2	90 - 120	Pale brown (10YR 6/3), moist, sand, non-sticky, non-plastic, very loose, pH (6.4).
R	120 Below	Unpenetrable due to hard rock.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	5	Soil Depth to (cm)	:	110 cm
Location	:	Brgy. San Jose, T'Boli	Boulders	:	
Author	:	Ncri and Party	Saturated Layer	:	
LMU	:	166 High Andesitic Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 111	Surface Texture	:	Sandy Loam
Longitude	:	124 01' 00"	Surface Impediments	:	NE
Latitude	:	6 06' 41"	Observed Rooting Depth	:	110 cm
Surface Landform	:	Hills (High Relief)	Elevation (m)	:	510 cm
Vegetation/Land Use	:	Grasses/Shrub/Corn	Flooding	:	None
Slope Average	:	18 - 30 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Rolling to Hilly
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 15	Grayish brown (10YR 5/2), dry, sandy loam, non-sticky, non-plastic, friable, presence of few small limestone fragments, many fine to medium roots,loose, many fine, pH (6.0).
A2	15 - 25	Brown (10YR 5/3), moist, sandy loam, non-sticky, non-plastic, loose, presence many rounded limestone fragments (1.0 to 2.0 cm diameter), many fine to medium roots, pH (6.8).
B1	25 - 45	Mottled, very pale browm (10YR 7/4)and pale brown (10YR 6/3), moist, fine sandy loam, non-sticky, non-plastic, loose, many fine roots, presence of few limestone fragments (1.0 to 2.0 cm diameter), pH (6.8).
B2	45 - 65	Pale brown (10YR 6/3), moist, fine sand, non-sticky, non-plastic, very loose, presence of few hard rounded limestone fragments (0.5 to 1.0 cm diameter) many fine roots, few fine distinct clear, brown (10YR 5/3) mottles, pH (6.8).
B3	65 - 80	Light brownish gray (10YR 6/2), moist, fine sand, non-sticky, non-plastic, very loose, few fine distinct clear (10YR 5/6) mottles, presence of soft and hard limestone fragments (1.0 to 2.0 cm diameter) few fine roots, pH (7.2).
C2	80 - 110	Light yellowish brown (10YR 6/4), moist, fine sand, non-sticky, non-plastic, loose, presence of soft and hard gravels (0.5 to 1.0 cm diameter), few fine distinct clear, dark yellowish brown (10YR 4/4) mottles, very few fine roots, pH (6.8).
C3	110 Below	Light yellowish brown (10YR 6/4), moist, very fine sand, non-sticky, non-plastic, very loose, presence of soft and hard gravels (1.0 to 2.0 cm diameter), few fine distinct clear, dark yellowish brown (10YR 4/6) mottles.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	6	Soil Depth to (cm)	:	75 cm
Location	:	Brgy. San Jose, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	114 High Pyroclastics Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 111	Surface Texture	:	Silt Loam
Longitude	:	125 03' 25"	Surface Impediments	:	NE
Latitude	:	6 07' 10"	Observed Rooting Depth	:	45 cm
Surface Landform	:	Low Hills	Elevation (m)	:	280 cm
Vegetation/Land Use	:	Coconut/Shrub/Grasses	Flooding	:	None
Slope Average	:	8 - 18 %	Dissection	:	Slightly Dissected
Soil Drainage	:	Well Drained	Topography	:	Moderately Sloping to Rolling
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 10	Brown to dark brown (10YR 4/3) moist, silt loams, slightly sticky, slightly plastic, firm, few fine roots, pH (6.0).
A2	10 - 20	Pale brown (10YR 6/3) moist, silt loam, slightly sticky, slightly plastic, firm, few fine roots, pH (6.0)
B1	20 - 45	Dark grayish (10YR 4/2) moist, fine sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (6.0)
B2	45 - 60	Dark yellowish brown (10YR 4/4) moist, fine sandy loam, non-sticky, non-plastic, loose, presence of soft limestone fragments, pH (6.24).
C2	60 - 75	Dark yellowish brown (10YR 3/4), moist, fine sandy loam, non-sticky, non-plastic, loose, pH (6.4).
R	75 Below	Unpenetrable due to hard rocks.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	7	Soil Depth to (cm)	:	95 cm
Location	:	Brgy. San Jose, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	53 DO Upper footslopes (volcanic hills and mountains) Light textured soil (Moderately sloping to rolling)	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Clay Loam
			Surface Impediments	:	NE
Topo Sheet No.	:	4038 - 111	Observed Rooting Depth	:	40 cm
Longitude	:	125 04' 09"	Elevation (m)	:	240 cm
Latitude	:	6 07' 10"	Flooding	:	None
Surface Landform	:	Upper Footslopes	Dissection	:	None
Vegetation/Land Use	:	Coconut/Corn	Topography	:	Moderately Sloping to Rolling
Slope Average	:	8 - 18 %			
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	Severely Eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Dark brown (10YR 3/3) moist, clay loam, slightly sticky, slightly plastic, firm, many fine roots, pH (6.0).
A2	20 - 40	Brown to dark brown (10YR 4/3) moist, clay loam, slightly sticky, slightly plastic, firm, few fine roots, pH (6.0).
B1	40 - 60	Yellowish brown (10YR 5/4) moist, sandy loam, non-sticky, non-plastic, loose, pH (6.0).
B2	60 - 75	Yellowish brown (10YR 5/4) moist, sandy loam, non-sticky, non-plastic, loose, few fine distinct clear, strong brown (7.5YR 5/6) mottles, pH (5.8).
C2	75 - 95	Yellowish brown (10YR 5/4), moist, sandy loam, non-sticky, non-plastic, loose, few fine distinct clear, strong brown (7.5 YR 4/6) mottles, presence of soft and hard rounded gravels, pH (5.8).
R	95 Below	Unpenetrable due to hard rocks.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 13, 1991

Observation No.	:	8	Soil Depth to (cm)	:	80 cm
Location	:	Brgy. San Jose, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	53 D Upper footslopes (volcanic hills and mountains) Light textured soil	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Sandy Loam
			Surface Impediments	:	NE
Topo Sheet No.	:	4038 - 111	Observed Rooting Depth	:	45 cm
Longitude	:	125 05' 15"	Elevation (m)	:	210 cm
Latitude	:	6 06' 50"	Flooding	:	None
Surface Landform	:	Upper Footslopes	Dissection	:	None
Vegetation/Land Use	:	Corn/Grasses/Shrubs	Topography	:	Level to Very Gently Sloping
Slope Average	:	0 - 03 %			
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No Apparent Erosion			

II. SITE OBSERVATION/REMARKS

Master Site Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Dark brown (10YR 3/3) moist, sandy loam, non-sticky non-plastic, loose, many fine roots, pH (6.8).
B1	20 - 45	Brown to dark brown (10YR 4/3) moist, sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (6.8).
C1	45 - 60	Yellowish brown (10YR 5/4) moist, fine sand, non-sticky, non-plastic, very loose, pH (7.2).
C2	60 - 80	Brown (10YR 5/43 moist, coarse sand, non-sticky, non-plastic, very loose pH (7.2).
C3	80 Below	Yellowish brown (10YR 5/4), moist, coarse sand, non-sticky, non-plastic, very loose, presence of small rounded gravels, pH (7.2).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	9	Soil Depth to (cm)	:	15 cm
Location	:	Lambangal, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	2 HD Lower River Terrace, well-drained Light textured soil	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Sandy Loam
Topo Sheet No.	:	4038 - 111	Surface Impediments	:	30 %
Longitude	:	125 09' 27"	Observed Rooting Depth	:	15 cm
Latitude	:	6 06' 25"	Elevation (m)	:	< 100 m
Surface Landform	:	River terrace	Flooding	:	Slight
Vegetation/Land Use	:		Dissection	:	None
Slope Average	:	0 - 03 %	Topography	:	Level to Very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No Apparent Erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A	0 - 15	Brown (10YR 5/3) moist, sandy loam, non-sticky non-plastic, friable, many fine roots, presence of gravel (0.5 cm diameter), pH (7.6).
R	15 Below	Unpenetrable

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	10	Soil Depth to (cm)	:	15 cm
Location	:	Tambler, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	09 HD Broad Alluvial Plains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 111	Surface Texture	:	Silt Loam
Longitude	:	125 09' 27"	Surface Impediments	:	30 %
Latitude	:	6 06' 25"	Observed Rooting Depth	:	15 cm
Surface Landform	:	River terrace	Elevation (m)	:	< 100 m
Vegetation/Land Use	:		Flooding	:	Slight
Slope Average	:	0 - 03 %	Dissection	:	None
Soil Drainage	:	Well Drained	Topography	:	Level to Very Gently Sloping
Erosion Class/Type	:	No Apparent Erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Brown (10YR 5/3) moist, silt loams, non-sticky non-plastic, loose, few fine roots, pH (7.2).
A2	20 - 30	Yellowish brown (10YR 5/4) moist, loamy sand, non-sticky, non-plastic, very loose, very few fine roots, pH (7.2).
B1	30 - 40	Pale brown (10YR 6/3) moist, sandy loam, non-sticky, non-plastic, loose, presence of few small rounded gravels (0.5 to 1.0 cm diameter), pH (7.2).
C	40 Below	Light gray (10YR 7/2) moist, loose sand, pH (7.6).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	11	Soil Depth to (cm)	:	90 cm
Location	:	Maan, T'Boli	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	164 Andesitic Mountains	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	3938 - 11	Surface Texture	:	Clay Loam
Longitude	:	124 58' 02"	Surface Impediments	:	None
Latitude	:	6 04' 52"	Observed Rooting Depth	:	45 cm
Surface Landform	:	High Relief	Elevation (m)	:	780 m
Vegetation/Land Use	:	Grasses/Corn	Flooding	:	None
Slope Average	:	8 - 18 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Moderately Sloping to Rolling
Erosion Class/Type	:	Severly eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 10	Very dark grayish brwon (10YR 3/2) moist, clay loam, slightly sticky, slightly plastic, firm, many fine to medium roots, pH (6.4).
A2	10 - 45	Brown to dark brown (10YR 4/3) moist, clay, sticky, plastic, firm, few fine distinct clear, very pale brown (10YR 7/4) mottles, presence of hard stone fragments (1.0 to 5.0 cm diameter), few fine roots, pH (6.4).
B2	45 - 90	Yellowish brown (10YR 5/4) moist, clay, sticky, plastic, firm, few fine faint diffuse, brownish yellow (10YR 6/6) mottles, presence of hard stone fragments (1.0 to 5.0 cm diameter), pH (6.4).
C2	90 Below	Very pale brwon (10YR 8/4) moist, clay, sticky, plastic, firm, presence of hard shale/snadstone fragments (1.0 to 5.0 cm diameter), pH (6.4).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	12	Soil Depth to (cm)	:	30 cm
Location	:	Brgy. San Jose, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	44 Infilled/Localized Valley	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 11	Surface Texture	:	Loose Sand
Longitude	:	125 01' 00"	Surface Impediments	:	None
Latitude	:	6 05' 15"	Observed Rooting Depth	:	30 cm
Surface Landform	:	Valley	Elevation (m)	:	420 m
Vegetation/Land Use	:	Grasses/Shrub/Corn	Flooding	:	None
Slope Average	:	0 - 3 %	Dissection	:	Severely Dissected
Soil Drainage	:	Well Drained	Topography	:	Level to Very Gently Sloping
Erosion Class/Type	:	No apparent eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 10	Brown to dark brwon (10YR 4/3) moist, loose sand, non-sticky, non-plastic, loose, many fine roots, pH (6.0).
A2	10 - 30	Dark brown (10YR 3/3) moist, loose sand, non-sticky, non-plastic, loose few fine roots, presence of stone and gravel, pH (6.0).
R	30 Below	Unpenetrable due to hard rock.

261

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	13	Soil Depth to (cm)	:	50 cm
Location	:	Brgy. San Jose, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	16 D Infilled/Localized Valley, Light textured soil (< 100 m elevation, < 8% slope)	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Sandy Clay Loam
			Surface Impediments	:	None
Topo Sheet No.	:	4038 - 11	Observed Rooting Depth	:	50 cm
Longitude	:	125 04' 50"	Elevation (m)	:	180 m
Latitude	:	6 05' 03"	Flooding	:	None
Surface Landform	:	Fotslope	Dissection	:	None
Vegetation/Land Use	:	Corn/Grasses/Shrub	Topography	:	Gently Sloping to Undulating
Slope Average	:	3 - 8 %			
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent eroded			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good

Fair

Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 30	Very dark brown (10YR 2/2) moist, sandy caly loam, slightly sticky, slightly plastic, firm, few fine roots, pH (6.0).
A2	30 - 40	Dark yellowish brown (10YR 3/4) moist, clay loam, slightly sticky, slightly plastic, firm, few fine roots, pH(6.4).
A3	40 - 50	Dark yellowish brown (10YR 4/4) moist loam, slightly sticky, slightly plastic, firm, few fine roots, pH (6.4).
B1	50 - 70	Dark yellowish brown (10YR 3/6) moist, sandy loam, non-sticky, non-plastic, friable, pH (6.4).
B2	70 - 80	Dark yellowish brown (10YR 4/6) moist, sandy clay loam, slightly sticky, slightly plastic, slightly firm, pH (6.4).
C	80 Below	Yellowish brown (10YR 5/4) moist, coarse sand, non-sticky, non-plastic, loose, pH (6.4).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 15, 1991

Observation No.	:	14	Soil Depth to (cm)	:	80 cm
Location	:	Lambangal, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	08 Beach Ridges/Swales	(H 2 O Table)	:	Not Encountered
Topo Sheet No.	:	4038 - 11	Surface Texture	:	Sandy Loam
Longitude	:	125 09' 24"	Surface Impediments	:	None
Latitude	:	6 06' 00"	Observed Rooting Depth	:	50 cm
Surface Landform	:	Ridges	Elevation (m)	:	[illegible] m
Vegetation/Land Use	:	Built-up Area	Flooding	:	Slightly Flooded
Slope Average	:	0 - 03 %	Dissection	:	None
Soil Drainage	:	Well Drained	Topography	:	Level to Very Gently Sloping
Erosion Class/Type	:	No Apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good

Fair

Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Brown to dark brown (10Yr 4/[illegible]) moist, sandy loam, non-sticky, non-plastic, friable to loose, many to medium to fine roots, pH (7.2).
B1	20 - 50	Very Pale brown (10YR 7/3) moist, fine sand, non-sticky, non-plastic, very few fine roots presence of small fragments of coralline limestone, pH (7.2).
B2	50 - 80	Very pale brown (10YR 8/3) moist, very fine sand, non-sticky, non-plastic, loose presence of few very fine fragments of coralline limestone, pH (7.2).
Cg	80 Below	Very dark gray (10YR 3/1) moist, sandy loam, non-sticky, non-plastic, loose, pH (7.6).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 16, 1991

Observation No.	:	15	Soil Depth to (cm)	:	40 cm
Location	:	Calumpang, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	09 HD Broad Alluvial Plains (width > 500 m) Well drained, coarse tectured soil	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Silt Loam
Topo Sheet No.	:	4038 - 11	Surface Impediments	:	None
Longitude	:	125 09' 00"	Observed Rooting Depth	:	20 cm
Latitude	:	6 05' 53"	Elevation (m)	:	15 m
Surface Landform	:	Alluvial plains	Flooding	:	Slightly Flooded
Vegetation/Land Use	:	Built-up Area	Dissection	:	None
Slope Average	:	0 - 3 %	Topography	:	Level to very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 20	Yellowish brown (10YR 5/4) moist, silt loam, non-sticky, non-plastic, loose, few fine roots, pH (7.2).
B1	20 - 40	Brown (10YR 5/3) moist, silt loam, non-sticky, nonplastic, loose, presence of gravel, pH (7.2).
C	40 Below	Very loose material, pH (7.2).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 16, 1991

Observation No.	:	16	Soil Depth to (cm)	:	60 cm
Location	:	Calumpang, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	09 HD Broad Alluvial Plains (width > 500 m)	(H 2 O Table)	:	Not Encountered
		Well drained, coarse textured soil	Surface Texture	:	Sandy Loam
Topo Sheet No.	:	4038 - 11	Surface Impediments	:	None
Longitude	:	125 08' 48"	Observed Rooting Depth	:	30 cm
Latitude	:	6 05' 11"	Elevation (m)	:	20 m
Surface Landform	:	Alluvial plains	Flooding	:	None
Vegetation/Land Use	:	GRasses/Shrubs	Dissection	:	None
Slope Average	:	0 - 3 %	Topography	:	Level to very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 30	Yellowish brown (10YR 5/4) moist, sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (7.2).
B1	30 - 60	Pale brown (10YR 6/2) moist, sandy loam, non-sticky, non-plastic, loose, presence of gravel, pH (7.2).
C	60 Below	Presence of loose material.

205

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 16, 1991

Observation No.	:	17	Soil Depth to (cm)	:	90 cm
Location	:	Low Silway, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	51 EF Lower Foostslope (volcanic hills and mountains) Medium to heavy textured soil.	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Silty Clay
Topo Sheet No.	:	4038 - 11	Surface Impediments	:	None
Longitude	:	125 07' 06"	Observed Rooting Depth	:	30 cm
Latitude	:	6 07' 12"	Elevation (m)	:	90 m
Surface Landform	:	Footslope	Flooding	:	None
Vegetation/Land Use	:	Pasture/Shrubs/Cotton	Dissection	:	None
Slope Average	:	0 - 3 %	Topography	:	Level to very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 30	Light brownish gray (10YR 6/2) moist, silty clay, slightly sticky, slightly plastic, slightly firm, few fine roots, pH (7.2).
B2	30 - 70	Brown (10YR 5/3) moist, fine sandy loam, non-sticky, non-plastic, loose, pH (7.2).
C3	70 - 90	Yellowish brown (10YR 5/4) moist, silty clay, slightly sticky, slightly plastic, slightly firm, few fine faint diffuse brown (10YR 5/8) mottles, pH (7.6).
R	90 Below	Unpenetrable due to hard rock.

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 16, 1991

Observation No.	:	18	Soil Depth to (cm)	:	50 cm
Location	:	Upper Maluk, Gen. Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	12 HD River Terraces, well-drained course textured soil	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Silt Loam
Topo Sheet No.	:	4038 - 11	Surface Impediments	:	None
Longitude	:	125 08' 44"	Observed Rooting Depth	:	30 cm
Latitude	:	6 06' 20"	Elevation (m)	:	40 m
Surface Landform	:	River Terrace	Flooding	:	None
Vegetation/Land Use	:	Grasses/Shrubs	Dissection	:	None
Slope Average	:	3 - 8 %	Topography	:	Level to Very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good

Fair

Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
A1	0 - 30	Brown (10YR 5/3) moist, sandy loam, non-sticky, non-plastic, loose, few fine roots, pH (7.2).
B2	30 - 50	Pale brown (10YR 6/3) moist, sandy loam, non-sticky, non-plastic, loose, pH (7.2).
C3	50 below	Yellowish brown (10YR 5/4) moist, coarse sand, non-sticky, non-plastic, loose, presence of gravel (0.5-1.0 cm diameter), pH (7.2).

DETAILED SOIL RESOURCES AND LAND USE SURVEY INFORMATION

I. FIELD OBSERVATION

DATE : March 16, 1991

Observation No.	:	19	Soil Depth to (cm)	:	90 cm
Location	:	Brgy. San Jose, Gen Santos City	Boulders	:	
Author	:	Neri and Party	Saturated Layer	:	
LMU	:	51 EF Lower Foostslope (volcanic hills and mountains) Medium to heavy textured soil	(H 2 O Table)	:	Not Encountered
			Surface Texture	:	Clay Loam
Topo Sheet No.	:	4038 - 11	Surface Impediments	:	None
Longitude	:	125 05' 57"	Observed Rooting Depth	:	45 cm
Latitude	:	6 04' 55"	Elevation (m)	:	170 m
Surface Landform	:	Lower Footslope	Flooding	:	None
Vegetation/Land Use	:	Pasture/Shrubs/Cotton	Dissection	:	None
Slope Average	:	0 - 3 %	Topography	:	Level to very Gently Sloping
Soil Drainage	:	Well Drained			
Erosion Class/Type	:	No apparent erosion			

II. SITE OBSERVATION/REMARKS

Master Site

Check Boring

III. LAND SUITABILITY CLASSES

Good Fair Marginal

IV. SOIL PROFILE DESCRIPTION

HORIZON	DEPTH	DESCRIPTION
Ap	0 - 20	Dark grayish brown (10YR 4/2) moist, clay loam, slightly sticky, slightly plastic, slightly firm, few fine roots, pH (6.0).
AB	20 - 30	Grayish brown (10YR 5/2) moist, silt loam, slightly sticky, slightly plastic, slightly firm, few fine roots, pH (7.2).
B	30 - 45	Brown to dark brown (10YR 4/3) moist, slity clay loam, slightly sticky, slightly plastic, slightly firm, few fine roots, pH (7.2).
B2	45 - 70	Yellowish brown (10YR 5/4) moist, slit loam, non-sticky, non-plastic, loose pH (7.2).
C	70 - 90	Pale brown (10YR 6/3) moist, fine sandy loam, non-sticky, non-plastic, very loose, pH (7.6).

268

APPENDIX D-8

MAJOR AND SECONDARY FISH GROUPS LANDED IN GENERAL SANTOS CITY

Appendix D-8

MAJOR AND SECONDARY FISH GROUPS LANDED IN GENERAL SANTOS CITY

COMMON ENGLISH NAME	SCIENTIFIC NAME	LOCAL NAME
Tuna:		
Yellowfin (adult)	*Thunnus albacares*	Bariles, Tambakol
Yellowfin (juvenile, 45 cm)	*Thunnus albacares*	Carao
Bigeye Scad, (less than 45 cm)	*Thunnus albacares*	Pirit, Tulay
Bigeye adult	*Thunnus obesus*	Bariles, Buldog
Bigeye (juveniles, 45 cm and less)	*Thunnus obesus*	Carao, Pirit, Tulay
Skipjack (adult)	*Katsuwonus pelamis*	Sambangon
Skipjack (juveniles)	*Katsuwonus pelamis*	Pirit, Tulay
Frigate tuna (adult)	*Auxis thazard*	Pirit, Tulay
Bullet tuna (adult)	*Auxis rochei*	Pirit, Tulay
Frigate tuna (juvenile)	*Auxis thazard*	Aloy
Frigate tuna (juvenile)	*Auxis rochei*	Aloy
Eastern little tuna, oceanic bonito	*Euthynus affinis*	Carao, Pirit
Marlin, Sailfish	*Istiophorus spp.*	Marang, Malasuque
Swordfish	*Xiphias gladius*	Marang, Atsi, Baboy dagat
Dolphin Fish	*Coryphaena hippurus*	Pandawang
Sardines	*Sardinella spp.*	Tamban, Tunsoy, Lapad
Anchovies	*Stolephorus spp.*	Bolinao, Dilis
Round Scad	*Decapterus spp.*	Borot, Galonggong
Moonfish	*Mene maculata*	Bilong-bilong
Spanish Mackerel	*Cymbium spp.*	Tanggigue, Taniggue
Parrot Fish	*Scarus spp.*	Molmol fish
Snapper	*Lutjanus spp.*	Bangbangin
Grouper	*Epinephelus spp.*	Lapo-lapo
Siganids	*Siganus spp.*	Danggit, Samaral
Surgeon Fish	*Acanthus spp.*	Labahita
Rainbow Runner	*Elegatis bipinnulatus*	Salmon
Barracuda	*Sphyraena spp.*	Torcillo
Flying Fish	*Cypselurus spp.*	Barongoy
Halfbeak	*Hemiramphus spp.*	Salawasid
Trigger Fish	*Balistes spp.*	Pakol

270

APPENDIX D-9

REPRESENTATIVE GENERAL RECORDED FROM THE DUMPAO POINT REEF PLATFORM

Appendix D-9
REPRESENTATIVE GENERA RECORDED FROM THE
DUMPAO POINT REEF PLATFORM

GENUS	DISTRIBUTION	RELATIVE ABUNDANCE	SUBSTRATE TYPE
SEA GRASS			
Enhalus	BR	C	S
Halophila	BR, RC	C	S
Thallasia	BR	P	S
SEAWEEDS			
Padina	RC	P	S, H
SOFT CORALS			
Lobophythum	RC	C	H
Sarcophythum	RC	C	H
Sinularia	RC	P	H
HARD CORALS			
Acropora	RC	P	H
Cyphastrea	RC	P	H
Favia	RC, BR	R	H
Favites	RC	P	H
Fungia	RC	P	H
Goniastrea	RC	P	H, S
Galaxea	RC	P	H
Millepora	RC	R	H
Montipora	RC	R	H
Plerogyra	P, UW	C	H, WP
Pocillopora	RC	P	H
Siderastrea	RC, BR	P	H
Tubastrea	P, UW	C	H, WP

(continued)

272

Appendix D-9 (continued)
REPRESENTATIVE GENERA RECORDED FROM THE
DUMPAO POINT REEF PLATFORM

GENUS	DISTRIBUTION	RELATIVE ABUNDANCE	SUBSTRATE TYPE	COMMON NAME
FISH				
Acanturus	RC, P	P	H, WC	Surgeonfish
Aeoliscus	RC	P	H	Shrimp Fish
Anthias	RC	P	H	Blue Green Anthias
Apogon	P, UW	C	H, WP, WC	Cardinalfish
Chaetodon	RC, RS	P	H	Butterfly Fish
Diodon	RC, RS	C	H	Spiny Porcupinefish
Dunckerocampus	RC	P	H	Banded Pipefish
Eleotriodes	RC, RS	P	S	Goby
Heniochus	RC, P	R	H, WC	Pennate Butterfly Fish
Labroides	RC	R	H	Cleaner Wrasse
Mugil	BR	P	S	Mullet
Parupeneus	BR, RC	P	S	Goatfish
Plectorbynchus	RS, P	R	S, WC	Grunt
Syngnathoides	RC, BR	P	H, S	Pipefish
Umbrina	RS, P	R	S, WC	Drum
Zebrasoma	RC, BR	P	H, S	Lancetfish
INVERTIBRATES				
Actinodendrum	RC	P	S	Venomous Sea Anemone
Cerianthus	RC, BR	P	S	Tube Anemone
Crassostrea	P	P	WP	Oyster
Linckia	RC	R	S	Pacific Blue Starfish
Microciona	BR	P	S	Sponge
Petrosia	RS	R	H	Basket Sponge
Stenopus	RC	P	H	Cleaner Shrimp
Synapta	BR	P	S	Sea Cucumber

Legend:

ABUNDANCE -
- C Common, major components of surveyed area
- P Present, minor components of surveyed area
- R Rare, individuals recorded

DISTRIBUTION -
- IF Intertidal Flat
- BR Back Reef
- RC Reef Crest
- RS Reef Slope
- P, UW Pilings, Under Wharf

SUBSTRATE TYPE -
- S Soft; sand, silt, mud
- H Hard; exposed coralline rock, corals and rubble
- WP Wharf Pilings
- WC Water Column

272

APPENDIX D-10

LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

Appendix D-10

LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
MAMMALS			
Tonguid Fruit Bat	*Macroglossus laqochilos*	dense clusters of banana leaves	common
Yellow-Brown Bat	*Scotophilus temmincoi*	leaves and roofs of houses, large bldgs.	common
Malayan ricefield Rat	*Rattus argentiventer*	ricefields/ cultivated areas near human settlements	- do -
	Cyanopterus brachyotis	agricultural areas	- do -
	Eonycrtis speleaa	agricultural areas	- do -
	Macroglossus minimus	- do -	- do -
	Pteropus hypomelanus	- do -	- do -
	Myotis muricola	agricultural areas	- do -
	Abditomys latidens	urban areas	- do -
	Mus musculus	agricultural areas	abundant
	Rattus exulans	urban areas	- do -
	Rattus norvegicus	- do -	- do -
REPTILES			
Philippine Bent-toed Gecko	*Cyrtodactylus philippinicus*	logs, rocks along stream bed	endemic/common
Toko Narrow-dislud Gecko	*Gekko qecko*	human dwellings, also in cultivated areas & grasslands	common/widespread

(continued)

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Common House Gecko	*Hemindactylus frenatus*	houses, coconut trees, garden trees	common/widespread
Small smooth-scaled Gecko	*Hemidactylus typus-typus*	leaves of arboreal/ ferns, undersides of tree barks and tree stems	
Brook's House Gecko, Butiki	*Hemidactylus brooki*	cultivated areas/ grasslands	
Philippine-Bent-Toed Gecko, Butiki	*Crytodactylos philippinicus*	cultivated areas/ grasslands	
Tender Skinned House Gecko, Butiki	*Gchyra mutilata*	settlement areas	
Two-striped mabouya, Bubuli	*Mabuya multicarinata*	wide range of areas	
Common Mabuya	*Mabuya multifascuata*	tree bank, tree holes, and logs of rotting vegetation	
Cumings Mabuya, Bubuli	*Mabuya cumingi*	- do -	
Brahmony blind snake	*Typhlops braminae*	vegetable matter	
Paradise Snake	*Chrysopelea paradisi*	coconuts, forest tress at low/med. alt.	
Northern Triangle-spottled Snake	*Cyclocorus lineatus*	secondary growth, coconut trees, and rotten logs or debris	
Common Bronze-backed snake	*Elephe erythrura*	lowlands near the vicinity of human dwellings	

276

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Common wolf snake	*Lycodon aulicus*	near human habitations	
AMPHIBIANS			
Brackishwater Frog	*Rana cancrivora cancrivora*	ricefields, ditches and ponds	
Everrets Frog	*Rana everetti*	on rock, in banks of streams and lakes	
Common Pond Frog	*Rana limnocharis*	ponds and streams	common/widespread
Common Tree Frog	*Polypedates leucomystar*	near settled areas	common/widespread
Slender-digit narrow mouthed frog	*Kaloula picta*	terrestial in low elevation	endemic
BIRDS			
Philippine Mallard	*Anas luzonica*	coastal areas and wetlands	common/resident
Brahminy Kite	*Haliastur indus*	grasslands, ricefields	common/resident
Bearded partridge	*Perdix barbata*	- do -	common/resident
Blue-breasted quail	*Coturnix chinensis*	- do -	common/resident
Barred Buttonquail	*Turnix suscitator*	grasslands, fields	common/resident
Banded rail	*Rallus philippinensis*	grasslands	common/resident
Plain Swamphen	*Amaurornis olivaceus*	rivers	common/resident
Common moorhen	*Gallinula chloropus*	ponds, marshes	common/resident
Pheasant-Tailed Jacana	*Hydrophasianus chiruqus*	marshes	quite uncommon
Painted snipe	*Rostratula benqhalensis*	grasslands, ricefields	- do -

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Javanese collared dove	*Streptpelia bitorquata*	grasslands, ricefields	- do -
	Soldoida armata	shores of streams, ponds	indeterminate
MITES			
Transverse crabmites	*Valleriola buenoi*	dry rocks on streams rivers; adaptable in deforested areas at lower elevations	indeterminate
	Polyphagotaronomos	agricultural areas with diversified crops and tree orchids	common/abundant
Onnate Red Mite	*Tuckerella grnata*	associated with orchids, citrus, henea and mamea	common/abundant
Green Bamboo Mite	*Aponychus copuzae*	associated with bamboos	common/abundant
Cendanas Citrus Mite	*Estetianychus cendanai*	feeds on citrus fruits	common/abundant
Oriental Red Mite	*Eutetrarychus orientals*	hosts on asparus plumosus, Bauchinia carica papaya, citrus gradus, citrus mintos, etc.	common/abundant
Alibangbang Spider Mite	*Oligonychus biharensia*	hosts on cultivated and wild plants	common/abundant
Kakawate Spider Mite	*Oligonychus matthysesi*	feed on kakawate	common/abundant
Monocot Spider Mite	*Oligonychus orthius*	hosts on monoco-tyledenous plants	common/abundant

278

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Velasco's Coconut Mite	*Oligonychus velascoi*	hosts on coconut, bananas, corchorus musa, paradisiaca and pennisetum	common/abundant common/abundant
Citrus Green Mite or Baltazar's Citrus Mite	*Tetranchus fijiensis*	feeds on palms citrus, Dieffenbachia pieta, Maranta anundinacea, Schizocasta porter	
Vegetable Mite	*Tetranychus neocaledonicus*	feeds on vegetable plants thus spinosus itibiscus syriacus	common/abundant
The First Phil. Spider Mite	*Tetranychus piercei*	feeds on cultivated crops like banana, gabi, papaya and sweet potato	common/abundant
Truncak Spider Mite	*Tetranychus truncatus*	feeds on cultivated crops	common/abundant
	Breuipalpus californicus	feeds on cultivated crops and ornamental plants	common/abundant
Red and Black Flat Mit	*Breuipalpus phoenicur*	feeds on fruit trees and ornamental plants	common/abundant
Fern Flat Mite	*Tenuipalpus orilloi*	found citrus plant and other tree crops	common/abundant
Common Fungus Mite	*Tyrophagus palmarum*	vegetation or litter grasslands	abundant
	Amblyseius colorai	riceland/grassland	common/abundant
	Amblyseius ovalis	fruit trees and vegetable crops	common/abundant

279

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
	Typholdromus contiqrues	fruit trees like citrus, cashew, mangoes	common/abundant
Ornate Citrus Crab Mite	*Cheletogenos ornatus*	found in citrus and orchid plants	common/abundant
Baker Carnosa Mite	*Grallachele bakeri*	found in citrus plants	not abundant
OTHER INSECTS			
Bristletails	*Campode sp.* *Machilis sp.*		common - do -
Springtails	*Smynthurus sp.*		common
Stoneflies	*Nemoura sp.* *Perlinella sp.*		common - do -
Ephemerids	*Caenis sp.* *Chirotonetus sp.*		common - do -
Dragonflies	*Agrion maculatum* *Lestes sp.* *Anax sp.* *Lebellula lactousa*		common - do - - do - very common
Katydids	*Microcentrum sp.*		common
Filed Crickets	*Gryllus sp.*		common
Mole Crickets	*Gryllotalpa africana*		common
Pygmy Locusts	*Acrydium sp.*		common
Short-boomed Grasshopper	*Trilophidia sp.* *Gastrimargus marmoratus* *Melanoplus sp.* *Melicodes tenebrosa*		common - do - - do - occasional

280

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Roaches	*Blatta sp.*		occasional
	Blattela germanica		- do -
	Rhyparobia maderae		- do -
	Periplaneta americana		common
Preying Mantis	*Mantis sp.*		common
	Callimantis religiosa		- do -
Walking Sticks	*Diapremomera sp.*		occasional
Earwigs	*Forficula sp.*		common
	Labia minor		- do -
Whirligig Beetles	*Gyrinus sp.*		occasional
Predaceous Diving	*Dytiscuc sp.*		common
Ground Beetles	*Agonoderus sp.*		occasional
Water Scavenger Beetles	*Lucabus sp.*		occasional
Fireflies	*Lucidota sp.*		common
Soldier Beetles	*Chauliognathus sp.*		occasional
Carrion Beetles	*Silpha sp.*		occasional
Skin Beetles	*Enoclerus sp.*		occasional
Woodborers	*Anthrenus sp.*		occasional
Click Beetles	*Monocrepidius sp.*		occasional
Lady Beetles	*Hippodamia sp.*		occasional
	Chilomenes sexmaculata		common
June Beetles	*Leocopholis irrorata*		common
Rhinocerus Beetles	*Oryctes rhinoceros*		common
Primitive Weevils	*Eupsalis sp.*		occasional

281

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Snout Bettles	*Hypera sp.*		common
Rice Weevils	*Calandra oryza*		common
Copra Beetles	*Necrobia rufipes*		common
Thrips	*Heliothrips sp.*		common
Stink Bugs	*Chlorochroa sp.*		common
Assassin Bugs	*Reduvius sp.*		common
Lace Bugs	*Corythuca sp.*		common
Water Striders	*Gerris sp.*		common
Water Measures	*Hydrometra sp.*		common
Back Swimmers	*Notonectus sp.*		common
Plant Bugs	*Lygus sp.*		common
Red Bugs	*Dysdercus sp.*		common
Chinch Bugs	*Blissus sp.*		common
Water Bugs	*Bellostoma sp.*		common
Water Scorpions	*Ranatra sp.*		common
Water Boatmen	*Artocorixa sp.*		common
Treehoppers	*Ceresa sp.*		common
Leaf-hoppers	*Platymetophius sp.*		common
Jumping Plant Lice	*Psylla sp.*		common
Coccids	*Lepidosaphes sp.*		common
Whiteflies	*Trialeuroides sp.*		occasional

252

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Plant Lice	*Aphis sp.*		common
Lace Wings	*Mantispa sp.* *Chrysopa sp.*		occasional - do -
Dobsonflies	*Sialis sp.*		occasional
Ant Lions	*Hesperoleon sp.*		common
Swallow-tails	*Papilio sp.*		common
Pierids	*Pieris rapae*		common
Monarch Butterflies	*Danaus sp.*		common
Meadow-browns	*Cissia sp.*		common
Nymphalids	*Euptoieta sp.*		common
Clear-wings	*Melittia sp.*		common
Teneids	*Tinea sp.*		common
Sphinx Moths	*Protoparce sp.*		common
Smoky Moths	*Harrisima sp.*		occasional
Bag Worms	*Pyrausta nubilalis*		common
Grant Silk-Worm Moths	*Thyridopteryx sp.*		occasional
Measuring Worms	*Cleora sp.*		occasional
Tiger Moths	*Estigmene sp.*		occasional
Corn Ear-Worm	*Heliothus armigera*		common
Tussock Moths	*Hemerocampa sp.*		occasional
Scoprion Flies	*Boreus sp.*		occasional

283

Appendix D-10 (continued)
LIST OF FAUNA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Crane Flies	*Tipula sp.*		common
Mosquitoes	*Culex fatigans*		common
	Anopheles minimus		- do -
	Acdes augyptai		occasional
Moth Flies	*Psychoda sp.*		occasional
Fungus Gnats	*Leia sp.*		occasional
Midges	*Dasyneura sp.*		common
	Chironomous sp.		- do -
Buffalo-gnats	*Posimulium sp.*		common
Horse Flies	*Tabanus striatus*		occasional
Common Houseflies	*Musca domestica*		common
Blue bottle Flies	*Calliphora vomitoria*		common
Dance Flies	*Rhamphomyia sp.*		occasional
Shore Flies	*Ochtheria sp.*		common
Fruit Flies	*Drosophila melanogaster*		common
Black Carpenter Ants	*Camponotus sp.*		common
Cow-Killer Ants	*Dasymutilla sp.*		occasional
Ichneumon Wasps			occasional
Typical Wasps	*Polistes sp.*		
Bumble Bees	*Bombus sp.*		common
Leaf-Cutter Bees	*Osmia sp.*		occasional
Honey Bees	*Apis milifera*		occasional

APPENDIX D-11

LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

Appendix D-11

LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
NON-DIPTEROCARP			
Isis	*Ficus ulmifolia*	low and medium alt. up to 1500 m.	abundant
Dolalog	*Ficus cariegata var sycomoroides*	- do -	indeterminate
Duguan	*Myristica philippinenses*	low and medium alt. up to 300 m. elev.	indeterminate
Margapali	*Dehaasia triandra*	- do -	depleted
Malaikmo	*Celtis philippinensis*	low to med. alt.	indeterminate
Anabiong	*Trema orientalis*	low to med. alt.	abundant
Malunggai	*Moringa oleifira*	low to med. alt.	abundant
Malak-malak	*Palaquim philippinensis*	low to med. alt.	abundant
White-Nato	*Pouteria macrantha*	- do -	- do -
Mangga	*Manqifera indica Lin.*	low to med. alt.	abundant
Santol	*Sandoricum koetjape*	low/med. alt.	abundant
Makaasim	*Syzyqium nitidum*	well drained lands at low/med. alt.	depleted
Malabayabas	*Tristania decorticata*	primary forest in low/med. alt.	indeterminate
Pototan-lalaki	*Bruquiera cylindrica*	clay soil at low/med. alt.	depleted
Malasangki	*Buonymus javanicus*	low to med. alt.	indeterminate

(continued)

Appendix D-11 (continued)
LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Prickly narra	*Pterocarpus vidalianus rolfe*	forest at low/med. alt.	depleted
Smooth Narra	*Pterocarpus indicus forma indicus*	primary/sec. forest at low/med. alt.	- do -
Katurai	*Sesbania grandiflora*	low to med. alt.	abundant
Aroma	*Acacia farnesiana*	grassland, waste places	- do -
Aklend-Parang	*Albizia procera*	thickets, secondary growth and green forest at low/med. alt.	- do -
Ipil-ipil	*Leucaena leucocephala*	low/med. alt.	abundant
Kamachile	*Pithecellobium dulce*	low/med. alt.	abundant
Raintree	*Samanea saman*	low/med. alt.	abundant
Banaba	*Lagerstroemia speciosa*	sec. forest at low/med. alt.	abundant
Bayabas	*Psidium quajava Lin.*	- do -	abundant
Duhat	*Syzyqium cumini Lin.*	low elev. with distinct dry	abundant
Ebony	*Diosypros ferrea*	thickets and inland dry slopes	indeterminate
Alibangbang	*Piliostiqma malabaricum*	open dry slopes	abundant
Sampaloc	*Tamarindus indica*	low to med. alt.	abundant under cultivation
Dapdap	*Erythrina orientalis*	low region	depleted due to urban dev.

287

Appendix D-11 (continued)
LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Rarang	*Eryhrina subumbrans*	low to med. alt.	abundant
Kakawate	*Glyriadia sepium*	low to med. alt.	abundant
Large leafed	*Mahogany swietenia macrophylla king*	low/med. alt.	depleted
Kamias	*Averrhoa bilimbi Lin.*	low to med. alt.	abundant
Balimbing	*Averrhoa carambola Lin.*	low to med. alt.	abundant
Malapapaya	*Polyscias nodosa*	open thickets/sec. forest at low/med. alt.	depleted
Kaatoan bangkai	*Anthocephalus cadamba*	low/med. alt.	abundant
Binunga	*Macaranga tanarius*	thickets, wasteland, open places & sec. forest at low/med. alt.	abundant
Malugai	*Pometia pinnata*	forest at low/med. alt.	- do -
ECONOMIC FERNS			
Tukod langit	*Helminthostachys zeylanica Lin.*	terrestial, in open brushy places near sea level	rare
Nito	*Lyqodium auriculatum*	lightly shaded tress	abundant
Tree fern	*Cyathea contaminans*	terrestial at open places at med. alt. to 1300 m.	- do -
Pagong-pagongan	*Pyrrosia piloselloides*	on tree trunks and branches at 20-100 m. elevation	- do -

Appendix D-11 (continued)
LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Lokdo	*Christella parasitica*	terrestial in fairly damp places or banks of canals	abundant
	Sphaerostephanos unitus	terrestial in fairly wet ground near waterways at med. alt.	- do -
Pakong parang	*Pteris mutilata*	terrestial at med. alt.	abundant
Pakong Alagdan	*Blechum orientale*	terrstial in open exposed places	abundant
Mosquito Fern	*Azolla pinnata*	rice paddies	abundant
	Pleochemia presliana	lowland areas	- do -
BAMBOO			
Spineless Indian bamboo	*Bambusa tulda*	cultivated in settled areas	abundant
Kamayan	*Dendrocalamus merrillianus*	forest cultivated in settled ares	abundant
PALMS			
Kaong	*Arenga pinnata*	forested areas at low alt.	abundant
Pugahan/Fish tailed Pala	*Caryota cumingii*	lowland	abundant
Fan Palm/Anahaw	*Livistona rotundifolia var. luzonensis*	forest at low/med. alt.	indeterminate
Bunga/betel nut	*Areca castechu*	cultivated in settled areas	- do -
Niyog	*Cocos nucifera*	cultivated	abundant

Appendix D-11 (continued)
LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
GRASSES			
	Dimeia ornithophoda	open grasslands, rice paddies and waste places in low/med. alt. ascending to 1,500 m elev.	indeterminate
Teosinte	*Euchlaena mexicana*	cultivated areas in warm climate/ moderate areas	- do -
Sibat-Sibatan	*Heteropogon Contortus*	sea level to an alt. of 1300 m., coastal inland areas	- do -
Dava	*Mnesithea laevis*	open grasslands and bank of rice paddies at low/med. alt.	common/abundant
	Panicum austro-asiaticum	open grasslands, waste places and roadsides at low/med. alt.	common/widespread
Baririan, Lalabko	*Paspalidium punctatum*	shallow water, open muddy places at low alt.	- do -
	Setaria splendida	loamy-clay soil with good drainage	- do -
	Sporobolus indicus	roadsides/waste places	- do -
Niknikan	*Panicum paludosum*	margins of shallow ponds, lakes and streams	- do -
Kangaroo grass	*Themida triandra*	open grasslnads at low/med. alt.	- do -

Appendix D-11 (continued)
LIST OF FLORA IN MAKAR AND ITS IMMEDIATE VICINITY

SPECIES (COMMON NAME)	SCIENTIFIC NAME	HABITAT	ECOLOGICAL STATUS
Corn	*Zea mays*	cultivated areas	common/abundant
Carabao grass	*Axonopus compressus*	- do -	- do -
Banoko	*Chloris barbata*	open areas, rice fields, roadsides, lawns, waste places and overgrazed grasslands	- do -
Rhodes grass	*Chloris gayana*	open ares	- do -
Bermuda Grass	*Cynodon dactylon*	open areas with sandy loam soil	common/widespread
Damong-balang	*Dactylochtenium aeqyptium*	open/waste areas and rice paddies	- do -
Kogon	*Imperata cylindrica*	grasslands, deforested/cultivated areas/creek and river banks	- do -

291

APPENDIX D-12

DOLEFIL - USAID
ENVIRONMENTAL PROJECTS
IN
SOUTH COTABATO

Provided by:

Community Development Department
DOLEFIL, INC. Polomolok,
South Cotabato

Appendix D-12
DOLEFIL - USAID
SARANGANI BAY MARINE & INLAND RESOURCE CONSERVATION PROJECT

A. PROBLEM

Sarangani Bay with a coastline stretch of 125 kilometers is the primary source of livelihood of the bay residents of South Cotabato. However, the marine environment of the bay is seriously threatened by the following problems, to wit:

- Overfishing
- Illegal fishing methods/techniques
  (muro-ami and dynamite fishing, fishpenning, etc.)
- Destruction of coral reefs/beds and mangroves; and
- Pollution.

The above mentioned problems have resulted in:

- Rapid depletion of marine life supply
- Reduced income for the residents; and
- Soil erosion

B. PROJECT

This 3-year project will:

- Organize 200 households/beneficiaries organized into cooperatives;
- Establish one (1) basic chemical laboratory in GSC which can later be developed as the forefront of marine research;
- Identify extent of destruction of natural reefs/mangroves and rehabilitate these areas;

- Build 250 artificial reefs at the least;
- Address concern for receding water table level; and
- Provide appropriate livelihood sources for the beneficiaries.
- Provide inputs on the proper fishing/aquaculture techniques that will augment the income of the beneficiaries but will not harm the marine ecology balance of the area.

C. CONCEPT OF THE PROJECT

The project will touchbase with the residents of the identified areas with prime focus on the fishermen and small prawn growers.

Beneficiaries of project are:

- Fishermen and prawn growers, are to be the prime resources of the project towards achieving its end objectives.

These two groups will become the rehabilitators/protectors of the Sarangani Bay marine environment even without the proddings of any governmental or private units.

Basic chemical laboratory of the project augmented by Dolefil laboratory facilities will provide services for prawn growers microbiology testing needs/soil conservation testing services.

D. PROJECT SITES

The proposed project site is within the province of South Cotabato, specifically in the shoreline area of the municipalities around Sarangani Bay.

E. PROJECT ROLEPLAYERS

Dole Philippines, Inc., as the grantee will be responsible for the over-all implementation and management of the project aside from the monitoring and evaluation of the pace and conduct of the project.

The United States Agency for International Development (USAID) and another government agency will provide back-up fundings for this specific project.

F. FUNDING

USAID	₱ 5,000,000	50%
Dole Philippines, Inc.	₱ 5,000,000	50%
	₱ 10,000,000	100%

TERMINAL OBJECTIVES OF THE PROJECT:

This 3-year project will:

		PROGRESS TO DATE 3RD QUARTER 1990 (9 months after)
1.	Organized 200 households/beneficiaries organized into cooperative;	♦ Organized 139 household beneficiaries composed of the following: a. Tinoto Farmers & Fisheries Association - 85 households b. Bawing Fishermen Association - 54 households c. Trained 139 beneficiaries on Human Resource Development conducted by MFI community organizers.

295

2. Establish one (1) basic chemical laboratory in GSC which can later be developed as the forefront of marine research;

3. Identify extent of destruction of natural reefs/mangroves and rehabilitate these areas;

4. Build 250 artificial reefs at the least;

- Built and submerged 788 artificial coral reefs and installed 16 payaos all done by beneficiaries.

  a. Tinoto - 484 artificial coral reefs - 7 payaos

  b. Bawing - 302 artificial coral reefs -9 payaos

5. Address concern for receding water table level;

6. Provide appropriate livelihood sources for the beneficiaries;

- Facilitate entry of organized community in seaweed farming and initiated linkage with Cebu based seaweeds buyer (Marine Colloids Inc.) for culture technology and market.

- Constructed 6 units fish pots/traps by project beneficiaries. (Project provided materials while labor was provided by organized communities)

7. Provide inputs on the proper fishing/aquaculture techniques that will augment the income of the beneficiaries but will not harm the marine ecology balance of the area.

DOLEFIL - USAID - DENR
MT. MATUTUM REFORESTATION & SOIL CONSERVATION PROJECT

A. THE PROBLEM

- 14,008 ha of the Mt. Matutum forest reserve is seriously threatened due to kaingin farming and illegal logging.
- Thus the need to protect/conserve the remaining forest resources and rehabilitate the denuded portions of the reserves.

B. LIFE AND OBJECTIVES OF THE PROJECT

- To address this need, a three-year Mt. Matutum Reforestation and Soil Conservation Project, which includes reforestation and agroforestry components, is being undertaken by Dole Philippines, Inc. (DOLEFIL) in cooperation with USAID and DENR.
- Terminal Objectives

  a. Approximately 150 forest dwellers (heads of households) organized around DENR integrated social forestry principles;

  b. Awarded individual stewardship titles to 400 hectares of forest reserve; and

  c. beneficiaries trained in and practicing sound reforestation techniques on 250 hectares and agroforestry planting on the 150 hectares.

C. CONCEPT OF THE PROJECT

- Community self-reliance and self-propulsion
- Provision of appropriate sources of livelihood to farmer beneficiaries. Most of whom are kaingin farmers.
- Conduit of vital social services and other inputs like training and technology back-up.

D. SITES

MAIN	SELDA
Lemblisong	Alnamang Glandang
Kawit	Tinefulan
Kinilis	Purok 6 Purok 7
Amgu-O	Ulo-Landan Bukay-Eel Bulol-Dalay

E. PROJECT ROLEPLAYERS

- Dole as the grantee is responsible for the overall management and implementation of the project.
- Government's Department of Environment and Natural Resources (DENR) will:
  - a. Provide expertise in reforestation and agroforestry techniques.
  - b. Responsible for the processing and issuance of Certificates of Stewardship Contracts (CSC) to farmer beneficiaries.

F. FUNDING

USAID (50%)	₱ 5 M
DOLEFIL (50%)	₱ 5 M
TOTAL	₱10 M

APPENDIX E-1

SUMMARY OF PUBLIC SCOPING SESSION RECOMMENDATIONS

Appendix E-1
SUMMARY OF SCOPING SESSION RECOMMENDATIONS

As one of the steps of this environmental assessment, Scoping Sessions were conducted in Manila (3/13/91) and General Santos City (3/15/91) to solicit public recommendations pertaining to the proposed expansion of the wharf. During the initial stage of the wharf study, alternative engineering designs were evaluated, namely Alternative A (expansion to the northeast) and Alternative B (expansion to the southwest). Based on subsequent findings detailed in the Preliminary Report of the Feasibility Study and specific issues raised during the Scoping Sessions, Alternative A, the staged expansion of the Makar Wharf to the northeast, was recommended and studied by the Consultant.

In addition to the public discussions and specific recommendations contained in the Scoping Session Report, the Environmental Assessment for the project was submitted in draft form to concerned agencies to solicit their review and comments. Thus, the final Environmental Assessment attempts to incorporate and address public concerns and recommendations in an integral process of project impact evaluation.

The Scoping Session Report of the Makar Wharf Environmental Assessment was submitted separately and includes the minutes, invitation and attendance lists of the sessions.

In summary, public recommendations and specific concerns raised in the Scoping Sessions include:

- Port design should reflect prevailing weather conditions of the area.
- Substantial fill requirement for Alternative A with possible lack of available fill in General Santos area.
- Limited potential of General Santos developing as a major port due to competing national developments, including free trade zones.
- Provision for waste management of ships at anchor or berth.
- Consideration of environmental problems, such as dust, generated by the bulk grain handling facilities.
- Recognition of the cultural needs of the Badjao community to live by the sea if relocated.
- Sensitive treatment of economically and culturally vulnerable communities subject to possible relocation.

301

- Potential for environmental impacts in any relocation area.
- Provision of facilities for disposal of solid and liquid wastes.
- Potential requirement for dredging if sufficient land-sourced fill is not available.
- Possibility of earthquakes in the port area.
- Consideration of increased traffic, congestion and noise generated by port operations and proposed construction activities.
- Requirement for port space by the Philippines Coast Guard for storage of newly acquired oil spill containment equipment.
- Need to consider impacts on personnel presently employed at the wharf and potential mitigation measures, such as additional training, to avoid displacement.
- Provision, for the fishing sector, of a communication facility to provide emergency ship to shore radio capacity.

APPENDIX E-2

REVIEW COMMENTS OF CONSTRUCTION CONTROL SERVICE CORPORATION PHILIPPINE ASSISTANCE PROGRAM SUPPORT (PAPS)

(Received June 7, 1991)

Appendix E-2
REVIEW COMMENTS OF CONSTRUCTION CONTROL SERVICES CORPORATION
PHILIPPINE ASSISTANCE PROGRAM SUPPORT (PAPS)
(Received June 7, 1991)

To	:	Howard "Pat" Johnson Chief of Party
From	:	Gregory M. Carmichael Environmental Engineer
Subject	:	MAKAR WHARF - DRAFT ENVIRONMENTAL ASSESSMENT

I have reviewed the above referenced document prepared by Louis Berger International, Inc. (LBII) for the Makar Wharf Project. My suggestions and comments are as follows:

- A reviewed for upgrading the current direct discharge of waste waters from the existing port into the ocean should be provided in first phase construction schedule;

- Recommendations for criteria for the Livestock Terminal area should include control or wastes and odor problems. The proximity of the proposed terminal to the office and the existing mosque (I assume hogs are to be loaded as well) should be re-evaluated and an environmentally and culturally acceptable alternative proposed. In my judgement the current location is unacceptable without further mitigation measures;

- Per the report solid waste from the adjoining communities is deposited in pits. I recommend exploring the possibility of alleviating this environmental hazard in conjunction with the proper handling of wastes from the port (e.g., transfer station with secured dumpsters);

- The "enormous underground water resources" have not been verifies by appropriate testing. The results of the Water Resources and Demand study currently being performed by Wilbur Smith and Associates needs to be coordinated and incorporated into this study as soon as possible. Draw down and pump testing results of the Badjao well should be included in this report. Only subjective analysis is provided;

- Both the high levels of copper, lead and cadmium found in off shore water samples and the fluctuations in COD indicate industrial wastes or motor vehicle fuel may be being discharged intermittently into Sarangani Bay. A strong recommendation for further study of this pollution should be included in the report;

- The previous destruction and conversion of mangrove areas and coral reed habitats should be quantifies as a percent of total original area;

- Mean value for Total and Fecal Coliform Counts is not an appropriate value for reporting if counts exceed the limits or the test at a particular dilution. The Median should be reported in those cases or further dilutions performed. A footnote in this regard would suffice;

- Mitigation measures to prevent further siltation and destruction of the off shore areas need to be strengthened and perhaps provisions for restoration included in the long term development plans for the Makar Wharf;

- Definite plans for meeting the proposals of the community listed on page 4-4 need to established and some guarantees provided (e.g., MOU's, trusts, etc.);

- An emergency plan for spills and other emergencies needs to be established as a required mitigation measure for impacts due to upsets, disasters or accidents;

- The need for establishing the cumulative and secondary impacts for this project with other proposed projects in South Cotabato is evident. Strong recommendations on providing this sort of impact analysis and proposing mitigation measures should be included in the report;

- As stated in the report, the monitoring of the project's impacts is essential to the successful implementation of the mitigation plan. Therefore, funding, formalized agreements, conditions for approval, regulations or other instruments need to be executed early in the project implementation stage. I recommend that these aspects be more fully covered in the Environmental Assessment;

- Formalized mitigation measures cited in the report with Dolefil-USAID and the Sarangani Bay Marine and Inland Resources Conservation Project should be established to implementation process;

Overall, the Environmental Assessment is well done and provides a great deal of information that will be useful in determining from subsequent projects in the General Santos City and South Cotabato Area. Some of the "loose ends" substantiate the need for a growth plan for the area to measure cumulative and secondary impacts for various projects and to plan for future sustainable growth in South Cotabato.

APPENDIX E-3

REVIEW COMMENTS OF ENVIRONMENTAL MANAGEMENT BUREAU
(Received July 16, 1991)

Appendix E-3
REVIEW COMMENTS OF ENVIRONMENTAL MANAGEMENT BUREAU
(Received July 16, 1991)

Undersecretary Rogelio L. Singson
Chairman, Committee on Official
Development Assistance (CODA)
14th Floor, Multi-storey Building
Central Bank Complex
A. Mabini Street, Ermita, Manila

Dear Usec. Singson:

This has reference to your application for an Environmental Compliance Certificate (ECC) for your Makar Wharf project located in Barangay Labangal, General Santos City.

After evaluating the document you submitted for the aforesaid project, this office has determined that the information contained therein is insufficient for us to arrive at an informed decision. Final action on your papers will be held in abeyance pending the submission of the following:

I. General:

1. Provide an approved land use map (scale 1:50,000) covering at least 5 km radius. The areas north and northwest of the site must likewise be included;

2. Climatological data seem not to reconcile with the presentation prepared by the Makar Airport proponent;

3. There is no mention of hotels/beach resorts as one of the land uses of the Sarangani Bay as indicative of the applicable water quality standard to be regulated;

4. The details for the disposal of 115,000 m^3 of silt/dredge materials offshore must be submitted including exact location of the site (longitude and latitude);

5. Make necessary correction on the scientific name of niyog on pp. 5-10;

6. Submit schedule of project implementation; and

7. Identify archaeological features in the project site and measures on how these can be preserved.

307

II. Water Quality

1. The livestock and domestic wastes must be treated completely by providing wastewater treatment facilities to be able to meet the prescribed effluent standards;

2. The EIS should include and oil-spill contingency plan;

3. There is no provision for oily wastes and domestic receptacles from ship/vessels. Also, there is no provision for discharging bilge water as provided for under the international convention.

III. Geology

1. Local and regional geologic map must be presented;

2. Inasmuch as the project is close to the very active Philippine Fault, where strong earthquake have been recorded (one of which was of Magnitude 8.2), this geologic factor must be seriously addressed in the EIS.

3. The mitigating measures for negative geologic impacts must be discussed;

4. Analysis of geologic data/information (Appendix A-3) should be discussed. Maps mentioned in 3rd paragraph Appendix A-3 is absent.

IV. Sociology

1. A perception survey should be considered mandatory;

2. The details of the relocation scheme plan should be presented including the agency responsible and the selection of the relocation site considering that the Badjao are coastal dwellers and are not inclined to live in-land; and

3. The complete profile of the health of the community including morbidity/mortality should be submitted.

Please be informed that you need to pay the filing and processing fee of ₱ 310.00 payable to EMB.

In your reply, please refer to the reference index code found on the upper lefthand corner of this letter. Your early reply in four (4) copies will facilitate the processing of your papers.

Very truly yours,

ELLA S. DEOCADIZ
OIC, Assistant Director

cc: Environment Sector
DENR - Region XII

APPENDIX E-4

REVIEW COMMENTS OF USAID/WASHINGTON
(Received September 2, 1991)

Appendix E-4
REVIEW COMMENTS OF USAID/WASHINGTON
(Received September 2, 1991)

To : Molly Kux,
Asia Bureau Environmental
Coordinator

From : Jim Tarrant,
ENE/DR and ASIA/DR

Subject: **COMMENTS ON MAKAR WHARF ENVIRONMENTAL ASSESSMENT**

SUMMARY

1. Recommend approval of this EA conditional on a few additions and revisions which are described below.

2. Recommend that USAID/Manila provide an action plan for the Mission based upon the recommendations in the Environmental Plan of Action. This should include specific contractual, monitoring or other provisions to be undertaken by the Mission.

3. Strongly recommend that USAID/Manila convene a discussion of the donors involved in the Mindanao Development Program to discuss the sustainability of their respective projects on the region (cumulative impacts), including Sarangani Bay.

DISCUSSION

This EA was prepared for USAID/OCP, Manila by Louis Berger International Inc. (LBII). It was received in Washington D.C., 6/6/91. All three of the Mindanao Development Program (MDP) EAs were drafted on the basis of a common outline and format, agreed upon during my TDY in April. LBII has followed this outline carefully.

1. GENERAL EVALUATION

Regarding format, presentation, clarity and compliance with A.I.D. procedures, this is a good EA, in my opinion. It also includes an explicit Environmental Plan of Action, for a change. The analysis identifies physical, socioeconomic and aesthetic/cultural impacts and provides

recommendations for action. Ideally, the analysis and especially the plan of action should have identified possible and/or mandatory actions for A.I.D., including benchmarks and monitoring criteria, but these can be inferred easily from the plan of action itself. As an overall comment, there are quite a number of typographical errors and a few awkward phrasings or missing sentence parts. The draft EA should be copy edited before final submission.

I recommend that the EA be approved subject to the following comments and revisions for the final report.

2. DETAILED COMMENTS

These comments follow the outline of the EA itself. A copy of the outline (Checklist) is attached to this memo.

(1.1.3) Stage in planning process. This section was adequate. However, there was no real discussion of how the MDP fits into USAID/Manila or agency policy and strategy. Actually, this discussion is found but in another section (2.2.2) which describes regional land use plans. I suggest the A.I.D. discussion in 2.2.2 be moved to 1.1.3. There is also little discussion of A.I.D. and GOP environmental procedures (1.1.4) as a preface to why the EA was organized the way it was, the scope of the discussion etc.

(1.3.4) No discussion of abandonment plans. If the government has no plans (after (2010) they should say so and state whether this has any foreseeable implications.

1.4 Discussion of alternatives was very good.

2.2. The largest single "land use" in this region is grassland according to the EA. Strictly speaking, this a land type, not use. Are grassland abandoned waste land? Are they publicly or privately-owned? Are they used for ranching? This should be defined.

Sections 2.3.1 to 2.3.6 describe the socio-economic conditions of the project site. Almost all of the data presented is done so in narrative form. This takes up a lot of space and the impact of the analysis of such data is correspondingly diminished by that kind of presentation. Much of the data could have been put into tables on socio-economic indicators (quality of life; income/occupation, ethnicity/religion; demography, etc.). The other critique (not enough to affect EA approval) was that a clear analytical framework should have been presented. Why did the authors choose these data sets, their significance and the relative emphasis of analysis of current socio-economic (and physical conditions) should make some reference, at least, to the scoping sessions, in which many of the issues were raised in the first place. There is no reference to these sessions in the main body of the document, although a summary of them is appended.

2.4 Physical Environment. This discussion was very good overall, especially the coastal and marine habitats, reflecting the expertise of the study team members as well as the subject matter. I would have emphasized even more the apparently dreadful state of fisheries statistics, to the extent that there is no real basis for assuming the current sustainability of regional fisheries much less any future expansion.

Sections 2.5 on aesthetic and cultural conditions and 2.6 on future conditions without the project are well-presented.

The chapter on future conditions without the project was very complete.

Chapter 4 on environmental impacts (Chapter 3 in the outline) was complete and detailed. The major socio-economic impact is the need for relocation of the Badjao community immediately adjacent to the current wharf and some Lower Makar hamlet residents. The analysis is comprehensive and recommendations for the plan of action are also provided.

4.1 (land use) and 4.2 (socio-economic conditions) contain one inconsistency with respect to impacts on labor supply. In section 4.1, it is stated that the wharf expansion will not generate new labor demand. In section 4.2, it is stated that the port expansion will require more stevedores and arrastres (loaders and unloaders in landlubber speech). This should be clarified for the final draft. This should be accompanied by an assessment of whether new housing/services would need to be provided if significant new labor supplies are needed.

4.3.2 Water Supplies and Quality. The principal physical impacts of the project will come from the dredging for the wharf extension. These will be fairly localized and can be contained and/or mitigated. The main concern for monitoring is the possible presence of high levels of heavy metals in the clay silt portion of the dredgeate. It is not certain which portion of these wastes are from industrial sources and which are natural background. So more detailed studies should be done before dredging begins.

4.7 Cumulative Effects makes the useful point that the coastal area of Sarangani Bay is increasingly being built up for industry and that there is a serious need for a comprehensive management plan for Sarangani Bay. I recommend concurrence with this suggestion and recommend that the Mission ascertain whether such a plan will be included in the proposed "Mindanao Growth Plan".

Chapter 5 deals with the mitigation measures. I would recommend concurrence with the suggestions that the Badjao relocation issue be tackled as early as possible after a go/no-go decision for this project has been made. I also think the suggestion to employ members of this community to help relocate the soft coral community to another area is a good and imaginative one. (These corals are relatively rare.) This section also recommends periodic monitoring of the new site of the Badjao community. I would suggest that, in the final report, that the team discuss the potential problem of "pyramiding". This occurs in densely populated areas (such as

213

this coastal region) in which relocation of a displaced community may end up displacing or causing serious public service (water, fuelwood, land) or socio-economic (jobs, cultural problems) impacts on the receiving community. This did not appear to addressed directly in the EA. It should be taken up explicitly in the environmental action plan and, in particular, a discussion of the respective roles of the NGOs and local government. Recommendations for involving NGOs are good but it will be local government (presumably) which will make the final decision of site location, provision of public services, etc. The issue of the receiving community is raised because the Badjao are regarded as gypsies and apparently suffer some degree of discrimination.

In the analysis of environmental impacts it was suggested that the spread of dredge silt can be localized by the use of an underwater plastic curtain, analogous to those used for containing building dust. This simple and sound recommendation does not seem to appear in the section on mitigation measures. Are we to assume this is a normal practice for wharf construction or ought it to be explicitly recommended.

The presentation of methodologies, interview schedules, lab results, references and list of preparers was fine.

APPENDIX E-5

FURTHER INFORMATION REQUESTED BY THE ENVIRONMENTAL MANAGEMENT BUREAU REGARDING MAKAR WHARF ENVIRONMENTAL ASSESSMENT

Appendix E-5
FURTHER INFORMATION REQUESTED BY THE ENVIRONMENTAL MANAGEMENT BUREAU REGARDING MAKAR WHARF ENVIRONMENTAL ASSESSMENT

I. GENERAL

1. Land Use Map

A land use map at a scale of 1:50,000 showing the Existing Land Use in a more than 5 km radius around Makar Wharf is attached (Figure E5-1).

2. Climatological Data

The confusion in the climatological data presented in the Makar Wharf EA and that of the General Santos Airport Service EA was a function of presentation. Table 2-4 of the Makar Environmental Assessment presents climatological normals for General Santos City, including mean monthly rainfall, mean monthly rainy days, mean monthly maximum and minimum temperatures, mean monthly relative humidity and mean monthly thunderstorm days. Table 9 of the General Santos Air Service Improvement Study EA shows essentially the same information. Table 2-5 of the Makar Wharf Environmental Assessment shows monthly climatological extremes and specifies the years when extreme climatological conditions occur.

Table 2-4 and 2-5 of the Makar EA are attached with clarification. (Figure E5-2)

3. Hotels/Beach Resorts on Sarangani Bay

Section 2.4.3.1 of the explicitly states that Sarangani Bay supports tourism development (page 2-47) and indicated the increase in hotel and beach resort establishments in the bay area (page 2-50). However, none of these facilities are found within the defined zone of influence of the proposed expansion of the Makar Wharf.

The recommended Class SC water quality standard for coastal marine waters within the zone of influence of the Wharf precludes water use for primary contact recreation (e.g., bathing and swimming).

The use of the SC Classification Criteria for the northeastern portion of Sarangani Bay is based on multiple use of the Bay and the existing water quality. Class SC coastal marine waters are intended for secondary contact recreation and commercial and sustenance fisheries. As the nearest resorts are beyond the Tambler agro-industrial site, they are outside of the influence of the ports.

4. Dredge Disposal

The total amount and composition of dredged material will be determined during the final design and by more detailed geotechnical work that is scheduled for Phase I of the project. The amount of dredge material may be reduced if the proposed draft depth at the wharf is decreased. Based on current discussions of the Feasibility Studies, this is likely to occur.

The approach in the EA was to provide a number of options (p. 5-6) that would allow for the most environmentally sound, cost effective method of disposal based on the detailed design. The report also stressed on p. 5-6 that once the amount of dredge material was determined, the dredging method was determined, and a dump site was required, final consultation with DENR and PCG would take place to determine an appropriate dumpsite.

The preferred dredge method is a clamshell dredge with a bottom dumping barge. Dredge could be disposed of in a deep water site in Sarangani Bay with minimal effect on marine habitat. Towards the center of the bay surface currents are very small, preventing dispersal of silt, while the depths reach over 200 m. The most productive marine habitat is located around the shallow, narrow coral shelf of Sarangani Bay and would not be affected.

As per discussions at the meeting of July 23, 1991, it was proposed that the conditions of the ECC include consultation with DENR and PCG during final design stages once the amount and composition of dredge materials has been determined in order to select an appropriate offshore dumpsite.

5. Scientific Name for Niyog

The correct scientific name for niyog or coconut will be incorporated into the report.

6. Project Implementation Schedule

The project implementation schedules are attached. (Figures E5-3 and E5-4)

7. Archaeological Features

Based on a survey made in 1979 (Solheim et al.) and an earlier survey of the area in 1947, only one archaeological site was identified near Makar Wharf at the Holy Cross Monastery in Calumpang. Because the Makar Wharf is composed of reclaimed area and the immediate surroundings have undergone considerable development, the likelihood of finding further archaeological features is considered extremely remote.

On the basis of the existing environment at the port site and the minimal additional disturbance expected it was agree at the meeting of EMB and the Consultant on July 23, 1991 that no further archaeological work was necessary.

III. WATER QUALITY

1. Treatment of Livestock and Domestic Wastes

The current system for treatment of domestic wastes produced at the port consists of septic tanks and leaching chambers. The effluent is then discharged into the storm sewer system and into Sarangani Bay. While not ideal, this is considered adequate given the minimal amount of effluent produced and the dilution factor provided by the Bay. By comparison, General Santos City discharges sewage directly into Sarangani Bay without any treatment at all.

Consideration was given to providing leaching fields for the port's domestic sewage rather than discharging from the septic tank and leaching chambers. However, it was determined that there was too great a risk of contaminating ground water quality given the nature of the soils of the area.

There is a study being undertaken to determine water and sewage requirements for General Santos City. Given that such a project is in process, the final EA will include a recommendation that in anticipation of a sewage system being in place in GSC, the Makar Port management should plan to link with this system for the treatment and disposal of its domestic wastes.

Phase II development plan includes the construction of waste treatment facilities to complement the livestock terminal (Figure 1-4 of EA). It is a desirable practice to isolate animal manure immediately and to economize in water use for cleaning animals and pens in order to bring about initial reduction of wastewater volume and pollution load. The liquid waste would then be treated in a conventional activated sludge treatment system, consisting of two digesters, an aeration tank, a settling tank and a chlorination tank. The effluent would be discharged by pipe at depth in the bay to ensure faster and greater dilution because of greater deep water currents. The specifics of the treatment plant will be determined during the detailed design phase and will comply with EMB effluent standards for the receiving waters (Class SC).

2. Oil Spill Contingency Plan

During the course of the EA, consideration was given to developing an oil spill contingency plan for the port. However, the Consultant determined that this was unnecessary at this time for the following reasons:

(1) Historical records bear the low probability of oil spillage occurring within the Bay or at the port area (page 2-60)

(2) The risk of vessel collision is practically nil because:

a. the bay has a wide entrance, wide channel, and a great depth (page 4-14);

b. additional navigational aids and communication equipment will be installed (page 4-10).

c. experienced pilots are employed to berth ships (page 4-14).

d. vessel traffic is not expected to increase as the trend is towards more containers and larger container ships (page 4-15).

(3) Oil spillage in the port area is unlikely because there are no provisions to store and supply fuel oil to berthed ships and vessels (page 3-10)

(4) A National Oil Spill Contingency Plan is already a place.

The National Plan covers all the sea, ports, harbors within the territorial jurisdiction of the Philippines. The agency responsible for the Plan is the Philippine Coast Guard which has a station at Makar Port. In Sarangani Bay the designated On-Scene-Commander (OSC) during a spill incident would be the Coast Guard Station Commander or a designate. The OSC has a number of responsibilities in the event of a spill, not the least of which is the activation of a response team to conduct containment, recovery, and clean-up operations. There is some oil spill clean-up equipment in Davao which is designated for large spills in international waters.

The Philippine Coast Guard NOCOP Regional Center Director based in Davao City explicitly expressed the interest to station oil spill clean-up equipment in the proposed port expansion area in order to improve the capability of the Coast Guard at the Makar Wharf to respond to such exigencies in the future (page 5-7).

3. Provision for Domestic Receptacles, Oily Wastes and Bilge Water

- oily wastes

  Ship cleaning is usually done at high sea. The amount of spent oil washed from ships/vessels berthed at port is likely minimal to be of any ecological significance.

- garbage receptacles

  It is a common practice for owners of ships/vessels to collect and disposed of their garbage and refuse upon berthing at port (page 3-8). The relatively litter-free, port area suggests the effectiveness of this approach and it is most likely to continue for sometime.

  However, the additional litter receptacles for on-land and shipboard collection of solid wastes and their storage, transport, and disposal has been recommended (Section 5.2.2.2 page 5-7).

- bilge water

  The disposal of bilge water at high sea is a common practice (page 2-59; 3-10). This practice is beyond the capacity of the port authority to control or regulate. It is primarily the responsibility and obligation of the ship owners to comply with international regulations on waste disposal at sea and the Coast Guard to enforce these regulations.

III. GEOLOGY

1. Local and Regional Geological Map

The local Geological Map is presented in Figure 2-22, page 2-70 of the Draft Environmental Assessment. Based on discussions with the reviewers on July 23, 1991, it is the Consultant's understanding that the reviewers wish to have a map of seismic activity included. A series of maps showing earthquake frequency, sites of destructive earthquakes and earthquakes epicenters, along with major fault zones of the Philippines is attached for additional information. (Figures E5-5, E5-6, E5-7 and E5-8). In addition, a provincial geological map is included (Figure E5-9).

2. Seismic Conditions

The description of seismic conditions was included in the Feasibility Studies. These sections are included here for further information in addition to the previously mentioned maps.

The Philippine Archipelago lies between two major tectonic plates of the world, the Pacific Plate and the Eurasian Plate. These plate interactions and movements along other active faults are responsible for the high seismicity of the Philippine Archipelago.

Earthquakes with magnitude seven or more (on Richter Scale) had affected the Philippines in the recent past, and the chance of these destructive earthquakes occurring again in the future is very strong.

At least five earthquakes per day occur in the Philippines. The most seismically active part is its eastern section including eastern Mindanao, Samar and Leyte with an average of 16 perceptible earthquakes per year. In General Santos City, the annual average number of perceptible earthquakes is six. Figure E5-5 shows the annual average number of perceptible shocks of the different parts of the Philippines.

In August 1976, an earthquake of magnitude 7.9 hit the Moro Gulf, Southern Mindanao, and caused severe damage and casualties. The highest recorded earthquake magnitude is 8.3 which occurred in July 1954 in Sorsogon. Figure E5-6 and E5-7 shows the distribution of epicenters of strong and major earthquakes in the Philippines.

Figure E5-8 shows the identified earthquake generators in the Philippine Archipelago. General Santos is situated about 20 km from the Mindanao Fault. An earthquake produced by this fault would affect the port of Makar.

Design of any structure of Makar Wharf must take into account earthquake forces. The National Building Code requires that every building or structure be designed and constructed to resist stresses produced by lateral forces such as earthquake and wind. Chapter 2, Section 2.1 of the National Structural Code of the Philippines (NSCP) provides the guidelines for the analysis of earthquake forces. The following considerations will be taken into account during Final Design of the Port Expansion.

- Seismic Considerations

  The occurrence of an earthquake is attributable to the relative movements of neighboring tectonic plates along their margins. The Philippine Archipelago lies between two major plates of the world: the Philippine Sea and the Eurasian plates. Ground motion induced seismic activities in the Archipelago are resultants of convergent displacements along these plates margins or along the strike-slip Philippine fault zone and other active faults.

Specifically, several faults and folds (synclinal axes) are present in the project area. Minor faults, if not active, are generally recent as evidenced by the fault scarp which cuts recent alluvial deposits.

The project area is marked by such a great number of major and minor faults occasioned by recent volcanic eruptions and diastrophic evolution of different physiographic units, that no major infrastructural project should be undertaken without observing opportune rules relative to design, construction materials and procedures.

- Liquefaction Potential of the Embankment Material

When fine sand or silty sand in a satured state is subjected to transient loadings such as earthquake loadings, intergranular sliding occurs. This attempt of the soil mass to achieve a denser packing results in pore pressures increase and in a drastic effective strength reduction, to a point, in effect, where the soil particle to particle contacts become inexistent, thus creating a "quick" condition. From the foregoing, it becomes evident that due attention must be observed during reclamation, with respect to the liquefaction susceptibility of the fill material.

- Liquefaction Potential of the Subgrade Soils

Because of the presence of loose granular zones in the foundation soils, as evidenced by the recorded low blow counts, there is concern relative to the liquefaction potential of these soils under seismic loadings. The Consultant has performed an analysis for the possibility of cyclic mobility of the site subsoils, assuming total and effective stresses corresponding to the existing overburden (a condition which will prevail prior to the fill material placement). The analysis indicated that the site granular strata are not susceptible to liquefaction. Moreover, after the soils have adjusted to the effective stresses corresponding to the anticipated surcharge loads, their relative densities as well as their Standard Penetration values will improve, thus further reducing their liquefaction susceptibility.

3. Mitigation for Negative Geologic Impacts

Other than the potential for earthquakes, no negative geologic impacts are expected, nor are any negative impacts on geologic formations expected as a result of the project. Future geotechnical work is recommended during Phase I of the project which will also contribute the detailed design. Design on the wharf structure will be in accordance with design criteria for earthquake forces and the aforementioned considerations.

4. Geologic Data Should Be Discussed

The geological data/information has been discussed and presented in Chapter 2, Section 2.4.5, page 2-66 of the EA Chapter 3, p. 3-19, Chapter 4, p. 4-16. The maps mentioned in Appendix A-3 are presented in the EA as Figures 2-22 (Geological Map), 2-23 (Land Management Unit Map), 2-24 (Erosion Map), 2-25 (Slope Map) and 2-26 (Present Land Use/Vegetation Map).

In addition, the reviewers requested information on changes to currents as a result of dredging and port construction. Section 4.3.3, p. 4-15 discusses these aspects of construction:

> "The area to be reclaimed is very small and the proposed alignment of the quay is almost parallel to the natural bathymetric contours. Hence, the proposed geometry of the wharf extension is not expected to affect the natural flow of the nearshore current system. Moreover, the reclamation shall be made on a coral reef area where it is very shallow and where these is not appreciable current.
>
> The dredging of the seabed to -15 m shall effect a very small area adjacent to the port. While the deepening of seabed shall tend to decrease the magnitude of wind driven surface current, this effect is so minimal in the project site, that it is not expected to disrupt the present surface transport characteristics of the nearshore water at Makar."

IV. SOCIOLOGY

1. A Perception Survey Should be Considered Mandatory

The Consultant submits that in consonance with the spirit and intent of the EIA, the perceptions of the communities affected by the proposed project were indeed assessed as duly reported in Chapter Four.

A perception survey may be done in several ways -- not only through structured interviews of statistical sample of respondents, but also through key informant interviews and focused group discussions. Although each of these techniques has its own advantages and disadvantages, each can also provide valid and reliable information.

Sample surveys are most appropriate when the population is expected to vary or be highly heterogeneous in terms of the variables being investigated. In the case of the Badjao, preliminary on-site visits indicated two major patters: (1) that the members are highly homogeneous in their social, cultural, and economic characteristics; and (2) that in their culture and tradition, members generally respect and heed the counsel and decision of the elders comprising their council.

In such a situation, therefore, one may validly assume, as the Consultant did, that views toward relocation would not differ considerably and that the view of the leaders would represent the position of the community.

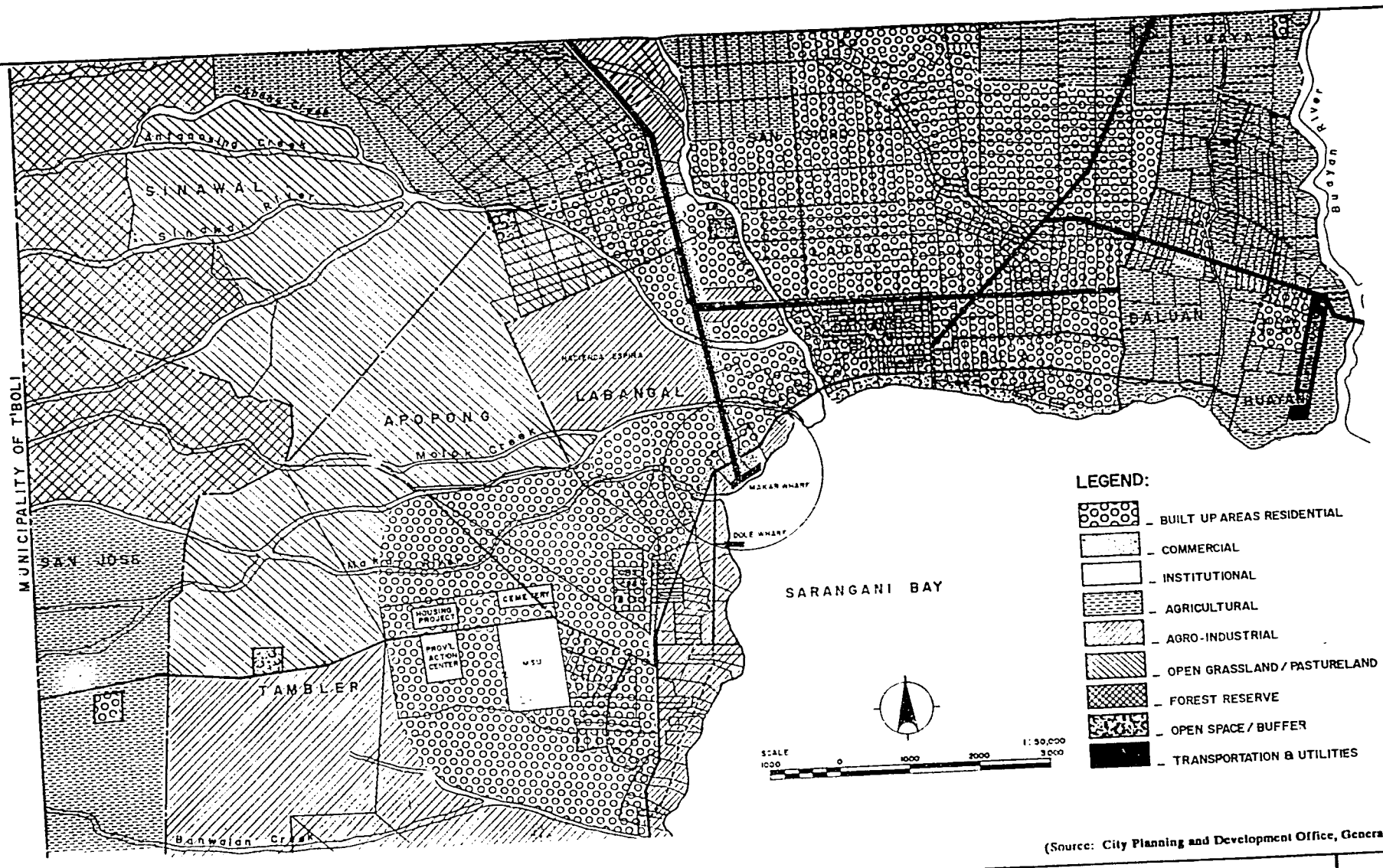
For these reasons, the Consultant opted to do a perception study by means of key informant interviews and group discussions rather than a sample survey with its usual bias for structured interviews of individual persons. As the Consultant's report shows, the former approaches elicited information with probably much more depth than what have resulted from a perfunctory use of EMB's proposed survey instrument.

Other relevant information on these interviews are also provided. The report mentions that discussion were held with "the purok chairman, the Iman, the purok secretary..., two other officials, and ten other members of the community,... and with another prominent community leader and the other health worker" (Chapter 4, Page 5) -- or a total of seventeen (17) informants. The number and composition of this group provide for some degree of validity and representativeness roughly equivalent to that of a statistical sample. After all, vis-a-vis the size suggested by EMB's guidelines (at least 10% of the affected families on a barangay level, or about 11 household representatives in the case of the Badjao), the number of key informants interviewed by the Consultant is more than adequate.

2. The Details of the Relocation Scheme Plan Should Be Presented.

The Consultant has presented the "details" of the relocation plan to the extent possible. In fact, the entire Chapter Five (pp. 5-1 to 5-4) addresses this crucial issue.

It does not seem proper for the Consultant (or any outside entity for that matter) to arrogate upon itself the duty to unilaterally decide on the agency and the relocation site. The Consultant considers it essential for the key sectors, most especially the community to be relocated, to participate in the very processes of decision-making and conflict-resolution that affect their lives, including the creation of the structures/agencies to manage the relocation and the selection of the site itself. As identified by the Consultant, an Urban Poor Council is in place and has functioned well in the past, alternatives sites close to the coast continue to be explored, and local organizations have expressed interest in introducing development programs. In addition, the Municipality of General Santos is already examining relocation sites for the Badjao Community.



(Source: City Planning and Development Office, General Santos City)

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MAKAR WHARF ENVIRONMENTAL ASSESSMENT

EXISTING LAND USE

FIGURE E5-1

Figure E5-2

MEAN VALUES OF CLIMATOLOGICAL NORMALS FOR GENERAL SANTOS CITY

(Period of Records: 1949-1986)

MONTH	MEAN MONTHLY RAINFALL (mm)	MEAN NO. RAINY DAYS	TEMPERATURE MEAN MAXIMUM	TEMPERATURE MEAN MINIMUM	TEMPERATURE MEAN	MEAN RH (%)	MEAN NO. THUNDERSTORM DAYS
Jan	64.1	9	32.6	21.5	27.0	76	1
Feb	73.2	8	32.9	21.6	27.2	76	2
Mar	39.5	7	33.6	21.8	27.7	75	2
Apr	50.5	8	33.7	22.4	28.0	77	4
May	87.5	12	32.7	22.7	27.7	80	6
Jun	112.5	14	31.4	22.3	26.8	82	4
Jul	104.3	13	31.0	22.0	26.5	83	4
Aug	87.2	13	31.0	21.9	26.4	83	4
Sep	80.6	12	31.4	21.9	26.4	82	4
Oct	94.4	12	31.8	22.0	26.9	81	4
Nov	87.0	12	32.4	21.9	27.1	81	4
Dec	74.1	11	32.5	21.7	27.1	79	3
Annual	954.9	11	32.3	22.0	27.1	80	3

Source: PAGASA

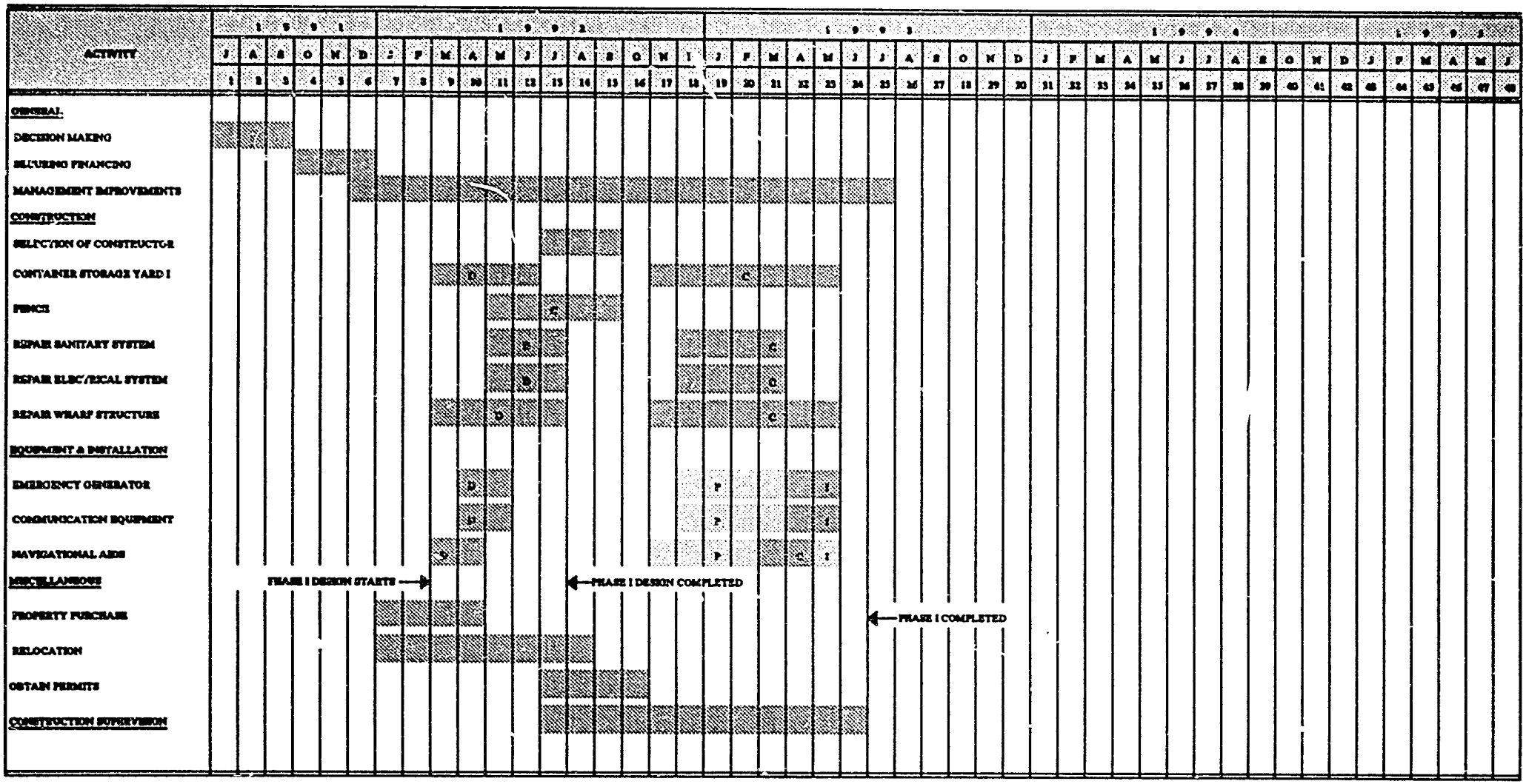
CLIMATOLOGICAL EXTREME VALUES FOR GENERAL SANTOS CITY

(1949-1986)

MONTH	TEMPERATURE HIGH	TEMPERATURE YEAR	TEMPERATURE LOW	TEMPERATURE YEAR	GREATEST DAILY RAINFALL MAXIMUM AMOUNT	GREATEST DAILY RAINFALL YEAR	HIGHEST WIND (mph) MAXIMUM SPD/DIR	HIGHEST WIND (mph) YEAR
Jan	36.4	1964	17.1	1965	105.9	1966	20/S	1982
Feb	37.8	1983	17.2	1958	79.0	1982	16/NNE	1975
Mar	38.0	1983	16.9	1963	55.6	1949	18/SW	1983
Apr	38.0	1983	18.3	1951	60.0	1964	19/S	1971
May	38.0	1983	18.7	1951	86.1	1955	14/S	1972
Jun	36.8	1979	17.9	1961	142.0	1983	17/S	1972
Jul	36.1	1973	17.2	1985	309.0	1983	17/SSE	1972
Aug	36.1	1973	17.2	1985	126.0	1959	17/S	1972
Sep	36.8	1979	18.0	1985	189.5	1977	18/SSE	1972
Oct	37.0	1980	18.2	1961	101.0	1970	17/S	1972
Nov	37.0	1983	18.3	1951	102.1	1962	15/SE	1970
Dec	36.7	1982	18.0	1950	62.2	1964	14/SSW	1972
Annual	38.0	1983	16.9	1963	309.0	1983	20/S	1982

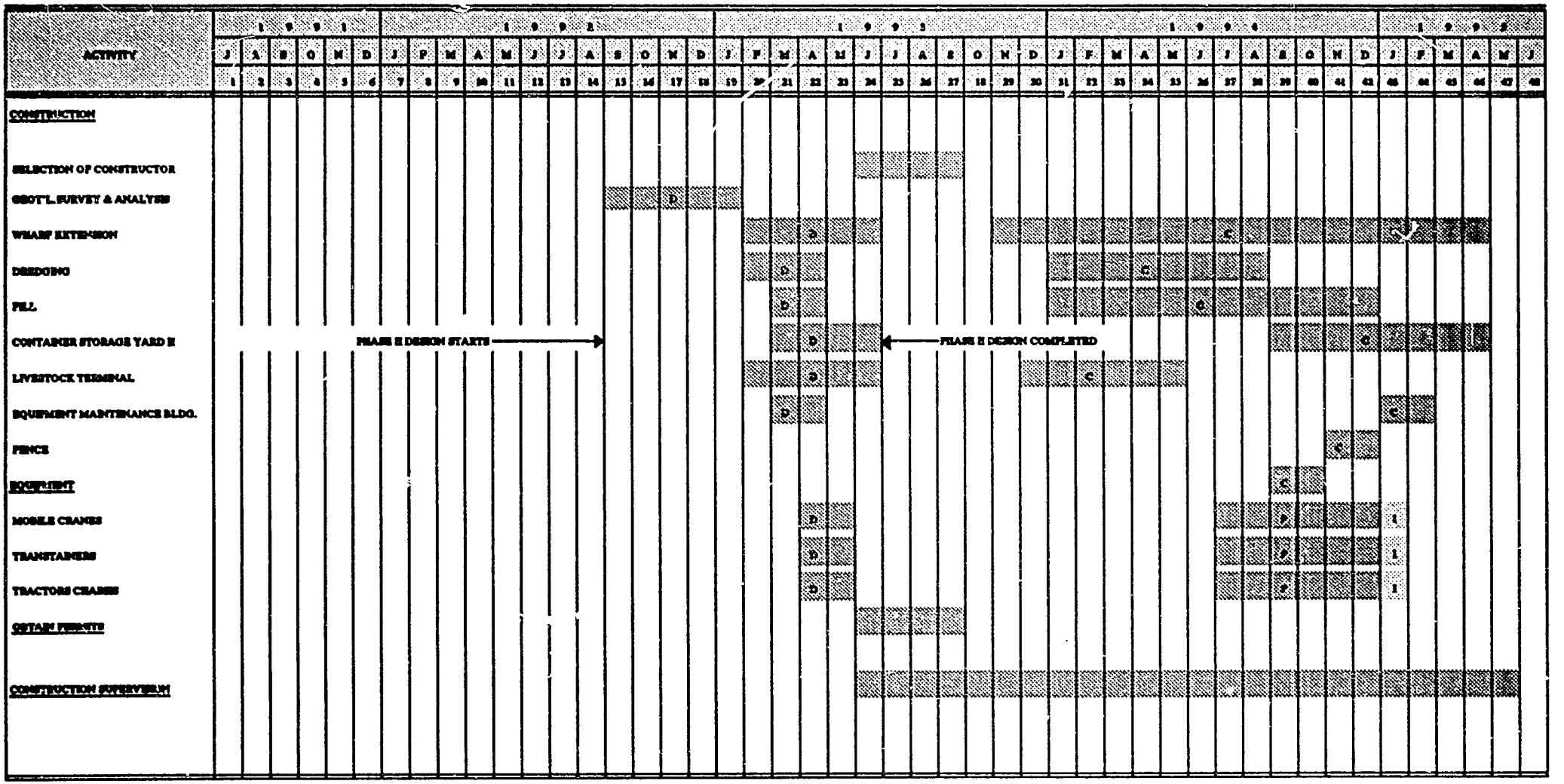
Source: PAGASA

Figure E5-3
STAGED IMPLEMENTATION PLAN
PHASE I



LEGEND: C - Construction D - Design P - Procurement I - Installation

Figure 5-4
STAGED IMPLEMENTATION PLAN
PHASE II



LEGEND: C - Construction D - Design P - Procurement I - Installation

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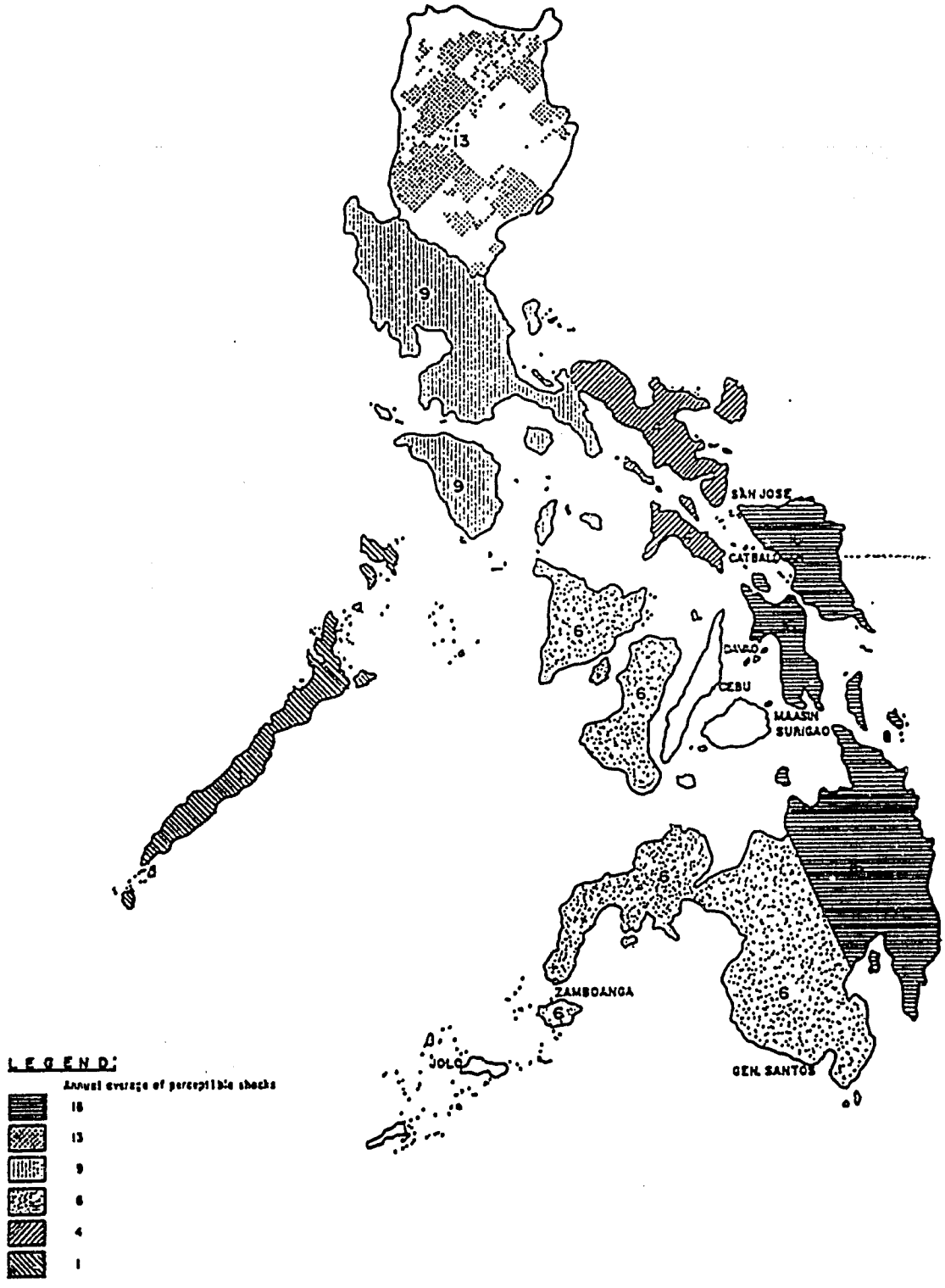
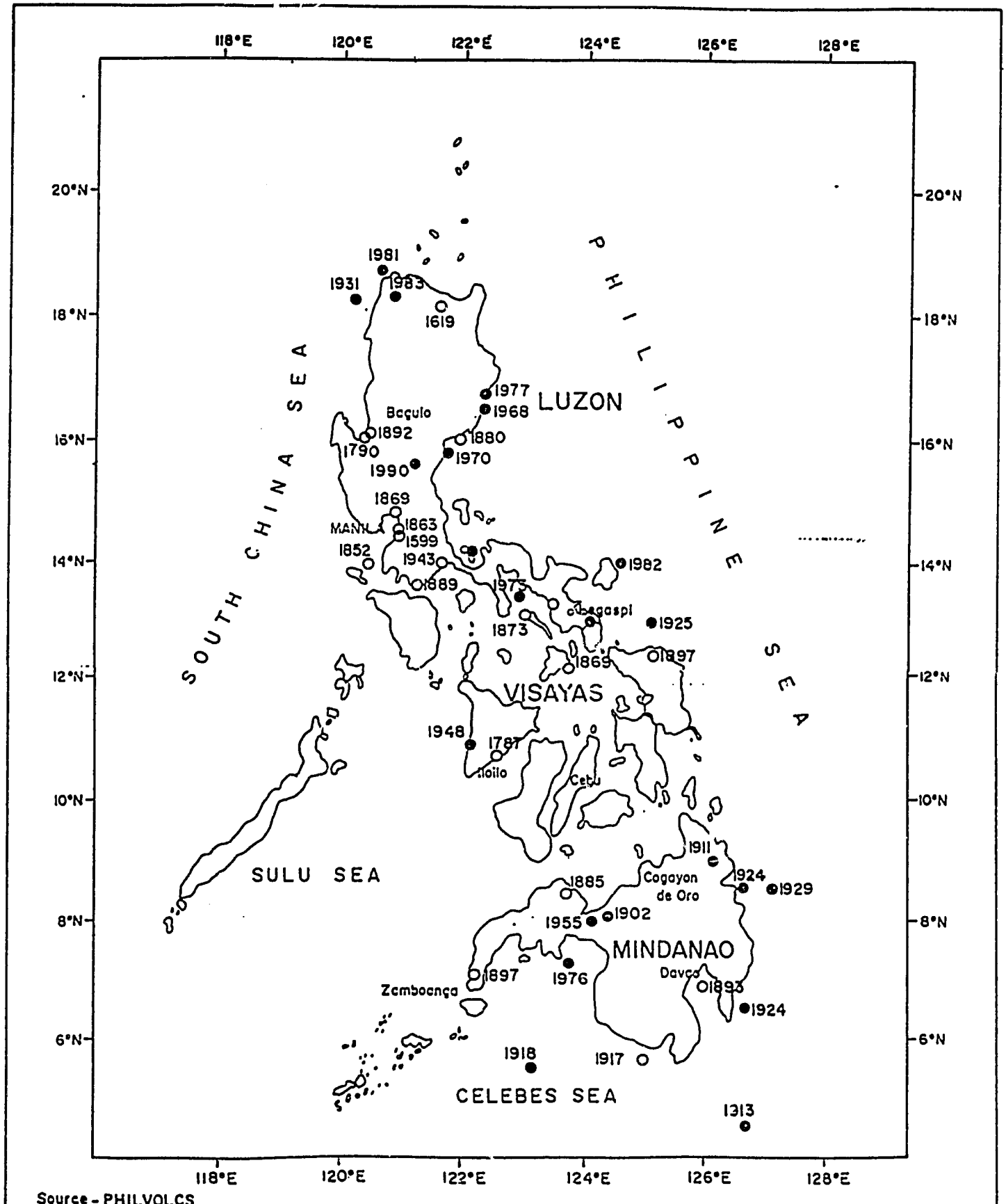


Source: PHILVOLCS

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT 492-0432-C-00-0089-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE E5-5
LOUIS BERGER INTERNATIONAL, INC. • LOCKWOOD GREENE INT'L • SINGT & YOUNG INT'L • GLOBETROTTERS ENGG. CORP. • TRANS-ASIA (PHIL.), INC. • CONSULTANT MANAGEMENT SERVICES, INC	ANNUAL AVERAGE NO. OF PERCEPTIBLE SHOCKS IN THE PHILIPPINES	

329



Source - PHILVOLCS

PHILIPPINE ASSISTANCE PROGRAM SUPPORT UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT CONTRACT 492-0452-C-00-0099-00	MAKAR WHARF ENVIRONMENTAL ASSESSMENT	FIGURE E5-6
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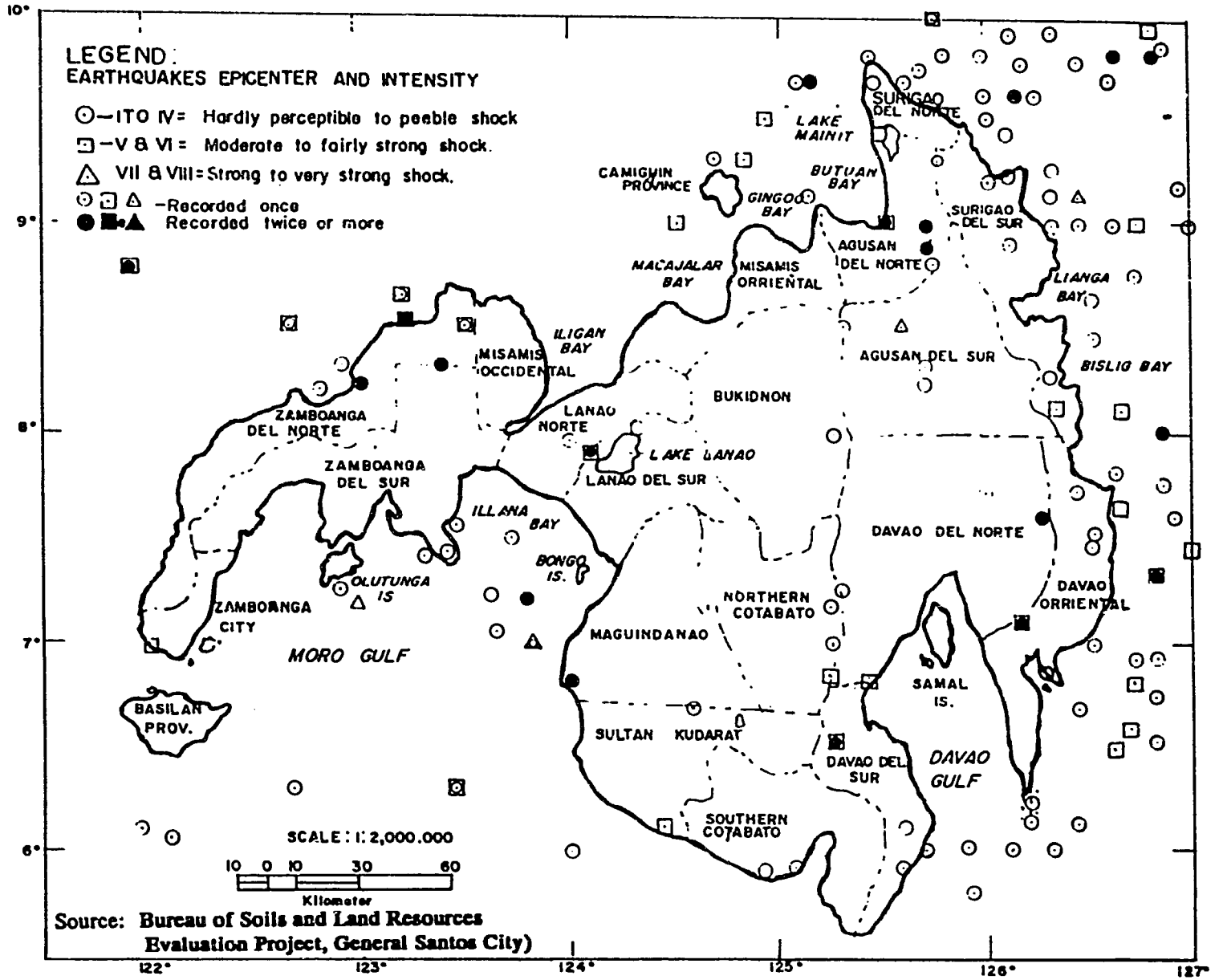
330



Source: Bureau of Soils and Land Resources Evaluation Project, General Santos City)

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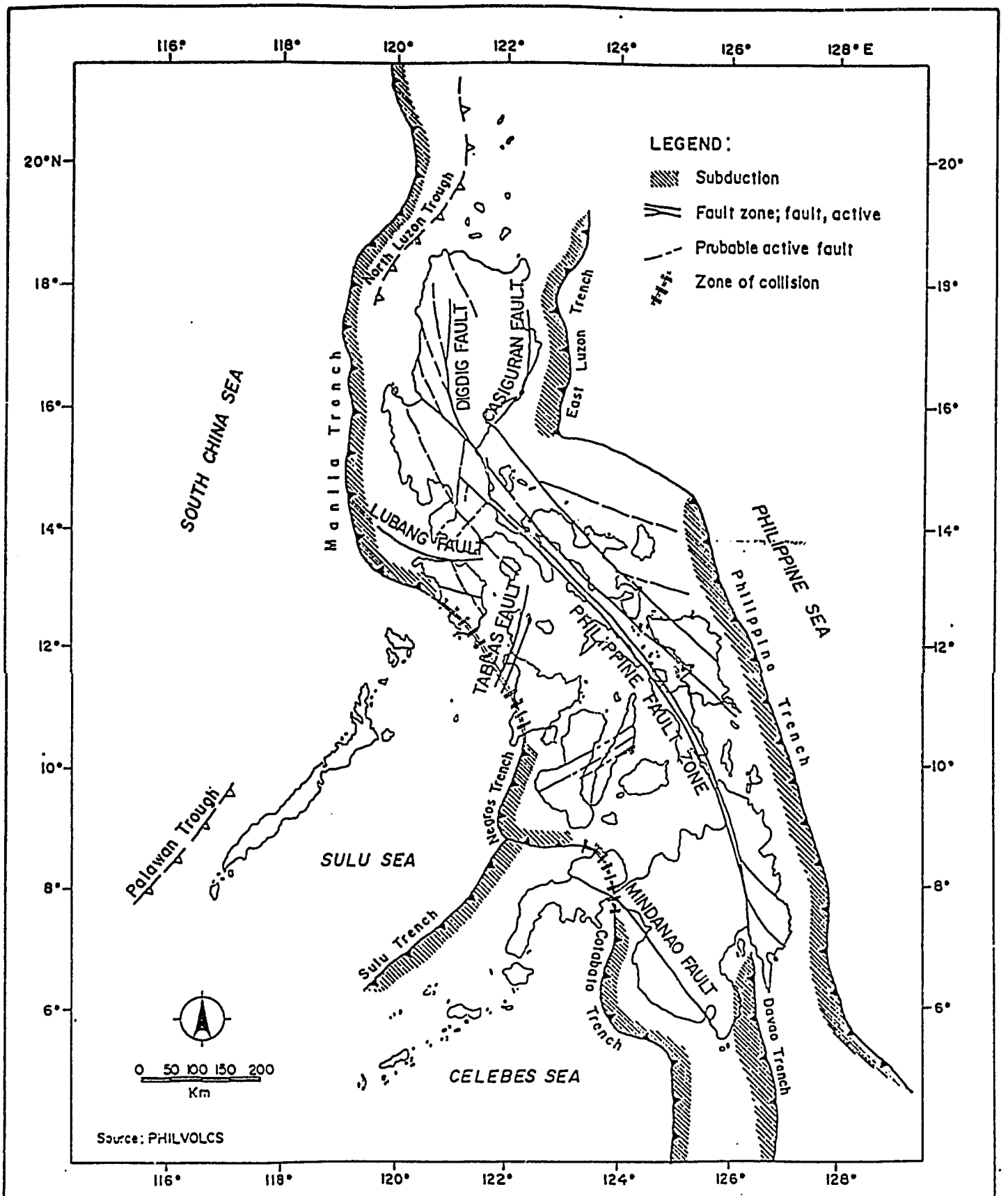
MAKAR WHARF ENVIRONMENTAL ASSESSMENT

LOCATION OF EARTHQUAKES EPICENTER IN THE PERIOD 1949-1976 (MINDANAO ISLAND)

FIGURE E5-7

331



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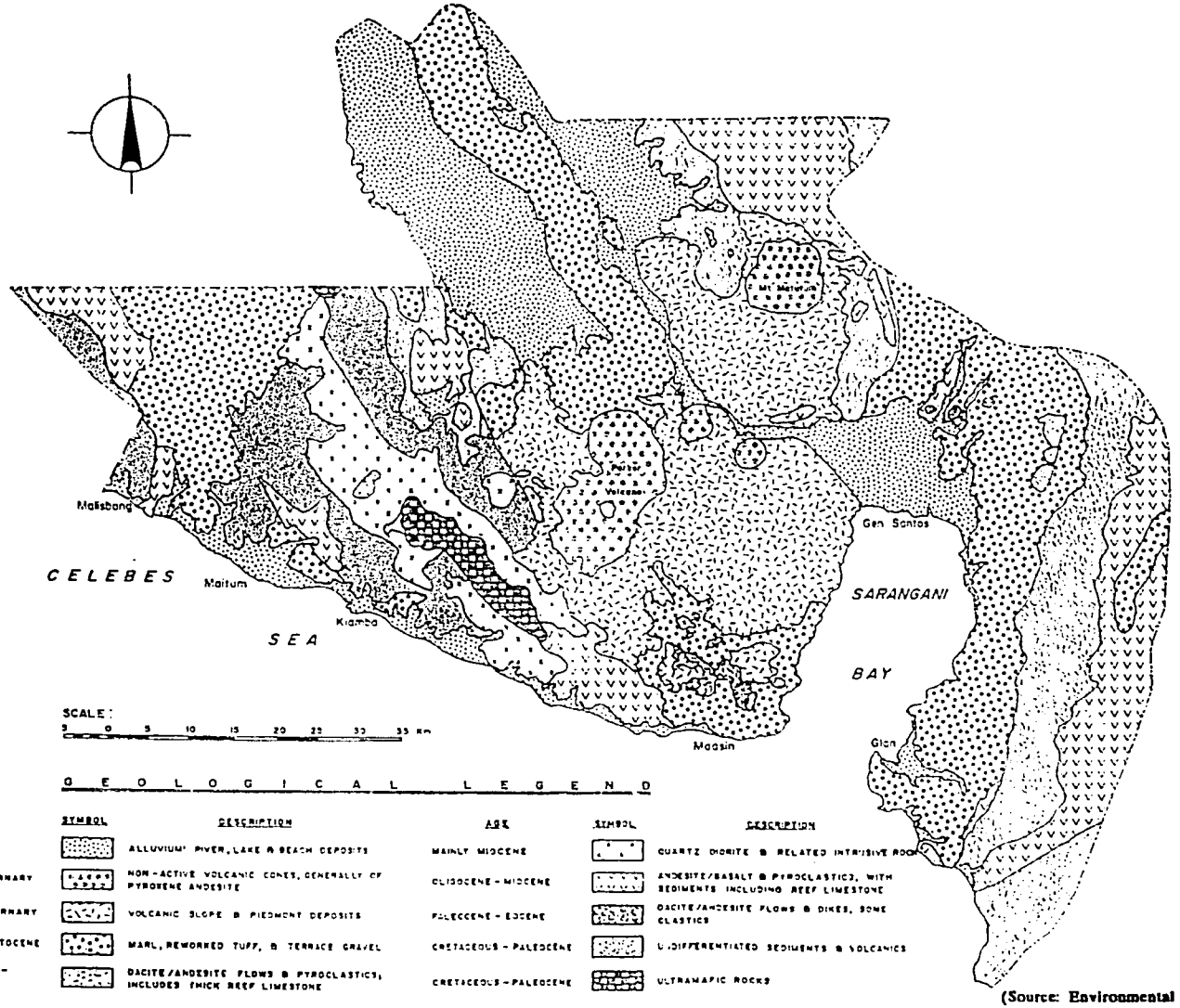
- TRANS-ASIA (PHIL.), INC.
- CONSULTANT MANAGEMENT SERVICES, INC

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

DISTRIBUTION OF EARTHQUAKE GENERATORS IN THE PHILIPPINES

FIGURE E5-8

32



GEOLOGICAL LEGEND

AGE	SYMBOL	DESCRIPTION	AGE	SYMBOL	DESCRIPTION
RECENT		ALLUVIUM: RIVER, LAKE & BEACH DEPOSITS	MAINLY MIOCENE		QUARTZ DIORITE & RELATED INTRUSIVE ROCKS
PLIOCENE-QUATERNARY		NON-ACTIVE VOLCANIC CONES, GENERALLY OF PYROXENE ANDESITE	OLIGOCENE-MIOCENE		ANDESITE/BASALT & PYROCLASTICS, WITH SEDIMENTS INCLUDING REEF LIMESTONE
PLIOCENE-QUATERNARY		VOLCANIC SLOPE & PIEDMONT DEPOSITS	PALEOCENE-EOCENE		DACITE/ANDESITE FLOWS & DIKES, SOME CLASTICS
PLIOCENE-PLEISTOCENE		MARL, REWORKED TUFF, & TERRACE GRAVEL	CRETACEOUS-PALEOCENE		UNDIFFERENTIATED SEDIMENTS & VOLCANICS
UPPER MIOCENE-PLIOCENE		DACITE/ANDESITE FLOWS & PYROCLASTICS; INCLUDES THICK REEF LIMESTONE	CRETACEOUS-PALEOCENE		ULTRAMAFIC ROCKS

(Source: Environmental Assessment – RIF Project South Cotabato)

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LOUIS BERGER INTERNATIONAL, INC.

MAKAR WHARF ENVIRONMENTAL ASSESSMENT

SOUTH COTABATO PROVINCE GEOLOGICAL MAP

FIGURE E5-9

APPENDIX F

LIST OF PREPARERS

ARMANDO A. ANDAYA, WATER QUALITY SPECIALIST

Dr. Andaya is a professor of environmental biology, holds a doctoral degree and a professional chair in biology at the De La Salle University, Manila. Research and publications are in the fields of pollution biology and aquatic toxicology. Specialized training includes industrial pollution control and toxic and hazardous waste management. Consultancy services in the past five years have been in the areas of environmental education, water resource and water quality management, and environment impact assessment. Member of the Environmental Impact Assessment Review Committee of the Environmental Management Bureau, Department of Environment and Natural Resources.

VIRGINIA APRIETO, FISHERIES SPECIALIST

Dr. Virginia L. Aprieto is Professor and Director of the Institute of Marine Fisheries and Oceanography of the College of Fisheries, University of the Philippines in the Visayas in Iloilo. One of the first Ph.D.'s in Marine Science in the Philippines, she obtained her masters and doctorate degrees from the University of the Miami, Florida. She is a marine fisheries specialist, having published over 30 scientific papers in the field of national and international journals. For her distinguished achievement, she received among other awards, the "Outstanding Filipino Woman for Science and Technology" by the Federacion International de Abogadas and the Professional Achievement Award from the University of the Philippines Alumni Association.

MARY JEAN COMFORT, TEAM LEADER

Mary Jean Comfort holds a B.Sc. in zoology and has worked for 15 years in the environmental field. She has worked in the field of wildlife and fisheries biology and in the area of public education and consultation on environmental issues. The most recent position held in Canada was as Senior Habitat Biologist for the Department of Fisheries and Oceans in Ottawa, Canada. Recent consulting experience included the examination of the applicability of habitat evaluation procedures developed in North America to Asian environmental assessments for the ADB and conducting environmental assessments on 11 road improvement projects in South Cotabato for the Rural Infrastructure Fund Project (USAID)

ROGELIO N. CONCEPCION, SOIL SPECIALIST

Dr. Concepcion holds a masters and a Ph.D. in Agronomy from Cornell University and specializes in soils and land use studies for rural development. His most recent work has included poverty alleviation projects for impoverished uplands, feasibility studies for the Regional Community Resource Management Project and Agro-Ecological mapping techniques.

JORGE DE LAS ALAS, AIR QUALITY AND OCEANOGRAPHY SPECIALIST

Dr. De Las Alas is a Professor and Chairman of the Department of Meteorology and Oceanography at the University of the Philippines, Diliman. He obtained his master's and doctorate degrees in Meteorology from McGill University, Canada. He has participated in a wide variety of studies ranging from environmental impact assessment on mining, geothermal, and road projects as well as specialized studies on Manila Bay monitoring and beach stability studies.

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Dr. Benjamin Cer. Gabriel is a holder of Ph.D. in zoology/ecology. He has also pursued a post-doctoral studies in estuarine ecology at the North Carolina University, U.S.A. He also obtained a master degree in Business Administration (MBA).

In the government, he has served as a senior technical consultant to the minister of the then Ministry of Natural Resources and helped organized the National Environmental Protection Council (NEPC) which became the nucleus of the present Environmental Management Bureau tasked to formulate and implement environmental policies of the government.

He has also been involved in the preparation of environmental impact statements of large scale development projects funded by institutions such as World Bank, Asian Development Bank, Japan International Cooperation Agency and United Agency for International Development.

For about 14 years, he was a member of the Faculty of Science at the University of the Philippines. At present, he is the Director for Environmental Services Division of the Trans-Asia Consultants Group, a lecturer in environmental and biological sciences at the University of Manila, and a member of the Environmental Assessment Review Committee of Environmental Management Bureau, DENR.

MICHAEL ROSS, MARINE BIOLOGIST

A resident of the Philippines for over ten years, Michael Ross holds a B.A. in Aquatic Biology from the University of California, Santa Barbara, and has completed extensive research on the coral reefs and related coastal resources throughout the country. His publications span a range from coral taxonomy and community structure, to coral fisheries and environmental assessment of development impact on coastal zones. In a management role, he has implemented projects as varied as the Small Island Community Development Project (USAID - A. Soriano Foundation funded; Cuyo, Palawan) to operation of the privately-owned Bohol Beach Club, in Bohol. His most recent assignment (April - December, 1990) was with the USAID-funded Rural Infrastructure Fund (RIF) Project, for which he was responsible, as Marine Biologist, for the field studies and technical assessment of the potential impact of 43 proposed port projects on the marine environment.

ROBERT SALAZAR, ANTHROPOLOGIST/SOCIOLOGIST

Robert Anthony C. Salazar is an associated professor of De La Salle University and Director of the Research Center. He obtained his A.B. Psychology (cum laude) and M.S. Applied Sociology-Anthropology degrees from the Ateneo de Manila University, and his Ph.D. in Anthropology from the Ohio State University, U.S.A. As Director of Research Center, he directs and supervises research, planning and evaluation of projects and programs for development. He also has extensive experience conducting social soundness analysis, impact evaluation and project monitoring and evaluation in many types of development projects. He is also a member of the Environmental Assessment Review Committee of Environmental Management Bureau, DENR.

CHARLES L. WRIGHT, ECONOMIST

Dr. Wright is an Associate Professor on Economics and a faculty member of the Master's Program in Urban Transportation at the University of Brasilia (currently on leave). He holds degrees from Michigan (A.B.), Sao Paulo (M.S.) and Ohio State (Ph.D.). His doctoral thesis analyzed the economics of grain transport and storage on the Paranagua export corridor in Brazil. Since that time, Dr. Wright has worked and published extensively in two applied fields, transportation economics and agricultural economics. Dr. Wright is the author of over 40 publications on topics such as transport-storage modeling, project formulation and evaluation, rural credit, income distribution, transport regulation, traffic safety, economic growth, and Brasilia. From 1977 to 1986, he was senior economist at the Brazilian Transportation Planning Company (GEIPOT), and from 1986 to 1989 was the coordinator of the Transportation and Communications Division of the IPEA Foundation, the research and policy analysis organ of the Brazilian Ministry of Planning. During the 1989-1990 academic year, Dr. Wright was a visiting scholar at the University of Michigan, where he wrote *Urban Transport Choices* (forthcoming, Temple University Press).

Appendix G
ENVIRONMENTAL PLAN OF ACTION

The following plan outlines the steps that are recommended to mitigate the identified environmental impacts of the proposed improvements to the Makar Wharf.

With the required review process and decision-making time, the project would not be expected to begin until 1992. At that point, most aspects of the project would be management, or design oriented. This provides a great deal of time for preplanning. Assuming a decision is reached on the project by December, 1991, preplanning could begin in January, 1992. All of the following dates are based on the assumption of project approval by December, 1991.

G.1 PRECONSTRUCTION

G.1.1 January 1992 - August 1992

During this eight month period the relocation process for the Badjao community should take place. While it is recognized that the construction expected to affect this community will not take place until Phase II of the project(1993), the Consultant recommends that the process be initiated very early in order to minimize anxiety to residents and eliminate the potential for rumors and misunderstandings. This will also serve to limit the relocation to those families that are living in the area now. The steps that are required in the relocation process are as follows:

(1) An initial step will be to secure an agreement with the community that the community size will remain approximately the same size during the relocation process. This will preclude a sudden influx of families into the area in order to avail themselves of the compensation.

(2) A community information campaign and consultative meetings should be held to outline the purposes of the wharf expansion and enable the community to clearly state their needs and goals for their relocation.

(3) The terms and conditions for relocation must be clearly explained to the community. Elements of compensation should include: the value of the house should it be demolished; costs of materials needed for preparing houses for relocation and for renovating them; cost of labor, and opportunity costs.

(4) The site selection process may be the most difficult and time-consuming of this

(4) The site selection process may be the most difficult and time-consuming of this process but this is the most important component. A site selection committee should be formed, comprised of representatives of the Badjao, the municipal government, the appropriate government agencies that would be involved, and an NGO with experience working with the Badjao community. As a relocation site may require purchase of land, a representative of the proponent should also be included. The site selection process should include selecting the parameters of possible sites, conducting on-site visits, assessing the relative costs and benefits, and making the final site selection.

(5) Once the site selection is complete, the site should be developed. Services that were already available to the Badjao must be included such as a water source, a place of worship, a recreation area, access to education and health services. As a minimum, public sanitation facilities and electricity should also be made available in the Badjaos' relocation site.

(6) In order for the Badjao to actively participate in the development of a new community, it will be important to strengthen their community organization capabilities. There are NGO's in the region that have experience with this type of program.

(7) Relocation of the entire community should then take place in as short as period as possible to minimize the disruption to the community itself.

(8) Monitoring of the community's development and progress once relocated will be required. Again, local NGO's that have worked with the Badjao and already have their trust would be the most appropriate groups to undertake this task.

Once the relocation process is underway, the cleared area adjacent to the wharf will then be fenced and secured in order to prevent any further "squatting". This will also provide an indication to the Badjao community that they were not relocated too early or for no reason.

G.1.2 January 1992

An estimated one week period is required prior to any construction taking place to provide the National Museum the opportunity to survey the undisturbed areas should they determine it is necessary.

G.1.3 March to June 1992

During the design phases of Phase I, it would be appropriate to conduct required training for port personnel and arastre service personnel. This will include training in handling of dangerous cargoes and the public education regarding disposal of wastes.

Following this and during the period of management improvements to the port, waste containers should be placed around the port and provisions made for regular collection.

G.1.4 September 1992 - January 1993

Geotechnical surveys and analysis are planned from which samples of potential dredgeate may be obtained and analyzed for heavy metal content. The results of this analysis should determine the preferred type of dredge and the preferred method of disposal of dredgeate.

G.1.5 March 1993 to April 1993

During this period which entails the design phase of most other aspects of Phase II, any marine mitigation that has been decided upon, can be carried out. The transplanting of soft corals could be accomplished during an estimated two week period. However, prior to the transplant an appropriate site should be selected in consultation with the municipal government, DENR and local interested groups.

In order to transplant these corals, it will be necessary to enlist the aid of preferably, a fisherman's group. A likely group may be the Badjao that have been relocated. A possible methodology is the use of the locally available payaos (cylindrical, welded steel-type) as floats with wire fencing material strung between acting as a basket. This could then be towed by boat while the corals remain submerged in the water. An educational process should also be incorporated into this mitigation to ensure that the fishermen's group understands basic ecological principles and the value of these programs to their livelihood.

G.2 CONSTRUCTION

G.2.1 November 1993 to January 1994

No other mitigation measures are required until the commencement of construction of the container area. From approximately November 1993 to January 1994, the dike around the proposed fill area will be built. Prior to that (October 1993), some initial dredging will have to take place. After the construction of the dike, the major dredging will commence. It is

expected that this dredging will last three months. From the onset of any construction activities, a water quality monitoring program will be necessary. As mentioned above, simple field equipment could be purchased and port personal could be trained in analysis and record keeping. Barring this approach, the Mindanao State University (MSU) in General Santos is presently involved in a water quality monitoring program and its lab cababilities are being upgraded as a result of this project. A second alternative would be to contract the water quality monitoring to MSU. The water quaility monitoring would be expected to last until June 1994 for construction activities. The requirements for the full water quality monitoring program for construction and operation is outlined in the operations section of this plan.

It is also during this time that pile-driving will be taking place. It is recommended that the regional office of DENR in Davao, which has noise monitoring capabilities, periodically monitor the construction site to ensure that noise levels are within standards as projected in this report.

G.2.2 March 1995

Following the completion of most of the construction of the container yard, and the beginning of paving, the final aesthetic measures may be taken, if deemed necessary. This would include a perimeter of trees around the port area. It would be particularly important at the livestock terminal as it would act as a sound barrier while providing shade. This work could be undertaken by port authority personnel.
A schedule of mitigation activities it shown in Figure G-1.

G.3 PORT OPERATION

G.3.1 Ongoing

During the early phases of the project, the environmental awareness campaign should be put in place for port employees and those that work in the port area. During this time garbage receptacles should be placed around the port area.

Training in the proper handling and storage of hazardous wastes should also be conducted during this time. Training in occupational health such as wearing of ear plugs when working around noisy equipment should be included.

G.3.2 Water Quality Monitoring Program

Water quality monitoring is required for various construction activities at the port. Some monitoring will also be required during operation. The extent of monitoring required should be determined in consultation with DENR. The following is a program designed to monitor significant parameters during construction and operation.

The monitoring program is designed to assess the effectiveness of the mitigation measures and water quality management programs proposed and the efficiency of their implementation.

The monitoring program will involve two parts:

(1) Determination of time- and site-specific changes in water quality parameters within the zone of influence of the project site during construction and operation of the new port facility at the Makar Wharf; and

(2) Evaluation of the implementation of the monitoring program with reference to compliance to water quality standards recommended for the identified water usage and classification.

G.3.2.1 Components of the Monitoring Program

(1) Water quality parameters to be monitored:

- (a) Suspended Solids (SS)
- (b) Biochemical Oxygen Demand (BOD)
- (c) Trace metals (Cd, Cr, Cu, Pb) - Following construction activities, these parameters could be eliminated as they are not expected to be the result of any port operational activities.

(2) Water Sampling Analysis

- (a) During dredging, reclamation, and spoil dumping activities.
- (b) Three (3) random samples obtained within 0.1, 0.5, and 1.0 km distance from project site.
- (c) Three (3) samplings at regular intervals within the working hours at 2-3 day intervals per week for the duration of the activities (except for trace metal analysis - 1 per week).
- (d) Water analysis should be completed within 12 hours after water sampling (samples for trace metal analysis should be acidified with nitric acid immediately after collection).
- (e) Data should be expressed as mean and range of values for all water determinations done.

(3) Evaluation of Results

(a) Compare estimated values with water quality standards established for identified water usage and classification (refer to DENR Administrative Order No. 34)

(b) Compliance with the set standard is desired:

For Class SC coastal marine waters, intended for secondary contact recreation and commercial fisheries, the maximum permissible limits for water quality parameters are:

Suspended Solids	-	30 mg/l
Biochemical oxygen demand	-	7 mg/l
Trace metals:		
Cadmium	-	0.01 mg/l
Copper	-	0.05 mg/l
Chromium	-	0.05 mg/l
Lead	-	0.05 mg/l

(c) Submission of water quality monitoring report to the EMB for information and evaluation.

(4) Implementation of Monitoring Program

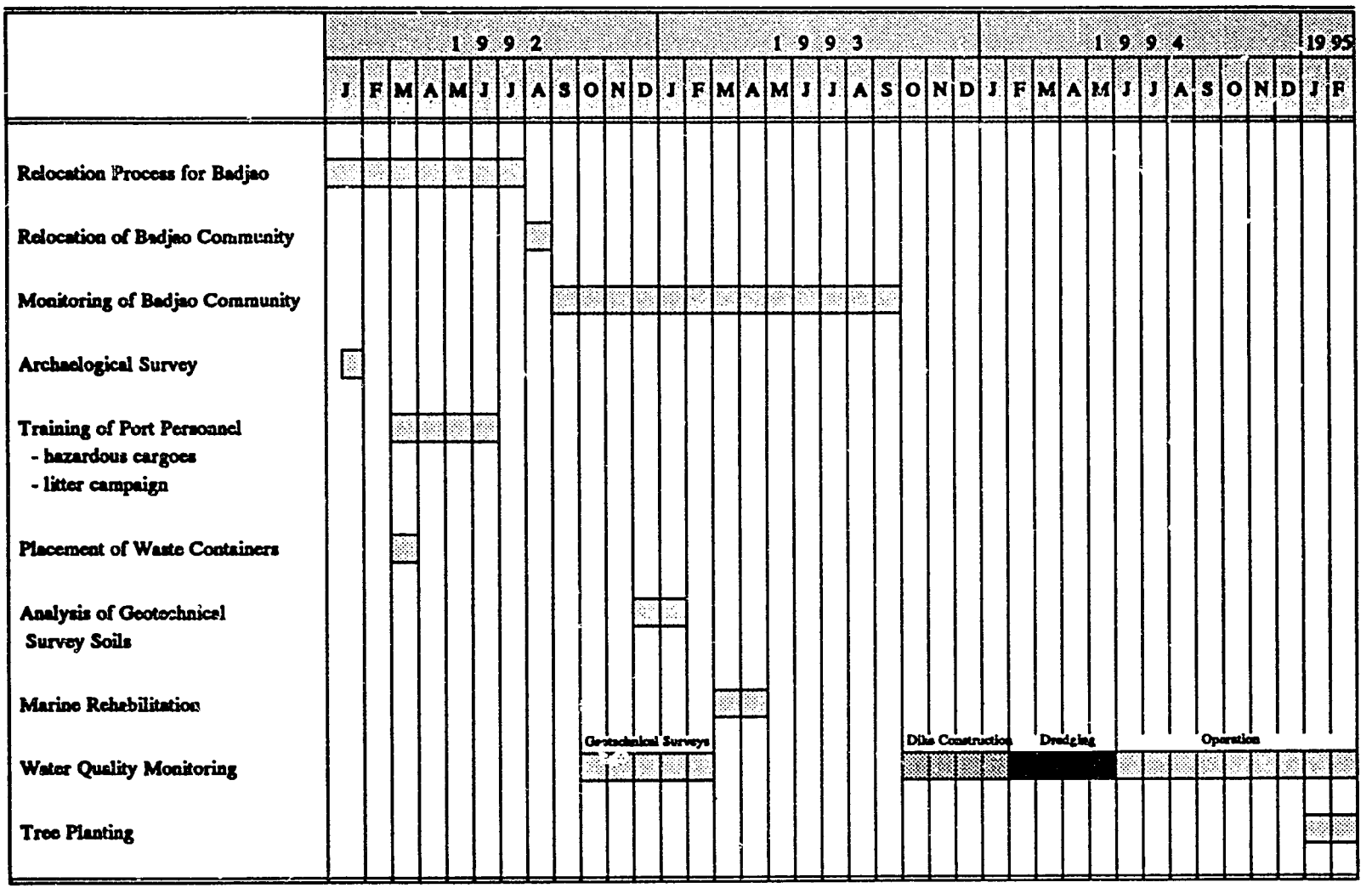
(a) Technical Manpower

(i) PPA designate personnel to be trained to conduct water sampling; Philippine Coast Guard boats may be used during sampling activities.

(ii) Staff and laboratory capability of MSU-GSC (particularly the Colleges of Science, Agricultural Engineering, and Fisheries) is being strengthened as a result of the Dolefil-USAID Marine and Inland Resource Conservation Project for the conduct of water quality analysis and interpretation.

(iii) Coordinate and cooperate with local and/or regional government agencies; e.g. DENR, DA, DOH for technical assistance and support.

Figure G-1
SCHEDULE OF MITIGATION ACTIVITIES



344

Appendix H
LIST OF ACRONYMS

BFAR	Bureau of Fisheries and Aquatic Resources
BOD	Biological Oxygen Demand
BPI	Bureau of Plant Industry
BSWM	Bureau of Soils and Water Management
CBHF	Corn Bulk Handling Facilities
COD	Chemical Oxygen Demand
CPUE	Catch per Unit of Effort
CRMP	Coastal Resources Managment Project
CSY	Contianer Storage Yard
CVRP	Central Visayas Regional Project
DA	Department of Agriculture
DENR	Department of Environmet and Natural Resources
DO	Dissolved Oxygen
DOH	Department of Health
DPWH	Department of Public Works and Highways
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
FS	Feasibility Study
FVA	Fisherman's Village Association
GI	Galvanize Iron
GSC	General Santos City
LBII	Louis Berger International, Inc.
LMU	Land Management Units
LWUA	Local Water Utilities Administration
MDP	Mindanao Development Project
MSU	Mindanao State University
NAMRIA	National Mapping and Resources Information Authority
NDDC	Notre Dame of Dadiangas College
NEE	Northeast Extension
NGO	Non-Governmental Oragnization
NNE	North-North East
NOCOP	National Operation for the Control of Oil Pollution
NSCP	National Structural Code of the Philippines
OSC	On Scene-Commander
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration

PAP	Philippine Assistance Program
PCG	Philippine Coast Guard
PFDA	Philippine Fisheries Development Authority
PPA	Philippine Port Authority
SAMAGEWU-TUPAS	Sarangani Marine and General Workers Union-Trade Unions of the Philippines and Allied Services
SARI	Sarangani Aqua Resources, Inc.
SCIPSI	South Cotabato Integrated Port Services, Inc.
SOCOTECO	South Cotabato Electric Cooperative
SS	Suspended Solid
SSW	South-South West
SWE	Southwet Extension
TDS	Total Dissolve Solid
TSP	Total Suspended Particle
TSS	Total Suspended Solid
USAID	United States Agency for International Development
WHO	World Health Organization