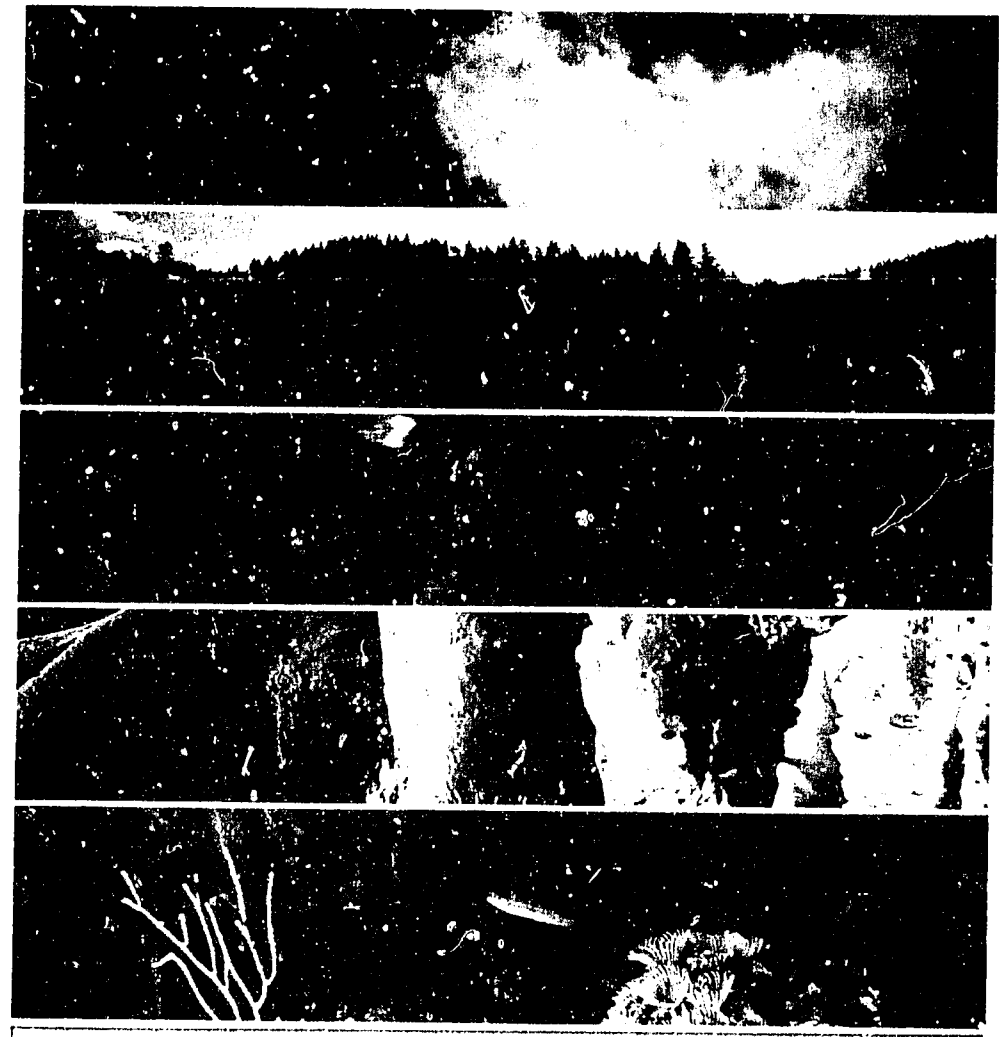
PN-ABK-947



DAMES & MOORE

PN-ABK-947

"This study was completed through the assistance of the United States Agency for International Development (AID). The views expressed and opinions contained in this report are the authors, and are not intended as statements of policy of AID or the author's parent institutions."

ENVIRONMENTAL ASSESSMENT OF AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX, GENERAL SANTOS CITY, SOUTH COTABATO PROVINCE PHILIPPINES

Final Report

DAMES & MOORE

28 February 1992

TABLE OF CONTENTS

	Page No.
Table of Contents	i
List of Figures	vi
List of Tables	vii
Acronyms and Abbreviations	viii
EXECUTIVE SUMMARY	x
Chapter 1 INTRODUCTION	1
1.1 Background	1
1.2 Proposed Action	1
1.2.1 Project Proponent	1
1.2.2 Project Type	2
1.2.3 Objectives	3
1.2.4 Need for the Project	3
1.2.5 Alternatives	5
1.2.5.1 Location	5
1.2.5.2 Alternative Project Plans	5
1.2.5.3 No Action Alternative	5
1.2.5.4 Summary of Alternatives Considered	7
1.2.6 Associated Projects	7
1.3 Relationship to USAID Policy	8
1.4 USAID Environmental Procedures	9
1.5 Philippine Environmental Legislation	11
1.6 Approach to the Environmental Assessment	13
Chapter 2 PROPOSED FACILITIES AND ALTERNATIVES CONSIDERED	15
2.1 Overview of the Proposed Project	15
2.1.1 Options Evaluated	15
2.1.1.1 Alternative Project Sites	15
2..1.1.2 Alternative Project Plans	15
2.1.2 Proposed Project	16
2.1.3 Timing and Duration	17
2.2 Plant Siting	18
2.3 Fishing Port Complex	18
2.3.1 DPWH Proposal	20
2.3.2 SingConsult Master Plan	21
2.3.3 Modified Singconsult Master Plan	25
2.4 Livestock Complex	25
2.5 Crops Processing	26
2.6 Support Infrastructure	28
2.7 Construction Activities	30
2.8 Facility Operations and Management	31
2.8.1 Safety Measures	32

Page No.

2.8.2 Environmental Protection Measures 32
2.8.2.1 Singconsult Master Plan 32
2.8.2.2 DPWH Master Plan 33
2.8.3 Contingency Plans 33
2.9 Wastewater Treatment Alternatives 33
2.9.1 Selection of Treatment Process 34
2.9.1.1 Primary Treatment 34
2.9.1.2 Secondary Treatment 34
2.9.2 Fish Port Wastewater Treatment 38
2.9.3 Agro-Processing Facilities Wastewater Treatment 38
2.9.4 Livestock Processing Facilities Wastewater Treatment 39
2.10 Wastewater Characterization 40
2.10.1 Fishing Port Complex Wastewater 40
2.10.2 Livestock Complex Wastewater 42
2.10.3 Crops Processing Wastewater 45
2.11 Effluent Disposal 47
2.11.1 Fish Port 47
2.11.2 Agro-processing Facilities 47
2.11.3 Livestock Processing Facilities 47
2.12 Air Emissions Characterization 47
2.13 Solid Waste Disposal 48

Chapter 3 EXISTING ENVIRONMENT 50

3.1 Geographical Setting 50
3.2 Climatology and Meteorology 52
3.3 Physical Oceanography 56
3.3.1 Tides 56
3.3.2 Waves 58
3.3.3 Currents 58
3.3.4 Sea Water Characteristics 63
3.4 Water Quality 69
3.4.1 Nearshore 69
3.4.2 Groundwater and Springs 70
3.4.3 Surface Water 70
3.4.4 Pollutant Sources 75
3.5 Marine Resources 77
3.5.1 Benthic Biota 77
3.5.2 Fish 79
3.5.2.1 Reef Fish Population 79
3.5.2.2. Sarangani Bay Fishery 85
3.5.2.3 Tuna Fishery 85
3.5.2.4 Fishing Methods 87
3.6 Aquatic Resources and Mangroves 88
3.6.1 Aquatic Biota 88
3.6.2 Mangrove Habitat 89

Page No.

3.7 Terrestrial Biota 92
3.7.1 Coconut Plantation 92
3.7.2 Secondary Growth Forest 93
3.7.3 Savannah Grassland 94
3.7.4 Threatened and Endangered Species 94
3.8 Geology and Soils 95
3.8.1 Regional Geomorphology 95
3.8.2 Site Conditions and Topography 95
3.8.3 Subsurface Conditions 97
3.8.4 Liquefaction Potential 97
3.8.5 Marine Geology 98
3.9 Groundwater 98
3.10 Land Use and Services 99
3.10.1 Land Use 99
3.10.2 Public Services and Facilities 101
3.10.2.1 Education 101
3.10.2.2 Health and Sanitation 103
3.10.2.3 Public Security and Safety 103
3.10.2.4 Communications 104
3.10.2.5 Roads 104
3.10.2.6 Water 105
3.11 Socioeconomic Conditions 105
3.11.1 Urban Functions and Settlement Structure 105
3.11.2 Population Characteristics 106
3.11.3 Economic Characteristics 107
3.12 Energy 11[illegible]
3.13 Air Quality 114
3.14 Archaeological Resources 117

Chapter 4 ENVIRONMENTAL EFFECTS OF THE PROPOSED PROJECT 119

4.1 Physical Oceanography 119
4.2 Water Quality 119
4.2.1 Nearshore Marine Water Quality 119
4.2.1.1 Biochemical Oxygen Demand 120
4.2.1.2 Viruses and Pathogens 121
4.2.1.3 Suspended Solids 126
4.2.1.4 Other Waste Constituents 127
4.2.2 Surface Water 129
4.2.3 Groundwater 130
4.3 Marine Resources 131
4.3.1 Benthic Biota 131
4.3.2 Fish 133
4.4 Aquatic Resources and Mangrove Habitat 134
4.5 Terrestrial Biota 135
4.6 Geology and Soils 136
4.7 Surface and Groundwater Hydrology 136
4.8 Land Use and Services 136
4.8.1 Land Use 136
4.8.2 Public Facilities and Services 137

Page No.

4.9 Socioeconomics 138
4.9.1 Employment and the Regional Economy 138
4.9.1.1 Employment 138
4.9.1.2 Regional Economy 141
4.9.2 Migration and Community Structure 143
4.10 Energy 146
4.11 Air Quality 146
4.11.1 Effects During Construction 146
4.11.2 Effects During Operation 146
4.12 Archaeological Resources 147
4.13 Irreversible and Irretrievable Commitment of Resources 147
4.14 Residual and Unavoidable Impacts 148

Chapter 5 ENVIRONMENTAL EFFECTS OF ALTERNATIVES TO THE PROPOSED PROJECT 149

5.1 Singconsult Master Plan Fish Port 149
5.1.1 Habitat Loss 150
5.1.2 Impact on Tuna Fishery 151
5.1.3 Impact on Water Quality 152
5.1.4 Other Effects 152
5.2 Relocation of DPWH Port on the Site 153
5.3 Alternative Wastewater Treatment 154
5.4 Effluent Disposal 155
5.4.1 North Reef Outfall 155
5.4.2 Outfall Depth at 20 m 155
5.4.3 Outfall Depth at 10 m 156
5.4.4 Discharge at the Waterline 156
5.4.5 Combined Outfall 156
5.4.6 Land Application 156
5.5 Alternative Water Supply 160
5.5.1 Radial Well Collectors 160
5.5.2 Siguel River 160
5.6 Solid Waste Management 161
5.7 Integrated Site Management 161

Chapter 6 ENVIRONMENTAL EFFECTS OF THE NO-ACTION ALTERNATIVE 162

6.1 Physical Oceanography 162
6.2 Water Quality 162
6.3 Marine Resources 163
6.4 Aquatic Resources 164
6.5 Terrestrial Biota 164
6.6 Geology and Soils 165
6.7 Groundwater 165
6.8 Land Use and Services 165
6.9 Socioeconomic Conditions 166

Page No.

6.10 Energy 166
6.11 Air Quality 167
6.12 Archaeological Resources 167

Chapter 7 CUMULATIVE IMPACTS 168

Chapter 8 MITIGATION MEASURES 170

8.1 Mangrove and Coral Reef Habitat 171
8.2 Marine Water Quality 172
8.3 Groundwater Protection 173
8.4 Solid Waste Management 173
8.5 Public Services and Socioeconomic Benefits 174
8.5.1 Housing 174
8.5.2 Water Supply 174
8.5.3 Residential Wastewater Treatment 174
8.5.4 Educations Services 175
8.5.5 Protection Services 175
8.5.6 Allocation of Socioeconomic Benefits 175
8.6 Archaeological Resources 175
8.7 Energy 176
8.8 Environmental Management Program 176
8.8.1 Construction Management 176
8.8.2 Habitat Conservation 176
8.8.3 Environmental Protection 178
8.8.4 Environmental Monitoring Program 179
8.9 Site Management 179

Chapter 9 RESPONSES TO COMMENTS 181

References 214
List of Persons Contacted 219
List of Preparers 223

APPENDICES

A - Scoping Report A-1
B - Oceanographic Data Report B-1
C - Biological Data Report C-1
D - Air Quality Data Report D-1
E - Numerical Modeling of Discharge Plume E-1

LIST OF FIGURES

Figure		Page No.
1-1	Regional location map.	4
1-2	Project vicinity map.	6
2-1	Proposed project site.	19
2-2	DPWH Master Plan site layout.	22
2-3	Singconsult site layout.	23
2-4	Proposed location of livestock processing facilities.	27
2-5	Activated sludge and extended aeration treatment systems.	37
3-1	GSAPC site topography and bathymetry.	51
3-2	Predicted tidal elevations at the Sarangani Bay tide station for January 1991.	57
3-3	Location of moored current meter and profiling stations, January-February 1991.	60
3-4	Representative examples of time-dependent current velocities off the GSAPC site.	61
3-5	Polar histograms of current speed and direction near the GSAPC site.	62
3-6	Typical vertical current profile off the GSAPC site.	64
3-7	Seawater temperature profiles offshore of the GSAPC site.	65
3-8	Salinity profiles offshore of the GSAPC site.	66
3-9	Seawater density profiles offshore of the GSAPC site.	67
3-10	Dissolved oxygen profiles (% saturation) offshore of the GSAPC site.	68
3-11	Nearshore Zone of the Proposed GSAPC Site.	78
3-12	Map of Sarangani Bay with other reef areas surveyed.	82
3-13	Vegetation Map.	91
3-14	Borehole location plan.	96
3-15	Existing Land Use, General Santos City.	100
3-16	Future Land Use, General Santos City.	102
3-17	Existing Agro-Processing Facilities, Fish Landing Sites and Fish Processing Facilities.	115
8-1	Habitat Areas Recommended for Conservation.	177

LIST OF TABLES

Table		Page No.
2-1	Primary Sources of Wastewater at the GSAPC	41
2-2	DENR Effluent Standards for BOD	44
3-1	Average Climatological Conditions Measured at General Santos City between 1951-1985.	53
3-2	Monthly Average Rainfall at General Santos City during 1981-1990.	54
3-3	Climatological Extremes at General Santos City between 1950 and 1986.	55
3-4	Seawater Quality at the Proposed Site	71
3-5	Mean and in Maximum Values of Water Quality Values for Coastal and Marine Waters of Sarangani Bay	72
3-6	Distance and Depth Profile of Water Quality of Coastal and Marine Waters of Sarangani Bay	73
3-7	Spring Water Quality	74
3-8	Water Quality at the Siguel River	76
3-9	Benthic Life Forms at 20 ft Isobath	80
3-10	Benthic Life Form at 40 ft Isobath	81
3-11	Dominant Fish Species Groups on the North Reef	83
3-12	Dominant Fish Species Groups on the South Reef	84
3-13	Commercially Important Fished Landed at General Santos City	86
3-14	Gross Sales and Number of Establishments by Sector General Santos City, 1988 - 1989	108
3-15	Area Planted to Temporary Crops by Barangay	109
3-16	Kilowatt-Hour Consumption by Users, 1980 to 1985	113
3-17	Results of Air Sample Analyses	116
4-1	Microbiological Quality of Water Guidelines/Standards	122
4-2	Plume Model Results	125
4-3	Construction Phase Employment	140
4-4	Economic Benefits GSAPC and Component Facilities	142
4-5	Annual Population Increment due to Increase and In-Migration, General Santos City	145
5-1	Survival Times of Selected Excreted Pathogens in Soil	159

ACRONYMS AND ABBREVIATIONS

%	percent
BFAR	Bureau of Fisheries and Aquatic Resources
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
CEQ	Council for Environmental Quality (U.S.A.)
CFR	Code of Federal Regulations (U.S.A.)
cm	centimeter
C°	degrees Celsius
COD	chemical oxygen demand
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
DPWH	Department of Public Works and Highways
DO	dissolved oxygen
EA	Environmental Assessment
ECC	Environmental Compliance Certificate
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
FAD	fish aggregating (or attracting) devices
F°	degrees Fahrenheit
g	gram
gal	gallon
GOP	Government of the Philippines
GSAPC	General Santos Agro-Processing Center
ha	hectare
kg	kilogram
kg/N/ha	kilograms of nitrogen per hectare
km	kilometer
kt	knot (nautical mile per hour)
kVA	
kV	kilovolt
kwh	kilowatt-hour
$l \cdot d^{-1}$	liter per day
LOI	Letter of Instruction
m	meter
m^2	square meter
m^3	cubic meter
$m^3 \cdot hr^{-1}$	cubic meter per hour
$mg \cdot l^{-1}$	milligram per liter
mgpd	million gallons per day
MLLW	Mean Lower Low Water
mm	millimeter
MSU	Mindanao State University
mt	metric ton
$mt \cdot d^{-1}$	metric ton per day
NEPC	National Environmental Protection Council
NGO	non-governmental organization
NPC	National Power Corporation
NPCC	National Pollution Control Commission
P	peso

PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PAP	Philippine Aid Plan
PD	Presidential Decree
PFDA	Philippine Fisheries Development Authority
pH	hydrogen ion concentration
psu	practical salinity units
TSS	total suspended solids
SOCOTECO	South Cotobato Electrical Cooperative, Incorporated
SS	suspended solids
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
USEPA	United State Environmental Protection Agency
US	United States
WWTP	waste water treatment plant

ENVIRONMENTAL ASSESSMENT OF AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX IN GENERAL SANTOS CITY

EXECUTIVE SUMMARY

1.0 Introduction

An Environmental Assessment (EA) is a procedural requirement of the US Agency for International Development (USAID) on all projects it funds that have potentially significant adverse impacts on the environment. Furthermore, Philippine laws require environmental impact assessments of environmentally critical projects or facilities that will be located in environmentally critical areas.

USAID is proposing to fund the construction of infrastructure for an agricultural processing complex in the local neighborhood of Tambler in General Santos City, South Cotabato Province, as part of its commitment under the Multi-Lateral Assistance Initiative (MAI). In addition, the Government of Japan is interested in funding construction of a fish port on the same project site. It is anticipated that a fishport complex and agro-processing facilities can be compatible on the site. As part of its participation in the MAI, USAID has agreed to include the fish port in its EA.

Although USAID is interested in funding the infrastructure for the agro-processing complex, no project proponent has yet been identified with a specific proposal for a processing facility on the site. At this stage of project planning, USAID funds would be used to proceed with site preparation and basic infrastructure once a developer proceeds with plans to build and operate a processing facility on the site.

The proposed project is intended to promote economic development in southern Mindanao Island. The southern region of Mindanao Island is an important agricultural producer, but little or no value-added processing of crops takes place in the provinces of South Cotabato, Sultan Kudarat, Maguindanao, and North Cotabato.

The project site is a 32 ha parcel located on the western shore of Sarangani Bay, approximately 12 km south of the urban core of General Santos City.

2.0 Alternatives Considered

The Philippine Department of Agriculture (DA), with funding from the Government of Singapore, prepared a feasibility study

for the proposed agro-processing facilities and a fish port on the project site. At the same time, the Philippine Department of Public Works and Highways (DPWH), with funding from the Government of Japan, prepared a feasibility study and master plan for a fish port on the same site. There are, therefore, alternative master plans for the fish port, but not for the agro-processing facilities.

The following major alternatives are considered in this EA:

- agro-processing facilities as described in the DA master plan, and fish port as described in the DPWH master plan (the proposed project);
- agro-processing facilities and fishport complex as described in the DA master plan; and
- no action by USAID.

In addition, wastewater treatment and disposal alternatives have been considered to improve environmental soundness of the project.

The DA master plan also proposes a livestock processing complex offsite, perhaps located across the national highway from the site. This component is briefly evaluated, primarily from the standpoint of wastewater management.

The support infrastructure for the site would include roads and utilities, administrative facilities, and facilities for commercial services such as restaurants, banks, vendors of fishing supplies and equipment, repair shops, and similar shops.

Separate wastewater treatment systems have been proposed for the fish port, agro-processing complex, and livestock processing complex. This EA recommends the extended aeration process as a preferred alternative for both onsite wastewater treatment plants (WWTP). A draft EIS prepared for DPWH recommended the installation of a WWTP to reduce the adverse effects of the fish port on the environment. The proposed WWTP includes screening, primary clarifiers, aeration, and secondary clarifiers. DPWH expects to construct a WWTP, and is awaiting further recommendations from its consultant.

The Draft EIS for the DPWH plan proposes that the effluent from the fish port WWTP will be discharged to the sea, or perhaps used for irrigation. The manner of discharge to the sea, however, is not made clear. The Singconsult Master Plan also appears to call for a discharge to the sea at the waterline. This approach is environmentally unacceptable. A submarine discharge to a depth of 30 m (100 ft) is recommended as the preferred alternative.

3.0 Environmental Consequences of the Proposed Project

3.1 Water Quality

3.1.1 Surface Water

Since the proposed discharge contains primarily wastes from fish and crops processing facilities and human waste, adverse effects due to heavy metals and toxic chemicals are not likely unless a can manufacturing facility is installed or biocides are used to prevent fouling in cooling water systems. The primary water quality concerns at the General Santos Agro-Processing Complex (GSAPC) are likely to be organic loading to the environment and public health concerns with respect to pathogens in human wastes.

The proposed WWTP for the agro-processing facilities will remove up to 95% of the BOD_5. This removal efficiency is more than adequate to meet even the most stringent DENR effluent standard for BOD_5 for new industry. Discharge of this effluent via a 100-ft deep outfall is expected to provide an initial dilution of at least 1,100:1. With a potential effluent BOD_5 of 25-30 mg/l from extended aeration treatment, the discharge will rapidly meet the most stringent coastal receiving water standard.

Coliform bacteria have been used by public health officials for several decades as a measure of water quality and potential impact on human health. For protection of human health, the Philippine fecal coliform standard for human contact with marine water is 200 MPN/100 ml. A numerical model was used to ascertain the dilution and dispersion of discharged wastewater. For all cases using the preferred discharge depth of 30 m, the discharge plume reached equilibrium (neutral buoyancy) before it reached the sea surface, with dilution values at the trapping depth (neutral buoyancy) always in excess of 1100:1. At the lowest rate of dilution for a 30-m outfall, the concentration of fecal coliforms is expected to be <200 MPN/100ml.

Keeping the wastewater plume from surfacing will significantly benefit public health, odor, and aesthetic conditions at the fish port. Discharge at the waterline or in shallow water, however, is likely to place fishermen (and others in contact with nearshore water) at unacceptable risk of exposure to viruses and pathogens in the water.

Overall, the impact of the proposed project on water quality in the nearshore zone is expected to be adverse if the fish port WWTP discharges to the waterline. Organic matter in the wastewater as well as pathogens and bacteria will occur in the boat landing and docking areas, with high risk of contact by fishermen wading in the water.

Water quality impacts associated with construction of the fish port include high levels of suspended sediments during dredging of the harbor, disposal of the dredge spoils to deep water, and construction of the breakwaters. Although plumes of suspended sediments in the nearshore zone are expected to be of short duration during the active construction period, they will have a significant adverse impact on the remaining nearby corals, i.e., those corals that are not directly destroyed by dredging or filling operations.

Discharge of hot water directly to the environment is potentially harmful to marine biota. Effects will be localized and discharges will be of short duration, but organisms encountering the hot water plume are likely to be immediately killed.

A potentially serious source of nearshore pollution is the grease and oil discharged by fishing boats during engine repair and maintenance, bilge pumping, or hull cleaning. Diesel fuel is typically used by small-scale fishermen to clean hulls of fouling organisms. Diesel oil slicks on the water are potentially hazardous in the harbor area and potentially cause adverse effects on marine biota, particularly marine birds.

3.1.2 Groundwater

Low-cost housing near the GSAPC site is needed for a minimum of 7,000 to 10,000 people (employees, fishermen, and their dependents). If this housing is not provided, the GSAPC site is likely to be occupied or surrounded by squatters. Without an adequate wastewater collection and treatment system, the squatter settlements (and even low-cost housing tracts) will have some sort of latrine/septic tank system, or will use the foreshore or vegetated areas for human waste disposal. The area around the GSAPC site has little topsoil, consisting mostly of sand and fractured and porous limestone. Seepage and overflow from septic tanks and latrines will rapidly percolate, resulting in contamination of the freshwater aquifers which comprise the groundwater and feed the springs on the GSAPC site.

Thus, construction of the GSAPC site poses a significant risk to deterioration of groundwater quality if adequate sewerage facilities are not provided to the population drawn to the site. This risk is particularly important in that the proposed project expects to use surfacing groundwater (the springs) on the site as the source of potable and process water. Although water treatment will be provided, the costs of water treatment depend largely on the quality of raw water.

3.2 Marine Resources

Indiscriminate destruction of coral reef habitat is contrary to Philippine policies. The EIS System identifies coral reef habitat as an environmentally sensitive resource. Because the Philippines does not have a wide continental shelf or areas of oceanic upwelling, productivity of the nation's nearshore fisheries is heavily dependent on coral reefs and mangrove habitats.

Construction of the fish port will practically destroy the existing corals as deep as the 20-m (60 ft) isobath on the north reef. This is either by direct destruction by dredging or breakwater construction, or indirectly by heavy siltation when dredging occurs during the construction stage. During dredging, corals in proximity to the dredge site are impacted because the suspension of silt and sediments causes turbidity which blocks out sunlight, which is needed by the corals. Furthermore, large quantities of either coarse or fine particles will bury corals.

Corals not killed during the construction stage of the project will still be exposed to stress due to the possible deterioration of the water quality in the immediate vicinity when the project's facilities are already fully operational. Changes in water quality to which corals are particularly sensitive include: suspended solids, temperature, salinity, and oil contamination. Oil contamination is very likely to occur if fishermen are allowed to use diesel fuel to clean the hulls at the fish port, or if proper waste oil collection facilities are not provided.

The loss of coral cover is followed by the loss of the coral-associated fish fauna. The net effect of the proposed fish port on reef fish populations is expected to be adverse and locally significant, primarily as a result of the destruction of reef habitat by dredging and filling.

On the south reef promontory, low-growing life-forms of coral are common down to about 60 ft. Below 60 ft, coral habitat is increasingly patchy, with increasing importance of sandy bottom habitat. At 100 ft depth, coral patches are scattered and the bottom is primarily sandy habitat. Discharge at this depth, therefore, minimizes adverse impact on corals. The probability of organic wastes from the submarine outfall building up in the sediments in biologically productive areas is low. The steep slopes and relatively large sand grain sizes in the area of the proposed outfall result in slow but steady transport of sediments downslope, which suggests that biological activity in the sediments around the proposed outfall is not likely to be high. Impacts on benthic biota from discharge of particulates from the GSAPC submarine outfall, therefore, are expected to be less than significant.

Construction of the fish port will improve sanitary conditions for fish landings, and therefore should result in a better quality and better price for sashimi. Although this might encourage additional fishing pressure, the fishery is primarily hook-and-line and is probably sustainable, with no significant adverse impact on tuna stocks. The majority of fish now caught in Sarangani Bay and landed in the wet fish market are small individuals, indicating the significant decline in fish stocks as a result of over-fishing. The change in location for fish landings and improvement in sanitary conditions is not expected to have a significant impact on the economic value or intensity of this fishery.

Most of the tuna now landed at the existing canneries in Sarangani Bay are very small juveniles caught by purse seiners fishing in tuna spawning grounds in nearby waters. This harvest is not sustainable, and represents a significant adverse impact on tuna stocks.

3.3 Mangrove Habitat

Indiscriminate destruction and loss of mangrove habitat is contrary to Philippine policy. The EIS System identifies mangrove habitat as an environmentally sensitive resource.

Construction of the proposed fish port and the agro-processing facilities together will completely eliminate the coastal mangrove habitat now located in the shoreward margin of the north reef and the inland mangrove habitat to the south. Although the total amount of habitat is not large (between 1 and 2 ha), the values of this habitat as spawning and nursery areas for marine species and as a source of detritus for marine food chains will be lost. This loss represents a small increment in the general decline of mangrove habitat area in Sarangani Bay, and on the west shoreline in particular. However, little mangrove habitat remains in Sarangani Bay, so the loss of even a small amount should be considered a significant adverse impact on the environment of Sarangani Bay.

3.4 Terrestrial Biota

Coconut plantation and grassland are abundant in the General Santos area, and the loss of approximately 19 ha of coconut grove and 5 ha of grassland is less than significant. Second-growth forest habitat found on the site is not abundant in the project vicinity. Although this habitat is of potential ecological value from the standpoint of not being common, it does not include threatened, rare, or endangered species. Therefore, the potential loss of approximately 6 ha is less than significant.

3.5 Surface and Groundwater Hydrology

Constructing a pond around the headwaters of the north spring to collect the artesian discharges may involve some risk to groundwater flows. The pond might create a hydraulic head larger than that of the artesian pressure, thereby forcing groundwater to emerge at another location. This would have a significant adverse effect on the water supply on the site.

3.6 Land Use and Services

The primary effect of constructing the proposed agro-processing and fish port complex at the Tambler site will be the conversion of 32 ha from its present uses. The proposed action, however, conforms to the City Development Plan, which has identified the site as being suitable for agro-industrial development.

It is virtually certain that the eateries, market, and residents deriving a livelihood from the existing fish markets will also relocate to the GSAPC site. If agro-processing site development is not undertaken simultaneously with fish port development, future development of the agro-processing facilities could be constrained by a rapid influx of settlers into the site and loss of control over land use in the project site.

While development of the proposed site as an agro-industrial facility is in conformance with the land use plan for General Santos City, it is possible that such development will induce conversions of nearby lands into non-conforming land uses. This can arise through in-migration of workers (either directly or indirectly employed by the proposed project facilities) and the need for housing and other services.

During and after the construction stage of the project, there will be a demand for affordable housing for laborers and their families. Corollary to this demand will be the need for other public services.

Since Tambler has been designated by the City Plan as an alternative growth area, it is expected that housing needs will correspondingly increase with the influx of workers who will prefer to be near their work places. There will be greater pressure in terms of housing and land-use type and density. Unless affordable housing is made available either on-site or off-site the complex, sub-standard dwelling units and settlements may sprout nearby, resulting in uncontrolled growth and inefficient land use.

Twenty-four families presently residing within the project site will be affected by the construction and operation of GSAPC.

These families have been living in the area anywhere between 3 and 20 yrs, deriving their income mainly from fishing.

The project, together with other developments, will influence property and taxable values in Tambler, particularly near the project site. Price movements may vary depending on the locality, but a conservative estimate of 15 to 30% increase per annum upon completion of GSAPC is reasonable. Such a prospect could make land prohibitively costly and out of reach for local residents and other public purposes unless incomes also rise.

In addition to creating demand for housing and sanitation facilities, development of the project may, through increased in-migration to the area, exacerbate shortages in educational and public safety services. The shortage of fire services may be particularly important if corn oil processing occurs on the site, as hexane is important in the processing and is highly flammable.

3.7 Socioeconomics

During the construction period of approximately 3 yrs, the project will generate a total of 4,775 jobs, amounting to ₱172 million. It is expected that at least 30% of construction laborers would come from within the City. It is very likely, however, that a substantial portion of construction manpower requirements may have to be sourced from migrant labor outside the City, i.e., from the Province or the Region, thereby accelerating the influx of potential settlers and transients into the City, particularly Tambler. This in-migration will exert further pressure on land, housing, and other public services.

Initially there would be more or less 1,600 construction laborers on the project who would need goods and services. Such a demand would attract informal family-operated business activities to locate near the construction site. The spatial distribution of these small business establishments will likely follow a linear pattern of development along the roadside. The prospects of these businesses staying beyond the construction period cannot be discounted and may give rise to squatting and other types of informal settlements that are not in accordance with the zoning plan and development envisioned for Tambler. This situation may further pose problems as regards land rights, environmental sanitation, and relocation.

The expenditures forecast for construction and operation of the GSAPC shows beneficial effects throughout the region. The magnitude will depend on the level of expenditure made for goods and services that are regional in origin. During operation of the facilities, the project's benefits would be realized as higher prices for agricultural and fish products and through expenditures of employment-generated income. Increased farm

prices should translate into increased economic activity through a combination of consumer expenditures and savings/reinvestment. Incomes to fishermen may improve as a result of improvements to the landing and market access. The principal limitation to fishing, however, is availability of the resource, i.e., over-fishing results in declined catch per unit effort.

Tambler had a pre-relocation population of 4,579. Approximately 12,000 persons (2,540 families) from the city center were transferred to this neighborhood in 1990. It is expected that more workers and other people will move in as a consequence of GSAPC and other developments. This influx will add to the cultural and social diversity of Tambler and the need and demand for various urban and community services. Moreover, this situation may give rise to employment competition between old-time residents and newcomers.

Tambler will undergo a relatively faster pace of growth on account of migration and commercial/industrial development. Such a development will impinge on traditional lifestyles and community patterns and may necessitate appropriate coping mechanisms in the light of emerging urbanization. Community and ethnic cohesion and stability will be affected, particularly in terms of maintaining and respecting traditional neighborhood boundaries, general livability, territoriality, and aesthetic quality.

3.8 Energy

With the implementation of the project, the power consumption in the city will increase by a minimum of 11.6 million kwh/yr in the year 1995. This is roughly 23% of the total demand in 1985. In drought years, the power system cannot meet existing demand. The project, therefore, potentially has a significant adverse impact on energy supplies unless power is generated on site.

3.9 Archaeological Resources

Development of the proposed project would, in the absence of any other conservation measure, result in the loss of six archaeological sites known to be present. This would occur during the construction phase of project development.

3.10 Irreversible and Irretrievable Commitment of Resources

Resources that will be irreversible and irretrievably consumed or lost as a result of construction and operation of the proposed project include:

- energy in the form of fossil fuels;
- cement and other materials used in construction; and
- arable land.

Of these, the loss of land for potential crop production is insignificant because the site does not have high quality soils. Requirements for energy and cement are justifiable with respect to economic returns from employment and value added to local products.

3.11 Residual and Unavoidable Impacts

The loss of some mangrove habitat on the site is unavoidable, although it is noted in Chapter 5 that relocation of the fish port further to the south might protect some of the mangrove habitat. Acceptability of this alternative, however, is dependent on whether adequate harbor protection can be provided at a reasonable cost.

Displacement of current residents on the site is unavoidable. More important, however, is the high probability that construction and operation of the facilities at the site will act as a magnet for new residences on the site or on adjacent properties. These may be incompatible with the objectives of the site, overall land use plans for the Tambler area, and existing shortfalls in public services.

Construction of the facilities poses a high risk of significant adverse impact on corals in the nearshore zone. Construction techniques that minimize generation of suspended sediments will help reduce the areal extent of the impact, but some loss of coral habitat is certain, particularly in construction zones.

Inadequate solid waste disposal facilities will pose a risk to groundwater quality, surface water quality, human health, and the perceived quality of life.

4.0 Effects of Alternatives

One of the primary alternatives under consideration is construction and operation of the fish port described in the DA Master Plan. In the process of carrying out field studies and beginning the EA, other potential courses of action were identified, and their environmental effects are also briefly considered in Chapter 5. The alternative measures included are:

- DA master plan fish port;
- relocation of DPWH fish port on the site;
- wastewater treatment alternatives;

- effluent disposal alternatives;
- alternative water supply;
- solid waste management;
- integrated site management; and
- no-action.

4.1 DA Master Plan Fish Port

From an environmental impact perspective, there are two primary differences between the fish port proposed in the DA Master Plan and the DPWH Master Plan.

First, the DA fish port will entail disturbance and habitat modification of the south reef. Thus, the DA plan extends areas of coral habitat loss to both north and south reefs, rather than the north reef only. The north reef probably has the greater habitat value. But the incremental loss of the south reef is significant from the standpoint of value of coral reef as environmentally sensitive habitat.

Second, the DA Master Plan also results in loss of both the coastal mangrove habitat on the northern shore and the thin band of inland mangrove behind the southern shore. This is a significant adverse impact in view of on-going decline of mangrove habitat in Sarangani Bay.

Although the DA Master Plan extends habitat loss and conversion to the entire shoreline of the project and to all mangrove habitat on the site, it is likely that this habitat would be lost anyway, because the City has designated the site for development of agro-processing and fish port facilities. Furthermore, the agro-processing facilities are likely to build over the band of inland mangrove habitat. Therefore, the difference in impact is probably less than significant.

4.2 Relocation of DPWH Fish Port on the Site

If it is feasible from a geotechnical and engineering standpoint to relocate the fish port facilities to the deepwater cove and the south reef, opportunities to preserve the coastal mangrove habitat and the higher quality coral habitat of the north reef could arise. This would represent a significant reduction in the project's adverse effects on the nearshore environment. Relocation of the fish port to the south, however, probably entails more elaborate design of breakwaters, because of its slightly higher exposure to prevailing waves.

4.3 Alternative Wastewater Treatment

Several methods of wastewater treatment were briefly considered. Separate WWTPs for the fish port and the agro-processing facilities is an inefficient use of land. Furthermore, significant improvement in economies of scale in construction, operation, and maintenance costs are likely if one WWTP is constructed to handle both of these waste streams.

It is not yet clear whether hot water will be discharged to the WWTP or directly to the marine environment. An acceptable alternative may be to predilute the discharge with seawater so that the water temperature of the effluent is less than 35°C. Other alternatives include: use the water to clean facilities in the fish market, or judicious use in cleaning the hulls of fishing boats.

4.4 Effluent Disposal

The DPWH and DA Master Plans call for wastewater discharge at the waterline. This, however, is not acceptable from an ecological and public health standpoint. Submarine outfall alternatives have been evaluated. Oceanographic data indicate that currents are adequate to obtain high rates of dilution at the promontories of both the north and south reefs. An outfall at the south reef, however, is recommended because diver surveys indicate that coral abundance is less at a depth of 30 m (100 ft) on the south reef promontory, compared to the north reef promontory. Furthermore, habitat values are greater on the north reef, and the north reef is located closer to a coastal fishing community at the mouth of the Banwalan River channel.

Outfall at depths of 20 m and 10 m result in the plume surfacing. Although dilution was adequate to eliminate concerns regarding public health, a surfacing plume was judged to be unacceptable from an aesthetic standpoint. Furthermore, coral habitat is more abundant (less patchy) at shallower depths on the south promontory, and adverse effects on corals are likely to be more extensive.

Discharge at the waterline represents an unacceptable health risk to fishermen as a result of viruses and pathogens in the effluent. Discharge at the waterline is likely to result in poor dispersion, with rapid build-up of organic matter in sediments in the immediate area. This will result in odor and aesthetic problems. The impact will be localized but significant.

Commingling effluent from the fish port WWTP, livestock processing WWTP, and the agro-processing WWTP will provide a net benefit in that the weaker effluent from the fish port and agro-processing facility will help dilute the higher levels of BOD in

the livestock effluent prior to discharge to the marine environment. Economies of scale in constructing, operating, and maintaining a single submarine outfall will also be achieved.

The Draft EIS for the DPWH fish port at General Santos City suggests land application of the effluent as an alternative to marine discharge. Treated wastewater can be a valuable resource for irrigation where supplies of fresh water are limited or soils are poor in nutrients. The sandy soil of the region potentially provides a deep zone of aeration where the residual dissolved organic materials will be degraded and stabilized by the soil bacteria. The suspended organic solids in the effluent will help build up the humus on the topsoil, which improves soil fertility. However, water percolates rapidly through sandy soils, and much of the Tambler area is characterized by karst limestone formations, which are highly fractured and porous. Groundwater is capable of flowing rapidly in both vertical and horizontal directions under these conditions. Therefore, care must be taken to ensure that an adequate depth exists between the soil surface at a land application site and underlying groundwater to ensure that all contaminants are removed before the effluent contacts the groundwater. This need for caution is particularly acute in the Tambler area, where groundwater supplies are the primary source of potable water.

Great care must be taken when land application includes domestic wastewater, because of the presence of pathogens and viruses in even treated wastewater and subsequent concerns regarding public health and worker safety. Such schemes can create problems if they are not well planned and managed. A prime consideration is to ensure that risks of disease transmission are eliminated.

4.5 Alternative Water Supply

Shallow radial well collectors in the vicinity of the north spring headwaters may be a feasible alternative to constructing a collecting pool in the area. Observations on the site of the headwaters of both springs revealed that a substantial fraction of the total flow was emerging through the channel bed. Construction of a collecting pool may alter the flow pattern, particularly if the hydraulic head of the pool is greater than the artesian pressure.

Although the springs on the site appear to be adequate in supply, there is a risk that site preparation may significantly alter groundwater movement. If this proves to be the case, feasibility studies may need to be conducted to examine seasonal flow regimes in the Siguel River, environmentally and economically suitable locations for stream diversions, and costs of treating and piping the water to the project site.

4.6 Solid Waste Management

The DA Master Plan assumes that solid wastes, including sludges from the WWTPs, will be disposed of in landfills in the General Santos City area. These do not exist. Solid waste is generally dumped near the banks of the Silway and Makar Rivers and is either burned, blown away, or transported to Sarangani Bay during storm flows. An alternative is to construct a suitable landfill in the vicinity as part of the infrastructure for the GSAPC site. The Draft EIS for the DPWH fish port at General Santos City recommends that sludges be used as a soil amendment because the wastes of agro-processing facilities are primarily organic material. Similar public health concerns, however, exist as for land application of effluent.

4.7 Integrated Site Management

At the present time, development of the fish port and the GSAPC facilities are proceeding on separate tracks. There is a high degree of inefficiency in separate design and construction programs, particularly given the differences in scale of the infrastructure required for the two facilities. Integrated site management is a rational alternative to redundant facilities and conflicts in use of the site.

4.8 No-Action Alternative

Under this scenario Japanese funding of construction of the fish port complex by DPWH could continue. Therefore, the no-action alternative in this case still includes some development on the site.

Discharge to the marine environment from the fish port will continue. If the agro-processing facilities are not built, opportunities are lost for the fish port WWTP to discharge its effluent via the proposed deep outfall for the agro-processing WWTP. Therefore, discharge of effluent to the waterline will prevail and result in poor quality water in the nearshore zone.

If the proposed agro-processing project is not implemented, the project site will continue to attract squatter families. The charter of PFDA limits it to projects of a nature similar to the proposed fish port. Hence the likelihood of the rest of the area turning into a squatter settlement without the agro-processing facilities is very high.

The no-action alternative still entails the loss of the north reef and the coastal mangrove habitat to the DPWH fish port. These are perhaps the two most valuable components of the nearshore habitat on the project site. Therefore, the no-action

alternative does not entail a significant benefit in protection of marine resources or sensitive habitats.

Under the no-action alternative, there would be substantially less demand for public facilities and services. While the magnitude of the demand will be less, it will remain significant in terms of the City's ability to provide these services, all of which are already in short supply.

With the no-action alternative, the project will realize a smaller set of economic benefits through construction of a fish port, but significant socioeconomic consequences, such as depressed social welfare and economic opportunities, will continue.

The archaeological resources identified as being present on the site will likely be lost in the absence of conservation measures, even under the no-action alternative. Housing developments in association with the fish port will quickly arise on any remaining open space on the site that is not dedicated to support of the fish port itself.

5.0 Mitigation Measures

Mitigation measures will minimize or eliminate the potential for significant adverse impacts, or partially mitigate for unavoidable impacts.

5.1 Mangrove and Coral Reef Habitat

Technically and economically feasible mitigation measures should be considered in project design and implementation. Two measures whose feasibility should be considered are:

- relocation of the fish port on the site to conserve the coastal mangrove habitat and the north reef; or
- off-site rehabilitation and protection of degraded mangrove habitat.

If cost and engineering studies indicate that relocation of the fish port to the deepwater cove or south reef area is undesirable, consideration should be given to offsite purchase and rehabilitation of at least 2 ha of shrimp ponds into mangrove habitat. Rehabilitation would entail restoration of tidal flushing and planting of mangrove seedlings. Protection and management of this offsite mitigation should be under the authority and responsibility of the site manager, perhaps in cooperation with a community PVO or NGO.

5.2 Marine Water Quality

If separate WWTPs are built for the fish port and the agro-processing facilities, it is recommended that the effluent from the fish port WWTP be discharged with the effluent from the agro-processing WWTP via an outfall at the 100-ft isobath on the promontory of the south reef.

To prevent the irreversible damage that siltation will inflict on the corals during dredging, tides and currents should be taken into account when determining periods of dredging. Tidal currents should be able to drive the silt towards the open ocean or towards the deep outer slopes. The construction contractor should be required to present a plan to minimize siltation during construction, and site inspections should be carried out to ensure that the plan is being properly implemented.

5.3 Groundwater Protection

Suitable wastewater collection and treatment facilities must be provided for employee housing. Precautions should be taken to not alter considerably the existing environment of the artesian springs. Radial collector wells may be an alternative solution to spring water collection.

5.4 Solid Waste Management

Suitable solid waste management facilities do not exist in the region. The project will potentially generate large quantities of solid wastes, primarily putrescible material. Although much of this conceivably could be routed through feed mills constructed as part of the agro-processing facilities, there is no guarantee that these will be built, will continue to operate, or can handle the full volume of organic waste. Furthermore, the problem of proper disposal of inorganic wastes remains. At minimum, a sanitary landfill (not an open dump) should be considered as part of the project infrastructure, perhaps in the vicinity of the offsite facilities. Consideration should also be given to co-composting organic wastes from the agro-processing facilities and sludges from the WWTPs for potential sale as a soil amendment. In the latter case, however, care should be taken to establish an operation that does not endanger public health from improper exposure to viable eggs of intestinal parasites.

Although scavengers do not ordinarily have social standing, they have an important role in recycling materials and efficiently managing waste streams. Consideration should be given to legitimizing scavenging operations as part of an overall

solid waste management program at the GSAPC site and the associated housing development.

5.5 Public Services and Socioeconomic Benefits

Provision of housing for project employees during the construction and operational phases should be made. Housing should also be provided to the 24 families currently living on the site.

Two options for wastewater treatment for employee housing should be considered. The first option is to hook up the housing development to one of the WWTPs, perhaps the livestock processing WWTP, as the blending of strong and weak BOD waste streams may be beneficial to the treatment process. Alternatively, the housing project should be equipped with "pour-flush" toilets with discharge into tight septic vaults and a soakage pit. The solid material must be pumped out annually and disposed of properly, and this should be done routinely under the authority and responsibility of the GSAPC site manager.

The fiscal impact of meeting the additional demand on educational facilities should be offset through development assistance funds or through advance payment of taxes by project proponents.

Priority should be given to employing persons currently residing on the site, in the Tambler area, and in General Santos City. Employers should coordinate with city officials and the barangay captains to coordinate community needs and employment opportunities.

The use of imported goods and services should be minimized so as to maximize the retention of benefits in the Philippines. The use of local goods and services should be maximized to encourage retention of benefits in the local area.

5.6 Archaeological Resources

Five of the six sites identified by the Philippine National Museum team should be excavated by qualified personnel prior to initiation of site construction to allow recovery of archaeological artifacts.

Prior to initiation of site work, construction crews should undergo a brief seminar on recognition of buried sites and artifacts. If any suspected archaeological site is uncovered during site preparation, all work in the immediate area should be stopped immediately and a qualified archaeologist consulted for preliminary evaluation and recommendations.

5.7 Energy

Electric power should be provided on a dedicated basis to both the GSAPC site and the worker housing.

5.8 Environmental Management Program

The construction contractor should be required to prepare and submit for approval an environmental management program to cover construction operations. Periodic site inspections should be made to verify that this plan is being implemented.

In addition to the key points noted above regarding minimizing siltation during marine construction and training staff in recognition of archaeological resources (Chapter 8), the plan should include the following key components:

- prevention of siltation of aquatic habitats;
- dust suppression measures during construction;
- measures for proper disposal of oily wastes, along with a program to confine and cleanup spills during refueling operations.

To the extent practical, habitat conservation should be included in site layout and design, not only for conservation of biological values on the site but also as open space amenity. Two candidate areas for habitat conservation include:

- the coastal mangrove community and beach north of the deepwater cove; and
- part of the second growth forest, including the headwaters of the two springs, located on the southwest corner of the site.

In addition, to the extent practical, the south spring, at least down to the southeast corner of the property, should be maintained in its natural condition. This entails protection of the stream channel and a buffer of natural vegetation up to approximately 3 m wide on each bank.

Buffer zones of natural habitat should be set up around the WWTP so as to provide possible habitat for displaced wildlife.

Areas of shoreline which will not be developed by the project should be replanted with mangrove trees to provide new spawning and nursery habitat for marine organisms.

To minimize the expected terrestrial habitat losses in the project area, the rehabilitation of existing vegetation to the extent practical is recommended. The proposed rehabilitation includes the enrichment planting of the second growth forest in as much of the area as possible, as well as mangrove habitat where feasible.

Sump oil and other oily waste resulting from engine maintenance wastes must be treated separately from other wastes destined for treatment in the WWTP.

The successful implementation of environmental protection measures and conservation of natural habitat can only be attained with full cooperation and participation of the community within the project site. It is necessary that proper extension service regarding environmental components of the project should be undertaken to generate awareness and address concerns among the constituents. To this end, the position of Environmental Officer should be created as a senior level staff position in the office of the site manager. Responsibilities should include: community education programs for fishermen, employees, and other users of the site and their families; monitoring performance and maintenance of waste disposal systems; and oversee habitat conservation and rehabilitation programs.

An environmental monitoring program should be implemented to check early signs of pollution in the spring water and the nearshore zone. In particular, the program should focus on bacteriological parameters. The environmental monitoring program should be carried out on a quarterly basis during mid- to late morning hours after most of the fish unloading activities have occurred. Parameters for analysis should include but not be limited to: total and fecal coliforms; oil and grease; and BOD.

5.9 Site Management

Site planning, development, and management should be coordinated and integrated into a single functioning entity as soon as possible.

The on-site WWTP system should take into consideration that processing facilities will not be fully operational for the first few years. The designer should consider a phased program of construction using a modular construction method for the aeration and clarification tank using common walls.

To ensure that the future project does not result in significant harm to the environment, USAID may wish to encourage establishment of a set of covenants or guidelines by which project proponents who wish to locate on the site agree to contribute to expansion and make use of the waste treatment

facilities, provide pretreatment as necessary, and operate in an environmentally responsible manner.

ENVIRONMENTAL ASSESSMENT OF AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX IN GENERAL SANTOS CITY

Chapter 1

INTRODUCTION

1.1 Background

An Environmental Assessment (EA) is a procedural requirement of the US Agency for International Development (USAID) on all projects it funds that have potentially significant adverse impacts on the environment. Furthermore, Philippine laws require environmental impact assessments of environmentally critical projects or facilities that will be located in environmentally critical areas.

The EA is just one element of a multi-faceted project appraisal process by USAID. Other important elements include technical soundness analysis, economic and financial analysis, and social soundness analysis. Through the EA, information regarding the proposed project, the existing environment, environmental impacts of the project, alternatives and mitigative measures, and environmental monitoring requirements will be provided. This information will be used by decision-makers regarding the course of action of USAID with respect to project design and implementation.

In the US, the environmental impact assessment is expected to occur early in the project planning stage, often when the project is still in the conceptual stage. The project proponent in theory has not yet committed major effort to detailed design. The ideal situation is to consider necessary project modifications due to environmental concerns before the project proponent commits major resources to a specific course of action and detailed design for that action. This EA is being prepared in accordance with this philosophy.

1.2 Proposed Action

1.2.1 Project Proponent

USAID is proposing to fund the construction of the basic infrastructure for an agricultural processing complex in the

local neighborhood (barangay) of Tambler in General Santos City, South Cotabato Province, as part of its commitment under the Multi-Lateral Assistance Initiative (Philippine Aid Plan). A feasibility study for the proposed agro-processing complex was prepared with funding by the Government of Singapore as part of the Philippine Aid Plan.

The project proponent at this stage of project planning for the agro-processing complex is the Department of Agriculture, Government of the Philippines. The Department of Agriculture has identified the proposed project as a priority for donor assistance under the Philippine Aid Plan.

Although USAID is interested in funding construction of the infrastructure for the agro-processing complex, no private-sector project proponent has yet been identified with a specific proposal for a processing facility on the site. At this stage of project planning and development, USAID funds would be used to proceed only with site preparation and development of basic infrastructure once a private sector developer proposes a processing facility for the site.

In addition to USAID's interest in construction of an Agricultural Processing Facility Complex in Barangay Tambler, the Government of Japan is funding construction of a fish port on the same project site. A feasibility study was prepared under contract to the Department of Public Works and Highways (DPWH). It is anticipated that a fishport complex and agro-processing facilities can be compatible on the site. As part of its participation in the Philippine Aid Plan, USAID has agreed to include the fishport complex in its environmental impact assessment. Decisions regarding the fishport, however, are not currently included in the USAID project.

1.2.2 Project Type

At the present stage of conceptual design, the project entails basic infrastructure for agro-processing facilities and a fish port. It is expected that agro-processing facilities would be considered light to medium industry. Waste discharges would tend to be primarily organic in nature, with potentially high oxygen demand. The fishport complex could be considered a major infrastructure project because it is a port facility.

1.2.3 Objectives

The proposed project is intended to promote economic development in southern Mindanao Island, the Philippines.

1.2.4 Need for the Project

According to indicators of the World Bank, the Philippines is classified as a lower-middle income country (World Bank 1989). Depressed prices of agricultural goods, combined with booming population growth and shortage of arable lands, have encouraged high levels of rural-to-urban migration. Most of this growth has been oriented toward Manila and Cebu, where industrial growth has been high. At the same time, however, quality of life in these cities has declined because of the inability to maintain concomitant growth of public infrastructure.

The southern region of Mindanao Island consisting of South Cotabato, Sultan Kudarat, Maguindanao, and North Cotabato provinces is generally poor, and government expenditures exceed revenue collections. These four provinces are partially isolated from the rest of the island by the absence of good quality roads. The economy of the area is predominantly agricultural, and the majority of the population lives in rural areas (National Census and Statistics Office 1985).

The southern region of Mindanao Island is an important agricultural producer, with agriculture, fisheries, and forestry contributing about 51 and 61% to the Gross Regional Domestic Product of Regions XI and XII, respectively, in 1986 (National Statistical Coordination Board). However, in the provinces of South Cotabato, Sultan Kudarat, Maguindanao, and North Cotabato, little or no value-added processing of crops takes place. For example, approximately 95% of the total agricultural, forestry, and fisheries exports from South Cotabato is unprocessed.

General Santos City, located in South Cotabato Province (Figure 1-1) is ideally suited as a market center for export of agricultural and fisheries products from the region. It is located on Sarangani Bay and has easy access to deep water for port development. A labor force characterized by high underemployment offers opportunities for processing of agricultural and fisheries products. Therefore, General Santos City provides an opportunity to implement an integrated regional development plan that diversifies the economy, increases income for the rural farmers and fishermen, and encourages development of a new regional growth center. The Government of the

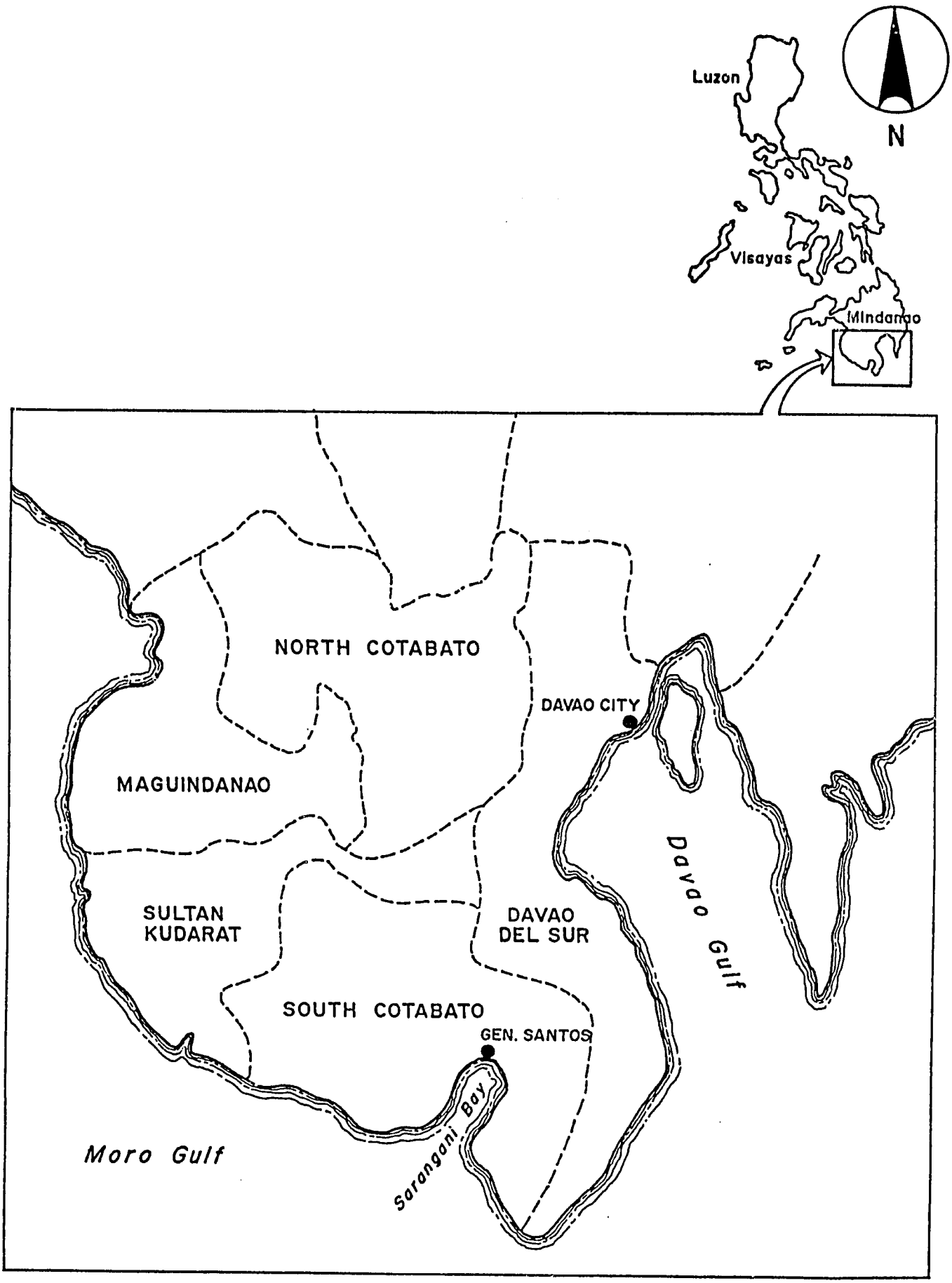


Fig. I-1 REGIONAL MAP

Philippines has identified General Santos City as a high priority target for foreign aid development assistance.

1.2.5 Alternatives

1.2.5.1 Location

The project site is 32 hectares located in Barangay Tambler in south General Santos City (Figure 1-2). The site, located approximately 12 km south of the built-up urban area of General Santos City, offers a water frontage of approximately 1.2 km on the shores of Sarangani Bay.

The site was selected by the Department of Agriculture for development of agro-processing and fish processing facilities as part of the Government of the Philippines' effort to establish priorities for the Philippine Aid Plan. Alternative sites, therefore, are not being evaluated by USAID or other donors.

1.2.5.2 Alternative Project Plans

Singconsult, a planning firm under contract to the Department of Agriculture with funding from the Government of Singapore, conducted field studies, consulted with local officials in General Santos City, and prepared a feasibility study for the proposed agro-processing facilities (Singconsult 1990). The proposed agro-processing facilities include a wide range of operations to process agricultural commodities from the region. At this stage of project planning, it is not known which, if any, of these operations would be implemented.

Singconsult (1990) incorporated into its preliminary master plan for the agro-processing facilities a feasibility study and preliminary master plan for fishport facilities on the site. The Singconsult design includes space for a tuna cannery and berthing facilities for purse seiners (Section 2.3.2). There are, therefore, alternative master plans for the fishport complex.

1.2.5.3 No Action Alternative

Under both US and Philippine regulations, the environmental impact assessment must include an evaluation of impacts without the project. Therefore, a third alternative is the "no-action" alternative, i.e., a decision by USAID to not fund construction of the agro-processing facilities. Under this scenario, however,

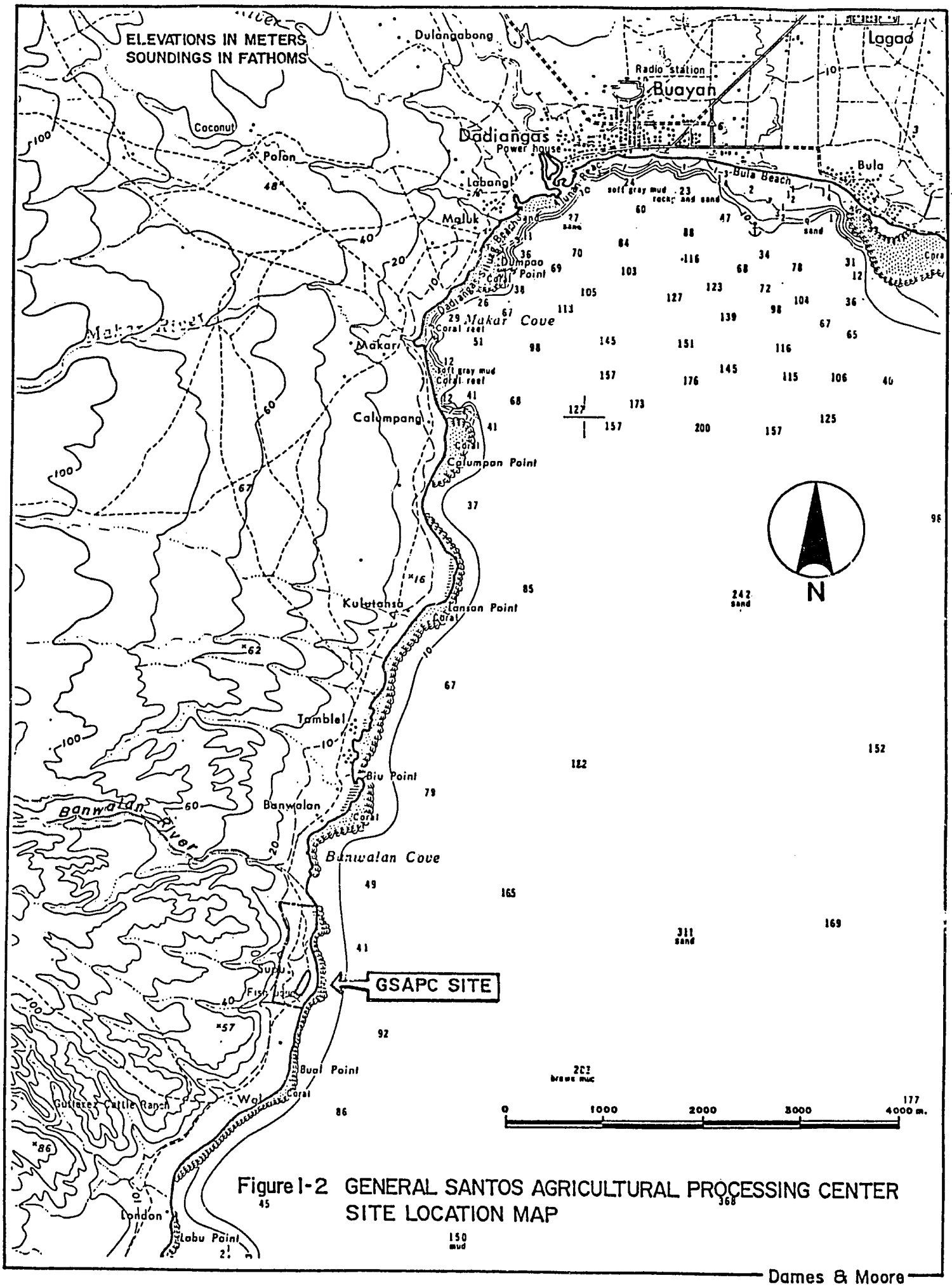


Figure 1-2 GENERAL SANTOS AGRICULTURAL PROCESSING CENTER SITE LOCATION MAP

Dames & Moore

Japanese funding of construction of the fishport complex would continue.

1.2.5.4 Summary of Alternatives Considered

In summary, the following alternatives are considered in this EA:

- o agro-processing facilities as described in the Singconsult feasibility study, and fishport complex as described in the DPWH master plan (the proposed project);
- o agro-processing facilities and fishport complex as described in the Singconsult feasibility study; and
- o no action by USAID, but construction and operation of a fish port on the site would continue through Japanese funding.

1.2.6 Associated Projects

The General Santos Agro-Processing Complex (GSAPC) is only one component of the South Cotabato-General Santos City Special Development Project under the Philippine Assistance Plan. Other key components potentially funded by USAID include:

- o Makar Wharf expansion, rehabilitation, and improvements;
- o relocation of the municipal commercial airport to the Tambler area; and
- o construction of 276 km of provincial (farm-to-market) roads.

All of these key components are designed to improve market access for farmers and fishermen and help diversify the economic base of the region. The success of the South Cotabato-General Santos City Special Development Project depends in part on the successful implementation of all these components. Separate EAs will be prepared by USAID for each of these key components.

A second major donor program that may significantly alter General Santos City and its environs is the Philippine Urban Development Program initiated by the Asian Development Bank. General Santos City has been included among the seven communities

chosen for loans for infrastructure projects. Potentially included in this package would be major infrastructure construction projects for potable water supply, solid waste management, storm drainage, roads and bridges, and paved city streets.

Finally, private sector initiatives are underway to develop a regional industrial center near the Makar Wharf.

1.3 Relationship to USAID Policy

Key objectives of USAID policy in the Philippines include:

- stimulating market-based growth of the private sector by promoting improvements in policies and institutional framework;
- encouraging policy reforms to promote a more open economy;
- supporting more efficient delivery of essential public services, albeit with a low level of USAID resources; and
- promoting policy changes and programs in effective and sustainable natural resources management, focusing on biodiversity and forestry management (USAID 1990).

USAID resources under the MAI program are directed toward supporting infrastructure such as ports that are necessary for private sector growth and enhancing private sector involvement in more efficient and effective delivery of basic services.

USAID notes that widespread government involvement in agribusiness has adversely affected competition and efficiency (USAID 1990). Furthermore, natural resources have been and continue to be managed on a depletion basis, i.e, for short-term immediate yield rather than long-term sustainable yield. In response, USAID proposes goals and strategies that accelerate growth of the private sector in agriculture through increased reliance on open market competition.

Agro-processing facilities and a fishport at General Santos City will benefit farmers and fishermen by adding value to their products and will benefit the South Cotabato area through diversification of the job base. There is a danger, however, that the Government of the Philippines will play a large role in the operation and maintenance of these facilities, especially the

fishport, as there are questions about the economic viability of the project without government support (Singconsult 1990). USAID's policy is to discourage excessive government involvement in management of the facility. In one sense, USAID decisions to provide the necessary infrastructure for agro-processing facilities appears to be consistent with USAID efforts to expand opportunities for private sector investment. A project board, chaired by the Secretary of Agriculture, has been established by the Government of the Philippines and is meeting monthly to coordinate development activities in South Cotabato. Among the board members are regional directors of several governmental agencies, the provincial governor, the mayor of General Santos, and two representatives of private sector NGOs. The board is the entity responsible for protecting the investment and ensuring that the facilities are operated in an environmentally acceptable manner.

1.4 USAID Environmental Procedures

The proposed project is designed to stimulate and diversify economic opportunities in the region, therefore, it is expected to benefit the human environment. However, construction and operation of the facilities may modify other aspects of the environment, with potential adverse effects. In particular, the proposed project will modify existing land uses, alter or destroy existing habitat types, and generate wastewater discharges, air emissions, and solid waste. Therefore, USAID requires an EA on the proposed project.

USAID's environmental procedures are found in 22 CFR Part 216, and are further explained in the Agency's Handbook 3, Appendix 2D. These guidelines, which were adopted in 1976, formalize the agency's commitment to environmental considerations during the decision-making process leading to implementation or rejection of a project. Within the process, reasonably foreseeable environmental impacts are identified, and alternatives or mitigating measures are recommended.

For projects falling in various classes of actions (Sect. 216.2.d), either an Environmental Assessment (EA) or Environmental Impact Statement (EIS) will be required. The proposed Agro-Processing Facilities and Fish Port Complex is an industrial facility that is expected to generate large quantities of wastewater and air emissions. Thus, an EA or EIS is required for the proposed project.

An EA is defined by USAID as "a detailed study of the reasonably foreseeable significant effects, both beneficial and

adverse, of a proposed action on the environment of a foreign country or countries" (Sect. 216.1.c.4). It must be prepared when an EIS is deemed unnecessary according to criteria in Sect. 216.7.

An EIS is defined by USAID as "a detailed study of the reasonably foreseeable environmental impacts, both positive and negative, of a proposed AID action and its reasonable alternatives on the United States, the global environment or areas outside the jurisdiction of any nation as described in Sect. 276.7 of the procedures" (Sect. 216.1.c.5). It must be prepared when "agency actions significantly affect... (1) the global environment or areas outside the jurisdiction of any nation (e.g., the oceans); (2) the environment of the United States; or (3) other aspects of the environment at the discretion of the Administrator" (Sect. 216.7.a). In the case of (1) and (3) above, an EIS "will generally follow the CEQ Regulations, but will take into account the special considerations and concerns of AID."

Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions), with which Regulation 16 is consistent (Sect. 216.1.a), states that an EIS must be prepared "with respect to actions... significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the oceans or Antarctica)."

The proposed Agro-Processing Facilities and Fish Port Complex will include wastewater discharges to Sarangani Bay. Sarangani Bay is located well within the territorial waters of the Philippines. The proposed project is located near the head of Sarangani Bay (Figure 1-2), and it is extremely unlikely that any pollutant discharged from the proposed facilities or any other effect on the environment would extend to the "global commons outside the jurisdiction of any nation." Therefore, preparation of an EA for the Agro-Processing Facilities and Fish Port Complex is an appropriate fulfillment of USAID environmental procedural requirements. This conclusion is consistent with historical agency practice, e.g., a decision to prepare an EA for a municipal wastewater treatment plant with discharge to Suez Bay in Egyptian waters (State Cable 77708, 11 March 1990).

As part of preparation of the EA, scoping meetings were held in General Santos City on 24 January 1991 and in Manila on 5 February 1991. The purpose of the scoping meetings was to bring together all parties with an interest in the proposed Agro-Processing Facilities and Fish Port Complex to assist in identifying environmental issues that should be addressed by the EA. Participants were invited to voice their concerns,

questions, and comments regarding environmental aspects of the proposed project. Participants were further invited to submit comments in writing to the Mayor's office in General Santos City or to the office of Dames & Moore, USAID's contractor for the EA, in Manila. The scoping report and a list of attendees at the scoping meetings in General Santos City and Manila are attached as Appendix A.

1.5 Philippine Environmental Legislation

It is USAID policy to take necessary steps to ensure USAID projects comply with local laws and regulations. This assessment will address the wide range of environmental issues associated with the development of the Agro-Processing Facilities and Fish Port Complex in the context of Philippine regulations for environmental impact assessment.

Environmental legislation in the Philippines is best characterized as a complex maze of numerous legislative acts, Presidential Decrees, Executive Orders, and Letters of Instruction, many of which are outdated, contradictory, no longer relevant, or now unimplementable. The confusion and complexity comes in part from a practice of accumulative rulemaking, i.e., establishment of new laws and policies without revoking older regulations. Also contributing to the regulatory complexity is the practice of both legislative and executive branches of government to set policy and formulate regulations.

Presidential Decree (PD) 1121 created the National Environmental Policy Commission in 1977 and mandated assessment of environmental impacts of projects. The policy framework for environmental impact assessment was established by PD 1151, and the administrative system was established by Letter of Instruction (LOI) 549. In 1978, PD 1586 established the Environmental Impact Statement (EIS) System and reduced the types of projects subject to the EIS requirement to those located in environmentally critical areas.

Within this context, the National Environmental Protection Council (NEPC) was created under the Ministry of Human Settlements and empowered to protect, conserve, maintain, and enhance the environmental quality of the nation. The National Pollution Control Commission (NPCC) was also established under the Ministry of Human Settlements and charged with promulgating, enforcing, and monitoring noise, air, and water quality standards and issuing permits for pollutant discharge.

In 1981, Proclamation 2146 defined certain areas and types of projects as environmentally critical and therefore subject to an EIS. About the same time LOI 1179 established the Environmental Compliance Certificate System and provided for exemptions of projects from the EIS requirement upon recommendation of the proponent ministry. PD 2146 specified the following projects as environmentally critical:

- heavy industries;
- resource extraction industries, including fishponds; and
- major infrastructure project (dams, power plants, land reclamation, roads, and bridges).

PD 2146 also specifies the following areas as environmentally critical:

- all areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries;
- areas set aside as aesthetic potential tourist spots;
- habitats for endangered or threatened species of Philippine flora and fauna;
- areas of unique historical, archaeological, or scientific interest;
- areas traditionally occupied by cultural communities or tribes;
- areas subject to frequent and severe natural disasters;
- areas with critical slopes;
- areas classified as prime agricultural lands;
- recharge areas of aquifers;
- water bodies tapped for domestic purposes, within controlled or protected areas, or which support wildlife and fishery activities;
- mangrove areas with primary pristine and dense young growth, adjoining major river mouths, near traditional productive fry or fishing grounds, which provide

shoreline protection, or which provide primary source of livelihood for people; and

- o coral reefs with >50% live coral cover, used as spawning and nursery grounds for fish, or which act as natural breakwaters.

The Department of Environment and Natural Resources (DENR) was created in a reorganization of the Ministry of Natural Resources in 1987 (PO 192). This Presidential Order mandated a complete change from a collection of line agencies with environmental functions coordinated only at the ministerial level to an integrated agency overseeing environmental quality and planning (and forestry, land, and minerals management). Responsibility for oversight of the EIS System and noise, air, and water quality standards was placed on the Environmental Management Bureau (EMB) within DENR.

Under present practice, EMB staff in Manila is responsible for review and recommending certification of EISs by DENR. An Environmental Compliance Certificate (ECC) is issued when a project proponent has complied with the requirements of the EIS system.

An EIS is probably required for the proposed Agro-Processing Facilities and Fishport Complex under Philippine law because:

- o the fishport complex could be considered a major infrastructure project because it is a new port facility (an environmentally critical project), although the scale of development is not clearly qualifying as a "major" infrastructure project;
- o the project site is presently occupied by a few hectares of mangrove habitat which offer a degree of shoreline protection, and milkfish fry were historically harvested along the shoreline in the project area (an environmentally critical habitat); and
- o coral reefs are present along shore and act as nursery grounds for fish and provide a degree of additional shoreline protection (an environmentally critical habitat).

1.6 Approach to the Environmental Assessment

In the Philippines, the EIS System requires considerable more detail on project design than is normally required under

USAID regulations. The Philippine approach is predicated on impact assessment during a much more advanced project planning phase. The EIS format required by the Philippine EIS System is appropriate for a project after the project proponent has undergone considerable development of plans and facility design. Many key decisions and commitments must be made by the project proponent before preparing the EIS. There is, therefore, a fundamental difference in philosophical approach to impact assessment between the Philippine and US governments.

The EA for the General Santos Agro-Processing Complex (GSAPC) is being prepared with USAID funding in accordance with the US philosophical approach to impact assessment. In other words, the EA is occurring early in the planning stage, when the project is still in its conceptual design. In following the spirit and intent of its regulations, key decisions and commitments by USAID are pending the outcome of the EA.

This EA is being prepared in a format commonly used in the US, and which is suited to evaluation of a project while it is still in the conceptual stage of planning. The majority of topics required to be analyzed by EMB are found in this format, although not necessarily in the sequence or at the level of information expected in the Philippine EIS System. Under this approach, EMB would be able to comment on the impact analysis and provide approval to certain project components, while reserving judgment on other components until specific project proponents and proposals are identified for the agro-processing facilities. A project-specific EIS or Supplemental EIS could then be prepared by the project proponent to meet Philippine requirements. USAID could require as part of its post-EA decisions that certain policies or measures be required as bounds within which future projects could be proposed and developed at the site, thereby, ensuring that future projects are consistent with its environmental concerns.

DENR has issued an ECC in response to the draft EA. The ECC, along with comments and responses to comments on the draft EA, are included in this final EA as Chapter 9.

Chapter 2

PROPOSED FACILITIES AND ALTERNATIVES CONSIDERED

2.1 Overview of the Proposed Project

2.1.1 Options Evaluated

2.1.1.1 Alternative Project Sites

As summarized in Section 1.2.5, alternative sites have not been considered by USAID for the agro-processing facilities. The site, located approximately 12 km south of the built-up urban area of General Santos City, was selected by the Department of Agriculture for development of agro-processing and fish processing facilities as part of the Government of the Philippines' effort to establish priorities for the Philippine Aid Plan.

In preparing the Draft EIS on the DPWH Master Plan for the fish port, Total Consultancy Services (1991) briefly considered alternative site locations at Lion Beach and Makar Wharf. Lion Beach is the existing fish landing site for municipal and small-scale fishermen, and is the waterfront of the urban core of General Santos City (Barangay Dadiangas). Lion Beach is currently congested, and inadequate sanitary facilities give rise to public health concerns. The lack of adequate space was considered a major impediment to selection of this site. Makar Wharf serves the international and inter-island shipping industry. The wharf is currently also a congested area, necessitating on-going plans to expand to meet large-scale commercial shipping needs. The Draft EIS concluded that location of the fish port near Makar Wharf would only aggravate congestion problems.

2.1.1.2 Alternative Project Plans

Singconsult, a planning firm under contract to the Department of Agriculture with funding from the Government of Singapore, conducted field studies, consulted with local officials in General Santos City, and prepared a feasibility study (Singconsult 1990) for the proposed agro-processing facilities. Singconsult incorporated into its preliminary master plan for the agro-processing facilities a feasibility study and preliminary master plan for fishing port facilities on the site.

The Singconsult design includes a tuna cannery and berthing facilities for purse seiners (Section 2.3.1).

A fishport facilities plan (Pacific Consultants International 1990) was developed simultaneously by DPWH with Japanese funding. There are, therefore, alternative master plans for the fishport complex, but not the agro-processing facilities.

These alternatives for the fish port are described in further detail in Section 2.3. In addition, based on the findings of this EA, there are a few minor modifications to the Singconsult Master Plan for the fish port and agro-processing facilities that are included in this EA as part of the proposed action. These are discussed in Sections 2.3, 2.9, and 2.11.

Under both US and Philippine regulations, the environmental impact assessment must include an evaluation of impacts without the project. Therefore, a third alternative is the "no-action" alternative, i.e., a decision by USAID to not fund construction of the agro-processing facilities. Under this scenario, however, Japanese funding of construction of the fish port could continue.

In summary, the following alternatives are considered in this EA:

- agro-processing facilities as described in the Singconsult feasibility study with minor modifications, and fishport complex as described in the DPWH master plan (the proposed project);
- agro-processing facilities and fishport complex as described in the Singconsult feasibility study; and
- no action by USAID.

2.1.2 Proposed Project

As summarized in Section 1.2, USAID is proposing to fund the construction of the infrastructure for an Agricultural Processing Complex in General Santos City, South Cotabato as part of its commitment under the Multi-Lateral Assistance Initiative (Philippine Aid Plan). In addition to USAID's interest in construction of the General Santos Agro-Processing Complex (GSAPC), the Government of Japan is interested in funding construction of a fishing port on the same project site. It is anticipated that a fish port and agro-processing facilities can be compatible on the site.

Although USAID is interested in funding construction of the agro-processing complex, no project proponent has yet been identified with a specific proposal for a processing facility on the site. At this stage of project planning and development, USAID funds would be used to proceed with site preparation and development of basic infrastructure for agro-processing facilities once a developer has decided to construct and operate a processing facility on the site.

The remaining sections of this chapter (Sections 2.2-2.13) describe in greater detail key components of the proposed project.

2.1.3 Timing and Duration

Once USAID has reviewed the EA, it will decide whether to continue with the project as currently proposed or as modified in response to environmental issues, or to decline further participation in the project on environmental grounds.

If a private sector project proponent decides to build and operate a processing facility on the site and USAID decides to continue with the project, the agency will begin to prepare the necessary bid documents for design and construction of the agro-processing facility complex. This process to contract award may take 6-9 months. Upon contract award, an additional year would be required to put the necessary infrastructure into place.

DPWH has solicited pre-qualification packages from potential construction contractors for the fish port and has prepared an EIS under Philippine regulations. The ECC has been issued for the project (Chapter 9). Funding has not yet been approved by the Japanese government. DPWH expects construction of the fishing port will begin in Fourth Quarter 1992, and be completed in 3 years (Encarnacion pers. comm.).

Coordination of planning and construction of the fish port proposed by DPWH and the infrastructure for the agro-processing facilities proposed by USAID will occur through the project board which has been established by the Government of the Philippines. It is not yet clear how the various infrastructure components will be merged into a functional, integrated site complex. Coordination will occur once Japanese funding is approved and a developer proposes a processing facility for the site. Once these occur, USAID will determine whether to proceed with the project and under what conditions.

There are no plans for abandonment of the site. The fishing port is expected to be a permanent structure, with repair and maintenance as required provided by the Government of the Philippines. The life expectancy of the agro-processing facilities will be driven in part by the market demand for the products and in part by the care taken in the design, construction, and maintenance of the facilities by private sector project proponents.

2.2 Plant Siting

The GSAPC site is a 32 ha parcel located on the western shore of Sarangani Bay at 06° 02'00" North Latitude and 125° 08'25" East Longitude (Figure 2-1). Sarangani Bay is on the southern margin of the island of Mindanao, and opens southward into the waters of the Celebes Sea.

Administratively the site is in barangay Tambler within the city limits of General Santos City, approximately 12 km south-southwest of barangay Dadiangas, the urban core of General Santos City. The city is located in South Cotabato province, which administratively is part of the national government's Region XI.

The site will be occupied by two distinct functional processing units: the fishing port complex and the crops processing complex. The Singconsult (1990) Master Plan proposes a third distinct unit, a livestock processing complex, located across the national highway from the site, perhaps between the north boundary of the site and the south bank of the Banwalan River channel. These three functional processing units are described in the following subsections.

2.3 Fishing Port Complex

Two alternative designs and master plans have been proposed concurrently for the fishing port complex. One plan is based on a feasibility study conducted by Pacific Consultants International (1990) for the Department of Public Works and Highways (DPWH) with funding from the Government of Japan. The other plan is based on a feasibility study carried out by Singconsult (1990) for the Department of Agriculture with funding from the Government of Singapore. In the former case, the fishing port would be constructed by DPWH with Japanese funding. In the latter case, the fishing port would be constructed under US government contract with USAID funding. In either case, responsibility for managing the fish port once construction is

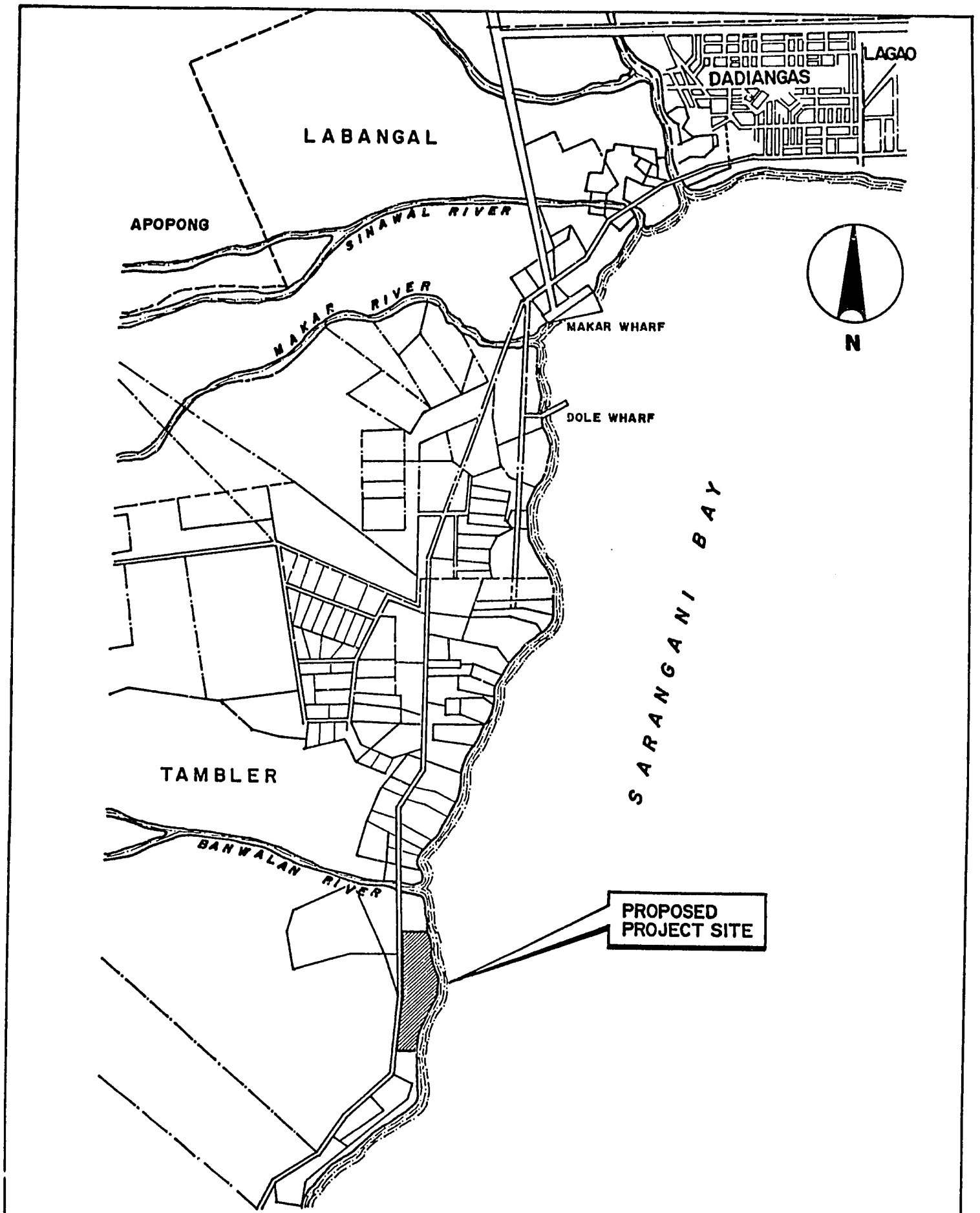


Fig. 2-1 PROPOSED PROJECT SITE

Dames & Moore

completed would be delegated to the Philippine Fisheries Development Authority (PFDA) of the Department of Agriculture.

2.3.1 DPWH Proposal

The DPWH proposal for the fishing port is currently the proposed action for these facilities.

Under contract to DPWH, Pacific Consultants International (1990) prepared a Master Plan for nine fish ports in the southern Philippines, including a fish port on the Tambler site in General Santos City. Basic fish port facilities for General Santos City that were proposed by the 1990 DPWH Master Plan included:

- a reinforced concrete wharf consisting of a 375-m long landing wharf with 1995 handling capacity of 38,000 mt of fish, a 280-m long preparation wharf, and a 253-m long lay-by wharf;
- an armored rock breakwater with a design wave height of 1.14 m from the SSE and a frequency period of 3.4 sec; and
- navigation aids consisting of two light beacons at the end of each of the breakwaters.

Other facilities proposed by the 1990 DPWH Master Plan at the fish port include:

- a refrigeration building consisting of
  - a 30 mt/day capacity ice plant and 10 mt ice storage,
  - four 270-kg capacity contact freezers,
  - a 240 m^2 processing room, and
  - a 60-mt cold storage facility with ammonia refrigerant;
- 5,025 m^2 fish market with a 5,800 m^2 parking area for fish buyers and their trucks;
- 420 m^2 administration building;
- maintenance shop;
- fish gear mending shed;
- fish container storage;

- public toilet;
- guard house; and
- dormitory and guest house.

The fish port facilities proposed by DPWH include a 700 m^3/day fresh water supply system using spring water on the site, sanitary system, drainage system, power supply, and communication system. The 1990 DPWH Master Plan proposes that effluent from septic tanks will be co-mingled with storm drainage and wash water collected by the drainage system before discharge to the sea at mean lower low water (MLLW). The draft EIS prepared for DPWH, however, proposes improvements to the wastewater treatment system for the fish port (Section 2.9.2), and DPWH will be considering the consultant's recommendations.

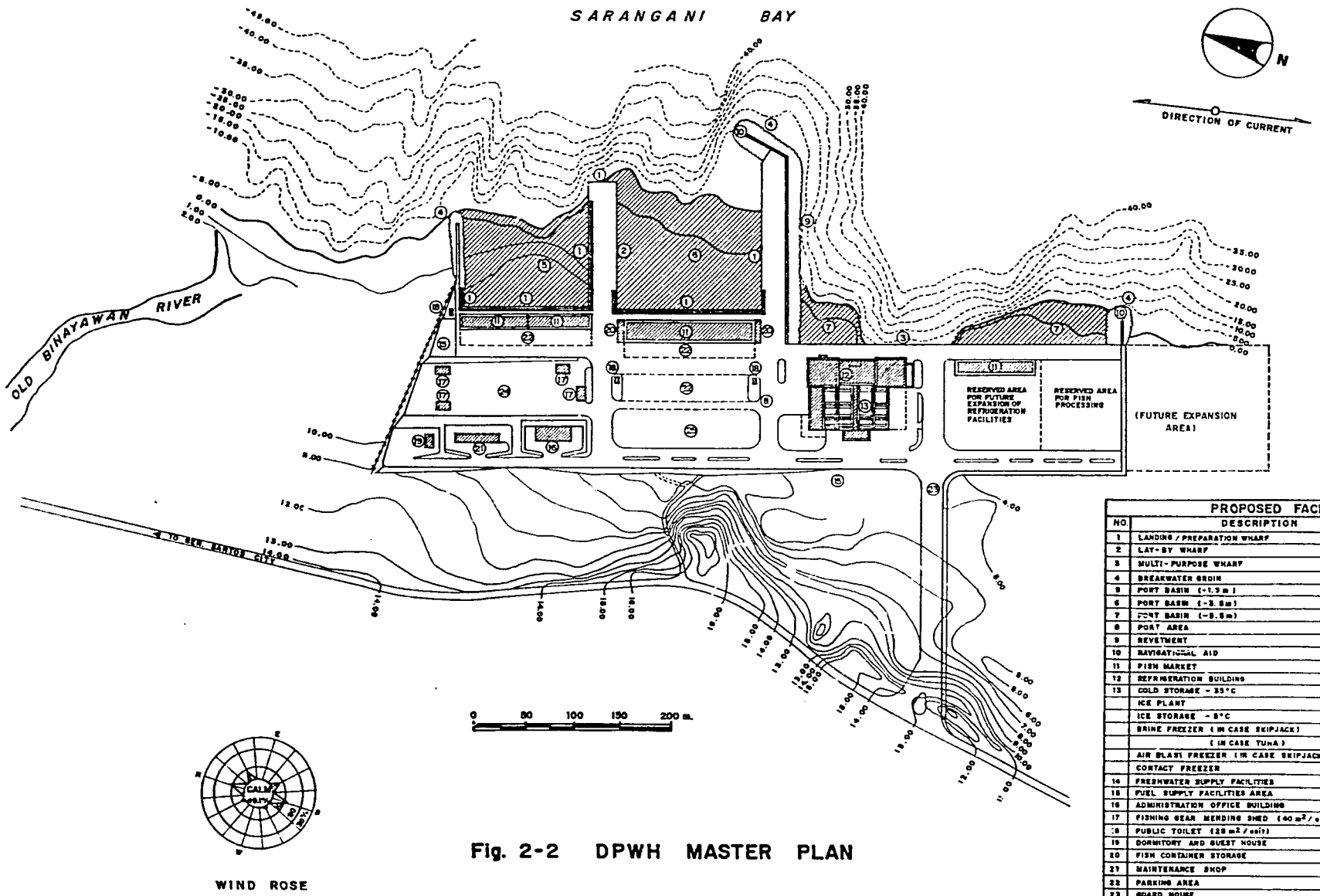
The DPWH 1990 Master Plan for the fish port includes areas set aside for potential construction of canneries, fish meal production, or other fish processing facilities that may be undertaken in the future by the private sector to take advantage of the existence of the fish port. Approximately 6,000 m^2 is also set aside for commercial shops, including potentially banks, vendors of fishing supplies and provisions, and eateries.

Since the 1990 DPWH Master Plan was prepared, DPWH modified the proposed project to include a purse seiner wharf. The most recent version of the proposed fishport project is shown in Figure 2-2.

2.3.2 Singconsult Master Plan

Since the draft EA was prepared, the Singconsult final report was submitted with modifications to the dock and wharf facilities and minor rearrangement of ancillary shore-based support facilities. The layout of the dock and wharf facilities as shown in the final Master Plan are shown in Figure 2-3 in this final EA. Rearrangement of some of the ancillary support facilities is not included in Figure 2-3. Thus, Figure 2-3 indicates the concept, but not the final details, of the Singconsult final report.

The Singconsult (1990) Master Plan incorporates three distinct fish landing areas designed to accommodate the needs of three separate fisheries: the sashimi tuna fishery, the municipal fishery, and the deep sea commercial fishery. Most of the 1.2 km shoreline of the site is dedicated to fish landing and boat handling facilities (Figure 2-3), whereas the DPWH plan occupies



WIND ROSE

Fig. 2-2 DPWH MASTER PLAN

PROPOSED FACILITIES		
NO.	DESCRIPTION	QUANTITY
1	LANDING / PREPARATION WHARF	620 m
2	LAY-BY WHARF	130 m
3	MULTI-PURPOSE WHARF	300 m
4	BREAKWATER GROIN	140 m
5	PORT BASIN (-1.5 m)	1.1 ha
6	PORT BASIN (-3.5m)	1.9 ha
7	PORT BASIN (-5.5m)	0.9 ha
8	PORT AREA	12 ha
9	REVETMENT	195 m.
10	NAVIGATIONAL AID	2 units
11	FISH MARKET	4,800 m²
12	REFRIGERATION BUILDING	7,439 m²
13	COLD STORAGE - 35°C	1,500 ton
	ICE PLANT	60 ton/day
	ICE STORAGE - 5°C	30 ton
	BRINE FREEZER (IN CASE SKIPJACK)	40 ton/day
	(IN CASE TUNA)	10 ton/day
	AIR BLAST FREEZER (IN CASE SKIPJACK)	8ton/unit/2units/day
	CONTACT FREEZER	270kg/shift x 4 units
14	FRESHWATER SUPPLY FACILITIES	700 m³/day
15	FUEL SUPPLY FACILITIES AREA	1,000 m²
16	ADMINISTRATION OFFICE BUILDING	420 m²
17	FISHING GEAR MENDING SHED (40 m²/unit)	4 units
18	PUBLIC TOILET (25 m²/unit)	3 units
19	DORMITORY AND GUEST HOUSE	140 m²
20	FISH CONTAINER STORAGE	280 m²
21	MAINTENANCE SHOP	380 m²
22	PARKING AREA	7,900 m²
23	GUARD HOUSE	20 m²
24	NET MENDING YARD	10,000 m²
25	COMMERCIAL SHOP AREA	6,000 m²

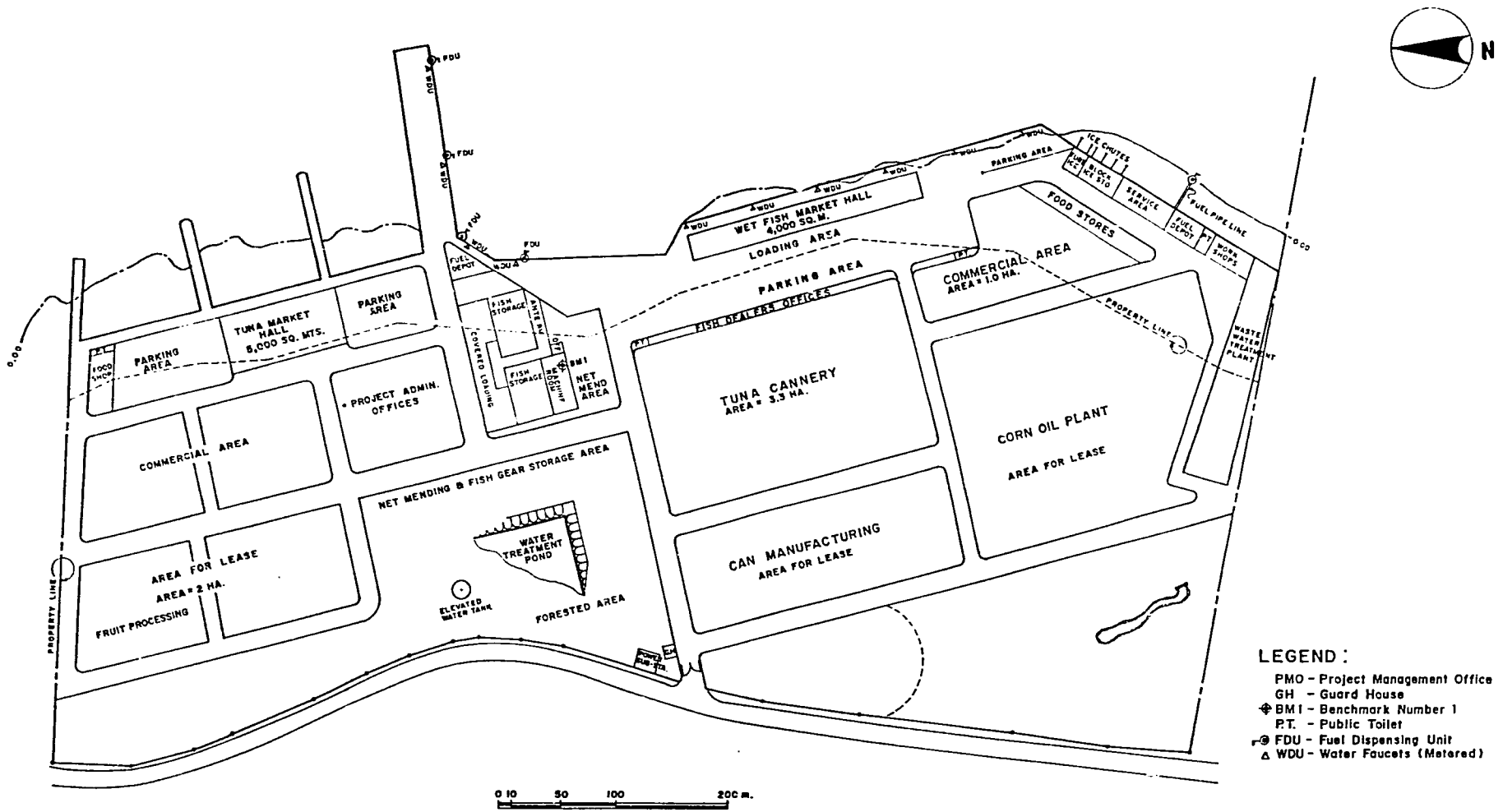


Figure 2-3. SINGCONSULT MASTER PLAN

only the northern sector of the site (Figure 2-2). From north to south these facilities are:

- a tuna landing quay for the sashimi fishery;
- a purse seiner wharf for commercial tuna boats; and
- a wet fish landing quay for the municipal and artisanal fishermen.

The tuna landing area will comprise docking and landing jetties that will accommodate 35 outrigger fishing boats of up to 4 gross tons, and a 5,000 m^2 fish auction hall. The fish auction hall is designed for a capacity of 300 people during fish auctions and includes space for scales, temporary storage, and packing tuna for shipment. Two flake ice makers, with a combined capacity of 30 mt/d, and a flake ice storage room will also be provided.

The purse seiner landing will have a 365 m wharf that will accommodate up to six vessels of between 300 and 2,000 gross tons, a 5,000 ton cold storage chamber, and a 10 ton capacity blast freezer.

The wet fish landing facilities will comprise a 215 m long stepped quay to accommodate up to 60 outrigger fishing boats, a 4000 m^2 fish market hall, and broker offices. An additional 100 m long stepped quay will provide access to a service area.

Ancillary support facilities common to the three fisheries include:

- a bonded warehouse, with four sub-units, and a combined storage of 10,000 m^3;
- a block ice plant with production capacity of 50 mt/d and storage capacity of 200 mt;
- a nugget ice plant with output of 100 mt/d;
- 2 fuel depots with dockside supply facilities;
- fishing gear and instrument repair facilities; and
- two seawater pumphouses to supply seawater for washing seafood, facilities, and equipment.

2.3.3 Modified Singconsult Master Plan

In the unlikely event that USAID proceeds with construction of the fishport complex at the site, consideration should be given to the following modifications as part of the proposed action:

- deletion of the purse seiner docking facilities; and
- deletion of the seawater pump houses.

Purse seiners are likely to service only the tuna canning industry, and not the sashimi industry. Tuna canneries already are located in Sarangani Bay, and they are processing primarily juvenile tuna (Chapter 3). If purse seiner docking facilities were economically attractive in Sarangani Bay, it is expected that existing canneries would construct them. USAID provision of purse seiner docking facilities is undesirable for two reasons: 1) USAID would be encouraging non-sustainable exploitation of the tuna stocks by the purse seiner fleet currently operating out of General Santos; and 2) USAID would be encouraging public sector competition with existing private sector enterprises.

Deletion of the seawater pump houses is recommended because this water would be used primarily to wash down equipment and floors in the auction halls, fish markets, and other fish processing facilities. This wash water potentially will have a significant organic load from fish body fluids and tissue scraps, and should not be directly discharged to the sea without treatment. Large quantities of seawater are undesirable in a wastewater treatment facility because of the corrosive effect and its ability to interfere with the treatment process.

2.4 Livestock Complex

A project proponent has not yet been identified for the livestock processing complex. The following facilities are assumed by the Singconsult (1990) Master Plan, based on a feasibility study that considered market conditions. It is not yet known whether these facilities would be built in the configuration considered by Singconsult, nor is it known if the land is available on the site proposed by Singconsult, although the owner has expressed an interest in selling the land.

The livestock complex is expected to include two abattoirs (slaughterhouses), meat processing and bone meal plants, a feed mill, and a wastewater treatment plant (WWTP). Except for the feed mill, which could be located on the 32 ha site, the

livestock processing facilities will be located offsite, perhaps west of the national highway between the north boundary of the 32 ha site and the south bank of the Banwalan River channel (Figure 2-4).

The Singconsult (1990) Feasibility Study assumes that one of the abattoirs will have the design capacity to process 1,000 hogs per day. The other abattoir would be fully mechanized to process cattle, carabao, and goats, with a design capacity of 100 head of cattle/day and 50-100 goats/day. Both abattoirs would be designed and operated to meet Grade AA export standards.

It is assumed that the meat processing plant would be designed to produce a wide variety of meat products in response to market demand, including fresh and frozen carcasses, meat cuts, and processed meats. Facilities would include production of market products such as beef tapa, corned beef, sausages, and meat balls.

The meat and bone meal plant would utilize animal waste and byproducts to produce protein meal and fats that will used in turn in the feed mill to produce livestock feed. The livestock feed mill would be designed for a capacity of 20 mt/hr feed production.

Further discussion of the proposed WWTP for the livestock complex is deferred to Section 2.9.

2.5 Crops Processing

Project proponents have not yet been identified for crops processing facilities. The following facilities are assumed by the Singconsult (1990) Master Plan, based on a feasibility study that considered market conditions. It is not yet known which, if any, of these facilities would be built, by whom, or whether in the configuration assumed by Singconsult.

Singconsult (1990) assumes that crops processing facilities will include a plant for processing a variety of fruit and vegetables, a vegetable oil extraction plant, and an activated carbon plant. A can manufacturing plant was also considered in conjunction with a prospective tuna cannery on the site (Figure 2-3).

The fruit and vegetable processing plant is assumed to have three production lines: chip making; dehydration; and canning and bottling. Banana chips in particular would be processed on the chip line using existing local technology at a capacity of

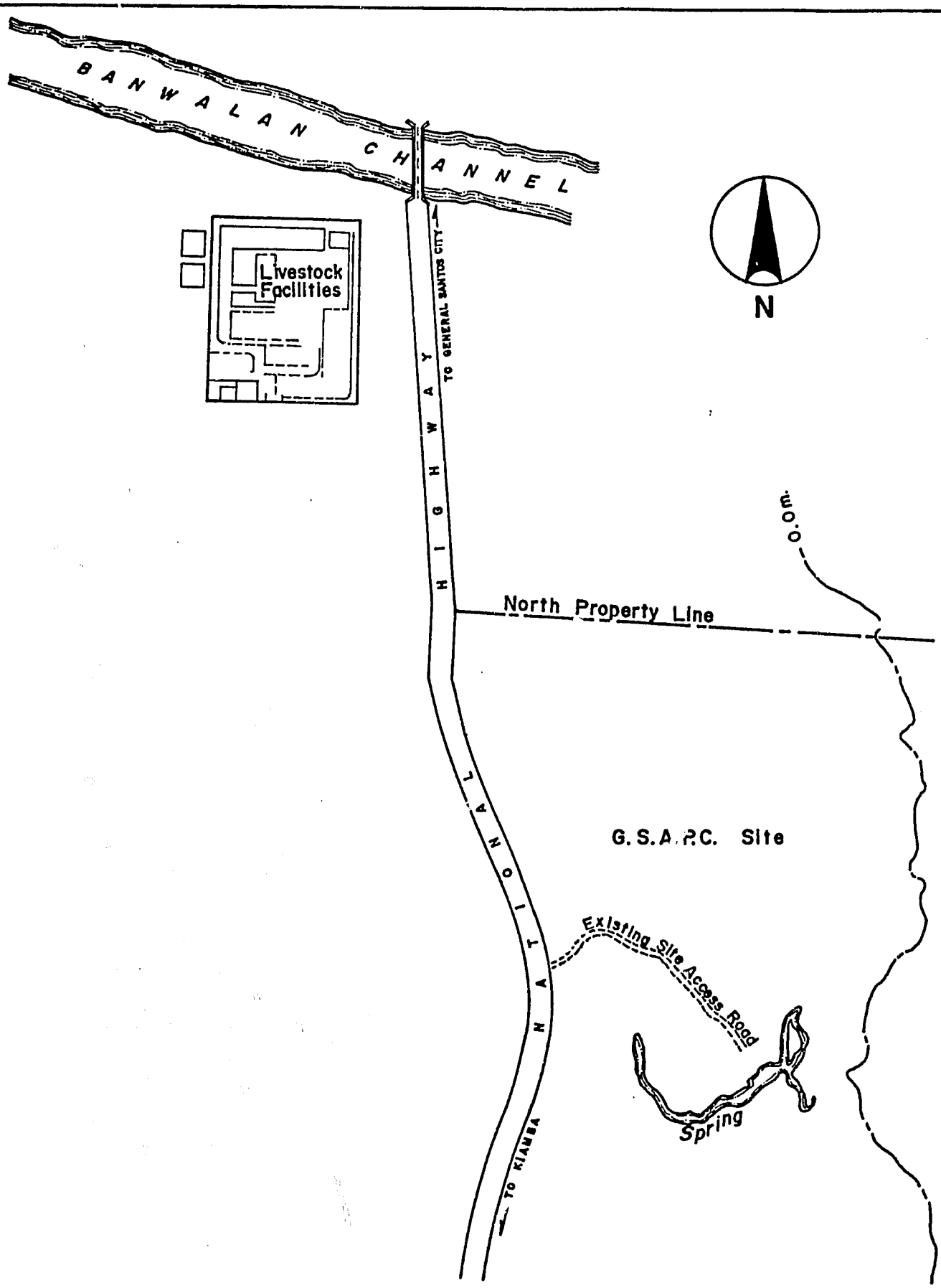


Fig. 2.4 PROPOSED LOCATION OF LIVESTOCK PROCESSING FACILITIES

Dames & Moore

5 mt/d. The fruit dehydration line is assumed to entail two processes: a) confectionery drying of mango, banana, jackfruit, pineapple, papaya, and calamansi; and b) flour drying of bananas and potatoes. The assumed capacity of the dehydration line is 5 mt/d. The canning and bottling line would process mango, papaya, and asparagus at a design capacity of 5 mt/d.

A vegetable oil extraction plant is assumed to have a design capacity of 50 mt/d of edible vegetable oil derived from corn and soya beans, and perhaps other oil-bearing seeds. The extraction plant will operate on a flexible schedule depending on market demand for the product and availability of feedstock. Marketable by-products of the oil extraction plant are assumed to include corn bran, de-oiled corn grain, soybean meal, and fatty acid oil.

The activated carbon plant is a prospective facility that is expected to be built at an unspecified location offsite. If constructed, it would produce activated carbon for the export market from carbonized coconut shells (or coconut shell charcoal). The plant is assumed to produce up to 5,000 mt/yr of activated carbon from 20,000 mt of feedstock (or about 50% of estimated available supply).

2.6 Support Infrastructure

The support infrastructure for the site would include roads and utilities, administrative facilities, and facilities for commercial services such as restaurants, banks, and vendors of fishing supplies and equipment. The facilities offered by the Singconsult (1990) Master Plan are more comprehensive than the DPWH Master Plan as the former are designed to meet the needs of both a fishport complex and the agro-processing complex on the 32 ha site. The site infrastructure and support facilities recommended by the DPWH Master Plan (Pacific Consultants International 1990) are designed only to meet the needs of the fish port.

It is not yet clear which infrastructure facilities will be built. Although the project board will be responsible for coordination of planning and construction, decisions await Japanese approval of funds for the fish port and an agro-processing project proposal from a developer.

Under the terms of the Singconsult (1990) Master Plan, roads on the site will be constructed of 20-cm thick concrete. The main road leading into the site from the national highway to the waterfront will be 20-m wide, with a 1-m wide median strip, and approximately 1,180 m long. Approximately 2,930 m of 8-m wide

secondary roads will be constructed on 15 m rights-of-way (Figure 2-3).

Singconsult (1990) proposes a 2.9 million liter/day (l/d) water supply system, of which 60% of the total would be reserved for the prospective abattoir (0.76 million l/d) and tuna cannery (1 million l/d). The proposed water source is the spring on the approximate center of the site, which has a dry season flow of 5.8 million l/d (241 m^3/hr). The proposed delivery system would have a peak pumping rate of 182 m^3/hr, or 70% of dry season flow at the spring. Potable water treatment would consist of filtration, chlorination, and pH adjustment.

The Singconsult (1990) plan proposes a wastewater treatment plant (WWTP) on-site for the agro-processing and fishing port facilities, and a separate WWTP for the abattoir and livestock processing facilities (Section 2.9).

Substantial improvements in operation and effects of discharge on the environment can be achieved by modifying the proposed WWTP system for the two sites. These modifications are discussed in greater detail in Section 2.9, and are considered in this EA as the proposed action.

Singconsult (1990) recommends dividing the 32-ha site into seven separate catchment areas for stormwater drainage, with separate drainage discharge to Sarangani Bay. The drainage systems would be designed to prevent flooding during heavy rains and to manage flow remaining in the springs below the diversion to the water supply system.

Singconsult (1990) estimates that electricity load demand of the site, with the agro-processing facilities that were considered in the Feasibility Study, would be 8.5 kVA, of which 1 kVA is set aside for a prospective tuna cannery. To meet this demand, a 69 kV transmission line would carry electric power to the site. A telephone trunk line would be installed with a capacity of 200 telephone lines.

The Singconsult (1990) Master Plan proposes that the administrative functions for the fish port and the agro-processing facilities be combined under one roof. Therefore, the administrative building would include:

- a 1,250 m^2 administration building (although the plan also refers to a 1,500 m^2 building);
- parking lot for the administrative staff and visitors;

- a 200 m^2 laboratory available for both administrative use (water quality analyses) and providing service to food processors;
- a motorpool building consisting of four 60 m^2 bays; and
- a guest house and dormitory building, with 5 bedrooms in the guest house for managerial staff and 10 2-bed rooms in the dormitory for support staff.

The Singconsult (1990) Master Plan also proposes commercial facilities for the site adequate for both the fish port and the agro-processing center. Requirements for commercial facilities are predicated on 3,500 people on site during fish landings and an additional 500 employees in the various agro-processing plants. To meet this demand, Singconsult proposes a 1,275 m^2 commercial complex near the tuna market hall near the north end of the site, and a 1,610 m^2 commercial complex towards the south end of the site.

Finally, Singconsult (1990) proposes construction of three public toilet facilities, as well as the appropriate number of toilets for administrative staff and employees in the processing facilities.

2.7 Construction Activities

To accommodate deeper draft vessels, part of the fish port harbor as proposed by DPWH (Pacific International Consultants 1990) will be dredged to a depth of 3.5 m, whereas the rest will be dredged to a depth of 1.5 m, for a total dredging volume of 116,500 m^3. Dredge spoils will be disposed of in deep water, presumably close by in Sarangani Bay. Although 3.8 ha of marine habitat will be reclaimed (filled) under the DPWH plan to a height of +3 m, requiring a fill material volume of 58,000 m^3, the dredge spoils are not suitable as reclaim material (Pacific Consultants International 1990).

The Singconsult (1990) Feasibility Study and Master Plan proposes that the site be re-graded in approximate 2 ha blocks of land to an elevation either 3 m or 6.5 m above mean lower low water (MLLW). Thus, the topography of the present site would be re-contoured into two platforms (terraces) for development.

Once site preparation is completed, roads, water supply and delivery, wastewater treatment, storm drainage, electrical service, and communication systems will be installed.

Detailed soil investigations are recommended by Singconsult (1990) for each building before detailed engineering design occurs. Generally, sites which are currently at an elevation below 5 m are susceptible to liquefaction, and buildings and facilities on this part of the 32-ha site may need to be supported by pilings. Buildings and structures may be placed on pad footings in areas which currently are above 5 m elevation.

2.8 Facility Operations and Management

The objective of the proposed organization framework for the GSAPC is to combine the mandates and interests of national government agencies, local government, non-governmental organizations (e.g., cooperatives), and private sector industries. Under the Singconsult (1990) Master Plan, the GSAPC would be managed by a newly established operating division of the PFDA. A governing board, comprised of at least 50% private sector and non-governmental organization (NGO) representation, would be established under the new PFDA division. The fishing port would be operated directly by the GSAPC Board, while the agro-processing facilities would be leased out to private sector companies.

Under the management organization recommended by Singconsult (1990), the site would be managed by a General Manager who will direct the activities of six division heads. In the continued absence of coordination between DPWH and USAID, it is presumed that two completely different managers and administrative facilities will be established for the fish port complex and the agro-processing complex.

Singconsult (1990) recommended that the major components of the GSAPC be constructed and operated as follows:

- The fishing port, ice plant, cold storage, and bonded warehouse would be built and operated by the Government of the Philippines (DPWH for construction, and PFDA for operations).

- The meat processing plant, feed mill, vegetable oil extraction plant, and fruit and vegetable processing plant would be built by the Government of the Philippines and leased out to the private sector.

- The abattoir and meat processing facilities would be built by the Government of the Philippines and managed by the private sector.

It is assumed that USAID funding would be provided for the basic infrastructure and selected components of the agro-processing (crop and livestock) facilities.

2.8.1 Safety Measures

Hexane is used in corn oil production to separate the oil from the corn germ. It is potentially toxic and flammable, but is not considered a priority pollutant under US government (US Environmental Protection Agency) regulations. The flashpoint of hexane is -26°C. Although it is expensive and can be cycled for reuse, care should be taken to monitor for leakage from the processing system and ensure that full ventilation is provided in the vicinity of hexane use.

2.8.2 Environmental Protection Measures

2.8.2.1 Singconsult Master Plan

The Singconsult (1990) Master Plan recommends that contractors be required to stabilize slopes and carry out erosion control measures during construction. Dust control measures and use of appropriate and functional engine mufflers is also recommended to minimize air quality and noise impacts during construction.

Although much of the site is expected to be re-contoured as part of site preparation, the Singconsult (1990) Master Plan recommends that construction contractors minimize the removal of trees and vegetation on the site to the extent practical, with judicious use of existing and natural vegetation in landscaping. The Singconsult plan encourages immediate re-vegetation of re-contoured land that is not immediately slated for development in order to minimize erosion until construction of buildings or other facilities commences on the lot.

Wastewater treatment plants are being proposed to serve the fish port and agro-processing facilities (Section 2.9).

The City anticipates constructing 5,000 low-cost housing units in Tambler in the project vicinity. If not properly sewered, this new community has a high probability of contaminating groundwater, as septic tanks are not suitable in karst geological formations. Furthermore, the Singconsult (1990) Master Plan assumes that sludge from the WWTPs and solid wastes will be hauled away and disposed of by local authorities in appropriate sites or sanitary landfills. These currently do not

exist in the General Santos City area. These wastes are also likely to contaminate groundwater wherever they are ultimately deposited.

2.8.2.2 DPWH Master Plan

The following paragraph quoted from the DPWH Master Plan (p. 10-14) constitutes the DPWH-proposed environmental protection measures.

> "Embankment and catch basins will be provided in the fuel depot to prevent leaks/spillage of oil and in the boats fishermen should bring with them containers where they could place the spent oil and oil waste and then discarded in the port. Waste water and wash water in the complex will be sewered and treated before it is discharged into the receiving water. Solid waste generated at the complex and in the boats will be collected and burned at the port. Fish discard will be collected and will used as source of protein for animal feeds and agriculture. Aside from the mitigation measures strict implementation of pollution laws will be undertaken and also the housing rules and regulations to prevent the creation of slums."

Elsewhere in the DPWH Master Plan (Pacific Consultants International 1990), however, the location or design of fuel depots, disposal facilities for waste oil, solid waste disposal, or processing of fish scraps into usable products are not addressed.

2.8.3 Contingency Plans

At the present time, no contingency plans have been developed.

2.9 Wastewater Treatment Alternatives

The purpose of wastewater treatment works is to remove pollutants to such an extent that the treated effluent will meet DENR water quality standards for effluent and receiving water. Both the process of removing objectionable matter from the wastewater and the final effluent disposal must be accomplished in an environmentally acceptable manner.

The design of a wastewater treatment plant (WWTP) is based on the expected volume and chemistry of raw wastewater and the required effluent limitations. The initial design step, after probable wastewater influent characteristics and effluent limitations have been determined, is to tentatively select alternative treatment processes to be used at the available site.

2.9.1 Selection of Treatment Process

The treatment alternatives for wastewater fall into three major categories: primary treatment; secondary treatment, and advanced (tertiary) treatment. The major role of primary treatment is to remove from the wastewater those pollutants which will settle (suspended solids) or float (such as oil and grease). The major goal of secondary treatment is to remove a large fraction of the soluble organics which exert a biochemical oxygen demand (BOD) in the water column. This fraction of the organic load escapes the primary process, and secondary treatment provides added removal of suspended solids. Secondary treatment may remove 85 to 95% of BOD and suspended solids. It will not remove significant amounts of nitrogen and phosphorus, nor does it completely remove pathogenic bacteria, viruses, or eggs of intestinal parasites (helminths). These latter pollutants may require further (tertiary) treatment where receiving waters are especially sensitive, which is not the case with Sarangani Bay. Therefore, advanced treatment is not considered here.

2.9.1.1 Primary Treatment

Primary treatment includes the use of septic tanks or other methods for settling solids or removing oil and grease. Septic tanks require periodic maintenance to remove the settled solids. Because the effluent from the agro-processing center and livestock processing facilities has very high organic content as measured by biochemical oxygen demand (BOD), primary treatment is not environmentally appropriate and not adequate for meeting DENR water quality standards.

2.9.1.2 Secondary Treatment

The secondary treatment processes, commonly used for the biological treatment of organic-rich waste flows, include the following:

- anaerobic lagoons;
- aerobic (aerated) lagoons;
- high rate trickling filter;
- rotating biological disks; and
- activated sludge process.

All of these treatment plant processes are capable of achieving BOD reductions of 75 to 95% and suspended solids reductions of 80 to 95 percent. Each of these systems has advantages and disadvantages.

Anaerobic lagoons function extremely well when the wastes have the desired characteristics. The disadvantages of this process are:

- The high permeability of the soil around GSAPC will not allow this type of installation anywhere near the GSAPC site, without prohibitively expensive liners.
- The facility must be located at least 1 to 2 km downwind of any residential area to avoid odor problems.
- BOD reduction will only be around 60 to 70 percent, which will be too low for the GSAPC.

Aerobic lagoons are designed for detention times of 2 to 10 days, the higher detention time being applicable to meat packing wastes. Aerated lagoons treating meat-packing wastes will normally achieve an average BOD reduction of 60 to 70 percent. The disadvantages of aerated lagoons are similar to those listed above, with the exception of odor, which is normally not associated with aerated lagoons, provided the lagoon contents are properly mixed. Energy costs of aeration are also quite high.

Under a trickling filter treatment system, the incoming raw wastewater undergoes primary clarification. The trickling filter then replaces the mechanical aeration step employed in extended aeration. To achieve the required BOD reduction, secondary clarification must also be employed. Disadvantages are:

- odor problems associated with the trickling filter operation;
- high initial cost;

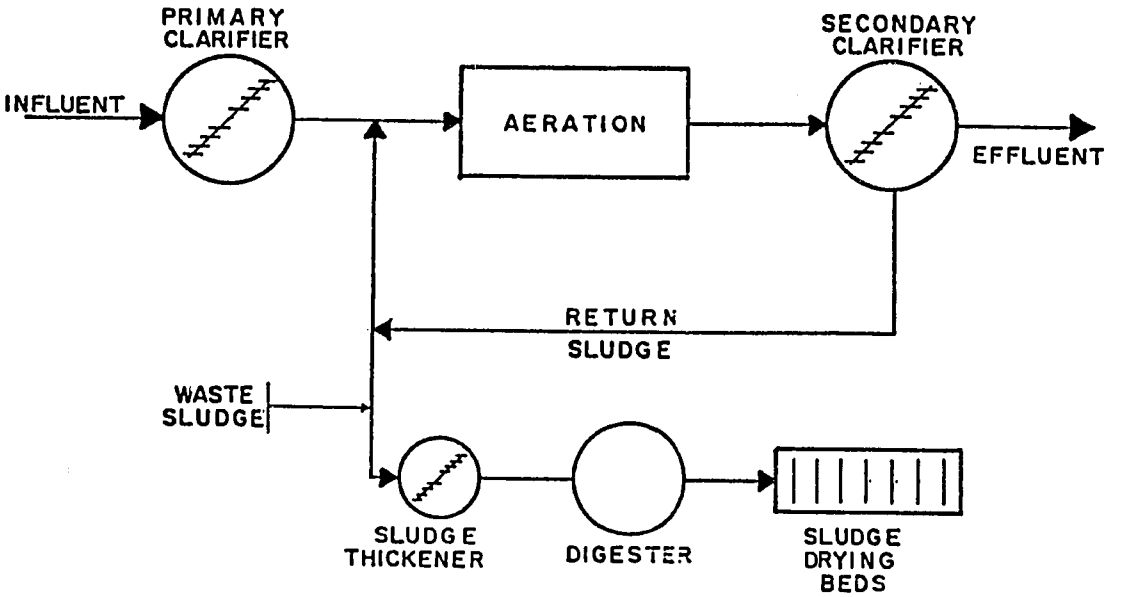
- requirement for primary clarification and sludge digestion; and
- difficult to operate and maintain.

Rotating biological disks have been employed for treatment of meat processing wastes for the last 20 years. In the Philippines, Purefoods installed this system to treat their wastewater around 15 years ago. The rotating disks system consists of large diameter, lightweight plastic disks, mounted on a horizontal shaft and placed in a semi-circular tank containing wastewater. Organisms present in the wastewater adhere to the disks, multiply, and use oxygen to reduce the organic matter in the wastewater. The disadvantages are:

- primary treatment is required either by lagoons or primary clarifier;
- rotating disks have to be installed under a roof;
- operation and maintenance is difficult; and
- high initial cost and high maintenance cost caused by corrosion.

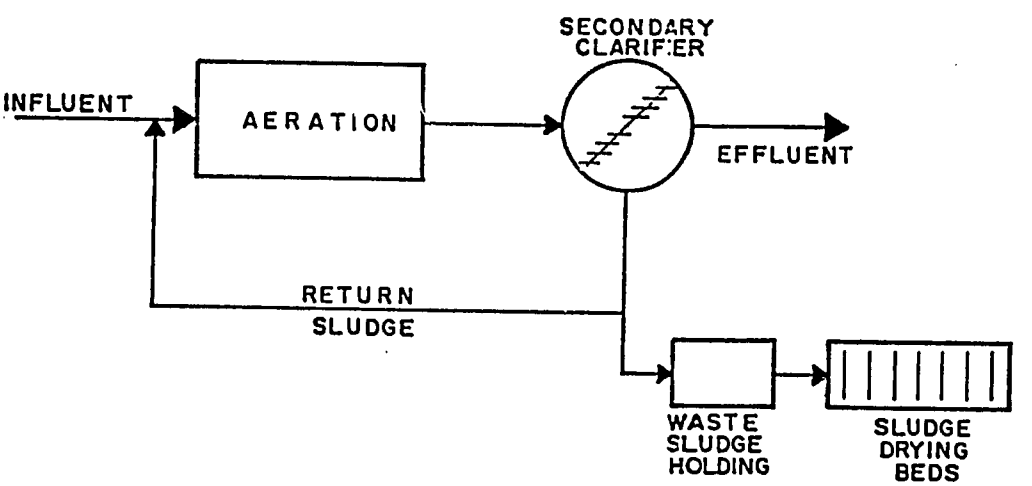
Probably one of the most efficient and widely used systems of biological treatment of wastewater is the activated sludge process. Aeration of wastewater containing biologically degradable material in the presence of micro-organisms produces a mass of settleable solids known as activated sludge. There are several variations of the activated sludge process. Of these, extended aeration (Figure 2-5) is the most reliable, from both the process and operation point of view. Extended aeration is a completely mixed activated sludge system designed for long retention times (24 hr or more). The extended aeration system operates at the lowest BOD loadings of any of the activated sludge systems. Removals of 95% can be achieved if the treatment plant is properly operated. The advantages of the extended aeration system are:

- simple to operate and easy to maintain;
- ability to handle shock loads;
- initial low capital cost due to the elimination of primary clarifiers and sludge digester; and
- no odor problems associated with this process.



CONVENTIONAL ACTIVATED SLUDGE SYSTEM

NOT TO SCALE



EXTENDED AERATION

NOT TO SCALE

Figure 2-5 ACTIVATED SLUDGE AND EXTENDED AERATION TREATMENT SYSTEMS

The primary disadvantage of the extended aeration system is a requirement for skilled operators.

The oxidation ditch process proposed in the Singconsult study is a version of the extended aeration process.

2.9.2 Fish Port Wastewater Treatment

The sewage disposal system as proposed in the DPWH Master Plan is not clearly defined. It appears that wash water from various buildings or facilities will be discharged untreated to the storm drainage system. Sewage from toilets will be run through septic tanks. The effluent from the septic tanks will then be conveyed to a catch basin, screened, and discharged at the water line along with storm drainage and wash water. Unfortunately, septic tank systems are unsuitable in karst geological formation, as the voids and cracks in the limestone rapidly convey poorly treated wastes for large distances.

The combination of septic tank overflow and untreated wash water from the market hall buildings, which will contain fish body fluids and scraps of fish tissue, will render the ocean foreshore areas unfit for any recreational activities. In essence, the situation will be little improvement over the existing unsanitary conditions at Lion Beach or the existing wet fish landing site.

The draft EIS prepared for DPWH (Total Consultancy Services 1991), realizing the environmental impact the untreated wastewater will have on the receiving waters, recommended the installation of a WWTP to reduce the adverse effects of the project on the environment. The proposed WWTP includes screening, primary clarifiers, aeration, and secondary clarifiers. The WWTP proposed in the draft EIS is a significant improvement over the sewage treatment system described in the 1990 DPWH Master Plan. DPWH will incorporate a WWTP in the final plan, and is awaiting recommendations from their consultants (Encarnacion pers. comm.).

2.9.3 Agro-Processing Facilities Wastewater Treatment

The Singconsult Master Plan proposes an oxidation ditch treatment process for the agro-processing site WWTP. Preliminary design of the oxidation ditch system presumes a daily work force on the site of 2,755, and a design flow of 2,484 m^3/d, of which 1,000 m^3/d would be generated by a prospective tuna cannery. The Singconsult Master Plan assumes that the WWTP on the 32-ha site

will treat wastes from both the fish port and the agro-processing facilities. The proposed WWTP would produce an effluent with 5-day biochemical oxygen demand (BOD_5) of 150 mg/l and total suspended solids (TSS) concentration of 50 mg/l.

Singconsult, however, proposes that washwater from market hall floor washing and fish cleaning operations will be collected in drains and discharged without any further treatment into the ocean. This is not an acceptable practice on environmental and public health grounds.

Rather than an oxidation ditch, extended aeration, a modification of the activated sludge process (Figure 2-5), is recommended as the proposed action. It is recommended that the WWTP be constructed in three modules, each module having a total volume of 400 m^3. Each module unit of 400 m^3 should combine aeration, mixing, clarification, and sludge digestion in a single rectangular structure, to utilize common walls for the additional modules, minimizing piping and space requirements.

2.9.4 Livestock Processing Facilities Wastewater Treatment

The Singconsult plan recommends that the developer of the livestock processing complex would need to build a WWTP with a design capacity of 760 m^3/12 hr operating day, and recommends lagoon treatment to meet a maximum BOD_5 concentration of 200 mg/l and maximum TSS concentration of 100 mg/l. It is envisioned that these facilities would be operating below their design capacity, reaching design capacity only after a number of years of operation.

It appears, however, that the treatment system proposed by Singconsult may not be adequate for the load. Standard waste load from packing houses, which includes killing, dressing, and cooking, are based on the total live weight kill (LWK). A total flow of 1046 gal/1000 lb LWK is typically allowed for packing houses. Total estimated wastewater flow from the livestock complex would be:

		LIVE WEIGHT	TOTAL LIVE WEIGHT
1000	Hogs	230 lbs	230,000 lbs
100	Cattle	1,100 lbs	110,000 lbs
100	Carabaos	1,300 lbs	130,000 lbs
100	Goats	60 lbs	6,000 lbs
Total Live Weight			476,000 lbs

At a total LWK of 476,000 lbs, the daily wastewater discharge from the meat processing complex would be 497,896 gal/day (gpd) or 1,885 m^3/day.

More importantly, the lagoon treatment system, as noted above, may be prohibitively expensive for the soil properties present on the site. An extended aeration system may be more appropriate both from a cost and environmental standpoint.

2.10 Wastewater Characterization

The wastewater components of major concern are those which deplete the oxygen resources of marine waters to which they are discharged, those which may stimulate undesirable growth of plants or organisms (such as algae) in the receiving water, or those which will have undesirable aesthetic effects. Primary sources of wastewater are summarized in Table 2-1.

2.10.1 Fishing Port Complex Wastewater

The main sources of wastewater from the fishing port complex will come from:

- marine wastewater (bilge water);
- market hall wash water; and
- domestic wastewater from public toilets and shower facilities.

Local fishing vessels, with the possible exception of the larger carrier vessels, are not equipped with holding tanks, recirculating toilets, or incineration devices which can alter the quantity or character of the marine wastewater before discharge into the harbor. Boat storage compartment wastes are produced when the fish are moved out of the fish storage compartments. Impurities in this wastewater consist largely of blood, particulates, dissolved fish wastes, oily scum, and fish scales.

The disposal of bilge and sanitary wastewater from vessels requires both collection and treatment systems if disposal occurs at the port. To collect wastewater, holding tanks would have to be provided on the dock to collect the wastewater and pump it to the proposed wastewater treatment plant. The wastewater could also be collected by tank truck and trucked to the wastewater treatment plant. Alternatively, the larger vessels will not be

Table 2-1. Primary Sources of Wastewater at the GSAPC.

WASTEWATER SOURCE	UNTREATED BOD (mg/l)	VOLUME (m^3/day)
1. Fishing Port Complex		
A. Wash water	300	250
B. Domestic wastewater	250	430
2. Fruit Processing		
A. Process Wastewater	400	200
B. Domestic Wastewater	250	40
3. Vegetable Oil		
A. Process Wastewater	110	250
B. Domestic Wastewater	250	15
4. Feed Mill		
A. Process Wastewater	-	-
B. Domestic Wastewater	250	10
TOTAL ESTIMATED EFFLUENT		1,195

allowed to discharge their bilge water at the port facilities. The bilge water could be transferred to ballast on the larger carrier vessel, and dumped at sea during fishing operations. The smaller boats with no ballast tanks could clean out their bilges while under way to the fishing grounds.

The market halls have to be thoroughly cleaned with fresh water after each trading day and again washed down before trading commences the next day. The wash water will contain blood, fish fluid, scales, fins, guts, and other matter, which should be screened out of the wastewater treatment plant. The screenings can be sent to the feed mill plant for conversion into fish meal. Another source of waste is the leakage from the wet fish storage boxes. The leakage occurs because of the weight of the fish stored in the boxes. This waste has a high concentration of blood and dissolved solids, which is washed away with the other market hall residue. The raw wastewater from the market halls and the domestic waste water will have a BOD level of between 250 and 350 mg/l and suspended solids of 250 to 300 mg/l. Total volume is expected to be 66,000 gallons/day (gpd) or 250 m^3/day.

The raw domestic wastewater generated by the employees, agents, brokers, and transient fishermen will have a BOD and suspended solids content of no more than 250 mg/l. Total volume is expected to be 430 m^3/day.

Pollutants in both the market hall washwater and the domestic wastewater from the fish port (680 m^3/day) are biodegradable, suitable for treatment in an activated sludge plant.

2.10.2 Livestock Complex Wastewater

The proposed livestock complex WWTP described by Singconsult does not provide any detailed waste characterization. Total volume of wastewater discharge from the livestock complex is given in their data base as 151 m^3/day for the stock pens and 700 m^3/day from the abattoir, compared with an estimated combined volume of almost 1900 m^3/day based on 10 gal/m^2 of the Meat & Bone Meal Plant, Abattoir, and Meat Processing Plant.

Typical slaughter house and packinghouse wastes are generally high in BOD (biochemical oxygen demand), total suspended solids, floatable material, and grease. Furthermore, the waste is generally at an elevated temperature and contains blood, bits of flesh, fat, manure, dirt, and viscera. Important processes such as blood recovery, grease recovery, separate paunch manure handling, and efficient rendering operations will

reduce the waste load from the livestock complex substantially and at the same time produce by-products which can be sold or used elsewhere.

Typical meat-packing houses, including killing, dressing, curing, and cooking operations, will discharge a standard waste load per 1000 lb of live weight kill (LWK):

Flow (gal)	1046
BOD (lb)	12.1
Suspended solids (lb)	8.7
Oil and grease (lb)	6.0

At a total estimated flow of 496,000 gpd (1885 m^3/day), the total BOD discharged from the GSAPC meat processing plant would be 5760 lbs. Because so much of the organic matter in meat processing wastes is originally solid (meat particles and fat) or sludge (manure solids), interception of this waste material by screens before it goes to the treatment plant is a natural step. Employing either static or rotary screens, solid material is screened out of the wastewater. The material from the screening process may be rendered. The design should achieve the following balance:

BOD in raw waste	5,670 lbs
Removed by pretreatment (15%)	864 lbs
BOD to Aeration	4,896 lbs
90% removal	4,406 lbs
BOD in effluent	490 lbs
or	123 mg/l.

The estimated 123 mg/l BOD in effluent is well within DENR Industry Classification for Coastal Water Class SC & SD (Table 2-2), which allows 200 mg/l BOD in effluent.

Blood has the highest BOD of any liquid material flowing out from a meat processing plant. It has an ultimate BOD (20 days) of 405,000 mg/l. Customary analytical methods for 5 day BOD are not accurate enough in these high ranges, but are estimated to be in the region of 150,000 to 200,000 mg/l.

If the blood from a single animal killed in a day is discharged to the sewer, its pollution load would be equivalent to that of 50 people. From this alone, it is evident that blood conservation pays.

Table 2-2. DENR Effluent Standards for BOD.

Industry Classification Based on BOD of Raw Wastewater	Maximum allowable limits in mg/l based on Coastal Waters Class SC & SD
Industries producing between 3,000 and 10,000 mg/l BOD	200 mg/l
Industries producing between 10,000 and 30,000 mg/l BOD	600 mg/l
Industries producing more than 30,000 mg/l BOD	900 mg/l

Class SC-
1. Recreational Water Class II
2. Fishery Water Class II
3. Marshy/Mangrove areas

Class SD-
1. Industrial Water Supply Class II
2. Other Coastal & marine waters"

Paunch manure is either wet or dry dumped for recovery of tripe. Wet dumping consists of cutting the paunch open in a water flow discharging to a mechanical screen and then to the manure sewer. This washing action carries a large amount of BOD from the paunch waste solids into the water phase. Paunch solids are about 75% water and weigh around 50 to 60 pounds per animal.

Dry dumping consists of dry discharge of the manure solids down a chute for ultimate disposal as a waste solid or for blending to produce a marketable solid. After dry dumping, fines are removed by washing and are discharged into the manure sewer.

Stock pen wastes are high in nutrients and should be separated to allow alternative methods of disposal. Pens should be regularly dry cleaned and the waste should be hauled away for use as fertilizer or land disposal. Runways and pens should be hosed down only periodically. The resulting strong liquid wastewater should be collected and disposed of directly on top of farmlands.

2.10.3 Crops Processing Wastewater

Most of the wastewater generated by the fruit and vegetable processing and canning industry contains a wide variety of liquid wastes. These varieties are due to differences in the type of raw commodity, its condition upon arrival at the plant, tonnage processed per unit of time, processing machinery used, and in-plant transportation methods. Another important consideration is the extent of water recirculation and reuse of water within the plant process. The major steps where water is used and solids and dissolved residual are generated are: washing, sorting, peeling, blanching, and processing. The washing and rinsing operations of the raw product constitute the major source of wastewater.

Based on a daily raw material input of around 50 mt of saba bananas and the same for fruit drying and canning (batch process only), washwater and process wastewater discharged from the whole operation would be 200 m^3/day. The raw process wastewater, diluted with the washwater, would have a combined BOD of 400 mg/l. Suspended solids would be around 300 to 350 mg/l depending on the type of operation which is finally installed. Domestic wastewater discharge from the crops processing complex would be around 40 m^3/day, based on a total work force of 300 people.

In processing soybeans and corn bran into meal and edible oil, it is the oil processing that produces the major portion of the pollutants that enter the wastewater stream. Some free fatty

acids and some triglycerides are retained in the oil washing processes, even after centrifugation or filtration. Further, the free fatty acids liberated in the acidulation process have some solubility in the hot (200°F) water used in that process. Considerable fatty materials also enter the wastewater stream from the cooling processes associated with deodorizing the refined oil to produce finished oil. Because the fatty materials are not readily amenable to biological treatment, physical/chemical treatment must be employed prior to biological treatment.

The total volume of wastewater discharged from a vegetable oil processing plant depends on the degree of recirculation and in-house pollution control. Modern vegetable oil refineries keep wastewater to a minimum. Since it is not known at this stage as to what type or make of refinery will eventually be installed in the GSAPC, this EA assumes that a total flow of around 250 m^3/day can be expected.

Pretreatment of the wastewater to remove most of the emulsified fatty material is a mandatory treatment step within the refinery before the wastewater is discharged to the central biological treatment plant. In the pretreatment step, the influent waters from the various collection points throughout the plant are sent to a mix tank where sulfuric acid is used to adjust the pH of the wastewater entering an equalization tank. By lowering the pH to 3 and by using a large flow-averaging tank, there is a substantial temperature reduction in the effluent, allowing for removal of a major portion of the fatty material by skimming. After skimming, the acidified effluent goes to a neutralization tank where caustic soda is added to adjust the pH. This adjusted pH water goes to a pressurized dissolved air floatation step. Before entering the pressurization system, lime, alum, and polyelectrolyte materials are added for flocculation, to help remove the suspended solids which carry fairly high BOD loading.

Effluent from the dissolved air flotation step with an oil and grease content of less than 30 mg/l and BOD content less than 110 mg/l can be achieved. The effluent from the dissolved air flotation system can then be pumped to the central biological treatment plant.

With an average BOD and suspended solids reduction of 90%, effluent from the GSAPC extended aeration treatment plant would contain around 25 to 30 mg/l BOD and suspended solids.

2.11 Effluent Disposal

2.11.1 Fish Port

The Draft EIS for the DPWH plan proposes that the effluent from the fish port WWTP will be discharged to the sea, or perhaps used for irrigation. The manner of discharge to the sea, however, is not made clear in the Draft EIS; the Master Plan calls for a discharge at the waterline in Sarangani Bay. Although land application of effluent for irrigation purposes is attractive, no commitments have been made for a land application site. The site-specific impacts of such a program on groundwater will need to be evaluated when a site for land application is identified and a site-suitability analysis conducted.

2.11.2 Agro-Processing Facilities

The Singconsult Master Plan also appears to call for a discharge to the sea at the waterline. This approach is environmentally unacceptable. A submarine discharge is recommended as the proposed alternative, with a depth of 30 m (100 ft) located off the point of either the north or south reefs selected as the preferred alternative (Chapter 4).

2.11.3 Livestock Processing Facilities

The Singconsult Master Plan also does not clearly describe the location of the outfall for the livestock facilities complex WWTP. Its location near the Banwalan River channel should not be considered an opportunity for disposal at this location, because the Banwalan River is dry during low flow periods and a small community of fishermen are located at the river mouth.

A submarine discharge is recommended as the proposed alternative, and it is further recommended that the effluent line be routed to join that of the agro-processing facilities WWTP. This provides the benefit of only one outfall, with a blending of the stronger livestock WWTP effluent with the significantly milder agro-processing WWTP effluent.

2.12 Air Emissions Characterization

Generally, there are three groups of air pollutants that will be generated from the project both during construction and operation of the project. These include: 1) emissions from power equipment; 2) emissions from motor vehicles; and 3) odors

emanating from putrefying raw materials, products, by-products, or waste materials. During the construction of the project, air pollutants will be of the first two groups and will include combustion gases from the engines of bulldozers, payloaders, backhoes, pile drivers, and trucks as well as the dust generated because of their movements. The combustion gases will include carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen oxides, and unburned hydrocarbons.

During the operation of the project, air pollutants generated will be of all three groups. Equipment emitting air pollutants will include the boilers which may be fired using either bunker, diesel oil, or locally abundant supplies of coconut shells. Gaseous emissions from boilers if fired using diesel or bunker will contain sulfur dioxide, carbon monoxide, carbon dioxide, nitrogen oxides, unburned hydrocarbons, and particulates. If fired using solid fuels like coconut shell, the gaseous emissions will include hydrocarbons, carbon monoxide, carbon dioxide, and large quantities of particulates.

Motor vehicles coming in and out of the facilities will also contribute to air pollution in the area. Emissions from motor vehicles will include carbon monoxide, carbon dioxide, nitrogen oxides, sulfur dioxide, lead, unburned hydrocarbons, and particulates.

Odors will come from the fish market and fish processing area. Fish that spilled and start to spoil as well as wastewater will give off fishy odors. Other areas where bad odors are likely to be encountered are facilities in the livestock complex which include the abattoir, the meat and bone meal plant, and in the drying area for animal skins. Odors in the crop processing complex may occur if wastes are not disposed of immediately. For example, seeds and skins of processed mangoes may ferment in the hot and humid environment, producing the characteristic odor of vinegar.

2.13 Solid Waste Disposal

The proposed WWTPs will have a waste sludge digestion step where the sludge is aerobically digested and dried on sand drying beds, from where it can be removed to be used as a soil conditioner. Alternatively, the digested sludge in liquid form can be hauled away by tank truck to be spread onto farmland. The digested sludge, containing essential plant nutrients and useful trace elements, has potential as a soil conditioner. The sludge, however, should not be used for root crops or crops consumed raw because of health considerations regarding the presence of

intestinal parasites in the domestic sewage component of the wastewater stream. Thus sludge can be used for pasture land, orchard crops, or corn.

Other solid wastes are by-products from the fruit and vegetable processing plant in the form of peels and reject raw material, and fish scales, fins, guts, and other matter from the fish market halls. These must be removed or further treated to produce either animal feed additives or compost. The solid waste disposal problem has not been considered in the Singconsult Study. Because of the seriousness of this solid waste disposal problem, a separate study must be made to find a suitable solution.

Chapter 3

EXISTING ENVIRONMENT

3.1 Geographical Setting

The General Santos Agro-Processing Center (GSAPC) site is located on the northwestern shore of Sarangani Bay, at 06°02'00" N Latitude and 125°08'25" E Longitude (Figure 1-2). Sarangani Bay is on the southern shore of the island of Mindanao, and opens southward into the Celebes Sea (Figure 1-1).

Much of the surrounding land area within 10 to 15 km of General Santos City is gently sloping pasture and agricultural land. The area inland of the GSAPC rises very slowly to the Mount Parker caldera containing Lake Maughan, at elevations greater than 1,800 m, lying about 30 km west-northwest of the site. The highest elevation in the region is 2,300 m on Mt. Matutum, a dormant volcano located 30 km north-northwest of the city. The east side of Sarangani Bay is a peninsula separating the bay from Davao Gulf; the peninsula is mountainous with elevations commonly exceeding 1,000 m.

The northernmost part of Sarangani Bay is characterized by a shallow and muddy seafloor. The Buayan, Silway, and Makar Rivers and other perennial streams enter the north end of the bay and deposit fine sediment which inhibits the growth of corals at the head of the bay. Fringing mangrove forests and coral reefs line the whole length of the eastern coastline of the bay. A number of milkfish and prawn farms are also located along the eastern shoreline. The western shoreline is characterized by sandy beaches, marginal mangrove forests, coconut trees, and patches of coral reefs, with dry and grassy mountains and hills inland. Commercial cargo and fishing wharves are located along the northwestern margin of the bay, with bathing beaches and day-use resorts located along the central western shoreline.

The GSAPC site proper is approximately 1,000 m long (north-south dimension) and 500 m wide; it lies between the National Highway and the shoreline. Most of the property is low-lying, with maximum elevation of 18 m atop one small hill along the west-central margin (Figure 3-1). Two freshwater springs are located on the property and are regularly used by local inhabitants and visiting fishermen. The immediate nearshore area comprises, from north to south: Banwalan Cove just to the north of the property, at the mouth of the normally dry Banwalan River; a prominent coral reef (termed the "north reef" in this

Figure 3-1 GSAPC SITE TOPOGRAPHY AND BATHYMETRY

document); a small cove where the north spring empties into the sea (the "deepwater cove"); and another prominent coral reef (the "south reef") extending to the southern property boundary. All of these features will be described more fully in following sections of this document.

3.2 Climatology and Meteorology

The principal air streams which affect the project site are the Northeast Monsoon, which prevails during late October to January, and the Southwest Monsoon, which occurs from June to early October.

The prevailing regional winds are topographically constrained by surrounding mountains to north-south directions. Thus, the northeasterly winds during the Northeast Monsoon are transformed into northerly winds, while the southwesterly winds during the Southwest Monsoon are transformed to southerly winds. These seasonal winds are modified by diurnal onshore/offshore breezes, which also blow northerly and southerly in Sarangani Bay.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) maintains a weather station located near City Hall in General Santos City. Weather data have been collected at this station since 1951, and provide the bases for good long-terms descriptions of local weather patterns.

Due to topographic shielding by the mountains which surround it, General Santos City is protected from the monsoonal rains. The average monthly rainfall at General Santos City over the period from 1951-1985 ranges from a low of 39.5 mm in March to a high of 112.5 in June (Table 3-1). Similar data for the last decade (1981-1990) range from a low of 35.3 mm in March to a high of 93.9 mm in August (Table 3-2), suggesting that the climate at General Santos City is becoming drier. General Santos City ranks among the driest places in the Philippines, with an average of 954.9 mm of rain falling annually. By comparison, Davao City (located less than 150 km northeast) had an annual average rainfall, over the same 1951-1985 time period, of nearly 1,800 mm; Surigao, on the northeastern tip of Mindanao, recorded an annual average rainfall of over 4,300 mm.

Tropical storms occasionally bring torrential rainfall to General Santos City. As of 1986, the greatest rainfall recorded in any 24-hour period was 309 mm, observed on 9 July 1983. Table 3-3 shows some climatological extreme values for rainfall and other parameters observed at General Santos City.

TABLE 3-1 AVERAGE CLIMATOLOGICAL CONDITIONS MEASURED AT GENERAL SANTOS CITY BETWEEN 1951 - 1985

MONTH	RAIN-FALL (mm)	RAINY DAYS	TEMPERATURE (deg C)						RH %	MEAN SEA LEVEL PRESSURE (mbs)	PREVAILING WIND		CLOUD (octa)
			MAX-IMUM	MIN-IMUM	MEAN	DRY BULB	WET BULB	DEW PT.			DIREC-TION	SPEED (mps)	
JAN	64.1	9	32.6	21.5	27.0	26.7	23.5	22	76	1010.4	N	3	5
FEB	73.2	8	32.9	21.6	27.2	29.6	23.6	22	76	1010.3	N	3	6
MAR	39.5	7	33.6	21.8	27.7	27.5	24.0	23	75	1010.5	N	3	5
APR	50.5	8	33.7	22.4	28.0	27.8	24.6	23	77	1009.8	N	3	5
MAY	87.5	12	32.7	22.7	27.7	27.4	24.7	24	80	1009.7	N	3	6
JUN	112.5	14	31.4	22.3	26.8	26.8	24.4	24	82	1010.2	S	3	6
JUL	104.3	13	31.0	22.0	26.5	26.4	24.2	23	83	1010.0	S	2	6
AUG	87.2	13	31.0	21.9	26.4	26.5	24.2	23	83	1010.3	S	3	6
SEP	80.6	12	31.4	21.9	26.6	26.6	24.2	23	82	1010.2	S	3	6
OCT	94.4	12	31.8	22.0	26.9	26.8	24.3	23	81	1010.1	S	3	6
NOV	87.0	12	32.4	21.9	27.1	26.9	24.3	23	81	1009.7	N	3	6
DEC	74.1	11	32.5	21.7	27.1	26.8	24.0	23	79	1009.7	N	3	6
ANNUAL	954.9	131	32.3	22.0	27.1	26.9	24.2	23	80	1010.1	N	3	6

TABLE 3-2 MONTLY AVERAGE RAINFALL AT GENERAL SANTOS CITY DURING 1981 - 1990

Month	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	MEAN	STD DEV
January	150.6	102.0	15.8	74.9	21.5	56.3	60.6	17.4	12.1	36.4	54.8	42.5
February	19.8	116.5	1.8	72.7	52.4	71.6	143.4	78.1	145.4	21.0	72.2	48.1
March	45.6	12.1	1.0	48.0	42.3	54.3	1.0	19.4	94.7	35.0	35.3	27.1
April	15.2	30.4	12.2	35.8	145.1	71.1	15.0	66.8	141.9	83.0	61.7	47.3
May	101.4	51.1	16.6	21.2	47.3	124.8	69.2	88.4	65.5	133.1	71.9	37.9
June	78.0	131.1	79.5	12.7	29.8	148.0	87.5	39.7	102.0	156.2	86.5	46.7
July	13.5	40.2	137.1	13.4	152.6	129.3	124.4	153.1	53.4	55.1	87.2	54.3
August	35.8	187.7	72.7	51.5	88.8	65.0	127.2	45.8	98.8	37.9	81.1	45.0
September	111.5	11.5	74.0	79.9	105.0	128.9	38.8	159.1	77.2	153.3	93.9	44.9
October	33.5	61.5	ND	61.1	201.5	56.1	110.7	117.9	135.1	23.8	85.1	55.5
November	12.0	47.5	91.9	57.6	67.8	67.7	34.2	138.8	85.3	65.7	66.9	32.7
December	35.5	92.0	56.2	58.1	80.6	3.4	8.1	61.5	25.1	25.7	44.6	28.3
TOTAL	702.4	883.6	558.8	586.9	1,034.7	976.5	819.8	986.0	1,036.5	826.2	841.1	167.6

(Source: PAG-ASA, GENERAL SANTOS CITY)

Table 3-3. Climatological Extremes at General Santos City Between 1950 AND 1986

Month	Temperature (Deg. C)				Greatest Daily Rainfall (MM)		Highest Wind MPS)		Sea Level Pressure (MBS)			
	High	Date	Low	Date	Amount	Date	SPD/DIR	Date	High	Date	Low	Date
JAN	36.4	25'64	17.1	24'65	105.9	17'66	20/s	9'82	1017.0	16'59	1001.7	2'50
FEB	37.8	21'83	17.2	4'58	79.0	4'82	16/NNE	3'75	1016.8	16'53	1000.0	9'85
MAR	38.0	19'83	16.9	9'63	55.6	15'49	18/SW	22'83	1017.7	30'58	1001.8	18'86
APR	38.0	20'83	18.3	11'51 11'63	60.0	21'64	19/S	19'71	1016.8	1'66	1000.5	11'85
MAY	38.0	12'83	18.7	14'51	86.1	21'55	14/S	29'72	1017.3	9'57	1001.8	2'86 11'86
JUNE	36.8	4'79	17.9	10'61	142.0	22'83	17/S	24'72	1016.0	2'66	1001.4	11'86
JUL	36.1	7'73	17.2	9'85	309.0	9'83	17/SSE	24'72	1017.3	2'65	1002.7	16'77
AUG	36.1	2'73	17.5	16'85	126.0	28'59	17/S	30'72	1015.8	23'65	1002.0	12'86
SEP	36.8	5'79	18.0	5'85	189.5	8'77	18/SSE	14'72	1016.0	15'63	1002.9	24'70
OCT	37.0	16'80	18.2	8'61	101.0	18'70	17/S	12'72	1016.0	8'59	1001.0	12'70
NOV	37.0	14'83	18.3	28'51	102.1	9'62	15/SE	7'70	1018.2	16'65	1001.6	20'76
DEC	36.7	29'82	18.0	30'50	62.2	14'64	14/SSW	8'72	1017.1	2'66	1000.9	8'84
OVERALL	38.0	3/19/83 4/20/83 5/12/83	16.9	3/9/63	309.0	7/9/83	20/S	1/9/82	1018.2	11/16/65	1000.0	2/9/85

Source: National Climatological Center

The annual average temperature measured at General Santos City during the period 1951-1985 is a mild 27.1°C (Table 3-1); the variance about that mean annual temperature is low. The warmest month is generally April, with a mean of 28.0°C. The mean annual maximum temperature is 32.2°C, with April registering a mean monthly maximum of 33.7°C. The lowest mean monthly temperature occurs in January, with a value of 21.5°C.

The prevailing wind direction is northerly between the months of November to May, and southerly from June to October (Table 3-1). Average wind speeds are 2 to 3 m/sec. Extreme monthly winds during the period 1966-1986 ranged from 14 to 20 m/sec and generally blew from southerly directions (Table 3-2).

The mean annual relative humidity is 80%, with the winter months slightly drier than summer months. The lowest monthly mean is usually recorded in the month of April while the highest monthly mean is either in July or August.

3.3 Physical Oceanography

3.3.1 Tides

Tides at General Santos City are mixed semi-diurnal, i.e., generally with two unequal high and low tides each day. As an example, Figure 3-2 shows predicted tidal heights at the Sarangani Bay tide station for January 1991. Tidal constants for Sarangani Bay (determined off Glan in the southeastern part of the bay) are reported (NAMRIA 1990) to have a mean range of 1.37 m and diurnal range of 1.62 m; mean tidal elevation is 0.76 m above mean lower low water (MLLW).

Tidal measurements were made at the site during a previous study (Pacific Consultants International 1990) using a tide staff read periodically over a 1-mo period (dates unspecified). The following tidal data were estimated from that data set.

DATUM	ELEVATION (m)
Spring High Water (SHW)	+2.018
Mean Higher High Water (MHHW)	+1.598
Mean Sea Level	+0.799
Mean Lower Low Water (MLLW)	0.000
Lowest Water Level (LWL)	-0.420

The design tide level for the DPWH plan for GSAPC was determined to be +2.018 m above MLLW datum.

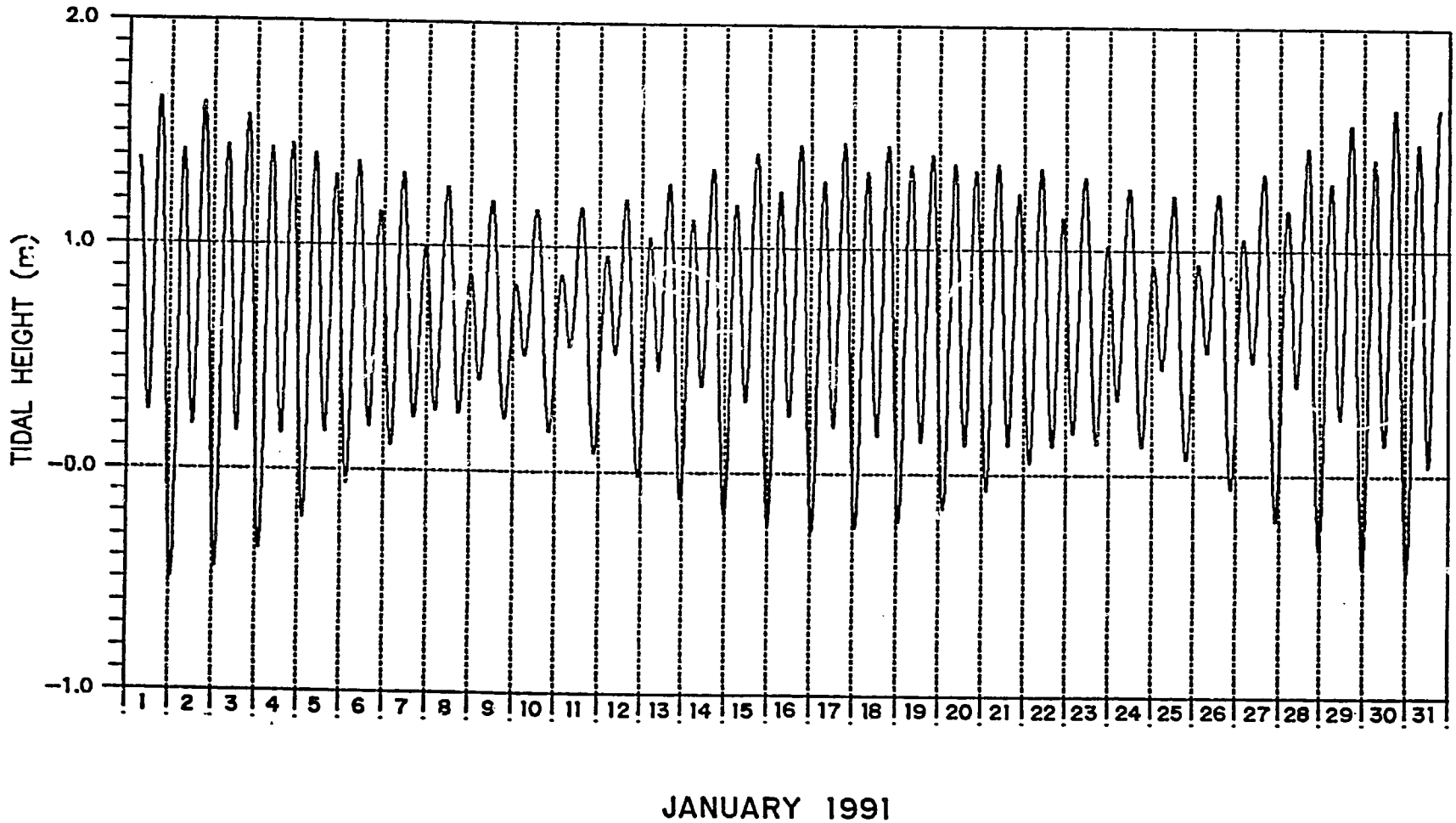


Figure 3-2 PREDICTED TIDAL ELEVATIONS AT SARANGANI BAY TIDE STATION, JANUARY 1991 (Source: Data from NAMRIA 1990)

3.3.2 Waves

Waves heights, periods, and approach direction have not been measured at the GSAPC site. Because of the limited fetch over which wind waves may be generated in Sarangani Bay, and because dominant winds blow parallel to the coastline, wave heights can be expected to be low (probably less than 1 m) and to have short period (less than 6 seconds).

Design waves parameters were estimated for the GSAPC in the DPWH plan (Pacific Consultants International 1990). They determined the design height to be 1.19 m, the design period to be 3.4 sec, and design wave approach direction to be south-southwesterly. (Note that the direction may have been mistakenly reported, since a SSW approach direction is from the shore; presumably the direction of approach should be south-southeasterly.)

3.3.3 Currents

The overall circulation patterns within Sarangani Bay are not well known, and present knowledge relies heavily on anecdotal information provided by ship captains, pilots, and fishermen. These reports suggest an oscillatory tidal flow, with currents along the western shore running north on a rising tide, and south on a falling tide. Net current flow in the northwestern part of the bay is reported to be northerly (i.e., toward the more heavily commercialized areas of Calumpang, Makar, and Dadiañgas).

Water currents were previously observed as part of the field investigation undertaken in late 1989 or early 1990 for the DPWH master plan study; details of the measurement program (dates, types of instrumentation, sampling frequency and duration, station location, and measurement depths) were not reported. Results presented (Pacific Consultants International 1990) consisted of a single speed value of 1.0 m/sec and southeast for direction.

Spring tide current measurements taken at the end of July 1990 were reported (Singconsult 1990) for the PFDA plan, but again no measurement details were provided. That report describes maximum speed as 0.70 kt (36 cm/sec), with northerly flow on rising tides and southerly flow on falling tides (in agreement with the anecdotal information described above).

Because none of the earlier current studies provided insights into the variability of nearshore current flow with time, depth, or location, a 1-mo program of additional current

measurements was undertaken as part of this environmental impact assessment. Measurement details and data are presented in Appendix B. The program comprised two moored current meter stations at which data were collected for the duration of the sampling period, and periodic vertical current profiling at three nearshore locations, during the period 19 January to 23 February 1991. Moored stations were located on the submerged coral promontories on the north and south reefs. These stations were initially located on the south sides of the promontories, but were moved midway through the program to sites on the tips of the promontories (Figure 3-3). The moorings were placed on the reef face in 18 m of water, with the current meters suspended 14 m below the sea surface.

The nearshore flow regime as measured during the field study (i.e., on the reef slope) is characterized by highly variable speeds and directions. Current speeds varied from near zero to about 100 cm/sec; directions tended to flow parallel to the reef face (generally in northerly and southerly directions). Currents exhibit a tidal influence in directions, but speeds appear to vary independently of flow direction.

Two representative 24-hr records of current speed and direction are presented in Figure 3-4; other time-series plots are given in Appendix B. The upper panels on Figure 3-4 show the highly variable current speed which go from near zero to 75 cm/sec or greater within time periods of less than 1 hr. Another important characteristic is that flow directions vary regularly between two dominant directions (south and northeast, in this example) with relatively steady flow in those directions for periods of several hours. The lower panels show a similarly varying speed history, but have a more pronounced bi-modal direction curve.

The overall flow characteristics at each moored current meter station are illustrated in Figure 3-5, which shows polar histograms for each data set. Within each set of measurement, every current velocity is plotted as a vector with origin at the middle of the polar plot. Vector lengths are proportional to current speed.

These measurements, along with observations in the field, suggest that the flow regime near the reef face at the GSAPC is inconsistent and difficult to predict, with flow speeds and directions varying widely and rapidly. A probable explanation is that these effects are the result of small migrating current eddies that are generated when the coral promontories comprising the north and south reefs interrupt a more uniform offshore flow. The high level of variability has practical significance in that

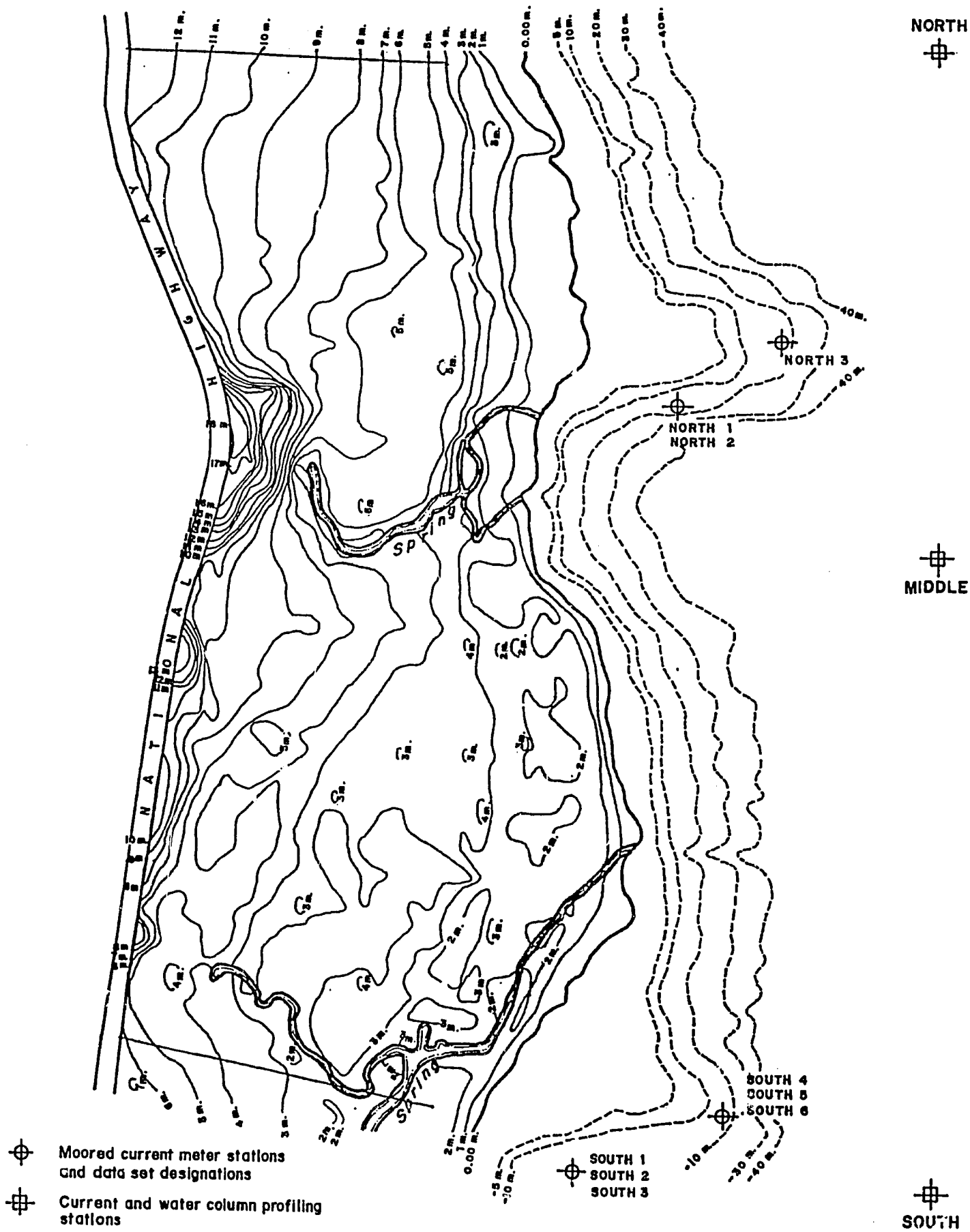


Figure 3-3 LOCATIONS OF CURRENT METER AND WATER COLUMN PROFILING STATIONS, JANUARY-FEBRUARY 1991

Dames & Moore

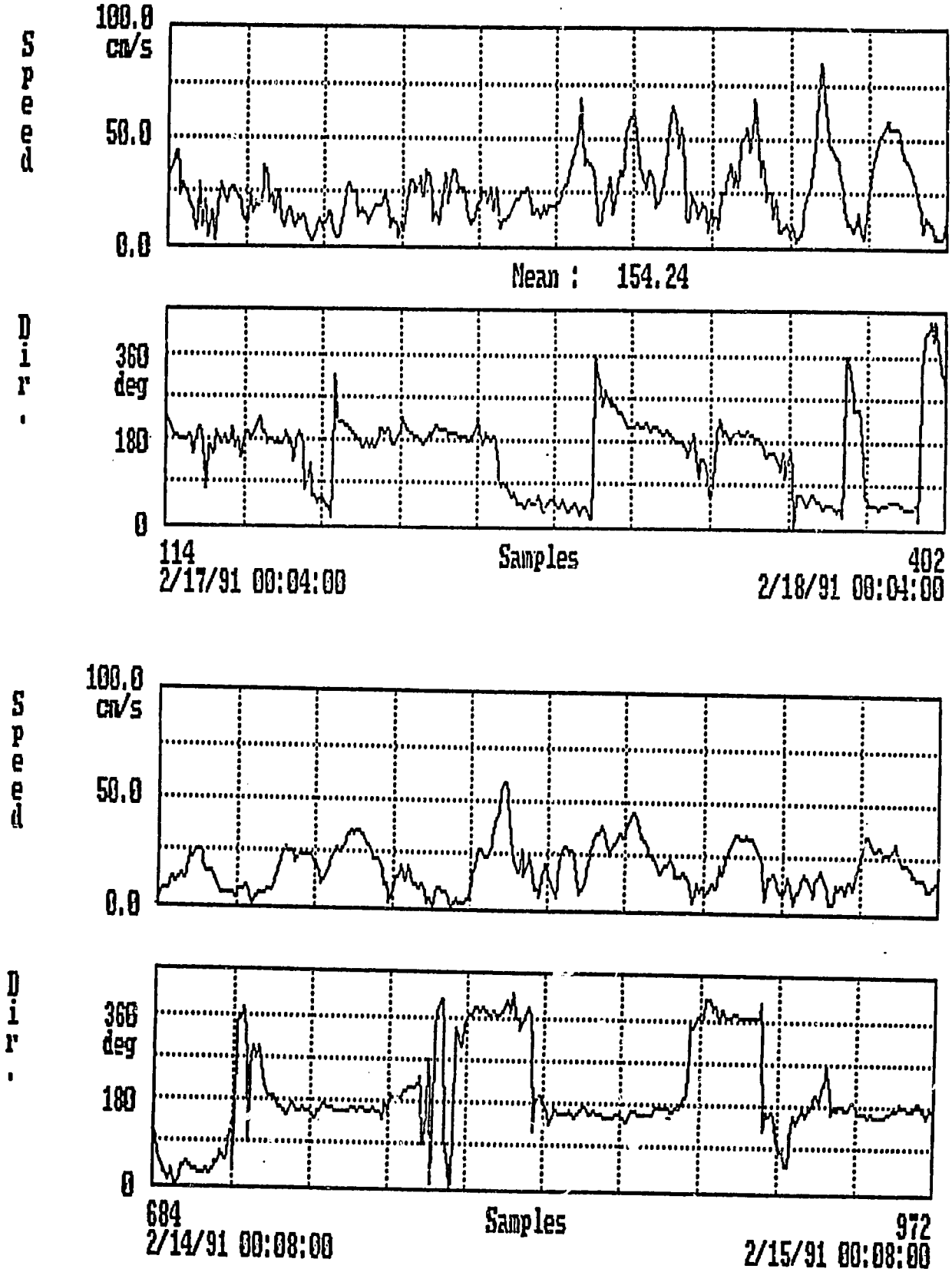


Figure 3.4 REPRESENTATIVE EXAMPLES OF CURRENT VELOCITY TIME SERIES OFF THE GSAPC SITE

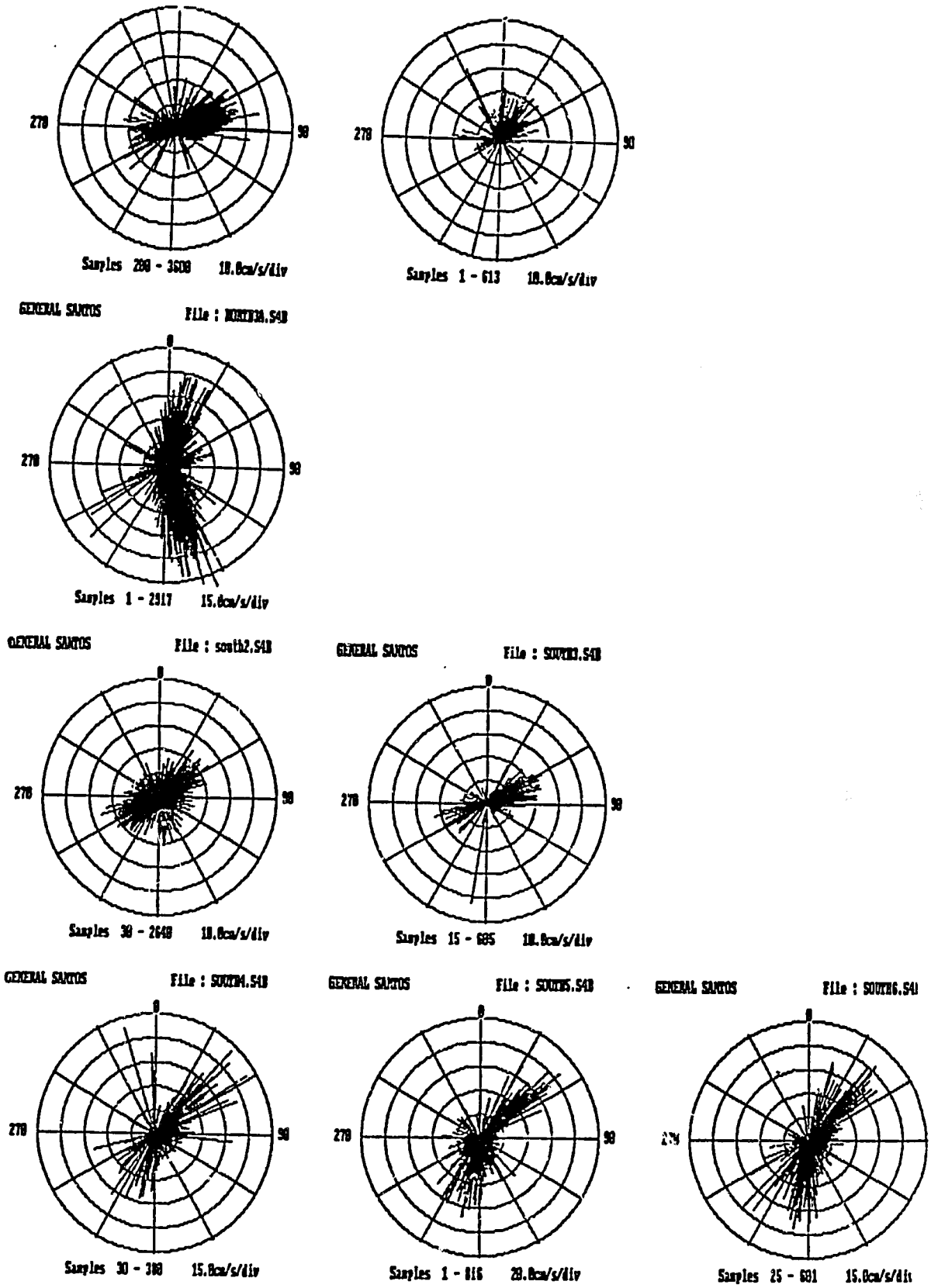


Figure 3-5 POLAR HISTOGRAMS OF CURRENT SPEED AND DIRECTION FOR EACH DATA SET COLLECTED DURING JANUARY-FEBRUARY 1991 OFF THE GSAPC SITE

wastewater discharged into nearshore waters at the promontories will be more rapidly dispersed and diluted than if they were released into a more hydrodynamically stable environment.

Vertical current profiles show similar variability, both with depth in a given profile and between profiles taken at the same location at different times. Figure 3-6 shows two representative current profiles taken about 2 hr apart on the same day at two stations separated by about 2 km; others are presented in Appendix B. The current direction on the upper panels on Figure 3-6 show uniform southerly flow in the upper 40 m of the water column; directions in the lower panels are uniformly northerly over the entire 70 m depth profile.

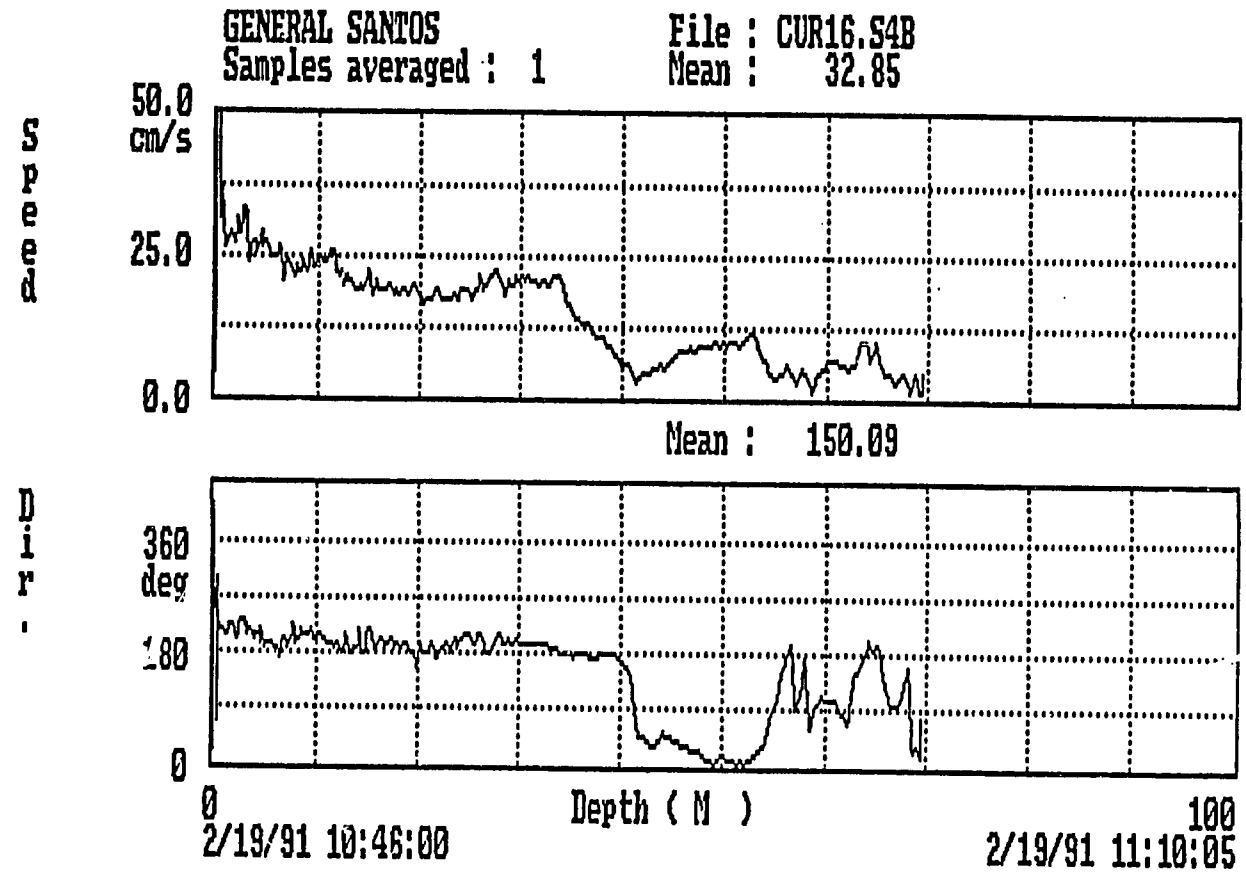
3.3.4 Sea Water Characteristics

Vertical profiles of seawater temperature, salinity, and dissolved oxygen (DO) concentration near the GSAPC site were measured repeatedly at three primary stations (Figure 3-3) during the January-February 1991 field survey. Details of the methods and instrumentation used for these measurements are provided in Appendix B.

The results of the profiling measurements are shown in Figures 3-7 through 3-10 for temperature, salinity, density, and dissolved oxygen (DO), respectively. All individual profiles are overplotted on each graph to illustrate the range of variability for each parameter.

Water temperatures in the upper 30 m of the water column were relatively constant, with most values falling between 26 to 27°C (Figure 3-7). Below 30 m the waters cooled rapidly with increasing depth, with a marked thermocline (i.e., a strong temperature gradient) lying at depths of 50 to 70 m. Although most profiles did not extend far below the thermocline, it appears that water temperatures below were between 21 and 22°C. The thermocline lies at depths associated with permanent thermoclines in many areas of the world, and is probably a permanent feature in the waters of Sarangani Bay.

Seawater salinity was computed from measured temperature and electrical conductivity; vertical profiles are shown in Figure 3-8. By convention, salinity is now reported in Practical Salinity Units (psu), which for all intents and purposes is equivalent to parts per thousand (ppt). Salinity within the upper 80 m of the water column increases with depth within a very narrow range of approximately 33.8 to 34.5 psu. There is no salinity gradient corresponding to the thermocline described in the paragraph



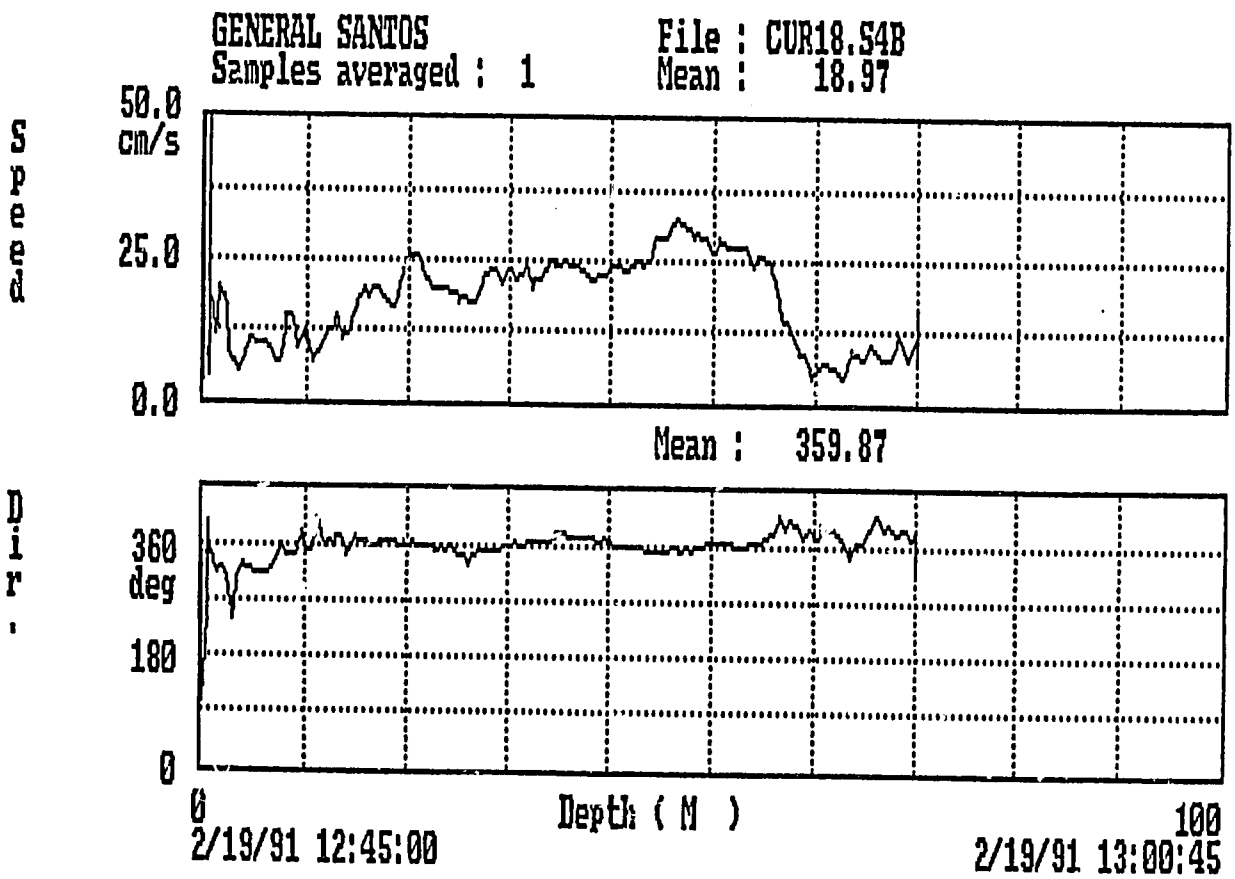


Figure 3-6 TYPICAL VERTICAL CURRENT PROFILES OFF THE GSAPC SITE

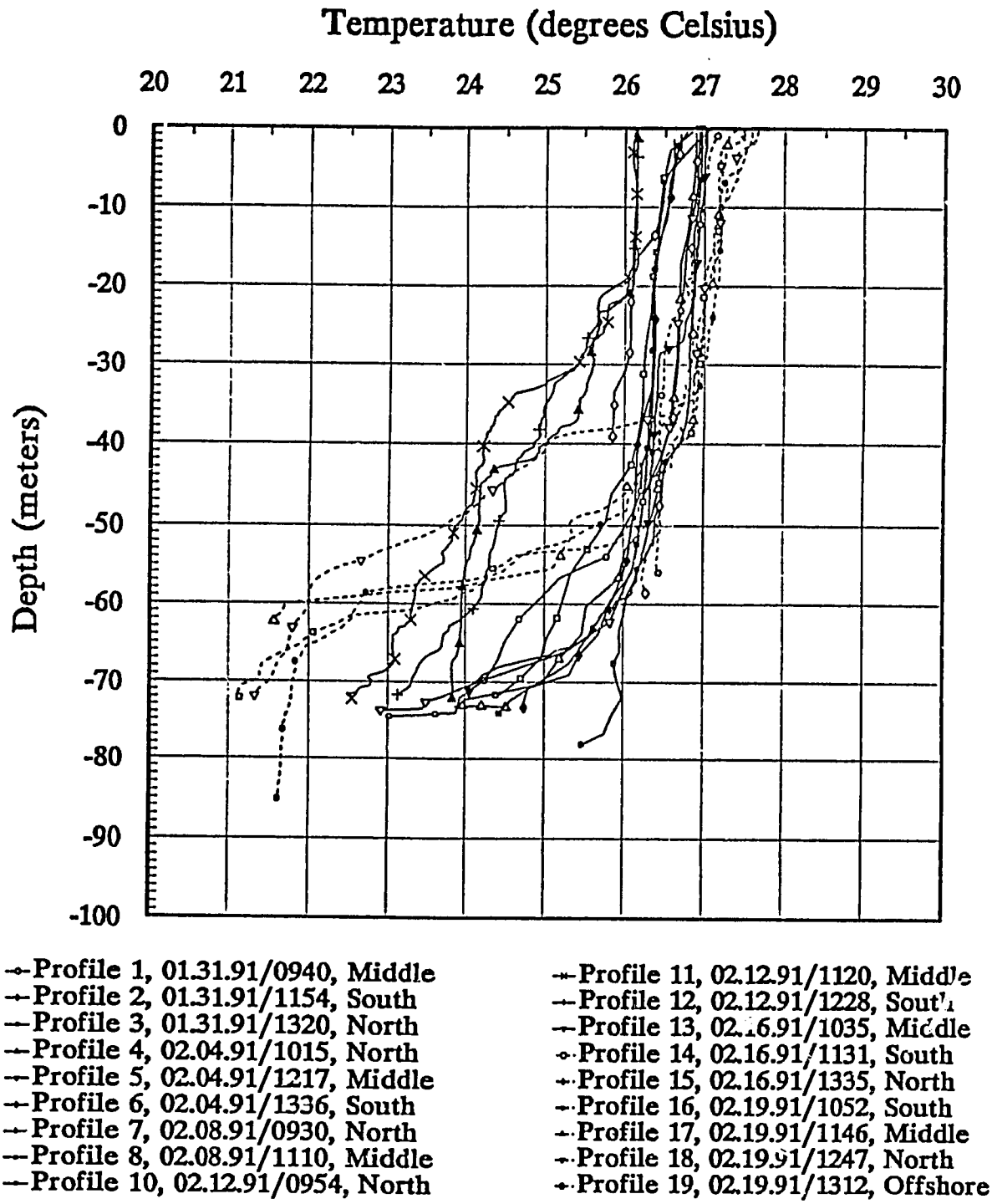
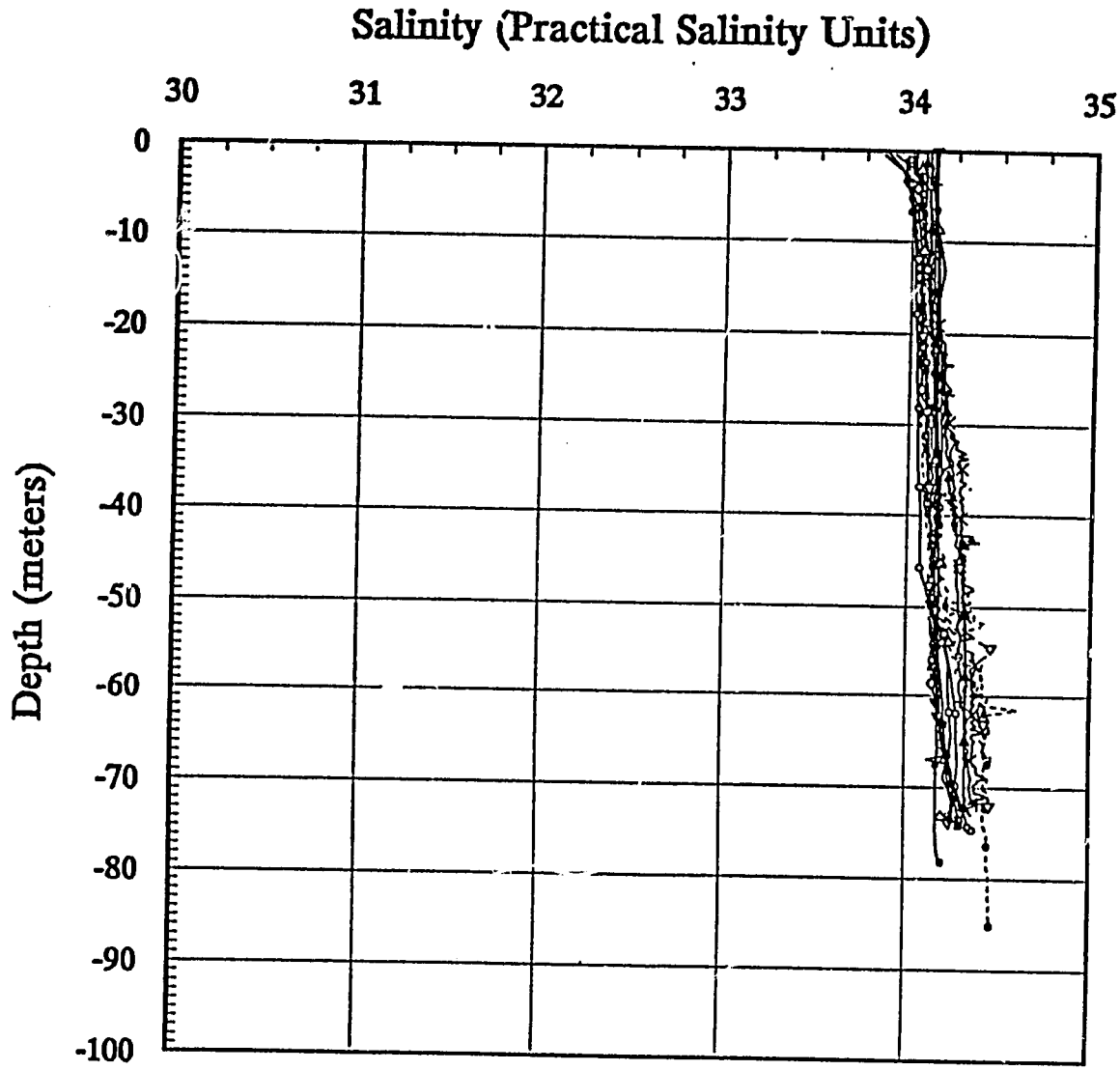
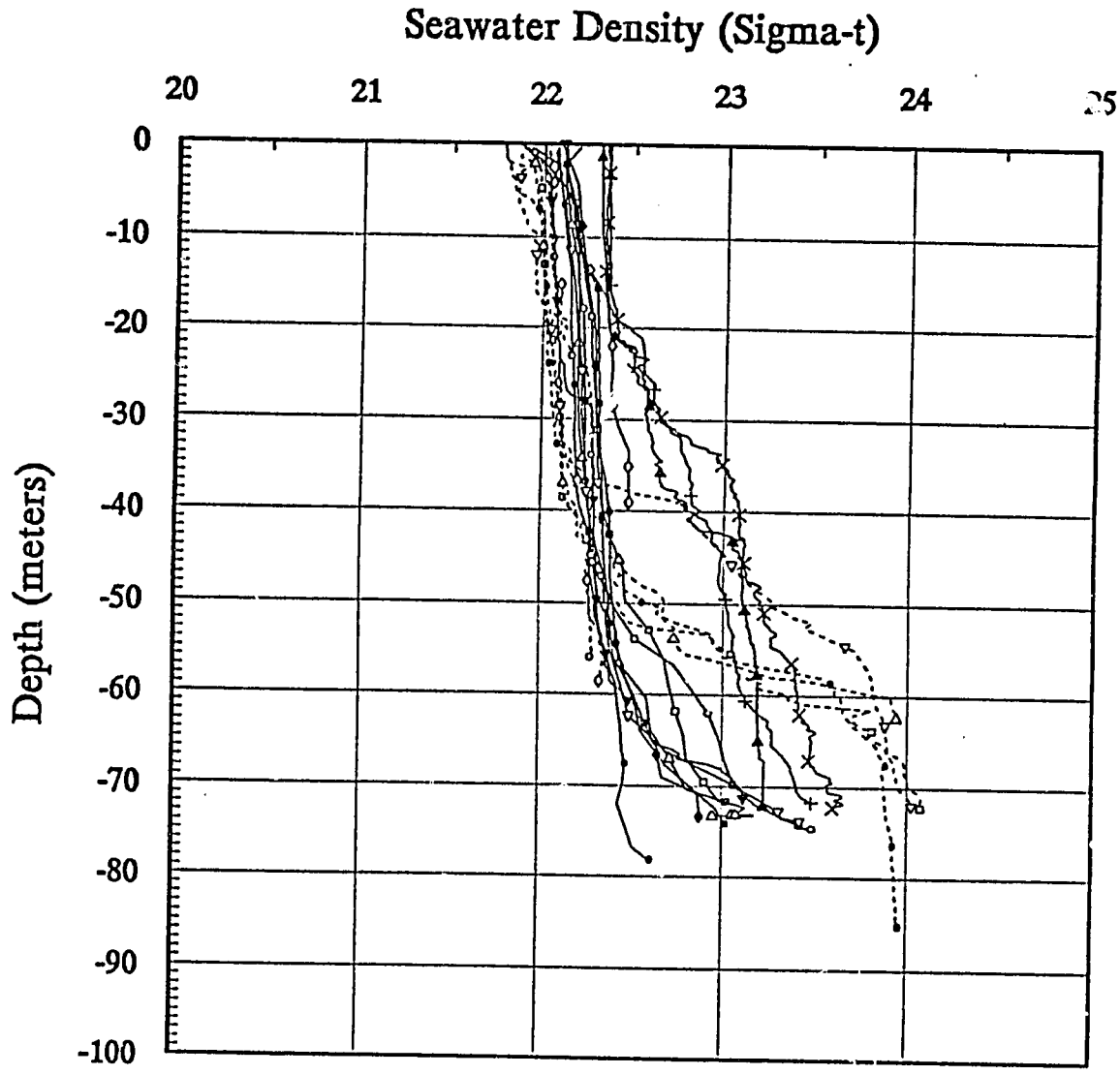


Figure 3-7 SEA WATER TEMPERATURE PROFILES OFF THE GSAPC SITE



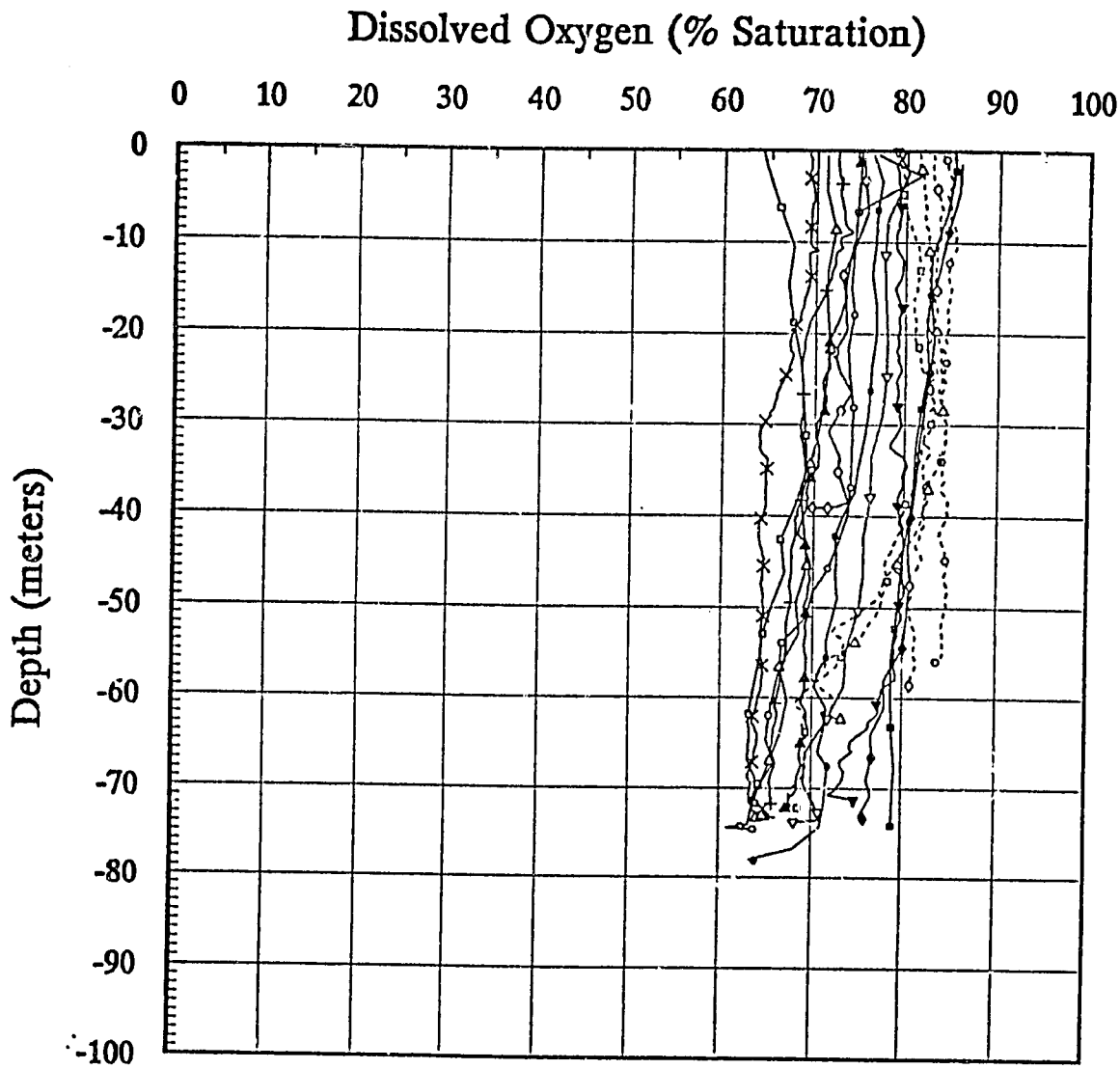
- Profile 1, 01.31.91/0940, Middle
- Profile 2, 01.31.91/1154, South
- Profile 3, 01.31.91/1320, North
- Profile 4, 02.04.91/1015, North
- Profile 5, 02.04.91/1217, Middle
- Profile 6, 02.04.91/1336, South
- Profile 7, 02.08.91/0930, North
- Profile 8, 02.08.91/1110, Middle
- Profile 10, 02.12.91/0954, North
- Profile 11, 02.12.91/1120, Middle
- Profile 12, 02.12.91/1228, South
- Profile 13, 02.16.91/1035, Middle
- Profile 14, 02.16.91/1131, South
- Profile 15, 02.16.91/1335, North
- Profile 16, 02.19.91/1052, South
- Profile 17, 02.19.91/1146, Middle
- Profile 18, 02.19.91/1247, North
- Profile 19, 02.19.91/1312, Offshore

Figure 3-8 SALINITY PROFILES OFFSHORE OF THE GSAPC SITE



- Profile 1, 01.31.91/0940, Middle
- Profile 2, 01.31.91/1154, South
- Profile 3, 01.31.91/1320, North
- Profile 4, 02.04.91/1015, North
- Profile 5, 02.04.91/1217, Middle
- Profile 6, 02.04.91/1336, South
- Profile 7, 02.08.91/0930, North
- Profile 8, 02.08.91/1110, Middle
- Profile 10, 02.12.91/0954, North
- Profile 11, 02.12.91/1120, Middle
- Profile 12, 02.12.91/1228, South
- Profile 13, 02.16.91/1035, Middle
- Profile 14, 02.16.91/1131, South
- Profile 15, 02.16.91/1335, North
- Profile 16, 02.19.9 1052, South
- Profile 17, 02.19.91/1146, Middle
- Profile 18, 02.19.91/1247, North
- Profile 19, 02.19.91/1312, Offshore

Figure 3-9 SEA WATER DENSITY PROFILES OFFSHORE OF THE GSAPC SITE



- Profile 1, 01.31.91/0940, Middle
- Profile 2, 01.31.91/1154, South
- Profile 3, 01.31.91/1320, North
- Profile 4, 02.04.91/1015, North
- Profile 5, 02.04.91/1217, Middle
- Profile 6, 02.04.91/1336, South
- Profile 7, 02.08.91/0930, North
- Profile 8, 02.08.91/1110, Middle
- Profile 10, 02.12.91/0954, North
- Profile 11, 02.12.91/1120, Middle
- Profile 12, 02.12.91/1228, South
- Profile 13, 02.16.91/1035, Middle
- Profile 14, 02.16.91/1131, South
- Profile 15, 02.16.91/1335, North
- Profile 16, 02.19.91/1052, South
- Profile 17, 02.19.91/1146, Middle
- Profile 18, 02.19.91/1247, North

Figure 3-10 DISSOLVED OXYGEN PROFILES OFFSHORE OF THE GSAPC SITE

above. Seawater salinity can be expected to show significant changes only after periods of heavy rainfall and high surface runoff, when freshwater will extend seaward from stream mouths. These fresher waters will float atop the denser seawater and form relatively thin lenses that may extend for several kilometers before they mix with the underlying seawater.

The density of seawater near the GSAPC site is shown as a function of depth in Figure 3-9. Because density is a function of temperature and salinity, and because of the relatively invariant salinity, the density can be seen to increase with depth, with a pronounced density gradient between 50 and 70 m depth corresponding to the thermocline.

Dissolved oxygen profiles are presented both in absolute units of mg/l and as percent of saturation (Figure 3-10). The profiles show a strong uniformity with depth in the upper 75 m of the water column, with saturation values ranging between about 65 and 85 percent. The uniformity with depth is significant because it suggests that there is little phytoplankton production occurring in the upper photic zone which would increase DO levels in shallower waters.

3.4 Water Quality

3.4.1 Nearshore

Sarangani Bay is large and deep, and its capacity to assimilate wastes, particularly organic (high BOD) wastes is expected to be great. Measurable levels of pollutants are expected to occur primarily in the nearshore zone around existing industrial waste discharges (including shrimp pond discharges), the mouths of perennial streams, coastal settlements and villages, and in the vicinity of Makar Wharf and the waterfront of General Santos City. Localized pollution of the nearshore zone may extend further out into Sarangani Bay at the head of the bay, where flushing is expected to be weakest and waste input greatest.

Seawater samples were collected near the surface just offshore of the GSAPC site on 12-13 March 1991. Nearshore quality is expected to be influenced by organic particulates (plant detritus) from the mangrove habitat and from the freshwater springs discharging to the shoreline. To a very localized extent, nearshore water quality parameters could also be effected by submarine freshwater springs emerging on the coral reef flats. Except for BOD, COD, and bacteriology, water quality analyses were performed on site. Results from the preliminary

analyses are shown in Table 3-4. Surprisingly elevated BOD in the one sample in which it was analyzed may be a function of the unusually high concentration of suspended solids. Observations made along shore over a 4-wk period from mid-January to mid-February noted freshwater plumes forming surface lenses for several tens of meters offshore the mouths of the springs, with fairly high detrital content.

Fishing boats are regularly beached on the site for minor repairs and cleaning and so that the crews can bathe, wash clothes, and take on fresh water supplies from the springs. Although surface slicks of oil were often observed along the GSAPC beach, no oil and grease was detected in the laboratory sample analyses. Pollutant levels are generally low near the site because of minimal discharges from the small population using the area.

Water quality data collected during the course of an environmental impact analysis program conducted at Makar Wharf at approximately the same time frame are summarized in Tables 3-5 and 3-6. These data indicate good water quality, even though the Makar Wharf is likely to be more polluted than the GSAPC site. Samples taken near Makar Wharf and the SAFI II fish wharf (approximately 1.5 km north of the GSAPC) showed oil and grease at 5.6-6.0 mg/l, ammonia-nitrogen at 14.9-15.8 mg/l, total nitrogen at 19.9-20.1 mg/l, and BOD at 2 mg/l.

3.4.2 Groundwater and Springs

Rainwater percolates into the porous sandy soils and karst limestone geological formations in the region and exists as groundwater, which occasionally emerges as springs. Two such springs are found on the GSAPC site (Figure 3-1). Ground and spring waters in karst formations typically have high concentrations of calcium bicarbonates (and high hardness values) because calcium salts are dissolved in the waters as they move through the subsurface limestone strata. Water quality analyses of GSAPC spring waters are given in Table 3-7 for samples collected in September 1989, and February and March of 1991. These data are generally consistent with good quality water as documented by sampling conducted as part of the Singconsult (1990) feasibility study.

3.4.3 Surface Water

Due to the absence of topsoil and thick vegetative growth capable of retaining rainwater, most of the rivers and creeks in

Table 3-4. Seawater Quality at the Proposed Site

Parameters	AM Mar 12	PM Mar 12	AM Mar 13
BOD (mg/l)	-	-	14
E. coli (MPN/100 ml)	-	> 11	> 11
Suspended solids (mg/l)	-	153	183
Conductivity (micromhos)	49.8	49.8	49.4
Total dissolved solids (mg/l)	23,500	23,000	23,000
Chloride (mg/l)	17,575	18,100	18,000
Hardness (mg/l)	6,200	5,980	6,100
Dissolved oxygen (mg/l)	5.2	5.2	5.0
pH	-	8.25	8.25

Table 3 - 5

MEAN AND IN MAXIMUM VALUES OF WATER QUALITY VALUES 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)	35.0
Temperature	°C	26.3 (26-27)	27 (26-28)	27.3 (27-28)	
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 x10-4	umbos / 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 mg/l
Total DS	mg/l	34387 (31123-35891)	34593 (32932-35851)	34828 (34304-35697)	
NO_3-N	mg/l				
PO_4-P	mg/l				
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
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 (T)	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	MPN / 100 ml	660.8 (7->1600)	76.8 (<2.2-300)	265.5 (8-1600)	<1000
Fecal Coliform	MPN / 100 ml	331.9	17.5	52.1	

* NSDW = National Standard for Drinking Water (DOH)

Source : Berger 1991

Table 3-6
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
Temperature °C	26.3	27.0	27.3	26.9	-	-	
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.[illegible]	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	30
Total SS	25.4	30.5	34.3	29.8	43.3	30.1	
Total DS	34627	34812	34924	34970	34832	34788	
NO_3-N							
PO_4-P							
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	.001	0.002	
Arsenic	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05
Codmium	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	414	438	18	333	1000
Fecal Coliform	98	63	274	185	9	139	

Note: Mean values are reported for each parameter.

Source : Berger 1991

Table 3-7. Spring Water Quality

Parameter	4 Sept 89	AM Mar 12	PM Mar 12	AM MAR 13	21 Feb.91
BOD (mg/l)	-	-	12	-	-
COD (mg/l)	-	-	-	6.9	-
E. coli (MPN/100ml)	-	-	> 11	> 11	-
Suspended solids (mg/l)	-	-	14	9	-
Conductivity (micromhos)	-	0.488	0.483	0.460	0.500
Total dissolved solids (mg/l)	318	244	242	230	320
Chloride (mg/l)	36	29	33	30	35
Hardness (mg/l)	170	165	134	148	162
Iron (mg/l)	n.d	0.0	0.01	0.0	tr
Dissolved oxygen (mg/l)	-	6.2	6.1	6.2	-
Sulphate (mg/l)	-	45	42	48	50
pH	7.2	-	7.9	7.9	7.2

the GSAPC area are typically dry even during the rainy season. Water flows in these waterways only during and immediately following periods of heavy rainfall. During the January-March 1991 study period, all of the local rivers and creeks (between the Siguel and Silway Rivers) were dry, and no samples could be collected for laboratory analysis. It can be expected that runoff in the stream beds will have high suspended solid loads during a storm, but that the solids will settle out rapidly when flow velocity is reduced in the stream bed or in the sea. After rain-fed flow, turbidity is also expected to drop quickly because clays are not a major component of the soils in the watersheds.

The Siguel River lies 9 km south of the GSAPC site, and its drainage area extends 40 km inland. Because of the size of the drainage area and because its source lies near a lake, the Siguel River is a perennial stream. It has been proposed as a source of freshwater for the GSAPC and was therefore sampled during the field study. Three samples were taken on 12-13 March 1991; analytical results are given in Table 3-8. Water quality appears to be acceptable for treatment and supply for GSAPC, but the necessary hydrographic studies to determine seasonal flows have not been done.

3.4.4 Pollutant Sources

A number of sources for domestic and industrial pollutants are found along the margins of Sarangani Bay. These include untreated sewage from urban areas of General Santos City and wastewater from small- and large-scale canneries, the prawn farms, and the coconut oil processing plant and tuna cannery recently established just south of the GSAPC site by Agrotex Commodities and Celebes Tuna Cannery, respectively. However, no current inventory of the nature or extent of pollution of each of those sources is available. It has been reported that one nearby tuna canning factory has been ordered closed by the EMB due to non-compliance with discharge criteria.

There is no adequate collection and treatment system for domestic sewage in General Santos City, and untreated domestic wastewater is released directly or indirectly into the bay. The location, discharge volumes, and wastewater characteristics are not known.

Pesticides and fertilizers from agricultural lands are washed from the fields and eventually reach the bay, primarily through the groundwater because of the nature of the soils and geology of the region. Singconsult (1990) reported that approximately 300 kg N/ha are applied by farmers in the region,

Table 3-8. Water Quality at the Siguel River

Parameter	Date of Sampling		
	AM Mar 12	PM Mar 12	AM Mar 13
BOD (mg/l)	-	-	13.0
COD (mg/l)	-	-	46.7
E. coli (MPN/100ml)	-	> 11	> 11
Suspended solids (mg/l)	-	13	22
Conductivity (micromhos)	0.380	0.388	0.392
Total dissolved solids (mg/l)	190	194	196
Chloride (mg/l)	20	21	20
Hardness (mg/l)	117	134	112
Iron (mg/l)	0.03	0.01	0.01
Dissolved oxygen (mg/l)	5.3	-	-
Sulphate (mg/l)	40	35	40
pH	-	8.2	8.2

much of which runs off due to the steep terrain and high rates of erosion in the area. The erosion and run-off problems, however, occur primarily in the higher elevations or in the watersheds of the Siguel, Silway, and Buayan Rivers, which are perennial streams.

The prawn farms along the coast of the bay are intensive farming operations which require high inputs of prepared feeds and antibiotics to support maximum prawn harvests. The aquaculture ponds are replenished continuously with fresh seawater and groundwater (up to 30% of the pond volume daily). Discharged brackish shrimp pond waters carry significant BOD loads as well as chemical by-products into the coastal waters of the bay (Primavera 1991).

3.5 Marine Resources

3.5.1 Benthic Biota

Little baseline information describing existing marine resources of Sarangani Bay as a whole, or the Tambler area specifically, is available. This necessitated a preliminary field survey of the marine environment in February 1991 to establish habitat conditions in the nearshore zone of the site. Details regarding methods of surveys are provided in Appendix C.

The nearshore zone of the proposed GSAPC site is characterized from north to south by the presence of a fringing coral reef along the northern third of the property (termed the north reef), a deepwater cove with a steeply sloping sandy seafloor in the middle of the site, and another coral reef (the south reef) near the southern border of the property (Figure 3-11). A thin band of seagrass is found near the reef flat of the south reef.

The reef flats of both reefs are composed mainly of coral debris and coralline rock, and are inhabited primarily by sea urchins, mollusks, and soft corals. Heavy intertidal gleaning by the local fishermen occurs during every low tide. Hard coral cover, although patchy in distribution, is in relatively fair condition from a depth of 6-20 m (20-70 ft.). These are mainly composed of Acropora spp. which are mostly branching and tabulate in form. Other hard coral forms on the site are the encrusting, massive, and mushroom growth forms.

Coral rubble comprises 50% of the substratum, especially at the 20-ft isobath on the north reef (Table 3-9) and the 40-ft isobath on the north slope of the north reef (Table 3-10), and

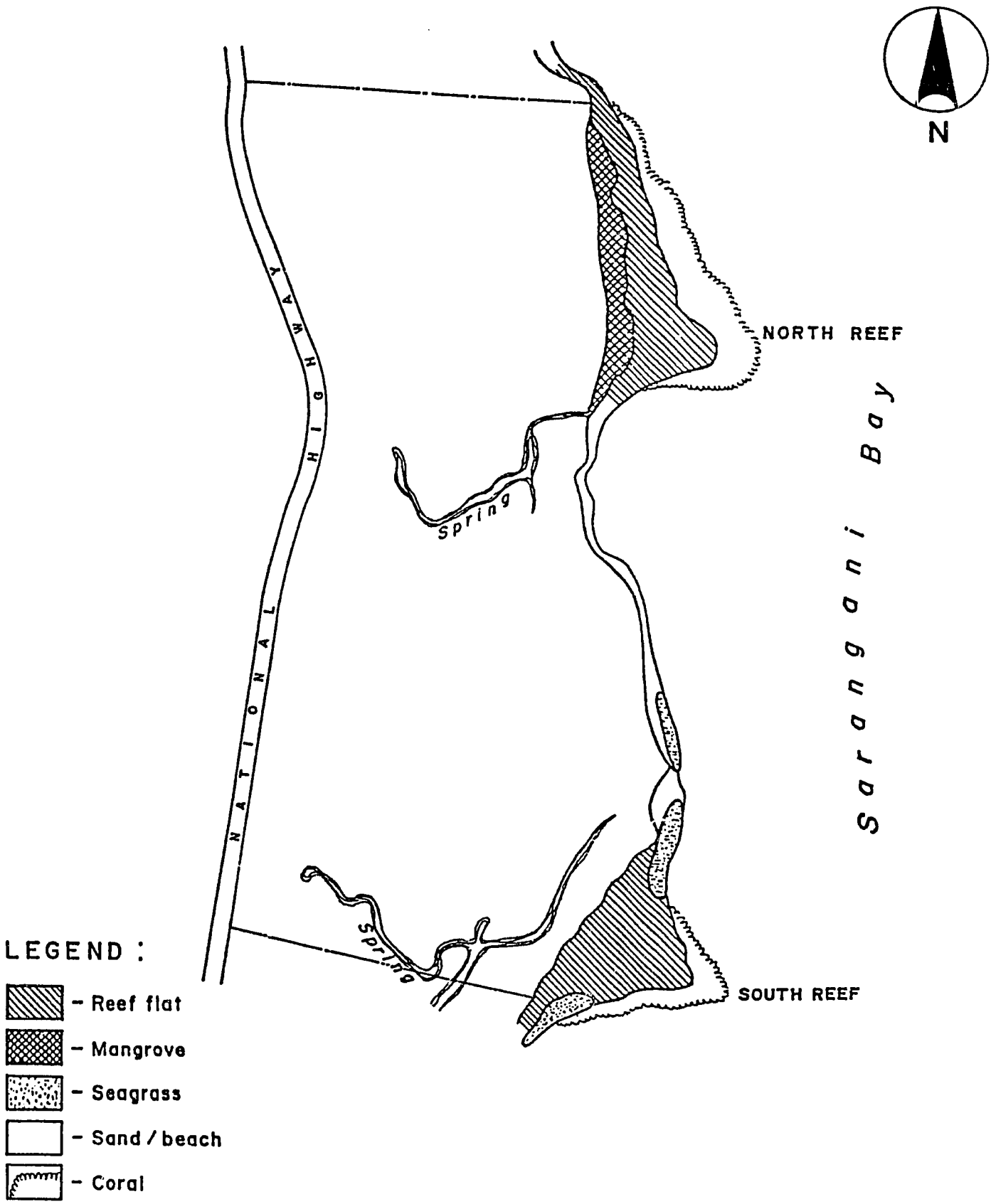


Figure 3-11 NEARSHORE ZONE OF THE PROPOSED GSAPC SITE

Dames & Moore

gradually thins out towards the deeper slope. The presence of large patches of rubble is attributable to the rampant use of dynamite and poison by fishermen in the past. Nevertheless, it appears that the corals at the site are in a state of recovery, as dynamite fishing has been effectively stopped for the past few years. This is evident in the observed presence of small recruit coral heads. A few algae are also found in shallow water, while soft corals, sponges, and anemones are observed in deeper waters near the 40-foot isobath. Sand is common between scattered coral heads and coral rubble, particularly on the south slope of the north reef and on the south reef. These are probably attributable to storm-fed runoff of the sandy shore, and reworking of beach sands by the spring outlets and by wave action.

Both reefs abound with crinoids and mushroom corals (Fungia spp.) (Tables 3-9 and 3-10). The presence of crinoids indicate good currents flow through the area, with only limited problems of turbidity or suspended solids. Other large organisms found in smaller numbers are starfishes, holothurians, and sea urchins.

The quality of the habitat off GSAPC was judged good compared to many other places in the Philippines, primarily because so many reefs in the country have been destroyed by dynamite fishing. Reef habitat is not extensive in Sarangani Bay (Figure 3-12). In comparison to other reef areas qualitatively surveyed off Tampuan Point, Tango Point, and north of the Banwalan River at Biu Point (Figure 3-12), it appears that the best coral cover is found off Tampuan Point. Tango Point has a good cover of branching and tabulate corals, while that north of Banwalan River at Biu Point are mostly dead due to siltation. In general, the corals in the project site are in a better state than those north of the Banwalan River, but less attractive than Tango and Tampuan Points to the south due to the better condition of hard coral cover of the latter two.

3.5.2 Fish

3.5.2.1 Reef Fish Population

A total of 105 reef fish species comprising 30 families were recorded during site surveys in February 1991 (Appendix C). Visual fish censuses conducted on the reefs of the proposed project site show that most of the abundant fishes recorded are small planktivores such as pomacentrids (damselfishes), caesionids (fusiliers), and anthiids (basslets) (Tables 3-11 and 3-12). Schools of unidentified fish larvae were also observed, which attest to the site as a nursery area and that recruitment

Table 3-9. Benthic Life Forms at 20 ft Isobath

	NORTH REEF		SOUTH REEF	
	North Slope	South Slope	North Slope	SouthSlope
Percent Cover				
Sand	24	24	50	34
Rubble	58	50	17	32
Hard Coral				
Staghorn	-	2	4	-
Branching	5	2	3	1
Massive	2	4	1	2
Encrusting	-	13	3	1
Tabulate	-	-	14	-
Erect foliose	-	-	4	-
Mushroom	1	1	-	
Cup-shaped	-	-	-	1
Soft Coral	-	4	2	4
Algae	2	-	1	25
Sponges	8	-	1	-
Anemones	-	-	-	-
Abundance/50 m^2				
Crinoids	>50	> 50	>100	> 50
Fungia	21	> 50	> 50	5
Acanthaster	0	1	0	0
Other sea star	4	2	0	2
Synaptids	0	0	0	0
Other holothuroids	0	0	0	1
Sea urchins	1	10	2	6

Table 3-10. Benthic Life Form at 40 ft Isobath

	NORTH REEF		SOUTH REEF	
	North Slope	South Slope	North Slope	South Slope
Percent cover				
Sand	6	51	48	21
Rubble	63	18	28	31
Hard Coral				
Staghorn	-	2	-	14
Branching	15	1	2	1
Massive	5	3	-	3
Encrusting	4	14	4	11
Tabulate	-	4	8	6
Erect foliose	-	-	-	-
Mushroom	1	3	1	3
Cup-shaped	-	1	-	-
Soft Coral	4	3	3	2
Algae	-	-	-	-
Sponges	2	-	5	6
Anemones	-	-	1	2
Abundance/50 m^2				
Crinoids	>100	> 50	> 50	> 50
Fungia	>100	>100	14	> 50
Acanthaster	0	0	0	0
Other sea stars	3	1	3	0
Synaptids	0	0	0	1
Other holothuroids	2	0	0	0
Sea urchins	2	4	2	0

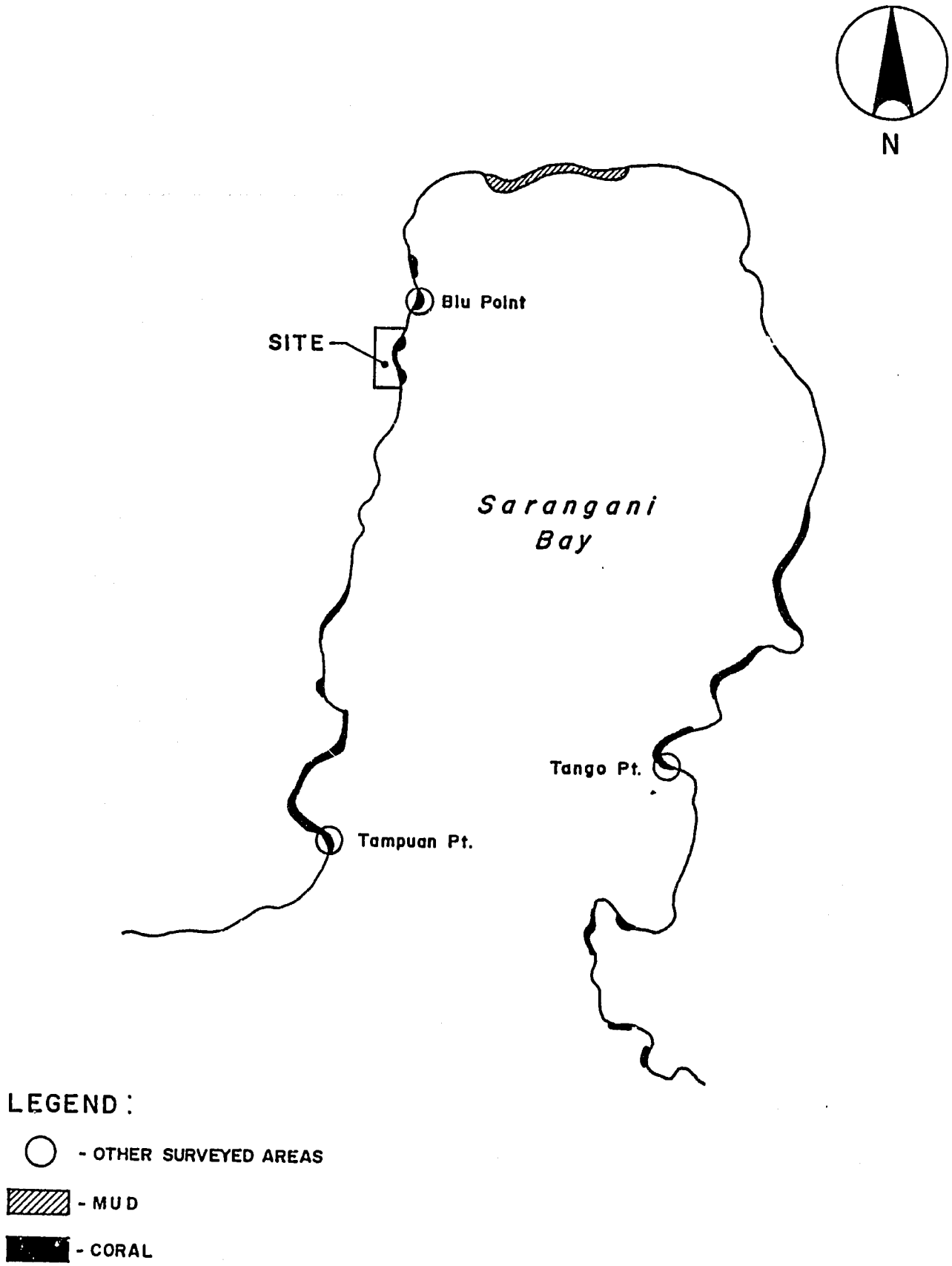


Figure 3-12 MAP OF SARAGANI BAY WITH OTHER REEF AREAS SURVEYED

Table 3-11 Dominant Fish Species Groups on the North Reef

Transect	Number of Families	Number of Species	Dominant Species	Family
North Slope				
20 ft	17	41	Paraglyphidodon melas	Pomacentridae
			Caesio pisang	Caesionidae
			Anthias mortoni	Serranidae
			Abudefduf vaigiensis	Pomacentridae
			Dascyllus reticulatus	Pomacentridae
			Dascyllus trimaculatus	Pomacentridae
			Chrysiptera hemicyanea	Pomacentridae
			Cirrhilabrus temmincki	Labridae
			Cirrhilabrus cyanopleura	Labridae
			Naso brevirostris	Acanthuridae
40 ft	16	44	Anthias squamipinnis	Serranidae
			Paracaesio xanthurus	Lutjanidae
			Caesio pisang	Caesionidae
			Anthias mortoni	Serranidae
			Anthias randalli	Serranidae
			Paraglyphidodon melas	Pomacentridae
			Amblyglyphidodon aureus	Pomacentridae
			Dascyllus trimaculatus	Pomacentridae
			Cirrhilabrus cyanopleura	Labridae
			Cirrhilabrus temmnincki	Labridae
			Naso brevirostris	Acanthuridae
South Slope				
20 ft	21	55	Paraglyphidodon melas	Pomacentridae
			Acanthochromis polyacanthus	Pomacentridae
			Paracaesio xanthurus	Lutjanidae
			Anthias squamipinnis	Serranidae
			Pomacentrus vaiuli	Pomacentridae
			Dascyllus Trimaculatus	Pomacentridae
			Dascyllus aruanus	Pomacentridae
			Chromis retrofasciatus	Pomacentridae
			Parupeneus trifasciatus	Mullidae
			Cirrhilabrus temmincki	Labridae
			Caesio pisang	Caesionidae
			Naso brevirostris	Acanthuridae
40 ft	18	41	fish larvae	
			Anthias squamipinnis	Serranidae
			Paraglyphidodon melas	Pomacentridae
			Paracaesio xanthurus	Lutjanidae
			Caesio pisang	Caesionidae
			Dascyllus trimaculatus	Pomacentridae
			Acanthochromis polyacanthus	Pomacentridae
			Pomacentrus amboinensis	Pomacentridae
			Amblyglyphidodon leucogaster	Pomacentridae

Table 3-12. Dominant Fish Species Groups on the South Reef

Transect	Number of Families	Number of Species	Dominant Species	Family
North Slope				
20 ft	19	38	Anthias squamipinnis	Serranidae
			fish larvae	
			Anthias mortoni	Serranidae
			Chromis retrofasciatus	Pomacentridae
			Dascyllus reticulatus	Pomacentridae
			Chromis xanthurus	Pomacentridae
			Dascyllus trimaculatus	Pomacentridae
			Cirrhilabrus cyanopleura	Labridae
			Cirrhilabrus temmincki	Labridae
			Caesio pisang	Caesionidae
40 ft	14	36	Acanthochromis polyacanthus	Pomacentridae
			Paracaesio xanthurus	Lutjanidae
			Caesio pisang	Caesionidae
			Anthias squamipinnis	Serranidae
			Pomachromis richardsoni	Pomacentridae
			Dascyllus trimaculatus	Pomacentridae
			Paraglyphidodon melas	Pomacentridae
			Chromis atripectoralis	Pomacentridae
			Halichoeres chrysus	Labridae
			Acanthurus mata	Acanthuridae
South Slope				
20 ft	16	37	Acanthochromis polyacanthus	Pomacentridae
			Paraglyphidodon melas	Pomacentridae
			Chrysiptera hemicyanea	Pomacentridae
			fish larvae	
			Dascyllus reticulatus	Pomacentridae
			Chromis lepidolepis	Pomacentridae
40 ft	17	47	Anthias randalli	Serranidae
			Anthias squamipinnis	Serranidae
			Paraglyphidodon melas	Pomacentridae
			Acanthochromis polyacanthus	Pomacentridae
			Chromis richardsoni	Pomacentridae

of reef fish populations is still going on. On the other hand, the absence of highly-favored "target" species or large fish such as lutjanids (snappers), lethrinids (emperors), carangids (jacks), and serranids (groupers) was noticeable. This could be due to on-going fishing activity on the reef with spears, traps, and gillnets.

3.5.2.2 Sarangani Bay Fishery

There is very little information on regarding the fish resources of Sarangani Bay itself. First hand information gathered from interviews and observation of the landing sites (Lion Beach and Poblacion) reveal that anchovies, roundscads, big-eye scad, moonfishes, and milkfish fry are caught by artisanal/municipal fishermen within Sarangani Bay. Milkfish fry used to be gathered in large quantities on the beach of the project site but this is now almost non-existent. This is attributed by local residents to the change in water quality of the surrounding waters since the establishment of prawn farms and other processing centers in the nearby areas. Intensive prawn farm systems are reported to release effluent and wastes which directly or indirectly affect coastal organisms (Primavera 1991). Prawn farms also pump in large volumes of seawater on a daily basis, probably entraining in the intake water milkfish fry swimming along shore, running them through the pumps, and depositing their remains in the shrimp ponds.

A very small number of reef fishes (~5% of total landings) are landed on an irregular basis in General Santos City (Ordoñez, pers. comm.). This include the balistids (triggerfishes), siganids (rabbitfishes), and caesionids (fusiliers) which have been observed in the landing site and the market. Most of these are reportedly caught in the South Sulu Sea.

3.5.2.3 Tuna Fishery

General Santos City is the main landing site for tunas and small pelagic fishes caught by municipal fishermen in the Moro Gulf, South Sulu Sea, and north Celebes Sea (Table 3-13). Among these, the yellowfin tuna ranked number one in the municipal fisheries with a total catch of 7,916,477 metric tonnes (mt) for 1988-89 as reported by the Philippine Fisheries Development Authority (PFDA). Yellowfin tunas are caught by fishermen from General Santos City mostly off the coast of Kalamansig, Kiamba, Milbula, Palimbang, Mistune, Balut Island, and as far as Basilan (Ganaden and Ali 1983). A recent report by Barut and Arce (1990)

Table 3-13. Commercially Important Fishes Landed at General Santos City

COMMON NAME	LOCAL NAME
Yellowfin tuna	Bariles Karao (juvenile)
Roundscad	Pirit
Big-eye scad	Borot
Skipjack tuna	Sambagon
Frigate mackerel	Tulingan
Marlin	Marang
Anchovy	Bolinao
Sardine	Tamban
Moonfish	Bilong-bilong
Dolphinfish	Pandawan
Triggerfish	Pakol
Slipmouth	Sapsap

shows that the bulk of the landings for yellowfin ranged in length from 130-145 cm, which are mature individuals.

On the other hand, skipjack tunas ranked number one for the commercial sector. However, more small-sized, immature (14-30 cm) (Ordoñez, pers. comm.) skipjacks are being landed (36,074,404 mt) compared to big (>65 cm) or adult individuals (19,989,006 mt). Skipjack tunas are caught with the aid of fish aggregating devices (FADs) in the Moro Gulf and Celebes Sea. The tunas are then processed as frozen/chilled or canned products for the export industry.

Based on studies made by Silvestre (1989), tuna stocks in the Moro Gulf and adjacent areas are believed to be heavily fished already, hence no possible sustainable increase in landings can be expected from this particular fishing region.

3.5.2.4 Fishing Methods

With the exception of intensive gleaning on the reef flats at low tide, fishing occurs at the GSAPC site in the form of one or two fishermen on small outrigger boats using spears, handlines, or bottom-set gillnets. The latter is a net which measures 1.5 m in height and 10 m or more in length, and is set on the reef bottom at shallow depths (<5 m).

A small number of milkfish fry are still caught near the deepwater cove by children using a small beach seine. This is a fine-meshed, cone-shaped net measuring approximately 3 m at the mouth and a length of around 5 m. The net is dragged by two persons along the beach and into the mouth of the north spring during high tide.

The small pelagic fishes in Sarangani Bay are caught mainly by using purse seines or ring nets with the aid of fish aggregating devices locally called "payaw." This is a floating raft anchored to a depth of 275 m with bundles of coconut palm fronds attached to it a few meters below the surface. The leaves act as a refuge and, along with the aid of a light source at night, attract the fishes. Fishing operation is conducted at night until dawn. A purse seine unit consists of one catcher vessel or mother boat from which the net is set out and retrieved, one or more light boats in the vicinity of the payaw at night, one scout boat, and two carrier vessels.

Outside Sarangani Bay, tunas are also caught by purse seiners with the aid of the "payaw." However, the use of the "payaw" has stirred controversy mainly because they have been

reported to be the cause of catching smaller-sized tunas (Floyd and Pauly 1984; Silvestre 1989). Larger tunas for the sashimi industry are caught by handline by fishermen onboard outrigger vessels locally called "palakaya." This is a large version of the traditional banca and is capable of travelling up to a range of 300 nautical miles. Again, handlining is also used with the aid of the "payaw" (Ganaden and Ali 1983). Thus, immature (20-58 cm) yellowfin tunas are also caught (Barut and Arce 1990).

3.6 Aquatic Resources and Mangroves

3.6.1 Aquatic Biota

Two small freshwater springs are located within the project area (Figure 3-1). Both are very shallow, with only the southern spring having waist-deep water near the beach. Land elevation is high enough to prevent extensive formation of estuarine conditions.

The water is clear from the point of origin, although leaf litter and small branches are scattered underwater in stretches where vegetation is thick. The absence of turbidity in the water indicates that decomposition of plant litter material is probably very low. Besides, water flow is rapid enough to flush out most litter, with the exception of the deeper stretch of the south spring, just behind the beach near the south property line.

Both springs are used for drinking and bathing, but the north spring is also used for washing clothes. Relatively more people use the north spring due to its accessibility to nearby villages and the beach. Quite a number of fishermen temporarily run their boats aground in the area of the deepwater cove to clean their boats, wash their clothes, bathe, and get freshwater supply.

The GSAPC site once included a fishpond operation, as evidenced by remnants of concrete dams, excavations, and mud dikes in some portions of the site, particularly in the vicinity of the south spring. A concrete dam originally blocked the natural flow of the north spring near the beach. Treasure hunters reportedly undermined the dam, and it no longer is functional. The north spring is heavily used by the small fishing community in the area, with extensive laundering activity and bathing occurring in the vicinity of the undermined dam.

Small shrimps (locally called "pasayan") and small crabs ("talangka") are common in the upper reaches of the north spring. Few fishes were observed upstream of the dam. Apparently the

dam, as well as the rocky and steep streambed inclination at the base of the dam and the laundry and bathing activity along this part of the spring, has impeded fishes from reaching the upper portion of the spring. Small fishes were observed in the lower reach of the north spring near the beach. The fishes are composed mainly of juvenile glassfishes (Ambassis spp.) locally called "ibis," mudskippers (Periophthalmus spp.) called "tambasahan," and another species of goby (Exyrias puntang).

The south spring has more fish fauna upstream, perhaps due to the absence of man-made barriers. Fishes observed include medium-sized mullets (Mugil spp.) called "banak," halfbeaks (Hemiramphus spp.), glassfishes, juvenile snappers (Lutjanus argentimaculatus), goatfishes (Upeneus spp.), and unidentified gobies. However, no fishes were observed near the headwaters, perhaps due to the disturbed condition of the area. This also reflects the greater diversity in the lower zones of the spring (Lowe-McConnell 1987). Small shrimps and crabs were also observed in the south spring.

The shrimps in the springs, being relatively small, are used mainly for bait. These are caught by electrofishing and by the use of scoop nets in the north spring. Gill nets, on the other hand, are used in the south spring. The fishes caught are consumed by the fisherfolks, while small fishes are also used for bait. Fishing activity may account in part for the small numbers of fish in the north spring.

No macroscopic aquatic plants are found thriving directly in the whole stretch of both springs. However, some green algal mats ("lamut") were observed on rocky portions of the north spring, particularly in and downstream of the area used intensively to wash clothes and bathe. Phosphate-rich detergents may be stimulating algal growth.

Plants found along the freshwater springs in the project site include the ferns dapo (Asplenium nidus), lagolo (Acrostichum aureum), and tangripas (Pteris vitata). Tambo (Phragmites australis) and small patches of litlit (Piper sp.) were recorded at the mouth of the north spring. Mangrove species (Cerbera manghas and Pongamia pinnata) were observed on the seaward section of the springs.

3.6.2 Mangrove Habitat

Coastal mangrove habitat occurs along the shoreline on the northern third of the property and in a thin band of mangrove swamp which extends across the whole area behind the beach

between the two springs (Figure 3-13). The mangrove vegetation in the project site accounts for about 6% of the total project area.

This vegetation type is dominated by pioneer colonies of Sonneratia spp. Noticeable also is the occurrence of pagatpat (S. alba) in the less saline part of the interior mangrove swamp; this species is common in deep muddy soil and along tidal steams and estuaries with slow moving water. However, pedada (S. caseolaris) prefers saltier water and survives well on rocky and sandy beaches with thin muddy soil. At the intermediate layer, the species of bani (Pongamia pinnata), tui (Dolichandrone spathacea) and bakawan lalake (Rhizophora apiculata) are found either singly or in small patches. Vine species of Derris and Caesalpinia are recorded in the ground layer in the interior mangrove swamp.

The mangrove swamp behind the beach is inundated during high tide. It is probable that this swamp was connected to the south spring, but has been disconnected some time in the past by mud dikes when the area was still used for fish ponds. The thin band of mangrove swamp behind the beach has been observed to harbor juvenile fishes and shrimps. These include, among others, glassfishes, gobies, snappers, terapons, milkfishes, barracudas, pipefishes, halfbeaks, and mullets. Other fauna observed in the swamp, including the upper canopy, are crabs, aquatic snakes, numerous insects, and fish-eating birds (kingfisher).

Most of the small fishes and shrimps in the swamp are caught by scoop nets after agitating and stirring up the muddy substratum of a portion of the swamp. These are then used for bait. Local residents report that large mangrove crabs (Scylla serrata) are caught within the swamp at night. The presence of these crabs is evidenced by the presence of large mud mounds in the area.

The extensive prop roots of mangroves act to reduce tidal currents and wave action, encourage deposition of mud and silt, and provide surfaces for attachment of marine organisms. In general, mangroves are not only important in extending coasts but also in protecting it from erosion. However, these conditions are not strongly evident in the mangrove habitat in the project site. The mangrove trees in the project site may not be effectively reducing erosion, as the beach area behind the mangroves is already eroded, exposing roots of coconut trees. As there are very few mangrove trees on the northern shore of the project site, continuous flushing of the shoreline discourages retention of mud and silt and associated organic detritus which

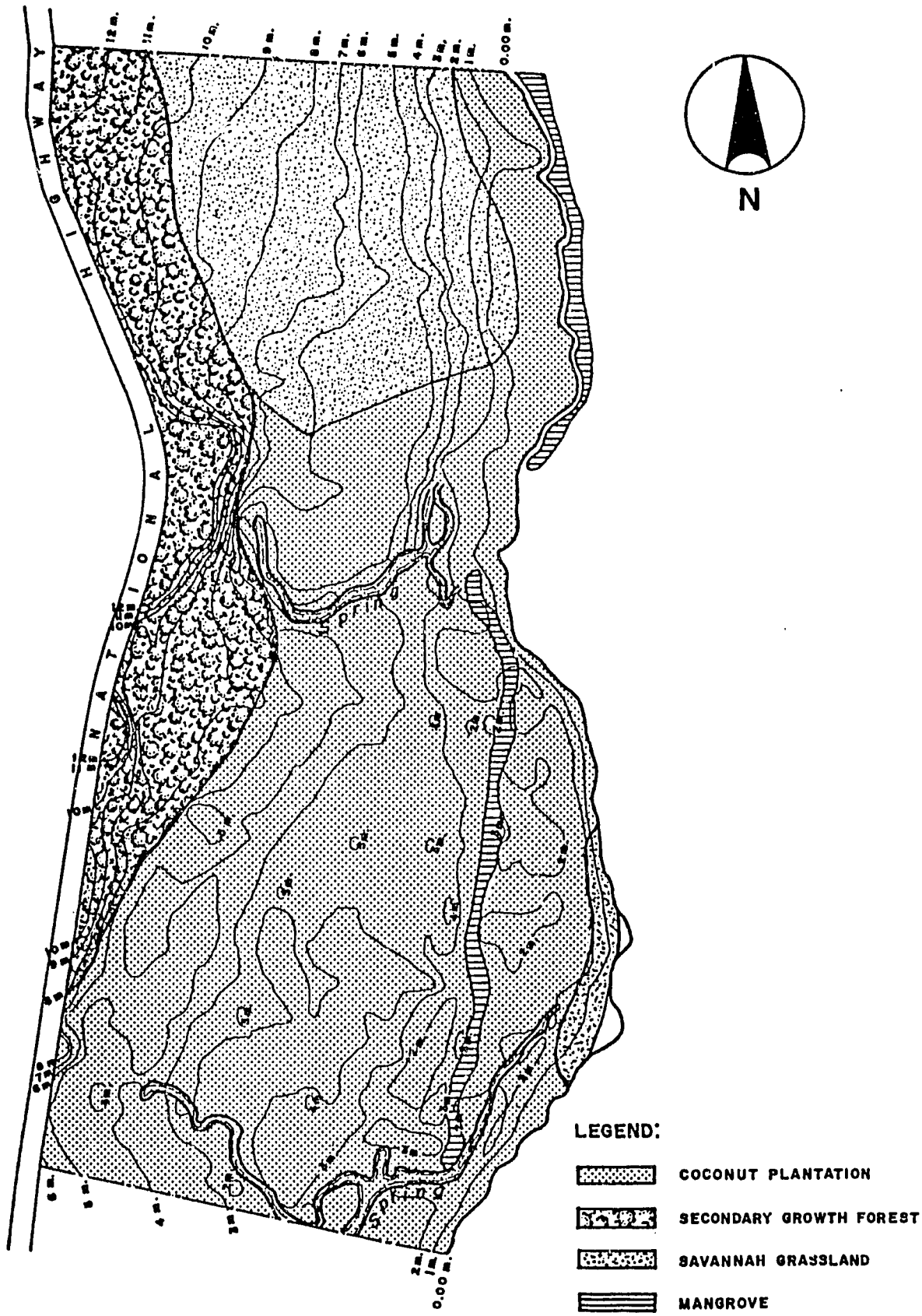


Figure 3-13 VEGETATION MAP

Dames & Moore

could be the sources of food for juvenile crustaceans and fish fingerlings.

It was further observed that branches are obviously being cut from the mangrove trees. Although the mangrove trees in the project site are still productive, it was observed that the prop roots are small and the numbers are not proportional to the size of the trees. This could limit the life span of the trees.

Mangroves represent economic and biologically significant habitat in the coastal zone. The existing mangrove habitat around Sarangani Bay is declining in quality and quantity as a result of conversion to shrimp and fish ponds and gradual industrialization in the vicinity of General Santos City. Mangrove habitat serves as a sanctuary and breeding ground for burrowing crabs, bangus fry, and other commercially valuable marine organisms. Mangroves also serve as source of firewood and light construction materials.

3.7 Terrestrial Biota

Plant species on the west side of the National Highway are mostly ipil-ipil, camachili trees, and grasses. These species survive well in sandy soil, even under the drier conditions in the project area. However, dust from passing vehicles has coated the leaves, thereby affecting plant productivity and photosynthesis. The foliage along the road is rather thin, perhaps due to a combination of dust problems and dry soil conditions, aggravated by the drought conditions. The road is undergoing improvements and will be paved in 1992 by USAID. Thus, dust problems caused by traffic will be virtually eliminated.

Terrestrial habitat types, as defined by dominant vegetation, on the 32-ha site are comprised primarily of coconut plantation, secondary growth forest, and savannah grassland (Figure 3-13).

3.7.1 Coconut Plantation

The coconut plantation covers about 58% of the project site. Coconut (Cocos nucifera) is the most dominant at the overstory layer. At the intermediate layer, the dominant and co-dominant species identified are ipil-ipil (Leucaena leucocephala) and bani (Pongamia pinnata) respectively. These species are also interspersed with shrubs, tree saplings, and vines. Common species include kayong (Glochidion littoralis), anagdong (Trema

cf. cannabina), pandakaki (Ervatamia pandacaqui), camachili (Pithecellobium dulce), alagao dagat (Premna integrifolia), tui (Dolichandrone spathacea), and vine species of Syzygium, Derris, and Caesalpinia. Beach type forest species are also present near the shoreline, e.g., bitaog (Calophyllum inophyllum) and talisay (Terminalia catappa).

The ground layer in the coconut grove is a mixture of grasses and herbs. The dominant species identified include cogon (Imperata cylindrica var. major) and guinea grass (Panicum maximum), while the co-dominant species are Napier's grass (Pennisetum purpureum), walisan (Sporobolus indicus), and kandi-kandilaan (Stachytarpheta jamaicensis). Recorded also in the ground layer near the beach are beach grass (Spinifex littoreus), Manila grass (Zoysia matrella var. matrella), Cyperus sp., and Fimbristylis sp.

Small clearings within the coconut plantation are planted to various annual and perennial crops. The agricultural crops recorded were as follows: saging (Musa sapientum), pandan banguhan (Pandanus amaryllifolius), gabi (Colocasia esculenta), and kamote (Ipomea batatas) which are cultivated in the backyards of local residents. Some fruit tree species which are sparsely distributed under the plantation include: caimito (Chrysophyllum cainito), guayabano (Annona muricata), guava (Psidium guajava) and papaya (Carica papaya).

3.7.2 Secondary Growth Forest

Secondary growth forest accounts for about 19% of the total project area. Most of this habitat type occurs either in small clusters or as a narrow band along the west property line (Figure 3-13). At the overstory layer, ipil-ipil (L. leucocephala) and Albizia sp. are the dominant species, and associated by anonang (Cordia dichotoma) and balete (Ficus spp.) as the co-dominant species. These species are most noticeable along the highway.

In the intermediate layer, spiny shrubs and vines are abundant along with saplings of balete (Ficus sp.), ipil-ipil, kayong, and Ziziphus sp. Also found in the area are Mallotus sp., Macaranga sp., Neonuclea sp., Litsea sp., matang hipon (Breynia rhamnoides), kamo-kamotehan (Ipomea pescapre), pandan dagat (Pandanus tectorius), and baki-baki (Spinifex littoreus). The dominant and co-dominant species identified at the understory layer, which occur in patches, are Napier's grass, guinea grass, hagonoy (Chromoleaina odorata), and kandi-kandilaan.

The process of plant regeneration and succession in the secondary forest area is curtailed due to various anthropogenic activities such as gathering firewood, harvesting for light construction and fence materials, and grazing by goats.

3.7.3 Savannah Grassland

The savannah grassland accounts for about 17% of the total area. When surveyed in April, it had recently been razed by a grassfire and only those species which were left in patches or on the periphery serve as the indicators of the vegetation. Nevertheless, the notable species identified are as follows: cogon, guinea grass, Napier's grass, and Sporobolus sp. The occurrences of these species are similar to the ground layer cover under the coconut plantation and second growth forest. The tolerance of the ground layer species, either in shaded, partially shaded, or open areas, may indicate homogeneity of soil and moisture conditions on the site.

3.7.4 Threatened and Endangered Species

From the listing of plant species found in the project site, as well as the type of habitat observed, no endangered, threatened, or rare species were found or are likely to thrive in this partially disturbed site. The different species identified in the project site are considered common and are widely distributed throughout the country.

Although the springs represent an ecologically interesting and perhaps uncommon habitat type, similar springs are located at scattered locations for several kilometers to the south in coastal coconut plantation habitat. It is not likely that the shrimp and fish species occupying the springs on the GSAPC site are rare, threatened, or endangered. Furthermore, the high use of the springs on the site by fisherfolk, including baitfishing in the spring, suggests that the biota associated with the springs on the GSAPC site are among the most disturbed and modified by human activity, compared to similar springs in the area.

While the mangroves are not classified as threatened or endangered species, the harvest, uses, and destruction of these species are extensively covered by various forest laws and regulations due to their limited areal coverage and their economic and ecological significance.

3.8 Geology and Soils

3.8.1 Regional Geomorphology

The Cotabato Subprovince, in which the GSAPC site is located, has two distinct physiographic features: 1) the Daguma Range, and 2) the Cotabato Valley. The Daguma Range, consisting of a series of relatively high mountains, upland lakes, and some active volcanoes, extends from the Province of Maguindanao to the southern extreme of South Cotabato (Figure 1-1) where it terminates abruptly at the coast. A stretch of narrow beaches occurs along the coastal margin, primarily on the western side of the range but extending from Llana Bay into Sarangani Bay.

The Cotabato Valley covers an area of over 1000 km^2 and extends from the Bukidnon-Lanao Plateau to the north, and slopes gently to the North Cotabato lowlands, where low-lying areas and tidal flats predominate. On the east of Sarangani Bay is the Diwata Range, which extends from Surigao to the north and terminates abruptly at Sarangani Strait to the south.

3.8.2 Site Conditions and Topography

The National Highway running between General Santos City and Kiamba is located along the western boundary of the site. There are culverts under the road that convey runoff from the inland catchment directly onto the site (Figure 3-14). Further south, another culvert carries surface runoff onto the adjacent Agrotex property, but flows through a channel leading to the south spring on the GSAPC site. Surface runoff on the site includes rain-fed flows from the catchment area and two perennial springs on the site. The estimated off-site catchment area is about 4 km^2. At an annual rainfall of 900 mm and an assumption of 90% of the total as run-off (Singconsult 1990, Appendix 5B), this translates to an annual surface flow of 3.2 million m^3 or 8,800 m^3 daily. Losses due to evapotranspiration and other factors, however, are not considered in the calculation. The heaviest recorded rainfall in General Santos City was 309 mm in a 24-hr period (Section 3-2). This indicates design stormwater flow through the site is approximately 3,000 m^3/day. The combined discharge of the two perennial artesian springs at the site is in the order of 10,000 m^3/day.

The topography of the site is undulating (Figure 3-1). The northwestern portion of the site is raised and slopes toward the southeastern part and to Sarangani Bay. There are ridges parallel to the shoreline, indicative of staged retreat of sea levels or uplift of the shoreline. On the west side of the

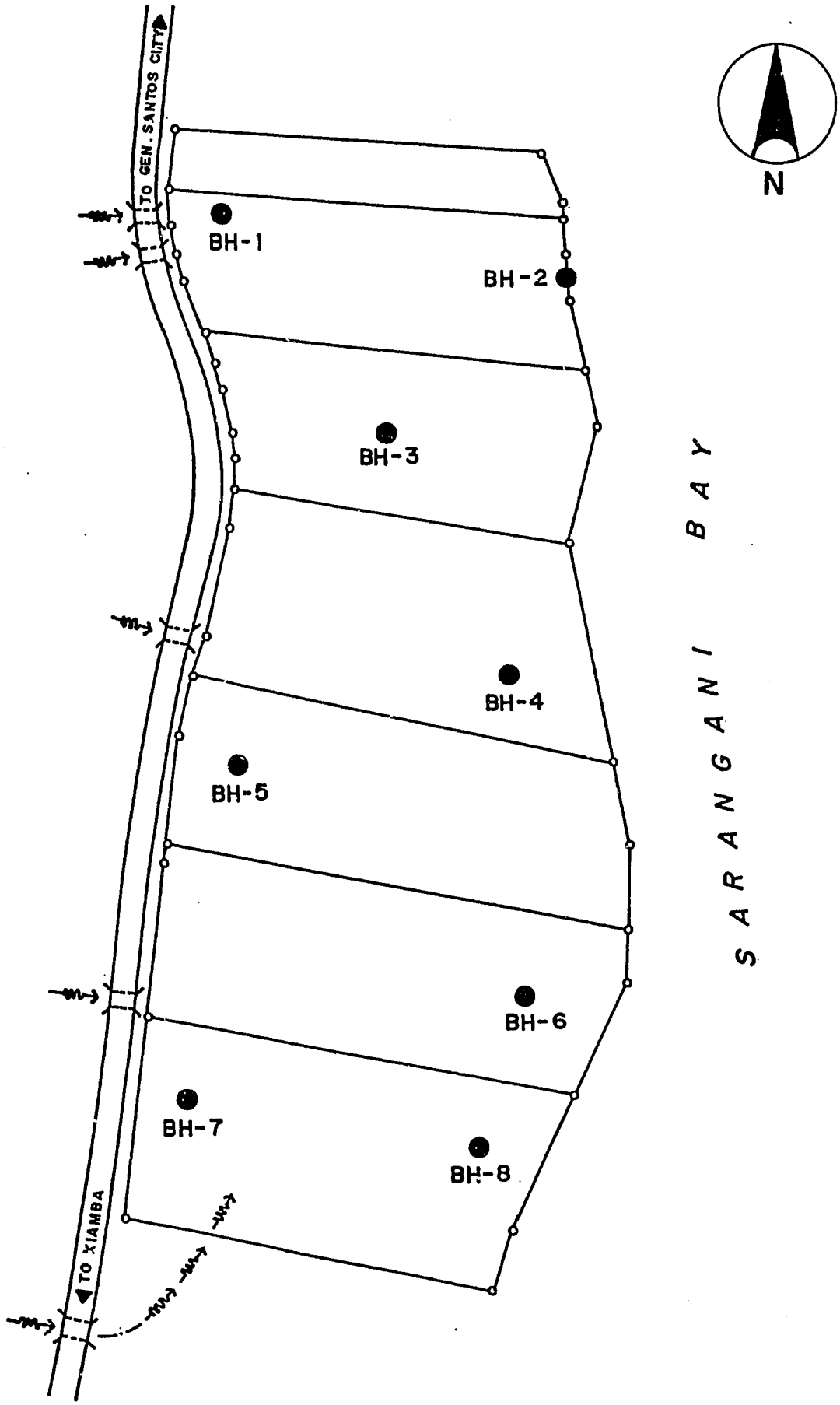


Figure 3-14 BOREHOLE LOCATION PLAN

Source: Singconsult Report 1990

project area, the topography ascends several meters forming a near 1:1 slope, then flattens into an upper terrace. The upper terrace west of the road rises slowly several kilometers to the eastern slopes of the Daguma Range.

3.8.3 Subsurface Conditions

During the data collection stage of the Singconsult (1990) feasibility study, a geotechnical exploration program was initiated. The program consisted of eight borings drilled to depths ranging from 20 to 30 m (Figure 3-14).

A review of the boring logs indicates that the subsurface materials consist mainly of silty, gravely sand to sandy gravel with some fines. There are layers of low plastic silt and clay, but their thicknesses and depths are not considered to be detrimental to the planned development. The upper 10 m of the site is generally loose to medium dense sand except in Borings 1 and 3, where tests indicate a dense to very dense consistency.

Layers of highly weathered coralline limestone of varying thickness and depth were encountered in almost all the borings. This deposit is also evident at the near surface of the site, particularly in the spring channels. Both the perennial springs at the site are in this formation.

3.8.4 Liquefaction Potential

One of the significant earthquake generators in the Philippine Archipelago, the Mindanao Fault, is exposed in the area. Thus, the area belongs to a zone of high seismicity. There are, however, no indications of major damage due the earthquake in the immediate vicinity of the site.

Although the consistency of the top 10 m is very loose to medium dense, the presence of gravel and considerable amount of fines may lessen its susceptibility to liquefaction. Another factor that can be considered as retardant to such phenomenon is the presence of coralline limestone formation within this depth. Liquefaction potential, however, is considered significant by Singconsult (1990) in that part of the site currently at an elevation less than 5 m.

Geological features and liquefaction are described further in Chapter 9 in response to DENR comments on the draft EA.

3.8.5 Marine Geology

Pacific Consultants International (1990) conducted submarine borings on the north reef flat. The coralline limestones which underlie the site extend seaward into Sarangani Bay, where they terminate abruptly at the edge of the coral shelf. Underwater observations indicate that the shelf is only a few meters wide in the deepwater coves and as much as 250-300 m wide below the coral promontories of both the north and south reefs. The reef slopes steeply descend to the floor of the bay. The slope materials consist of predominantly fine to medium gray sand forming a steep slope, and continuous downslope movements were apparent, particularly in the coves. There are often boulder-sized remnants of coralline limestone that are fringing the upper slope.

Based on the published hydrography of Sarangani Bay (US Navy Hydrographic Office Chart H.O. 14608), it is apparent that the floor of the bay is relatively flat, with depths ranging from about 450 m at the north end to as much as 1,700 m near the mouth. The seafloor materials consist of brown mud, sands, and gravels.

3.9 Groundwater

There are five prominent lakes in the Daguma Range, and these are assumed to charge the aquifer that feeds several artesian springs along the coastal fringe of the Daguma Range. There are also several fairly large perennial rivers in the area whose year-round flow is benefitted by the presence of these lakes.

Groundwater was encountered in all the borings on the GSAPC site. Depths ranged from 0 m bgl (below ground level) in Boring 7 to 4.34 m bgl in Boring 1. Boring 1 is at elevation 11.5 m (above MSL), and Boring 7 is at elevation 4.0 m. Previous measurements indicated groundwater fluctuations in the range of 0 m in Boring 7, which is free-flowing, to 1.3 m in Borings 1 and 4.

The study on groundwater potential reported by Singconsult (1990) indicated the presence of a thick aquifer within the area. The specific or safe yield of the aquifer, however, has not been fully determined. All indications point to the aquifer as capable of yielding the water requirements of the proposed project, based on the discharges of the two artesian springs in the site. The report indicates that no saline water was detected in Borehole 1 (Figure 3-14).

An inventory of wells in the general vicinity of the GSAPC site was conducted by Singconsult (1990). The results have indicated that some wells in the vicinity of nearby shrimp ponds are exhibiting saltwater intrusion.

Previous research on the aquifer have concluded that a well should be fully penetrating with screen length of at least 80% of the aquifer thickness to ensure a horizontal inflow to the well. Setting the well in a shallow depth can cause extensive lowering of the water table which can result to a considerable magnitude of subsidence of the affected area.

The artesian springs on the site are expected to supply the water requirement of the project, which is estimated on the order of 3,000 m^3 per day. It is apparent that either spring can sufficiently supply the estimated daily consumption of the planned development.

3.10 Land Use and Services

3.10.1 Land Use

General Santos City has a total land area of 53,606 ha (53.6 km^2) categorized into eight major land uses (Figure 3-15). In terms of area, open grassland is the largest land use (24,637 ha, 46%), followed by agriculture (23,161 ha, 43%), built-up areas (3,160 ha, 6%), forest reserve (200 ha), prawn/fishpond (195 ha), open space (94 ha) and transport/utilities (87 ha) (General Santos City Government 1989).

Forty-seven percent (1,477 ha) of the built-up area is found in urban barangays, with the largest in Lagao (668 ha). Rural barangays have 1,683 ha of built-up areas, with the three largest areas in Apopong (916,96 ha), San Isidro (157 ha), and Tambler (149 ha).

General land use in Tambler consists of 7,452 ha (95%) of open grassland, 186 ha (3%) agriculture, 149 ha (2%) built-up areas, 30 ha (0.04%) open space, 29 ha (0.04%) prawn/fishpond, and 6 ha (0.01%) infrastructure. Residential and industrial uses constitute 72% and 73%, respectively, of built-up areas, including a 350 ha relocation site for approximately 2,540 families from the city center.

The City Development Plan envisions General Santos to be a major agro-processing center and trading hub for South Cotabato and Region XI. Towards this end, the Plan has provisions for the

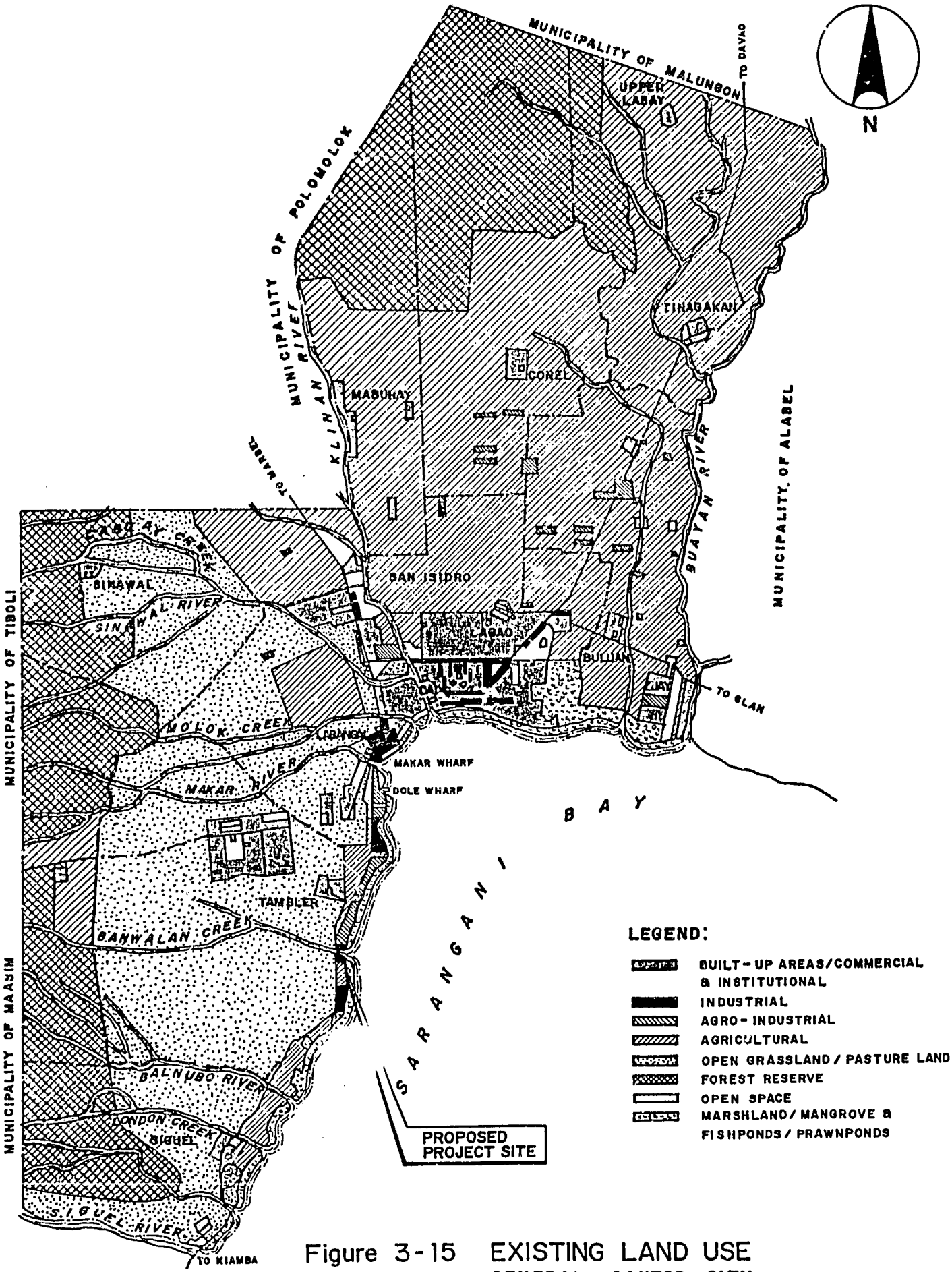


Figure 3-15 EXISTING LAND USE
GENERAL SANTOS CITY

SOURCE: CITY PLANNING AND DEVELOPMENT OFFICE

Dames & Moore

expansion of existing general land uses and specifying measures to control and direct such expansion. Land for industrial and agro-processing activities, for example, is programmed for compact development with appropriate buffer zones from other land uses. In order to manage the growth of the urban center, alternative self-contained growth areas have been designated, one of which is Barangay Tambler. The proposed land use plan for General Santos City is shown in Figure 3-16.

Most of the 24 families currently living on the site live along the shoreline. Livelihoods generated on the site are primarily based on fishing, coconuts, and goats. The land west of the site and the national highway is grazing land, although a limited amount of small-scale sand and gravel quarrying occurs along the national highway opposite the GSAPC site.

San Miguel Corporation owns the parcel of land to the north between the GSAPC site and the Banwalan River channel. A small fishing community of about 50 families is located at the cove at the Banwalan River mouth. San Miguel Corporation has no current development plans for its property. Further to the north of the proposed site are prawn farms, purse seiner wharves, tuna canneries, and a commercial port (Makar Wharf).

A narrow strip of land to the south of the GSAPC site is privately owned; it currently contains coconut plantation, springs, and a small amount of second-growth forest. Agrotex operates a coconut oil plant nearby to the south, and the Celebes Tuna Cannery was recently constructed just south of Agrotex. Much of the shoreline extending several kilometers to the south is occupied by day-use beach resorts. A shrimp hatchery is operated near the mouth of the Siguel River by DoleFil.

Thus, the project site is slowly being surrounded by agro-processing industries and fish landing and processing facilities, which eventually will displace the small fishing communities in the immediate vicinity.

3.10.2. Public Services and Facilities

3.10.2.1 Education

Elementary, secondary, and tertiary education in the City is offered by 80 schools, 50 of which are government-controlled and 20 are privately sponsored. Government schools include 42 elementary schools, five high schools, one state university, and two vocational schools. The private sector provides education through 12 elementary schools, 12 secondary schools, three

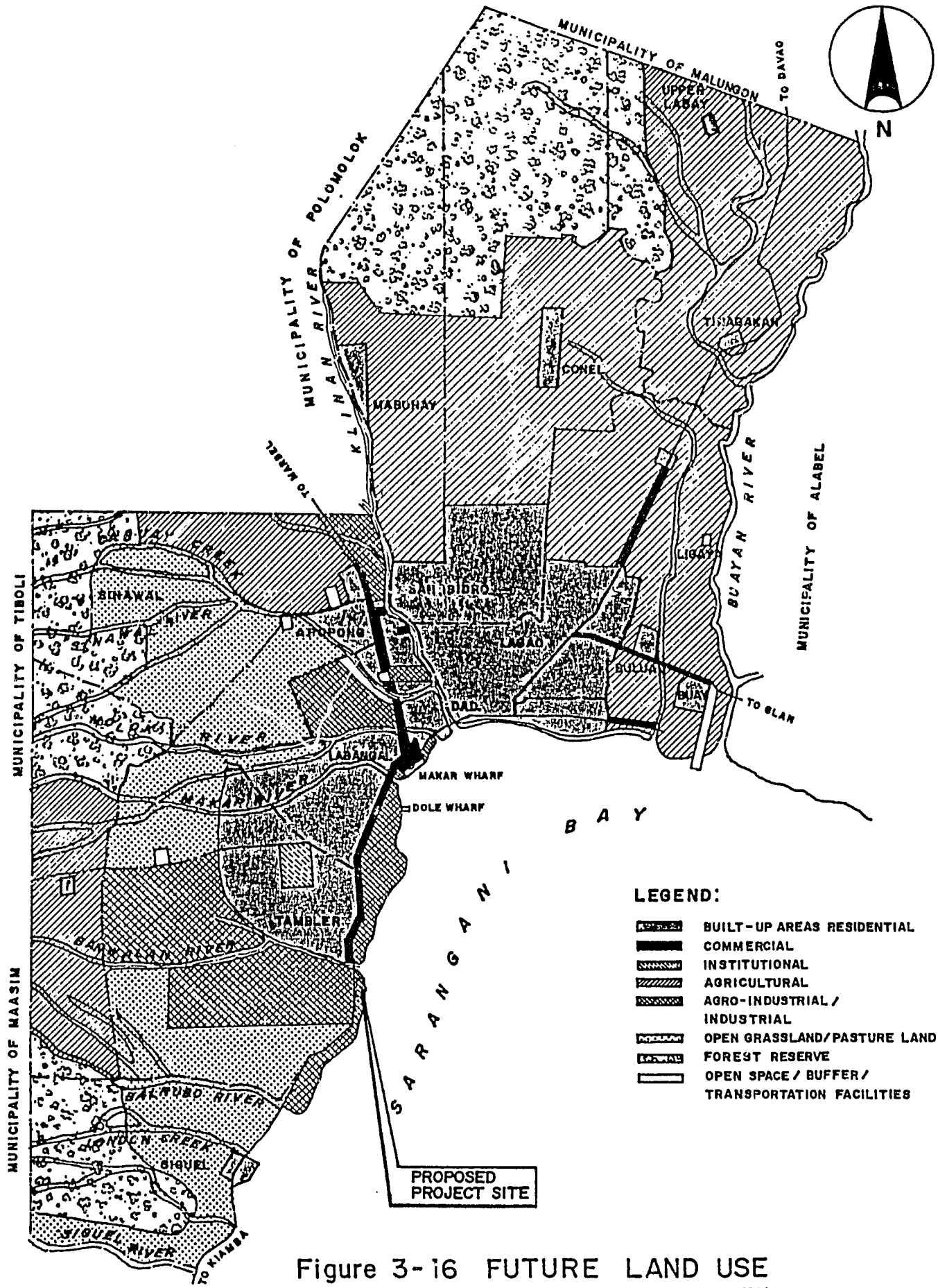


Figure 3-16 FUTURE LAND USE
GENERAL SANTOS CITY

SOURCE: CITY PLANNING AND DEVELOPMENT OFFICE

Dame & Moore

colleges, and three vocational-technical schools. There are also non-formal institutions for pre-school and adult education.

Secondary school enrollment (17,742) for the school year 1989-1990 was almost evenly divided between private (7,726, or 44%) and public (7,690, or 43%) schools, with the remainder (2,326, or 13%) attending high school at Mindanao State University.

Available data (1989) show that there are 834 public elementary school classrooms and 160 high school classrooms. There is a shortage of classrooms at both elementary and secondary levels (General Santos City Government 1989).

3.10.2.2 Health and Sanitation

The provision of health services in the Philippines is primarily a responsibility of the national government in collaboration with appropriate local government agencies. The public health sector in General Santos consists of one district hospital with a bed capacity of 100, and the main health center and barangay health stations which offer primary and referral health care services. Private sector health care facilities include two hospitals, four lying-in clinics, 26 medical clinics, and 12 dental clinics.

Public health care personnel include 13 physicians, 23 public health nurses, 21 public health mid-wives, four dentists, nine sanitary inspectors, one medical technologist, one X-ray technician, and 633 barangay health volunteers. In almost every category, the City has a shortage of public health personnel.

Among the undertakings of the City is the environmental health program, which involves water sampling and treatment of water supplies, the promotion and construction of water-sealed toilets, and the inspection of food establishments and food handlers. This program closely relates to the occupational health and sanitary needs of the city's business establishments.

3.10.2.3 Public Security and Safety

General Santos has a police force of 208 officers and men. Police facilities include one central police station in the downtown area, three sub-stations, five police outposts, one city jail, and five patrol vehicles. Based on a service standard of one policeman for every 1000 population, the city has a shortage of 40 policemen.

The fire-fighting force has 43 officers and men, two fire trucks, and one rescue truck. At a standard of one fire-fighter for every 2,000 population, the City has a shortage of 81 firemen and 39 fire trucks.

Clearly, the need to meet service standards and to upgrade protective services assumes more importance in view of the city's plan to become a major commercial, industrial, fisheries, and agro-processing center.

3.10.2.4 Communications

Telecommunication services in General Santos City include a city wide telephone system, telegraph services, and radio and television networks.

As of 1989, there were three telephone companies which offer long distance services. These are the Radio Communications of the Philippines, Inc. (RCPI), the Philippine Telegraph and Telephone Corporation (PT&T), and the Philippine Telephone Corporation (PILTEL), a subsidiary of PLDT. Recently, RCPI has introduced direct dialing services for long distance calls.

There are 10 telegraph stations which operate in the City, two of which are nationwide commercial networks (RCPI and PT&T) while the rest are operated by the Bureau of Telecommunications. In an effort to modernize and upgrade the existing radio equipment, the Department of Transportation and Communications has made available to the public their ICOM system to make the communication systems in General Santos City more efficient.

3.10.2.5 Roads

As of 1989, the road network of General Santos City has a total length of 466 km or 8.85% higher than that of 1988 (428 km). Out of this total, 12% (57 km) is classified as national road, 46% (215 km) city road, and 42% (195 km) barangay road.

General Santos has six national roads which serve as the link to its major port facilities and to other municipalities of South Cotabato and the Region, including Davao. By type of construction, 43% is concrete, 33% asphalt, and 25% gravel. Practically all national roads are in good structural condition.

The condition of the city and barangay roads, however, is inadequate. Major portions of the roads are unpaved, and only a few asphalted or concreted. Provincial and barangay roads are

generally unpaved at 87% (186 km) and 99% (192 km), respectively. The road adjacent to the proposed GSAPC site is a national highway which connects General Santos City and the coastal communities of South Cotabato. The road is lightly travelled south of the Banwalan River and unpaved. Between the Banwalan River and Makar Wharf, the road is mostly paved and under heavy use. USAID is funding improvements of the road from Makar Wharf to Kiamba, with paving to occur in 1992.

3.10.2.6 Water

At present, General Santos City is experiencing problems in the supply of potable water. Most residents obtain water from wells, while a few rely on rainwater and rivers. Out of 96 water supply systems in the City, 90 of them (94%) are classified as Level I, and most of these are located in the rural barangays. Barangay Tambler, site of the proposed GSAPC, has a total of seven water supply systems, six of which are supplied solely by deep wells.

The Rural Waterworks, Sewerage and Sanitation Program (RWSSP) of the Department of Interior and Local Government (DILG), DPWH, and the Office of the City Engineer are the agencies responsible for the construction of water supply systems in the City. Those residing at the proposed project site obtain their water supply from the freshwater springs located on the property. These springs are also used to meet water needs of numerous fishermen who arrive on the site by boat and temporarily anchor on shore and fetch water.

3.11 Socioeconomic Conditions

3.11.1 Urban Functions and Settlement Structure

General Santos City is classified as a first class city with an annual income of ₱65.55 million as of 1989. It is one of two such cities in Region XI; the other is Davao. General Santos City is subdivided into 18 barangays, four of which are classified as urban and comprise the central business district (Bula, Dadiangas, Labangal, and Lagao), and the rest rural. The project site is located in Barangay Tambler, a rural coastal barangay that has been zoned for agro-industrial, institutional, and residential development.

The city core exhibits a well laid-out street system and land use with definite areas for institutional, commercial, and governmental activities. Its planned lay-out results from its

pioneer heritage as a pre-war and Commonwealth period resettlement area for Christian settlers under the sponsorship of the then National Land Settlement Administration. Spatial development tends to be compact and nucleated in the central business district and the adjoining barangays to the north. Linear development is evident in the coastal barangays to the south where major establishments and other economic activities are predominantly port and sea oriented.

As one of two major growth centers in Southern Mindanao, General Santos City has present and potential roles as a center for agro-processing, transhipment, manufacturing, trading, and institutional services (government, education, and commercial). With a relatively strong agricultural sector, the City has a mixture of urban and rural socio-economic characteristics that differentiates it from small towns in terms of commercial activities and social/institutional services. Yet the City is lower in rank than Davao which offers higher-order urban services particularly with respect to manufacturing, commerce and government. It should also be noted that while Davao is "self-contained" because of the large hinterland within its city limits, General Santos City acts as a service center for other municipalities of South Cotabato and even of the Region; hence the prospects of General Santos evolving into a full-service urban center show very strong signs of development.

Tambler, where the GSAPC is proposed, has the largest land area among the 14 rural barangays at 7,852 ha, constituting 15% of the total land area of the City. It is approximately 12 km from the downtown district, is sparsely populated, and features a campus of the Mindanao State University, a recently opened resettlement site for 2,540 families from the squatter and blighted areas of the city proper, and four major tuna canneries. The City Development Plan has earmarked Tambler as an alternative growth point to include residential, agro-industrial, and institutional development. The port facilities of Dole Philippines and Makar are just to the north of Tambler, in barangay Labangal.

3.11.2 Population Characteristics

The estimated population in 1989 was 248,147, representing approximately 27% of the population of the province and 6% of the Region, assuming medium projections from an official census of 149,398 in 1980. For the next 10 years, the City Plan assumes an annual growth rate of 5.8%, at least twice as high as national, regional, or provincial figures. It is projected that by the year 2000 the city population would have reached 461,373. A major

portion of the increase in population will occur from in-migration.

Overall population density of the City is 463 persons/km^2, about 3.5 times higher than the provincial figure. Taken together, urban barangays have an average density of 3,098 persons/km^2, the highest being in the downtown district of Dadiangas at 21,632. Mean rural density is 189/km^2, with the highest (1,239/km^2,) registered by Buayan. Population density in Tambler has increased from 58/km^2 to 211/km^2 as a result of the recent relocation of 2,540 squatter families (approx. 12,000 persons) from the city proper.

A significant proportion (63%) of the population resides in the urban areas. While rural barangays have 91% of the City's land area, these contain only 34% of the entire population. The relocation of 12,000 persons to Tambler has given it the largest population among the rural barangays. As an alternative growth point, Tambler's population is expected to grow relatively faster than other rural barangays, principally because of such population drawing activities like the MSU campus, ports, and agro-industrial establishments.

More than half (54%) of the city population belongs to the 16-64 age group, followed by those between 0-14 years old (45%). The elderly population (65 and over) constitutes 1.8%. Males slightly outnumber females by a ratio of 104 males to every 100 females. There is no significant variation between male and female distribution in either urban or rural areas.

3.11.3 Economic Characteristics

Agriculture and fishing are among the dominant economic activities in South Cotabato Province. In terms of gross sales in 1989, crops, fishing, and livestock accounted for ₱2.1 billion, manufacturing for ₱2.3 billion, and wholesale and retail trade for ₱5.4 billion (Table 3-14).

Major agricultural products include corn, banana, rice, coconut, and livestock/poultry. Permanent crops include coconuts and fruit trees, totalling 8,571 ha. Coconuts account for 98% (8,422 ha) of permanent cropland, while fruit trees are planted to 150 ha. Total copra production for 1989 was 7,667 mt, for an average yield of 0.87 mt/ha. Tambler has 143 ha of coconut groves, almost all along the shoreline.

Temporary crops (Table 3-15) include corn, rice, banana and cotton. Corn is chiefly used in the manufacture of animal feeds.

Table 3-14. Gross Sales and Number of Establishments by Sector General Santos City, 1988 - 1989

Sector	Gross Sales (P)		Percent Share %		Increase/ (Decrease)	Number of Establishment		Percent Share		Increase Decrease
	1988	1989	1988	1989		1988	1989	1988	1989	
Crops/Fish/ Livestock	781,478,782.90	2,133,411,342.56	8.99	20.51	173	276	355	7.03	6.73	28.62
Manufacturing	2,120,864,045.91	2,350,124,770.25	24.39	22.6	10.81	168	241	4.28	4.57	43.45
Wholesale and Retail	5,320,394,042.73	5,396,163,383.94	61.17	51.89	1.42	2411	3405	61.4	64.6	41.32
Repair Shops	6,546,587.73	8,421,860.55	0.08	0.08	28.64	152	258	3.87	4.89	69.74
Community Wide and Personal Services	468,088,044.33	511,944,028.12	5.38	4.92	9.37	920	1012	23.43	19.2	10
TOTAL	8,697,371,503.60	10,400,065,385.42	100	100	19.57	3927	5271	100	100	34.22

SOURCE: Socio-economic Profile, General Santos City, 1989

Table 3-15. Area Planted to Temporary Crops by Barangay

Barangay	Rice	Corn	Sorghum	Banana	Cotton	RTC	Vegetables	Others	TOTAL	& Share
Urban	440.00	150.00	-	167.46			15.00	20.00	792.46	9.11%
Bula	40.00	-	-	-	-	-	-	-	40	8.46%
Dadiangas	-	-	-	-	-	-	-	-	-	-
Labangal	-	-	-	91.97	-	-	-	-	91.97	1.06%
Lagao	400.00	150	-	75.49	-	-	15.00	20.00	660.49	7.59%
Rural	809	4,291	645	934.59	750	109.07	47.83	310.91	7,905.4	90.89%
Apopong	-	43	10	-	25	-	-	-	78	0.90%
Baluan	450	2	-	33	-	2.20	0.83	17	505.03	5.81%
Buayan	80	-	-	-	-	1.70	-	8	89.70	1.03%
Conel	30	650	70	24.06	287	-	-	38	1,099.06	12.64%
Katangawan	70	350	-	-	-	2	-	23	445	5.12%
Ligaya	100	80	-	-	-	12.50	10	28.91	231.41	2.66%
Mabuhay	-	300	200	202.35	150	4	-	38	894.35	10.28%
San Isidro	70	200	-	525.18	-	61.17	25	27	908.35	10.44%
San Jose	9	750	-	-	-	-	12	7	778	8.94%
Siguel	-	50	-	-	-	-	-	20	78	.90%
Sinawal	-	450	40	-	266	-	-	35	791	9.09%
Tambler	-	25	-	-	-	-	-	18	43	0.49%
Tinagacan	-	700	145	-	-	25	-	30	900	10.35%
Upper Tabay	-	691	180	150	30	0.5	-	13	1,064.5	12.24%
TOTAL	1,249	4,441	645	1,102.05	758	109.07	62.83	330.91	8,697.86	100.00%
% Share	14.36%	51,06%	7.42%	12.67%	8.72%	1.25%	0.72%	3.80%	100%	

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

In 1989, production averaged 3.99 mt/ha for a total yield of 14,048 mt, as compared to 12,130 mt in the previous year. Only 25 ha were planted in corn in Tambler in 1989; the yield was 1,225 mt.

Data for 1989 show that total palay (rice) production was 5,745 mt from 1,149 ha of rice land. This yielded a rice supply of 3,734 mt, which supplied 16 % of the total rice demand of the City. Compared to the previous year, 1989 production was lower by 43%. Average production per hectare dropped from 5.2 mt in 1986 to 5.0 mt in 1989, principally because of the lack of financing for inputs, particularly fertilizer, and the inadequacy of irrigation water.

Cavendish banana is cultivated chiefly for the export market on 919 ha by 103 contract growers and one plantation. Other varieties are grown for the local market and for processing into banana chips.

Data for 1988 and 1989 on livestock and poultry production indicate a general decrease in performance because of the high cost of feeds and feed supplements, the deterioration and shrinkage of grazing land, and transportation costs. Only egg production increased, from 5.7 mt in 1988 to 41.5 mt in 1989. There was a surplus of production of cattle (3,475 mt) and swine (10,523 mt); shortages, however, were incurred in carabao (612 mt), poultry (970 mt), and eggs (778 mt).

The fishing industry is a major source of income for 20,000 persons (fishermen, fishing boat operators, laborers, retailers, and exporters). Commercial fishing is undertaken by 29 operators. Municipal fishing involves approximately 7,000 fishermen utilizing 5,000 motorized and non-motorized fishing vessels. Inland fish production includes prawn, bangus, and tilapia. Prawn production increased from 11 farms in 1988 to 13 in 1989, located in Baluan, Buayan, Tambler, and Siguel. There are five prawn farms in Tambler with a combined area of 28.52 ha. Production is oriented to the export market. Total catch in 1989 was 89,268 mt, a decrease of 18% from the previous year of 90,954 mt. Commercial fishing accounted for 88% (78,253 mt) of total catch in 1989, municipal fishing 12% (10,861 mt), and inland fishing 0.17% (155 mt). There was a total of 33,784 fishing boat arrivals in 1989, of which 80% were municipal and 20% commercial, that utilized the 21 private and one government-owned fish landing areas in the City.

Investments in commerce and industry in 1989 totalled ₱502.16 million, an increase of 208% over the 1988 figure of ₱162.85 million. Business permits issued to establishments in

1989 (5,271) increased by 34% from that of 1988 (3,927). Gross sales registered in 1989 by the 5,271 establishments was ₱10.4 billion, 21% higher than 1988 (₱8.6 billion), and are distributed as follows: 3,405 wholesale and retail firms with ₱5.39 billion (52% of total); 241 manufacturing firms with ₱2.35 billion (22%); 355 crop/fish/livestock operations with ₱2.13 billion (20%); 1,012 commercial/personal services firms with ₱511.9 million (5%); and 152 repair shops with ₱8.4 million.

Foreign export earnings in 1989 was placed at US$128.25 million, while imports were valued at US$40.97 million, for a positive trade balance of US$87.28 million, representing an increase of 69% over 1988 (US$51.78 million). The ten leading exports from General Santos City in 1989 were: canned, fresh, and dried pineapple; bananas; canned tuna; lumber; frozen tuna; cotton seeds; scrap copper; bat guano; and fresh asparagus.

First Quarter 1989 data reveal that close to 50% of the city population is of working age (15 years old and over), 76% of which are in the labor force and 24% out of the labor force. Those who are fully or partially employed number 83,339, or 89% of the labor force; the totally unemployed constitute 9,942, or 11%. Agricultural and non-agricultural workers represent 55% (46,111) and 45%, respectively, of those who are employed.

Available data at the regional level indicate that the average family income in Southern Mindanao (Region XI) for 1988 (at 1985 prices) was ₱32,107, with average annual expenditures of ₱25,993, for an annual savings of ₱6,114. The number of families below the poverty line was estimated at 52%, an improvement from the 1988 figure of 62%.

3.12 Energy

Because the nation is composed of numerous islands, the national power supply is composed of separate grids. Mindanao Island has its own power grid, with a December 1990 installed capacity of 1130.3 megawatts (Gesmundo, pers. comm.).

Electricity generation in the project area is primarily by the Maria Cristina hydroelectric power plant with a capacity of 1,080 megawatts. Power shortages in General Santos City in February 1991 were commonplace, with daily programmed blackouts in the community still occurring in February 1992. The shortage of power was due in part to a severe drought in most of Mindanao Island, which significantly impacted the generating capacity of the hydroelectric facility. Diesel power generators are used as a stand-by system for General Santos City, with plans to add

standby capacity by floating generators in on a barge. Plans to develop a geothermal field on Mt. Apo near Davao City have met serious resistance by local residents in the Mt. Apo region.

The power supply situation in General Santos City worsened in 1991 at the onset of the dry season because of the prolonged drought. NPC was forced to reduce electric power 13 April 1991 by 35% in Mindanao as water level at Lake Lanao dropped 6 cm below the critical water level for power generation (699.15 m above sea level). The five diesel-fired plants in Misamis Oriental and in General Santos City cannot sufficiently supply the power requirements of the entire Mindanao Grid.

The electrical power requirement of General Santos City is provided by the National Power Corporation (NPC) which has a substation at Calumpang, Labangal. The substation is capable of supplying 30 megawatts of power. Electrical distribution is managed by the South Cotabato II Electric Cooperative (SOCOTECO), which buys the power from NPC and retails it to consumers. NPC maintains standby diesel-fired generators; however, for short durations of power failure or shortage, the diesel-fired generator is not used because of the very high cost of start-up.

The electrical power consumption in General Santos City has been increasing at a very fast rate as shown by Table 3-16. Total electrical consumption in 1980 was only 13,646,000 kwh, but has increased to 51,279,000 kwh in 1985, or an average annual increase of 39%. Industrial consumption increased more than four-fold in a span of 5 years, from 5,717,000 kwh in 1980 to 24,654,000 kwh in 1985. The 1985 consumption of 51,279,000 kwh is still way below the capacity of NPC's plant which would be able to supply 190,000,000 kwh. SOCOTECO, however, supplies other areas such as Polomolok, Tupi, Alabel, Glan, Malungon, Kiamba, and Maitum. In 1989 SOCOTECO contracted NPC to supply a minimum of 8.5 million kwh and a maximum of 11.9 million kwh monthly, or 142.8 million kwh annually, which is still below the 190 million kwh capacity. However, brown-outs still occur because the power source is unable to supply the power.

Power rates in General Santos City in 1989 were:

- residential - ₱ 1.19/kwh
- commercial - ₱ 1.21/kwh
- industrial - ₱ 1.17/kwh.

For comparison, over the past 2-3 years US residential customers have paid about US$0.075/kwh and commercial users about US$0.06-0.065/kwh. At an estimated exchange rate of ₱ 27/US$, industrial

Table 3-16. Kilowatt-Hour Consumption by Users, 1980 to 1985 (in 000)

	YEAR					
Classification	1980	1981	1982	1983	1984	1985
Residential	3,547	6,182	6,534	8,439	9,600	15,658
Commercial	4,382	5,951	6,336	8,186	9,101	10,967
Industrial	5,717	12,248	15,074	17,453	23,286	24,654
TOTAL	13,646	24,381	27,944	34,078	41,987	51,279

users in General Santos City have been paying about US$0.043/kwh and commercial users about US$0.045/kwh.

To account for resource scarcity, USAID requires project feasibility analyses using "economic" or shadow prices of labor, capital, energy, and other inputs. Regarding energy, the shadow price for petroleum is basically its price in the world market, and for electricity, the long range marginal cost (LRMC) of generation from new power plants. World Bank (Razavi, pers. comm.) estimates that the LRMC of new power generation in the Philippines is 1.0 to 1.2 pesos/kwh.

3.13 Air Quality

A large portion of General Santos City, including the project site, is still rural in character. Traffic along the national highway fronting the GSAPC site is estimated to be no more than 100 vehicles per day. Aside from air pollution from vehicles, the other possible major source of air pollution in Tambler are various factories. The nearest operating factory is Sancanco Tuna Canning Factory (Figure 3-17). A vegetable oil mill has been built just south of the project site by Agrotex Commodities but is not yet operational (as of March 1991). The next nearest factory is New Purefoods Tuna Canning Factory; it lies 3 km north of the project site and around 2 km north of Sancanco.

The prevailing wind in General Santos City throughout the year is either northerly or southerly. Even though the GSAPC site lies east of the national highway, air pollution from vehicular traffic (especially dust) still affects the site because of its proximity to the highway. Paving of the road in 1992 will alleviate this problem.

When the wind blows from the south, the emissions from the Celebes Tuna Cannery will affect the site. If the wind blows from the north, there is a possibility that the air pollutants from Sancanco will reach the site. For factories like Celebes and Sancanco, the radius of influence of airborne pollutants is generally no more than 1 km. The project site will therefore be on the periphery of the zone of influence of Sancanco; it is expected that it will not have a significant influence on the project site. The Celebes Tuna Cannery, however, will influence air quality on the site.

Table 3-17 shows the result of the sampling and analysis made on March 13-14 1991, prior to construction of the Celebes Tuna Cannery (refer to Appendix D for a more complete description

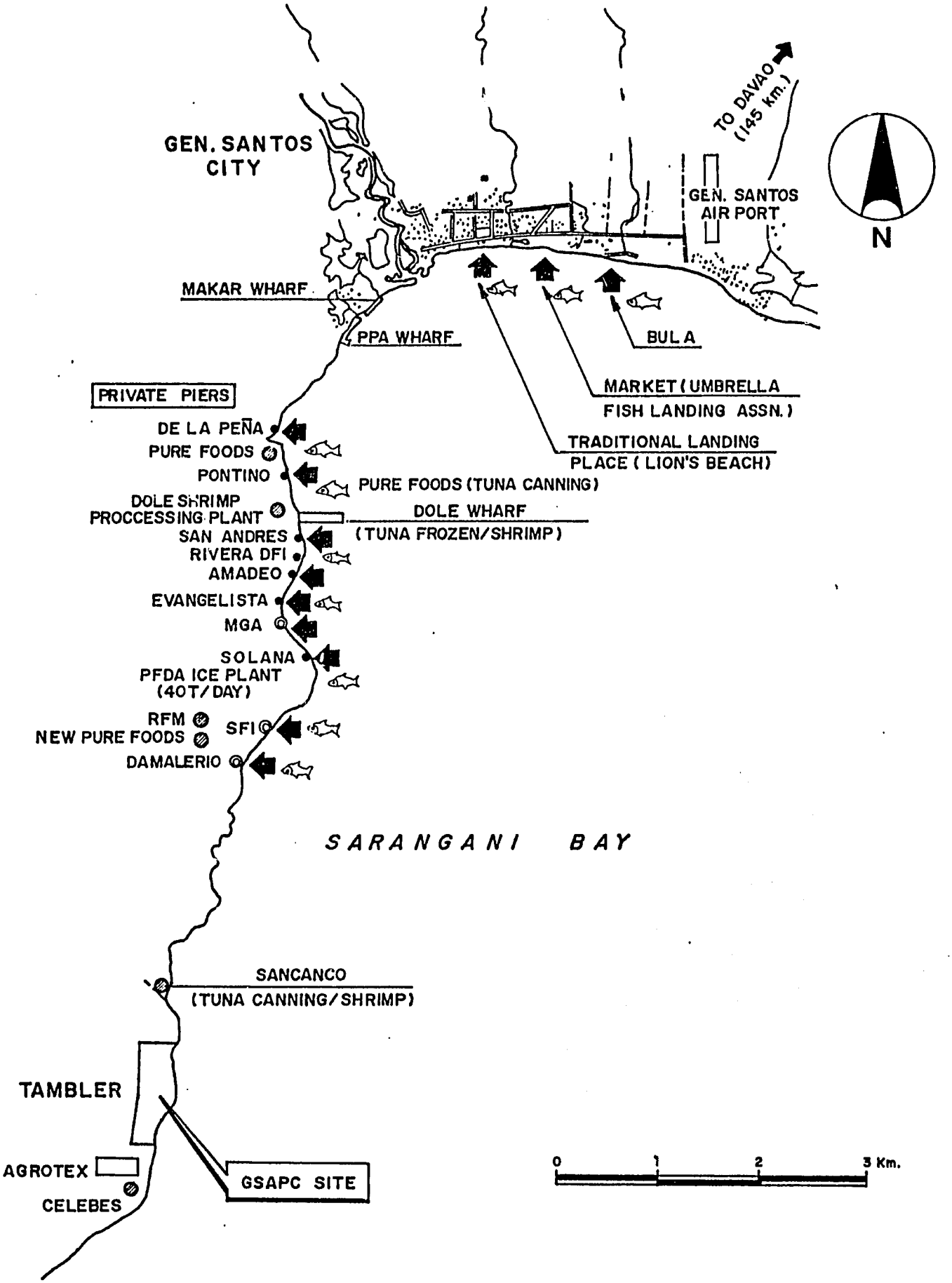


Figure 3-17 EXISTING AGRO-PROCESSING FACILITIES, FISH LANDING SITES AND FISH PROCESSING FACILITIES

Table 3-17. Results of Air Sample Analyses

Station	Particulates		
	First Sample	Second Sample	Average
AGROTEX			
Station A (3 m from national road)	914	747	830
Station B (10 m from the sea	221	371	296
SANCANCO			
Station C (3 m from national road)	724	853	788
Station D (10 m from the sea	261	296	278

of the sampling regime). The average particulates concentration at the road side is 830 ug/scm and only 788 ug/scm at Sancanco. The difference is not significant considering the large variation in the results.

The level of particulates at both Agrotex and Sancanco either at the road side or near the sea are all very high and above the 1 hr per day exposure standard set by EMB at 250 ug/scm. This is expected because of the dust generated by the movement of vehicles on the national highway. Large amounts of dust are suspended when vehicles pass through because the road is very dry and unpaved. This problem will be eliminated when the road is paved in 1992.

3.14 Archaeological Resources

An archaeological survey of the proposed project site was undertaken to determine whether archeological resources were present and, if present, the significance of those resources. The survey was undertaken by staff from the National Museum and addressed both land and underwater resources.

The land survey covered the 32 ha area of the proposed project site, and indicated the presence of six archeological sites on the surface in the project area. The materials at the six sites consist of earthenware sherds (pottery fragments) and molluscan shell remains. The nearshore zone was surveyed by snorkeling and SCUBA diving along the reefs and shoreline; no indications of marine archaeological resources were found.

Based on the assessment of the physical setting of the project area and the preliminary analysis of materials collected, it is inferred that the six surface sites were areas of human activities and were possibly habitation sites. All the molluscan shell fragments from the six sites are of edible varieties. The large number of shells found at the sites have broken apices and other forms of disarticulation. These, in association with the sherds, are clear indications that molluscs provided the former occupants of the area a part of their dietary requirements. The locations of these sites are considered strategic. Their proximity to the freshwater streams and to the Sarangani Bay coastline provide an ideal setting for the gathering of shellfish in a brackish environment. Shellfish-gathering activities are still carried out by the current inhabitants of the area.

The types of the earthenware sherds, as well as the design found on them, are typical of the Metal Age Period (500 BC - 200 AD). However, the presence of sherds of trader ceramics,

primarily porcelains attributed to the Late Ming period dating from the 16th to the 17th centuries AD, and the other Southeast Asian ceramics in association with the earthenware sherds found on the surface, indicate definite use of the area during a later time. Shallow test pit excavations conducted at two of the sites indicated no evidence of direct association of trader ceramics on the heap of earthenware sherds and shells. It is, therefore, premature to establish the relative dating of the sites. The consistency of patterns and designs of earthenware sherds found at four of the sites is an indication that the period of occupation of these sites were contemporaneous. One site is very much disturbed, nevertheless, this site could provide a good reference for the systematic collection of various types of earthenware sherds. One site is possibly a midden composed of a heap of shells (marine and brackish) and earthenware sherds. However, it is also possible that this site has been disturbed through natural processes since the surface materials were found eroding from the slopes of the stream bank.

Earthenware sherds with cord-mark and carved-paddle designs recovered from the project site were found to be similar to those recovered by Dr. Wilhelm G. Solheim II in 1972. He conducted an archeological excavation at the compound of the Holy Cross Monastery in Barangay Calumpang, approximately 5 km south of General Santos City. Barangay Calumpang is only about 7 km north of the project site in Sitio Supu of Barangay Tambler and both are located on the western side of the Sarangani Bay.

Chapter 4

ENVIRONMENTAL EFFECTS OF THE PROPOSED PROJECT

4.1 Physical Oceanography

The proposed project will have no significant impacts on the tide, current, and wave characteristics of the area. It is anticipated that changes to the physical oceanography of the area, if any, will derive from the submerged discharge and will appear as localized changes in the physical characteristics of the water column in the vicinity of the outfall. Given the strength and high degree of variability in local current flows, the submarine wastewater discharge is not expected to have any perceptible effects on the nearshore flow regime.

4.2 Water Quality

4.2.1 Nearshore Marine Water Quality

The major environmental concerns regarding wastewater discharges into marine waters derive from the following factors:

- increased oxygen demand and consumption through biological or chemical oxidation of decomposable organic matter;
- human health problems associated with enteric (intestinal) pathogens such as bacteria, viruses, protozoans, and other parasites;
- increased nutrient loading (primarily nitrogen and phosphorus) and biostimulatory growth of phytoplankton and algae;
- acute or chronic toxic effects from heavy metals, pesticides, and other chemicals discharged to the sewer system by industry;
- smothering of benthos by settleable solids, or production of anoxic sediments due to organic enrichment by settleable organic solids; and
- aesthetic degradation from suspended and settleable solids, oil and grease, and floatable materials.

Since the proposed discharge contains primarily wastes from fish and crops processing facilities, with an additional quantity of human waste, adverse effects due to heavy metals and toxic chemicals are not likely unless a can manufacturing facility is installed or biocides are used to prevent fouling in cooling water systems. The primary concerns at the GSAPC are likely to be organic loading to the environment and public health concerns with respect to pathogens in human wastes.

4.2.1.1 Biochemical Oxygen Demand

The raw wastewater from the GSAPC will contain high concentrations of organic materials, primarily proteins, carbohydrates, and fats and oils. The wastes are biodegradable in nature and are amenable to biological waste treatment processes. The main pollutant effect of biodegradable organic compounds is to deplete the dissolved oxygen in the water column as the organics are decomposed by microbial organisms in the water. The pollutant effect is measured in terms of biochemical oxygen demand during 5 days of decomposition (BOD_5), as this is the fraction which is most likely to exert an adverse effect on water quality. Only in rare cases (in small, poorly flushed embayments or estuaries with high volumes of discharge) is the total oxygen demand of the wastewater (expressed as chemical oxygen demand, or COD) of concern in the marine environment. Oxygen depletion results in fish kills and suffocation of benthic biota. When the organic matter concentration is very high, which can happen quite easily in sediments subjected to high organic waste loading, anaerobic organisms will predominate and produce hydrogen sulfide which is highly toxic to fish, exacerbating problems with low dissolved oxygen.

The untreated wastewater falls in the category of strong wastes, i.e., with BOD greater than 500 mg/l, under current DENR rules and regulations. The proposed WWTP for the agro-processing facilities will remove up to 95% of the BOD. This removal efficiency is more than adequate to meet even the most stringent DENR effluent standard for BOD_5 for new industry (100 mg/l). Discharge of this effluent via a 30-m (100-ft) deep outfall is expected to provide an initial dilution of at least 1,100:1 (Section 4.2.1.2). With a potential effluent BOD_5 of 25-30 mg/l (Section 2.9.1.2) from extended aeration treatment, the discharge will rapidly meet the most stringent coastal receiving water standard of 3 mg/l BOD_5.

Overall, however, the impact of the proposed project on water quality in the nearshore zone is expected to be adverse if the fish port WWTP discharges to the waterline. Organic matter

in the wastewater as well as pathogens and bacteria will occur in the boat landing and docking areas, with high risk of contact by fishermen wading in the water.

4.2.1.2 Viruses and Pathogens

Coliform bacteria have been used by public health officials for several decades as a measure of water quality and potential impact on human health. The actual concern for human health, however, is not associated with coliform bacteria, but with viruses and pathogens that are frequently found in human wastes. Coliform bacteria are readily detected by simple laboratory techniques, whereas viruses and other pathogens are not. Thus, coliform bacteria, particularly fecal coliforms, have been used as indicators of potential presence of fecal matter and pathogens found in human wastes.

In the past decade, however, it has gradually become recognized that survival of viruses is often greater in marine waters than in fresh water. Furthermore, it appears that standard methods for measuring survival of fecal coliforms in marine waters may be significantly over-estimating die-off rates (Brayton et al. 1984). In partial response to these problems, the US Environmental Protection Agency (EPA 1986) has recommended that enterococcus (fecal streptococci) bacteria replace fecal coliforms as an indicator, based on the work of Cabelli (1983) and others. This recommendation has not yet been widely accepted or adopted.

Upon contact with seawater contaminated with viruses and pathogens, swimmers are at risk for contracting gastro-intestinal diseases or skin ailments. Exposures and risks have been studied extensively. Epidemiological studies have shown, however, that there is often a poor correlation between these indicators and the actual incidence of diseases (Rose 1986; Fattal et al. 1986; El Sharkawi 1986; Salas 1986; Cabelli 1989; Payment 1989). This has resulted in considerable debate over the selection of the most appropriate water quality standards, with a number of countries and health organizations establishing guidelines for maximum allowable concentration of bacteria in the water for the protection of human health (Table 4-1).

Table 2-1 indicates that the volume of sewage is approximately 42% of the total discharge from the agro-processing facility and fish port complex (not including discharge from the livestock facility, and assuming no tuna cannery). Raw domestic sewage typically has a fecal coliform count of 1×10^7 organisms/100 ml, and secondary waste treatment processes such as

Table 4-1. Microbiological Quality of Water Guidelines/Standards (per 100 ml)

Country	Shellfish Harvesting		Primary Contact Recreation			Protection of Indigenous Organisms	
	Total Colif.	Fecal Colif.	Total Colif.	Fecal Colif.	Other	Total Colif.	Fecal Colif.
EPA		14[a]	200[a]				
United States		90% < 43		90% < 400			
California	70[a]		80% < 1000[h]	200[h]			
	90% < 230		100% < 10000[k]	90% < 400[j]			
EEC[b]			500[c]	100[c]	Fecal Streptococci 100[c]		
Europe			10000[d]	2000[d]	Salmonella 0/litre[d] Enterovirus 0 PFU/Litre[d]		
Venezuela	70[a]	14[a]	90% < 1000	90% < 200			
	90% < 230	90% < 43	100% < 5000	100% < 400			
Peru	80% < 1000	80% < 200	80% < 5000	80% < 1000		80% < 20000	80% < 4000
Mexico	70[a]		80% < 1000[f]			10000[a]	
	90% < 230		100% <10000[k]			80% <10000	
						100% < 20000	
Brazil			80% < 5000[m]	80% < 1000[m]			
Japan	70		1000			1000	
France			< 2000	< 500	Fecal streptococci <100		
Yugoslavia			2000				
Israel			80% <100[g]				
USSR					E. coli <100		
Poland					E. coli <1000		
Puerto Rico	70[b]			200[b]			
	80% < 230			80% < 400			

[a] Logarithmic average for a period of 30 days of at least 5 samples
[b] Minimum sampling frequency - fortnightly
[c] Guide
[d] Mandatory
[e] Monthly average
[f] At least 5 samples per month
[g] Minimum 10 samples per month
[h] At least 5 samples taken sequentially from the waters in a given instance
[i] Period of 30 days
[j] Within a zone bounded by the shoreline and a distance of 1000 feet from the shoreline or the 30 foot depth contour, whichever is further from the shoreline
[k] Not a sample taken during the verification period of 48 hours should exceed 10,000/100 ml
[l] Period of 60 days
[m] "Satisfactory" waters, samples obtained in each of the preceeding 5 weeks

Source: Salas 1986 (cited in WHO 1989).

extended aeration may remove 96% of the bacteria count (expressed as most probable number/100 ml, or MPN/100 ml). Thus, the sewage component discharged to the sea would have an end-of-pipe fecal coliform level of 400,000 MPN/100 ml. It can be assumed, however, that this component will be diluted by process waters in the WWTP that are likely to have very low fecal coliform contamination. Adjusting for relative volume, and assuming as a conservative case that the fish port sewage is treated and discharged from the agro-processing WWTP, the fecal coliform bacteria count in the effluent from the WWTP is expected to approximate 170,000 MPN/100 ml. For protection of human health, the following fecal coliform standards have been recommended for human contact with marine water:

Philippines	200 MPN/100 ml
World Health Organization (WHO 1989)	1000 MPN/100 ml
United States (EPA 1986)	200 MPN/100 ml.

Clearly the effluent should be discharged in a manner that human contact with the undiluted effluent is prevented.

Reported coliform die-off rates in the marine environment vary over an order of magnitude. The rate might be expected to be high in Sarangani Bay because sunlight is known to be bactericidal. On the other hand, a growing body of literature indicates that fecal coliform die-off rates in marine waters have been significantly over-estimated. Furthermore, the highest rate of waterfront activity at the fish port is expected to be in the early morning hours, when bacterial die-off rates are likely to be low. Thus, an offshore submerged outfall is warranted to protect human health in the nearshore zone.

A numerical model was used to ascertain the dilution and dispersion of discharged wastewater. Specifically, the model UOUTPLM, developed by the US Environmental Protection Agency (Muellenhoff et al. 1985), was used to determine the behavior of the discharge plume for several representative test cases. Input data were based on the assumed wastewater properties described in Section 2.10 and the ambient current and water column conditions described in Section 3.3. Details of the model and results are provided in Appendix E.

Although the Singconsult (1990) Master Plan suggests that wastewater could be discharged at the waterline, this is considered an environmentally unacceptable solution to effluent disposal. From an ecological standpoint (Section 4.3), a discharge to a depth of 30 m (100 ft) via an outfall off one of the coral promontories is the preferred action.

Model runs were performed using effluent flow volumes of either 0.01 or 0.03 m^3/sec. The lower value corresponds to an estimated discharge volume of 1,200 m^3/day from the combined fish port and agro-processing center, and the larger corresponds to an estimated 3,000 m^3/day to also include wastewater from the livestock complex. (At the present time, the fish port constructed by DPWH is expected to have its own wastewater treatment system. Effluent will be discharged via an outfall, but no decision can be made yet regarding combined use of the proposed 30-m deep outfall because the relative timing of the two projects is not known.) Effluent temperature was assumed to be 30°C, which is near ambient air temperature, given the long retention times in the proposed extended aeration WWTP. All process waters used in the complex are assumed to be fresh, and the effluent salinity was therefore assumed to be 1 ppt. This represents a conservative scenario in that a higher salinity effluent would encourage more rapid dilution of the plume. (For comparison, two model runs were carried out using 0 ppt salinity; results are given in Appendix E and show little difference between 1 ppt.)

The ambient current speeds used in the modeling (10 and 25 cm/sec) represent the lower and middle range measured in the field. The model results, therefore, are probably conservative in that higher speeds will often occur. The models also assume constant flow, and therefore will underestimate the dilution obtained by mixing in highly turbulent conditions such as those observed off the GSAPC site.

In only one of the test cases (Case 4) was initial dilution of the effluent less than 500:1 (i.e., 500 parts of receiving water for 1 part of effluent); that was for the case where ambient current flow was 10 cm/sec, the larger of the two discharge volumes was used, and a 10 m discharge depth was used. For all cases using the preferred discharge depth of 30 m, the discharge plume reached equilibrium (neutral buoyancy) before it reached the sea surface, with dilution values at the trapping depth (neutral buoyancy) always in excess of 1100:1 (Table 4-2).

The data from Table 4-2 indicate that a discharge at a depth of 10 m or shallower is likely to form a surface plume, even in the case where a 2-port diffuser is provided (Case 15). Either weak currents or high waste volumes will likely produce a surfacing plume with an outfall depth of 20 m (Cases 2 and 5; Table 4-2). With an outfall at 100 ft (30 m) depth, the outfall plume will not surface (Table 4-2), and the risk of exposure to viruses and pathogens is greatly reduced.

Table 4-2. Plume Model Results

Case	Ambient Current (cm/sec)	Waste Flow (m^3/sec)	Outfall Depth (m)	Ports (no.)	Trapping Depth (m)	Dilution[a]
1	10	0.01	10	1	0.0	560:1
2	10	0.01	20	1	-6	1,460:1
3	10	0.01	30	1	-17	1,100:1
4	10	0.03	10	1	0.0	80:1
5	10	0.03	20	1	0.0	530:1
6	10	0.03	30	1	-5	1,140:1
7	25	0.01	10	1	-2	1,900:1
8	25	0.01	20	1	-12	2,080:1
9	25	0.01	30	1	-21	2,600:1
10	25	0.03	10	1	0.0	910:1
11	25	0.03	20	1	-6	1,800:1
12	25	0.03	30	1	-18	1,260:1
13[b]	10	0.01	30	1	-17	1,110:1
14[b]	25	0.01	30	1	-21	2,650:1
15	10	0.01	10	2	-0.3	1,600:1
16	25	0.01	30	2	-23	3,040:1
17	10	0.01	30	4	-21	3,000:1
18	25	0.01	30	4	-25	3,340:1

[a] Dilution at surface or at trapping depth (depth below surface).
[b] At 0 ppt salinity, all other cases at 1 ppt.

At the lowest rate of dilution for a 30-m outfall (Case 3), the concentration of fecal coliforms is expected to be <200 MPN/100ml. Although some viruses and pathogens may travel to the surface with oil and grease droplets, these are likely to be transported with prevailing northerly or southerly winds, and not toward shore.

The data from Table 4-2 indicate that the BOD discharge from the agro-processing WWTP also will have no significant adverse effect on water quality in the marine environment. Dilution rates are high, and the assimilative capacity of Sarangani Bay is likely to be great. With an assumed BOD of 123 mg/l, even effluent from the livestock processing facility will be rapidly diluted to less than significant levels at >1100:1 dilution.

Keeping the wastewater plume from surfacing will significantly benefit public health, odor, and aesthetic conditions at the fish port. Discharge at the waterline or in shallow water, however, is likely to place fishermen (and others in contact with nearshore water) at unacceptable risk of exposure to viruses and pathogens in the water.

4.2.1.3 Suspended Solids

Suspended solids will be discharged or generated in the nearshore environment as a result of both construction and operation of the facilities.

Water quality impacts associated with construction of the fish port include high levels of suspended sediments during dredging of the harbor, disposal of the dredge spoils to deep water, and construction of the breakwaters. Although plumes of suspended sediments in the nearshore zone are expected to be of short duration during the active construction period, they will have a significant adverse impact on the remaining nearby corals, i.e., those corals that are not directly destroyed by dredging or filling operations.

Suspended sediments in surface runoff during site preparation and construction of the agro-processing complex is also likely to have an adverse effect on marine biota, especially the remaining corals, in the nearshore zone as a result of turbidity and sedimentation. The potentially low content of fine silts and clays in the soils on the GSAPC site, however, suggest that the areal extent of these adverse effects will be limited and potentially less than significant.

Once construction is completed, suspended sediments are likely to be discharged periodically to the marine environment in stormwater runoff and constantly as part of the wastewater discharge. Suspended sediments in stormwater runoff are likely to be heavily contaminated by oil and grease and heavy metals from parking lots and roadways. Build-up of these pollutants in sediments near shore will have an adverse effect on benthic biota in the vicinity of the stormwater discharges. The zone of impact, however, is expected to be localized, and wave action in shallow water will quickly transport some of these particulates to the steep slopes and into deep water. The impact, therefore, is expected to be less than significant.

Suspended sediments in the wastewater discharge will be a combination of organic and inorganic solids. With a discharge to a depth of 100 ft on the coral reef promontory, the suspended sediments are likely to be rapidly advected away and dispersed by strong currents, or readily transported down steep slopes into very deep water below the photic zone.

4.2.1.4 Other Waste Constituents

Nitrogen and occasionally phosphorus are often the main controlling parameters on algal productivity in the sea. The effluent from fish processing is high in nitrogen and phosphate, primarily from fish protein and blood. While a limited discharge of these nutrients will enhance the algal productivity in the wastewater plume, excessive discharges could result in widespread algal blooms. While algae produce oxygen in the water body during daytime by photosynthesis, they undergo respiration and compete for the dissolved oxygen at nighttime. Excessive algal bloom could result in fish kills at night. The risk of adverse impact on Sarangani Bay, however, is considered less than significant because of the great assimilative capacity of the bay and the comparatively insignificant size of the wastewater plume and the percentage of total phytoplankton biomass occurring in the plume. Discharge from the fish port to the waterline is likely to induce localized dense growth of attached algae on the submerged harbor facilities and nearby seabed, but the impacts are expected to be less than significant.

Organic oil and grease from fish processing and agro-processing are primarily in emulsified form and in low concentration. For this reason, organic oil and grease are more difficult to separate and remove in waste treatment processes. Organic oil and grease in the marine environment readily undergo biological assimilation by marine microorganisms. However, oil and grease droplets in the wastewater plume will tend to rapidly

rise to the surface, even though the main wastewater plume may reach neutral buoyancy below the surface. Viruses and pathogens in the effluent are likely to be carried by the oil and grease droplets to the surface. Under calm water surface conditions, oil and grease droplets may coalesce and form a thin film. This is unlikely to occur offshore of the GSAPC site, however, because of the normal wind and wave conditions in Sarangani Bay. The impact, therefore, is considered to be less than significant.

Hot water or steam is used in cooking produce, and will be included in the waste flow to the WWTP. Steam is also used in sterilization and cleaning of food processing equipment, and in power generation. Condensed steam in power plants is usually recycled, but once the dissolved solids concentration reaches 3,000 mg/l, part of the condensate is discarded or bled off. The condensate wastewater is discharged, usually without further treatment, at temperatures between 80-95°C depending on the cooling tower efficiency. Discharge of hot water directly to the environment is potentially harmful to marine biota. Effects will be localized and discharges will be of short duration, but organisms encountering the hot water plume are likely to be immediately killed.

Hot wastewater may also be discharged without treatment from the refrigeration plant. Heat is typically removed from the refrigerant in a heat exchanger, with cold water as the coolant. The coolant water is discharged at temperatures of 40-50°C. The coolant water is recycled, but once the dissolved solids reach 5,000 mg/l and the hardness above 100 mg/l, part of the coolant is bled off and replaced with fresh water.

From time to time, wastewater from the water softening plant is discharged. That wastewater contains high concentrations of sodium chloride and calcium chloride. The effect of the softening equipment on freshwater streams could be significant, especially for small streams such as the springs on the site. However, when it is discharged to the sea, the effects are not detectable because the inorganic salts are rapidly diluted and the discharge volumes are usually very small.

Another potential source of nearshore pollution is the grease and oil discharged by fishing boats during engine repair and maintenance, bilge pumping, or hull cleaning. Diesel fuel is typically used by small-scale fishermen to clean hulls of fouling organisms. Diesel oil slicks on the water are potentially hazardous in the harbor area and potentially cause adverse effects on marine biota, particularly marine birds.

In addition to carrying suspended sediments, stormwater runoff from parking lots and other impermeable surfaces on the site is likely to carry oil and grease, litter, and other wastes that are accidentally spilled or carelessly dumped on the site. Although screening will remove most of the litter and larger waste particles, it will not remove oil and grease, heavy metals, or other easily dissolved substances, or small particulate matter. The zones in the immediate vicinity of storm drain outfalls will probably be characterized by heavily contaminated sediments, with contaminated water occurring in the immediate vicinity after each storm event. The area of impact, however, is expected to be localized and less than significant.

4.2.2 Surface Water

Surface water on the GSAPC site consists only of the two springs, of which the north spring is proposed as the source of potable and fresh processing water. Water demand is not expected to require more than approximately 70% of dry season flow of the north spring, and may be significantly less if a tuna cannery is not built. Therefore, spring water in the south spring and a substantial percentage of the spring water in the north spring will continue to flow on the site and is potentially subjected to pollution.

Construction is expected to be a source of significant adverse impact on spring water quality. Site grading and preparation will result in exposure of large areas of bare soils to surface runoff and wind-driven (aeolian) erosion. Furthermore, it is highly likely that the spring channels themselves will be significantly disturbed during construction, if not destroyed and replaced by man-made conveyances. Certainly construction of a water collection system at the headwaters of the north spring will adversely impact water quality of the spring during the construction period.

Once construction is completed, impact on spring water quality will depend on the fate of the natural channels, particularly of the south spring. If left to their natural channels with a 3-5 m wide strip of stream-side vegetation, the spring water quality could continue to be good. The large number of people and vehicles present on the site, however, is likely to generate sufficient quantities of uncontrolled litter and other pollutants as to jeopardize the quality of this water, especially if the spring is thoughtlessly treated as an open waste receptacle. Uncontrolled littering appears to be a pervasive problem in the Philippines, and it is highly unlikely that any open water on the site would remain in good quality. Runoff from

parking lots and roads, if allowed to get into the springs, will contaminate the flow with oil and grease and heavy metals.

If channeled in man-made structures, covered up as a storm drain, or piped to the beach, the spring water is likely to retain its good quality, but be worthless as habitat.

4.2.3 Groundwater

Based on a projected employee population of 3,500 plus 2,000 transient fishermen, the number of dependents for this population could easily number 15,000 to 20,000. Assuming that 50% of the employee and fishermen population and their dependents do not wish to move to the immediate vicinity of the GSAPC site because they already have homes elsewhere in General Santos City, some sort of low-cost housing outside of the GSAPC would still need to be provided for a minimum of 7,000 to 10,000 people.

If this housing is not provided, the GSAPC site is likely to be occupied or surrounded by squatters. Initially, squatter density will be low. However, this will increase rapidly as the GSAPC begins to generate direct and indirect employment and incomes. People seeking employment who are not yet living in General Santos City will almost certainly move their families into the area once long-term jobs have been found.

Without a wastewater collection and treatment system, the squatter settlements and even low-cost housing tracts will have some sort of latrine/septic tank system, or will use the foreshore or vegetated areas for human waste disposal. Geological surveys have shown that the ground around the GSAPC has little topsoil, consisting mostly of sand and fractured and porous limestone which retain very little of the rainfall. Rainwater readily percolates down into the lower levels of the karst limestone formation. The same principle will apply to seepage and overflow from septic tanks and latrines, resulting in contamination of the freshwater aquifers which comprise the groundwater and feed the springs on the GSAPC site.

Thus, construction of the GSAPC site poses a significant risk to deterioration of groundwater quality if adequate sewerage facilities are not provided to the population drawn to the site. This risk is particularly important in that the proposed project expects to use surfacing groundwater (the springs) on the site as the source of potable and process water. Although water treatment will be provided, the costs of water treatment depend largely on the quality of raw water; poorer quality water requires more treatment.

High rates of pumping of shallow groundwater at some of the shrimp ponds in the nearshore zone around Sarangani Bay have resulted in reported incidents of lowered water table and intrusion of saline water. This problem is particularly important in karst limestone formations, because the fissures and porous limestone allows for water movement in either direction, so long as it is down gradient. Shallow submarine freshwater seeps were observed to be numerous on both the north and south reefs, with some instances of clearly substantial discharge volumes. These flows hypothetically could be reversed by extensive groundwater pumping.

Collection of artesian spring water on the site at or near the surface is not likely to significantly impact the groundwater table, nor is it likely to result in saline intrusion. Shallow water pumping, however would. This is particularly important with respect to development of residential areas in association with the GSAPC site.

4.3 Marine Resources

4.3.1 Benthic Biota

Construction of the fish port will practically destroy the existing corals as deep as the 20-m (60 ft) isobath on the north reef. This is either by direct destruction by dredging or breakwater construction, or indirectly by heavy siltation when dredging occurs during the construction stage (White 1987; Chou 1988). During dredging, corals in proximity to the dredge site are impacted because of the suspension of silt and sediments caused during and after the dredging. The suspended particles causes turbidity which blocks out sunlight, which is needed by the corals. Furthermore, large quantities of either coarse or fine particles will bury corals, which are unable to withstand sedimentation longer than 1 or 2 days (Salvat 1987).

Corals not killed during the construction stage of the project will still be exposed to stress due to the possible deterioration of the water quality in the immediate vicinity when the project's facilities are already fully operational. Changes in water quality to which corals are particularly sensitive include: suspended solids, temperature, salinity, and oil contamination. Oil contamination is very likely to occur if fishermen are allowed to use diesel fuel to clean the hulls at the fish port, or if proper waste oil collection facilities are not provided.

As pointed out by Marshall (1982), the continuous presence of man-induced stress will lead to the loss of population diversity of corals and other reef-associated organisms. More stress will lead to its complete death until the old reef structure becomes smothered with algae. Indiscriminate destruction of coral reef habitat is contrary to Philippine policies, but is widespread nonetheless. The EIS System identifies coral reef habitat as an environmentally sensitive resource. Because the Philippines does not have a wide continental shelf or areas of oceanic upwelling, productivity of the nation's nearshore fisheries is heavily dependent on coral reefs and mangrove habitats.

Another possible source of coral destruction will be damage from anchors.

The construction of an outfall on any of the two promontories, i.e. north or south reefs, will also mean the potential loss of corals to a depth of 100 ft along the path of the outfall. However, this impact is highly localized to a narrow corridor of a few meters in width, depending on construction methods, and much of its linear distance will occur across the reef flat, which has very little living coral.

The soft-bottom benthic communities of the deepwater cove and the sandy areas among the corals on the slopes below the reef flats, particularly the north slope of the south reef, are probably those commonly associated with coarser-grain bottoms. Benthic communities occupying sandy bottoms generally are less productive than those occupying soft bottoms with higher content of fine sediments and organic matter. Productivity of soft-bottom communities in the nearshore zone of the GSAPC site is probably additionally reduced by the steep slopes and the tendency for a slow but steady downslope slippage of sediments. Many burrowing organisms are unable to cope with this downslope sediment movement.

Soft-bottom benthic communities respond to wastewater discharge in several ways. Biomass in the vicinity of the outfall may often rise in response to organic enrichment, unless toxic chemicals are also present in the wastewater or organic loading is too high and causes anoxic conditions in the sediments. The rise in biomass is often accompanied by a shift in community dominance from above-surface suspension feeders to below-surface deposit feeders (Mearns and Greene 1976; Word et al. 1977). The degree of these changes is inversely related to the concentration of organic matter in the sediment.

On both the north and south reef promontories, low-growing life-forms of coral are common down to about 60 ft. Below 60 ft, coral habitat is increasingly patchy, with increasing importance of sandy bottom habitat. At 100 ft depth, coral patches are scattered and the bottom is primarily sandy habitat. Discharge at this depth, therefore, minimizes adverse impact on corals.

The probability of organic wastes from the submarine outfall building up in the sediments in biologically productive areas is low. Furthermore, the steep slopes and relatively large sand grain sizes in the area of the proposed outfall result in slow but steady transport of sediments downslope, which suggests that biological activity in the sediments around the proposed outfall is not likely to be high. Impacts on benthic biota from discharge of particulates from the GSAPC submarine outfall, therefore, are expected to be less than significant.

Discharge of wastewater at the waterline is expected to result in a build up of organic material in the sediments below the discharge point, unless the discharge occurs at the brink of the steep slopes into deep water. In the former case, organic loading of the sediments will reach sufficient levels to exclude all but pollution-tolerant species in the immediate vicinity of the discharge, with potential anaerobic sediment conditions prevailing. In this event, the discharge will have a significant but localized adverse effect on benthic organisms in the nearshore zone. In the latter case, impacts on benthic organisms are expected to be more dispersed and less than significant.

4.3.2 Fish

The loss of coral cover is followed by the loss of the coral-associated fish fauna. Sano et al. (1984) have reported that fishes disappear from dead coral colonies due to the absence of food and the reduction in living space or shelter when the structural complexity of dead coral colonies is decreased.

In some cases, however, algae-covered reefs might produce more fish than those not so covered (Marshall 1982), primarily as a result of a significant increase in the number of herbivores or grazers. The occurrence of high suspended solids, however, can hinder the growth of algae (Siew Moi 1988) or make the water column and substratum unsuitable for many marine organisms (Seng et al. 1987). The net effect of the proposed fish port and sewage outfall on reef fish populations is expected to be adverse and locally significant, primarily as a result of the destruction of reef habitat by dredging and filling.

Construction of the fish port will improve sanitary conditions for fish landings, and therefore should result in a better quality and better price for sashimi. Although this might encourage additional fishing pressure, the fishery is primarily hook-and-line and is probably sustainable, with no significant adverse impact on tuna stocks. The majority of fish now caught in Sarangani Bay and landed in the wet fish market are small individuals, indicating the significant decline in fish stocks as a result of over-fishing. The change in location for fish landings and improvement in sanitary conditions is not expected to have a significant impact on the economic value or intensity of this fishery.

Most of the tuna now landed at the existing canneries in General Santos City are very small juveniles caught by purse seiners. This harvest is not sustainable, and represents a significant adverse impact on tuna stocks. As a logistical support base for the high seas tuna purse seine fleet in the southwest Pacific, a purse seiner dock at General Santos would have little or no adverse impact on tuna stocks. However, as a logistical support base for the purse seiners currently bringing their catch to canneries in General Santos City, the proposed facility will have an adverse impact by encouraging unsustainable harvests. The decision regarding the fish port lies with the project board established by the Government of the Philippines and not USAID, as USAID is not contemplating funding for the fish port.

4.4 Aquatic Resources and Mangrove Habitat

Shrimp and small fish now occurring in the springs are periodically subjected to harvest for bait. It is not known whether this harvest is sustainable.

Development of the site includes diversion of a substantial percentage of the flow in the north spring to potable water supply. Although the fate of the remaining water in the north spring and flows in the south spring has not been clearly addressed in either Master Plan, both plans indicate that these flows will be diverted into a storm drainage system. If diverted out of their natural channels, the aquatic biota in the springs are likely to be extirpated.

Although it is likely that aquatic biota in the springs will be lost through habitat disturbance and conversion, the impact is expected to be localized to the GSAPC site and therefore less than significant. Other springs located on the shoreline for several kilometers to the south will retain their biological

value, unless unsustainable harvest for bait is occurring in these springs.

Indiscriminate destruction and loss of mangrove habitat is contrary to Philippine policy. The EIS System identifies mangrove habitat as an environmentally sensitive resource. Mangrove habitat is critical to the productivity of nearshore fisheries.

Construction of the proposed fish port and the agro-processing facilities together will completely eliminate the coastal mangrove habitat now located in the shoreward margin of the north reef and the inland mangrove habitat to the south (Figure 3-13). Although the amount of habitat is not large (between 1 and 2 ha), the values of this habitat as spawning and nursery areas for marine species and as a source of detritus for marine food chains will be lost. This loss represents a small increment in the general decline of mangrove habitat area in Sarangani Bay, and on the west shoreline in particular. However, since the remaining mangrove habitat around Sarangani Bay has been significantly reduced to low levels, and much of the remaining habitat could be lost to continued human activities, the loss of even a small amount of mangrove habitat should now be viewed as a significant adverse impact on the environment of Sarangani Bay.

4.5 Terrestrial Biota

Construction and operation of the fish port and the agro-processing facilities potentially will eliminate most of the terrestrial biota on the site. The Master Plan for the fish port proposes to develop only the shoreline area along the north reef (Figure 2-2). The Singconsult Master Plan assumes the fish port will occupy the entire shoreline, with an undefined area around the headwaters of the north spring set aside for open space (Figure 2-3). Therefore, there appears to be some scope for habitat preservation on the GSAPC site. On the other hand, the proposed project as it now stands does not include any specific plans for agro-processing facilities. Therefore, the requirements for space by future occupants are not known.

Coconut plantation and grassland are abundant in the General Santos area, and the loss of approximately 19 ha of coconut grove and 5 ha of grassland is less than significant. The second-growth forest habitat is not abundant in the project vicinity. Although this habitat is of potential ecological value from the standpoint of not being common, it does not include threatened,

rare, or endangered species. Therefore, the potential loss of approximately 6 ha is less than significant.

4.6 Geology and Soils

Landforms, both terrestrial and submarine, will be modified during construction of the facilities. Land areas will be graded, and the nearshore reef flat on the north reef will be dredged or built upon to accommodate the vessel berthing area and breakwaters. The impacts of these modifications will be minor and of no significance to the geology and soils.

Construction of the breakwater jetties will interrupt the normal longshore transport of beach materials, which may lead to shoreline erosion on the downdrift sides of the structures. The normal direction of longshore drift along northwest Sarangani Bay is northward, as indicated by sediment accumulation on the south sides of existing structures, geomorphological evidence, and visual observations from an aerial overflight. Apart from the deepwater cove, little sandy beach material exists in the vicinity of the GSAPC, and the impacts of littoral entrapment are expected to be of little significance.

4.7 Surface and Groundwater Hydrology

Constructing a pond around the headwaters of the north spring to collect the artesian discharges may involve some risk to groundwater flows. The pond might create a hydraulic head larger than that of the artesian pressure, thereby forcing groundwater to emerge at another location. This would have a significant adverse effect on the water supply on the site.

4.8 Land Use and Services

4.8.1 Land Use

The primary effect of constructing the proposed agro-processing and fish port complex at the Tambler site will be the conversion of 32 ha from its present uses (low-density residential use, agricultural use, and natural habitat). The proposed action, however, conforms to the City Development Plan, which has identified the site as being suitable for agro-industrial development. Development of the site will also result in relocation of the small-scale fish landing market and sashimi market from its present locations on the waterfront in the urban core of General Santos City.

It is virtually certain that the eateries, market, and residents deriving a livelihood from the existing fish markets will also relocate to the GSAPC site. If agro-processing site development is not undertaken simultaneously with fish port development, future development of the agro-processing facilities could be constrained by a rapid influx of settlers into the site and loss of control over land use in the project site.

While development of the proposed site as an agro-industrial facility is in conformance with the land use plan for General Santos City, it is possible that such development will induce conversions of nearby lands into non-conforming land uses. This can arise through in-migration of workers (either directly or indirectly employed by the proposed project facilities) and the need for housing and other services.

4.8.2 Public Facilities and Services

During and after the construction stage of the project, there will be a demand for affordable housing for settled-in and migrant laborers and their families. Corollary to this demand will be the need for other public, specially sanitation, services.

Since Tambler has been designated by the City Plan as an alternative growth area, it is expected that housing needs will correspondingly increase with the influx of workers who will prefer to be near their work places. There will be greater pressure in terms of housing and land-use type and density. Unless affordable housing is made available either on-site or off-site the complex, sub-standard dwelling units and settlements may sprout nearby, resulting in uncontrolled growth and inefficient land use.

Twenty-four families presently residing within the project site will be affected by the construction and operation of GSAPC. These families have been living in the area anywhere between 3 and 20 years, deriving their income mainly from fishing. Most of them are migrants from other regions; five are from Indonesia.

The project, together with other developments, will influence property and taxable values in Tambler, particularly near the project site. Price movements may vary depending on the locality, but a conservative estimate of 15 to 30% increase per annum upon completion of GSAPC is reasonable. Such a prospect could make land prohibitively costly and out of reach for local residents and other public purposes (e.g., low-cost housing, public parks, infrastructure) unless incomes also rise.

Housing demands near the project site have been briefly discussed in Section 4.2.3 in context of potential impacts on groundwater quality. Failure to provide adequate sanitation facilities or potable water supply is a potential source of a significant adverse impact on the environment.

Impacts on health and sanitation will be indirect, principally being a result of the type and quality of human settlements that may develop as a consequence of GSAPC and other projects. Uncontrolled growth and informal settlements are usually characterized by heavy density and the absence of sanitary facilities and waste disposal systems. The transfer of 12,000 persons to Tambler has already exerted significant pressures on maintaining public health and sanitation.

Garbage and refuse generated by the increasing number of dwelling units and business establishments will pose environmental and health problems chiefly in terms of vector-borne diseases.

In addition to housing and sanitation facilities, development of the project may, through increased in-migration to the area, exacerbate shortages in educational and public safety (police and fire) services. The shortage of fire services may be particularly important if corn oil processing occurs on the site, as hexane is important in the processing and is highly flammable. The project will also result in increased traffic between General Santos City and the project site during both the construction and operation phases. At present, the road between General Santos City and a point approximately 3 km north of the site is paved and adequate for the increased traffic, although some congestion undoubtedly will occur during shift changes. The last 3 km of road, however, are unpaved and, therefore, unsuitable for increased traffic demand.

4.9 Socioeconomics

4.9.1 Employment and the Regional Economy

4.9.1.1 Employment

The immediate impact with respect to employment will occur during the construction stage of the project. Construction activities are envisioned over a 3-yr period for the entire complex and its component facilities.

The following major assumptions were made in determining the immediate impact of the project on employment:

- Labor cost was assumed to be 15% of construction cost.
- Average annual labor rate was set at ₱36,000/yr.

During the construction period of approximately 3 years, the project will generate a total of 4,775 jobs, amounting to ₱172 million (Singconsult 1990). Over 2,000 jobs will be generated by construction of the fish port. The second biggest source of jobs will come from building the GSAPC Management Office, which is expected to result in over 1,100 jobs.

During the first year, construction of the GSAPC, fish port, and abattoir/meat and bone meal plant will be started. This will entail a labor cost of ₱59 million, for an equivalent of 1,600 jobs.

In the second year, the project will create 1,800 jobs from the construction of the feed mill, fruit processing, and vegetable extraction facilities, in addition to continued work on the facilities started in the first year.

The third and last year of the construction period will have the equivalent of 1,350 jobs. Most of these jobs will come from continuing construction activities on the feed mill, fruit processing, and vegetable oil extraction facilities (Table 4-3).

It is expected that at least 30% of construction laborers would come from within the City. It is very likely, however, that a substantial portion of construction manpower requirements may have to be sourced from migrant labor outside the City, i.e., from the Province or the Region, thereby accelerating the influx of potential settlers and transients into the City, particularly Barangay Tambler. This in-migration will exert further pressure on land, housing, and other public services.

At any given year, there would be more or less 1,600 construction laborers on the project who would need goods and services that are physically accessible to the job site. Such a demand would attract informal family-operated business activities, particularly food vending, small-scale trading, and retailing, to locate near the construction site. The spatial distribution of these small business establishments will likely follow a linear pattern of development along the roadside. The prospects of these businesses staying beyond the construction period cannot be discounted and may give rise to squatting and other types of informal settlements that are not in accordance with the zoning plan and development envisioned for Barangay Tambler. This situation may further pose problems as regards land rights, environmental sanitation, and relocation.

Table 4-3 Construction Phase Employment

Facilities	TOTAL		
	Const'n Cost	Labor Cost	Equivalent Jobs
1. GSAPC Management	267,011,273	40,051,722	1,112
2. Fishing Port	327,337,055	73,272,756	2,035
3. Abattoir and Meat and Bone Meat	120,202,180	18,030,322	501
4. Meat Processing	27,198,600	4,079,790	113
5. Feed Mill	75,001,590	11,250,239	312
6. Fruit Processing	13,155,500	5,969,812	111
7. Vegetable Oil Extraction	128,701,620	19,305,243	536
TOTAL	1,119,755,590	171,959,884	4,775

Source of Basic Data: SINGCONSULT REPORT

Note: Labor Cost = 15% of construction costs
Equivalent Jobs = Labor cost * verage annual labor rate
Average annual labor rate ₱36,000

Economic benefits from employment generation are summarized in Table 4-4. The assumptions regarding the operation of the tuna cannery in the Complex should, however, be re-examined in the light of the economic viability of the existing canneries in General Santos City and other institutional, particularly regulatory, constraints and technical problems.

It is realized that other jobs will be created as an indirect effect of the project. These jobs will be in the service sector of the City, thereby helping to absorb excess urban labor, particularly in the relocation site in Tambler. Further employment will be generated in the agricultural sector because of increasing demand for primary produce that may be processed in GSAPC.

Families residing near the present fish landing site at Lion Beach who derive their income by providing "pick-up" labor and other services (e.g., food vending) will be displaced or will incur additional transportation/commuting cost with the transfer of fish landing operations to Tambler. These families live in dwelling units of light materials in a squatter area that makes it possible for some of them to move, and illegally occupy lands, near the project site.

Residents in the Tambler relocation site will have the chance to avail themselves of job and livelihood opportunities generated by the project during the construction and operational stages.

4.9.1.2 Regional Economy

The expenditures forecast for construction and operation of the GSAPC will have beneficial effects throughout the region. The magnitude of the benefits will depend on the level of expenditure made for goods and services that are regional in origin. During operation of the facilities, the benefits of the project would be realized as higher prices for agricultural and fish products and through expenditures of employment-generated income.

The cost of constructing the agro-processing and fish port complex at the Tambler site has been estimated at ₱1.1 billion (1989 prices). Potential employment to construct the facilities has been estimated to be more than 4,700 over the 3-yr construction period. It should be recognized that this is an estimate of equivalent positions; some mobility from one component to another is anticipated, resulting in fewer persons in actual employment. It should also be realized that there has

Table 4-4 Economic Benefits (Employment Generation) GSAPC and Component Facilities (in P'000)

Facilities	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 25
1. GSAPC management		5,299	5,564	5,842	6,134	6,441	6,763	7,101	14,763
2. Fishing Port		5,160	5,418	5,689	5,973	6,272	6,585	6,915	14,375
3. Feedmill		1,886	1,980	2,079	2,183	2,292	2,407	2,527	5,253
4. Abattoir	10,047	10,549	11,077	11,630	12,212	12,822	13,464	14,137	29,389
5. Meat Processing Plant	5,898	6,193	6,502	6,827	7,169	7,527	7,904	8,299	17,253
6. Bone Meal Plant	1,229	1,291	1,355	1,423	1,494	1,569	1,647	1,730	3,569
7. Vegetable Oil Plant		1,946	2,043	2,146	2,253	2,365	2,484	2,608	5,422
8. Fruit & Vegetable Processing Plant		7,258	6,621	8,002	8,402	8,822	9,263	9,726	20,221
TOTAL	17,174	39,582	41,560	43,638	45,820	48,110	50,517	53,043	110,245

Source: Singconsult, 1990

been a considerable increase in labor and other costs since the estimates were made by Singconsult (1990).

Investments in trade and industry in 1989 totalled ₱500 million, a significant increase over the previous year. The investment of ₱300 million per year for 3 years for the development of the proposed project will represent a significant expansion of the industrial investment in General Santos City. To the extent that there is sufficient capacity locally to provide goods and services to meet the needs of the project, increased economic activity will result. It is estimated that approximately 50% of the goods and services necessary for the project can be supplied within the region without constraining or impeding other investments. Due to the strong linkages that such investments have to other sectors of the economy, it is estimated that the multiple effect of a ₱300 million/yr investment could result in twice the economic activity. This increase, in turn, will manifest itself in increased employment opportunities, but of unknown duration.

The long-term economic benefits of the project result from the value added to processed commodities. With the exception of pineapples, much of the agricultural commodities produced in South Cotabato are shipped for processing elsewhere. This shipment prior to processing manifests itself in higher costs to the consumer, lower prices paid to the producer to cover the cost of transport, and high rates of spoilage and loss. Increased farm prices should translate into increased economic activity through a combination of consumer expenditures and savings/reinvestment.

Incomes to fishermen may improve as a result of improvements to the landing and market access. Provision of an ice plant will allow fish to be iced prior to sale and shipment, thus expanding the potential market from local to more regional focus. The principal limitation to fishing, however, is availability of the resource, i.e., over-fishing results in declined catch per unit effort.

4.9.2 Migration and Community Structure

The combined developments and future growth of General Santos City would result in substantial increases in population. Official planning documents places the annual population growth rate at 5.8%. It is estimated that 2.8% (48% of the growth rate) is due to natural increase and 3% (52% of growth rate) to in-migration. In other words, the annual population increment is almost evenly divided between natural increase and in-migration.

Table 4-5 provides data on annual population increments. Over a 10-yr period (1991-2000), 198,833 persons will be added to the estimated 1990 figure of 262,540. Of the cumulative increment, 95,440 is attributable to natural increase while 103,393 to in-migration. It is expected that a significant number of migrants would settle in Tambler because of employment opportunities.

The projected growth in population, particularly with reference to in-migration, may contribute to ethnic diversity, an expansion of the working-age population, and the need and demand for additional urban and other public services, especially health and education.

Based on studies and field observation, the migrants who will be attracted to General Santos City would belong to the productive age-group of 15-24 years. Given the plan of the City to be an industrial and agro-processing center, General Santos City will attract migrants in search for employment in the non-agricultural sector. If this sector is able to progressively absorb new entrants to the labor force, the proportion of non-agricultural employment will increase. Such a development, however, may have regional implications in that productive manpower is drawn away from farms and the rural areas.

Substantial migration may also have the additional effect of displacing indigenous tribesmen, (e.g., B'laans) from their traditional landholdings. These natives generally do not have formal and legal documents attesting to ownership of their lands. Within the project site, there is at least one B'laan family who claims ownership of the land they presently occupy. Until this problem is resolved, this situation may pose a legal obstacle to developing the project site.

Tambler had a pre-relocation population of 4,579. Approximately 12,000 persons (2,540 families) from the city center were transferred to this barangay in 1990. It is expected that more workers and other people will move in as a consequence of GSAPC and other developments. This influx will add to the cultural and social diversity of Tambler and the need and demand for various urban and community services. Moreover, this situation may give rise to employment competition between old-time residents and newcomers.

Tambler will undergo a relatively faster pace of growth on account of migration and commercial/industrial development. Such a development will impinge on traditional lifestyles and community patterns and may necessitate appropriate coping mechanisms in the light of emerging urbanization. Community and

Table 4-5. Annual population increment due to natural increase and in-migration General Santos City, 1990-2000

Year	Projected Population	Annual Increment		
		Natural Increase	In-migration	Total
1990	262,540			
1991	277,767	7,309	7,918	15,27
1992	293,877	7,733	8,377	16,110
1993	310,922	8,182	8,863	17,045
1994	328,956	8,656	9,378	18,034
1995	348,035	9,158	9,921	19,079
1996	368,221	9,689	10,497	20,186
1997	389,578	10,251	11,106	21,357
1998	412,174	10,846	11,750	22,596
1999	436,080	11,475	12,431	23,906
2000	461,273	12,141	13,152	25,293
TOTAL		95,440	103,393	198,833

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

ethnic cohesion and stability will be affected, particularly in terms of maintaining and respecting traditional neighborhood boundaries, general livability, territoriality, and aesthetic quality.

4.10 Energy

With the implementation of the project, the power consumption in the city will increase by a minimum of 11.6 million kwh/yr in the year 1995. This is roughly 23% of the total demand in 1985. In drought years, the power system cannot meet existing demand. The project, therefore, potentially has a significant adverse impact on energy supplies unless power is generated on site.

4.11 Air Quality

4.11.1 Effects During Construction

The main significant effect during the construction of the project will be the generation of dust during the site grading operations as well as during construction. If site grading will be done during the rainy season, the problem of dust will be minimized. However, the contractor will face the problem of mud. Additional vehicular and construction equipment emissions will not be significant in the absolute term but may be substantial compared to the present volume of air pollutant emissions in the area.

4.11.2 Effects During Operation

Air pollution sources include the boilers for the abattoir, meat and bone meal plant, fruit drying and fruit and vegetable canning, and the furnace of the banana/potato chip processing plant. Although the feasibility study gave the capacity of boilers for the fruit drying and fruit canning factories as 200 hp and 100 hp respectively, the others were not given. It is assumed that the abattoir, meat and bone meal plant, and fruit drying plant will each have a 200 hp boiler bringing a total of 900 hp capacity for all the boilers. It is assumed that all the boiler will be fired with Bunker C. For this capacity, the fuel consumption is estimated to be 1020 liters per day.

If one assumes that the available Bunker C will have 2% sulfur and that all sulfur in the fuel will be oxidized to sulfur dioxide, the total amount of sulfur dioxide that will be released

to the atmosphere will be 59.5 kg/day. Since the location of the boilers and their smokestack diameter and height are not yet known, the atmospheric dispersion of the sulfur dioxide and other pollutants cannot be estimated. However, for a conservative estimate we assume that:

- the air pollutant is only dispersed within 60 m height;
- that the wind is blowing at an average speed of 3 m/sec;
- the boilers will be within a strip whose width is 500 m; and
- the air being blown to the site has an ambient concentration of 4.0 ppm.

The predicted resultant concentration will be 204 ug/scm, which is lower than the 24 hr exposure standard of 369 ug/scm.

Odors will be one of the serious problems. These will come from the operation of the fish market, the meat and bone mill, and skin drying operations. Odors from the meat and bone mill and skin drying operations will be a significant nuisance to residents that migrate into the area for jobs.

4.12 Archaeological Resources

Development of the proposed project would, in the absence of any other conservation measure, result in the loss of the six known archaeological sites present. This would occur during the construction phase of project development.

4.13 Irreversible and Irretrievable Commitment of Resources

Resources that will be irreversible and irretrievably consumed or lost as a result of construction and operation of the proposed project include:

- energy in the form of fossil fuels;
- cement and other materials used in construction; and
- arable land.

Of these, the loss of land for potential crop production is insignificant because the site does not have high quality soils.

Consumption of fossil fuels and cement is insignificant in terms of national and regional supplies and consumption; these losses are undetectable incremental increases in local and regional uses of these resources. Although the cumulative consumption of these (energy in particular) is of environmental concern on a national and global level, the potential benefits to local employment and regional incomes as a result of commitment of these resources is probably well worth the extremely small cumulative impact.

4.14 Residual and Unavoidable Impacts

The loss of some mangrove habitat on the site is unavoidable, although it is noted in Chapter 5 that relocation of the fish port further to the south might protect some of the mangrove habitat (primarily on the north end of the property). Acceptability of this alternative, however, is dependent on whether adequate harbor protection can be provided at a reasonable cost.

Displacement of current residents on the site is unavoidable. More important, however, is the high probability that construction and operation of the facilities at the site will act as a magnet for new residences on the site or on adjacent properties. These may be incompatible with the objectives of the site, overall land use plans for the Tambler area, and existing shortfalls in public services.

Construction of the facilities poses a high risk of significant adverse impact on corals in the nearshore zone. Construction techniques that minimize generation of suspended sediments will help reduce the areal extent of the impact, but some loss of coral habitat is certain, particularly in construction zones.

Inadequate solid waste disposal facilities for the entire General Santos City area will continue to pose a risk to groundwater quality, surface water quality, human health, and the perceived quality of life.

Chapter 5

ENVIRONMENTAL EFFECTS OF ALTERNATIVES TO THE PROPOSED PROJECT

Alternatives to the proposed project have been considered in the course of developing the scope for the EA on the proposed project (Appendix A). One of the primary alternatives under consideration is construction and operation of the fish port described in the Singconsult (1990) Feasibility Study and Master Plan.

In the process of carrying out field studies and beginning the EA, other potential courses of action were identified, and their environmental effects are also briefly considered here. Thus, the alternative measures included in this chapter are:

- Singconsult fish port;
- relocation of DPWH fish port;
- wastewater treatment alternatives;
- effluent disposal alternatives;
  - 20-m deep discharge
  - 10-m deep discharge
  - discharge to the waterline
  - land application;
- alternative water supply; and
- integrated site management.

5.1 Singconsult Fish Port Master Plan

From an environmental impact perspective, primary differences between the fish port proposed in the Singconsult Master Plan and the DPWH Master Plan are as follows.

- The Singconsult Master Plan envisions developing the entire shoreline of the GSAPC site for fish port facilities (Figure 2-3), the DPWH Master Plan develops only along the north reef and the deepwater cove (Figure 2-2).

- The Singconsult Master Plan encourages construction of a tuna cannery on the site, the DPWH Master Plan neither disallows nor encourages a tuna cannery on the site.

- The WWTP in the Singconsult Master Plan treats wastes from both the fish port and agro-processing facilities, the WWTP under the DPWH proposal will treat only fish port wastes.

The remainder of this section notes the ways in which the environmental effects of the Singconsult Master Plan will differ from the environmental effects of the DPWH Master Plan (the proposed action).

5.1.1 Habitat Loss

The alteration of the entire shoreline of the site under the Singconsult Master Plan will virtually eradicate the small-scale milkfish fry harvest along the beach. Discussions with local residents, however, indicate that milkfish fry have already experienced a significant decline in Sarangani Bay. The impact, therefore, is less than significant.

The Singconsult Master Plan will entail disturbance and habitat modification of the south reef. Thus, the Singconsult plan extends areas of coral habitat loss to both north and south reefs, rather than the north reef only. The south reef has more patchy coral habitat, as indicated by the higher percentage of sandy areas (Tables 3-9 and 3-10), and less total surface area (Figure 3-11). The north reef also has a higher number of common fish species (Tables 3-11 and 3-12). Thus, the north reef probably has the greater habitat value. But the incremental loss of the south reef is significant from the standpoint of value of coral reef as environmentally sensitive habitat. Furthermore, the south reef includes small patches of seagrass beds (Figure 3-11), which are of high value as a food source for marine organisms and offer shelter for larvae and juveniles of some species.

The Singconsult Master Plan also results in loss of both the coastal mangrove habitat on the northern shore and the thin band of inland mangrove behind the southern shore (Figure 3-13). This is a significant adverse impact in view of on-going decline of mangrove habitat in Sarangani Bay.

Although the Singconsult Master Plan extends habitat loss and conversion to the entire shoreline of the project, it is likely that this habitat would be lost anyway, because the City has designated the site for development of agro-processing and fish port facilities. Therefore, the difference in impact is probably less than significant.

It is possible that the Singconsult Master Plan could be modified to delete the purse seiner landing in the deepwater cove. This modification would be little different from the proposed action, except that the fish landing facilities would be spread over the north and south reefs. If it is feasible from a geotechnical and engineering standpoint to relocate the tuna landing quay (Figure 2-3) to the area for the purse seiners, very minimal or no dredging may be necessary at the north reef. Furthermore, opportunities to preserve the coastal mangrove habitat could also arise. This would represent a significant reduction in the project's adverse effects on the nearshore environment.

5.1.2 Impact on Tuna Fishery

The Singconsult Master Plan (Figure 2-3) and the most recent DPWH fish port design (Figure 2-2) both envision constructing a purse seiner landing wharf in the deepwater cove. Current tuna landings by purse seiners at existing canneries in General Santos City are comprised primarily of small juveniles, which is an unsustainable use of the resource. Construction of a purse seiner landing is probably not a significant adverse impact on the tuna stocks, but it indirectly would encourage construction of a tuna cannery which is also likely to end up processing juveniles. This is considered a significant adverse impact on the tuna fishery.

The southwest Pacific tuna resource is believed by the South Pacific Commission to be currently underexploited with regard to skipjack. General Santos City, providing a deepwater port in a fair weather zone, could provide an excellent base for the high seas tuna fleet in the southwest Pacific. Skipjack spawning areas, however, are located off the southern coast of Mindanao Island, and the purse seiners currently landing skipjack at General Santos City are catching primarily juveniles from the spawning areas.

The present purse seiners which comprise the commercial sector in General Santos City have their own wharf facilities and ice plants, which means there is less need for these new facilities compared to needs of the handliners or municipal fishermen (Ordoñez, pers. comm.). A purse seine landing wharf may lead to the building of more boats, and thus increase fishing effort which may lead to more intense overfishing in spawning areas. Therefore, the alternative of not building a purse seiner landing wharf and tuna cannery may be beneficial in the long run.

While this alternative will reduce the potential impact of the development on the tuna fishery and on water quality (Section 5.1.3), when other decision variables are considered, the purse seiner wharf may still be implemented. A major share of the volume and value of fish products in General Santos City is from tuna fishing.

5.1.3 Impact on Water Quality

Construction and operation of a purse seiner landing suggests that larger volumes of fuel will be handled at the port. The risk of oil and fuel spills, therefore, increases. At low concentrations in the water, gasoline and diesel may cause reproductive failure in corals, and chronic pollution may lead to loss of the coral community (Tilmant 1987).

In terms of wastewater generated, the DPWH proposal will have smaller volumes and lower concentration of BOD. Tuna canneries generate wastewater with high concentration of grease and oil, chunks of fish meat, blood, and other fish body fluids. The wastewater BOD from tuna canning is in the range of 14,000 to 20,000 mg/l, depending on water usage and housekeeping practices in the factory. In fact, in some waste streams, such as from the pre-cooking operation, the BOD could reach 40,000 mg/l. Even if the biological treatment removes 95% of the wastewater BOD, the effluent will still contain from 70 to 150 mg/l BOD. Total BOD would be significantly reduced by screening the waste stream and transporting solids to a fish meal (or feed mill) plant, but there is no guarantee that such a facility will be built on the site or in General Santos City.

Plume modeling conducted as part of the impact analysis of the proposed action (Section 4.2) did not include increased volume and BOD loading from a tuna cannery. However, the preliminary analysis indicates that adequate dilution is likely to reduce the impact on water quality to less than significant levels.

5.1.4 Other Effects

Deletion of the tuna cannery significantly reduces the water demand of the GSAPC and fish port facilities by 33% (Section 2.6). The north spring will be more than adequate as a water supply, and the requirements for collecting and treating the spring water are reduced significantly in scale.

The proposed project and the alternative differ in the intensity of the development. The DPWH proposal primarily aims to put up a fish port with facilities for ice making, refrigerated storage, and a small area for buying and selling the products. However, the value added on the product and its linkage to other industries in General Santos City is minimal. Economic consideration may call for more intensive development to increase the value-added components by local labor and resources as well as to widen the industrial linkages to present and future developments in General Santos City. If an adequate, sustainable supply of tuna could be obtained, a tuna cannery would accomplish this goal.

The effects on air quality will be the same as the proposed project except that without the tuna cannery, there will be less air pollutants emitted. Assuming the tuna cannery will have a 200 hp boiler, then the air pollutants emitted from such source will be decreased proportionately (approximately 22%).

Elimination of the tuna cannery also results in a large decrease in electrical power requirements. Although the Singconsult feasibility study did not give an estimate of the energy requirement of the tuna canning factory, it is roughly estimated as 30% of the total. Thus, a 30% decrease in electrical power requirement compared to the proposed project is expected.

5.2 Relocation of DPWH Fish Port on the Site

Although the DPWH project will cover an approximate area of over 8 ha, the identified location (Figure 2-2) will impact the mangrove area at the north end of the project site (Figure 3-13).

As indicated in Section 5.1.1, if it is feasible from a geotechnical and engineering standpoint to relocate the fish port facilities to the deepwater cove and to the south reef, opportunities to preserve the coastal mangrove habitat and the higher quality north reef coral habitat could arise. This would represent a significant reduction in the project's adverse effects on the nearshore environment. Relocation of the fish port to the south reef, however, probably entails more elaborate design of breakwaters, because of its slightly more exposed position to prevailing waves.

5.3 Alternative Wastewater Treatment

Several methods of wastewater treatment were briefly considered in Section 2.9. Primary treatment methods were considered unacceptable because of their inability to adequately treat high BOD wastes to meet DENR effluent standards. Lagoon treatment was also considered unacceptable because the poor soil and geological conditions in the project area result in either: a) high risk of groundwater contamination, or b) high cost of lining the lagoons to prevent seepage.

Other wastewater treatment alternatives considered in Section 2.9 are probably acceptable from the standpoint of generating effluent of adequate quality to meet DENR effluent standards. However, maintenance costs and reliability are important factors, because ultimately they affect the risk of failure and upset and the probability of adverse effects on water quality. Therefore, this EA recommends an extended aeration system as the proposed action, with the system to be built in modular fashion. This approach provides the greatest reliability and requires the least amount of land.

At the present time, three WWTPs are proposed: a WWTP for the fish port; a WWTP for the agro-processing facilities; and a WWTP for the livestock processing complex. The separate WWTP for the livestock complex is appropriate, because a significant degree of pretreatment is required for the extremely high BOD of these wastes.

Separate WWTPs for the fish port and the agro-processing is an inefficient use of land. Furthermore, significant improvement in economies of scale in construction, operation, and maintenance costs are likely if one WWTP is constructed to handle both waste streams. Plume modeling conducted as part of the impact assessment on the proposed project assumes a combined waste stream as the conservative case, and indicates that adequate dilution is available with an outfall at a depth of 100 ft (30 m).

It is not yet clear whether hot water discharges from boilers or the cooling water system for the refrigeration plant will be discharged to the WWTP or directly to the marine environment. The wastewater from the cooling water system will contain from 5,000 to 7,000 mg/l dissolved solids and from 100 to 200 mg/l hardness. While the water contains high concentrations of dissolved solids when compared to most freshwater sources, this is very dilute compared to seawater. If discharged to the marine environment at high temperature, these wastes will rapidly rise to the surface or, if discharged to the surface, form a hot

surface layer. These plumes will likely kill marine organisms that encounter them. On the other hand, periodic discharge of very hot water to the WWTP may upset the treatment process. Acceptable alternatives may be to predilute the discharge with seawater so that the water temperature of the effluent is less than 35°C, or use the water to clean facilities in the fish market.

If oil and grease become significant problems in the WWTP or in the receiving water, they could be removed by air flotation.

5.4 Effluent Disposal

The DPWH and Singconsult Master Plans call for wastewater discharge at the waterline. This, however, is not acceptable from an ecological and public health standpoint. The Draft EIS for the DPWH Master Plan recommends land application of effluent. The Singconsult Master Plan does not address the location and type of discharge from the livestock processing complex WWTP.

Submarine outfalls have been evaluated as part of this EA on the General Santos Agro-Processing Facilities and Fish Port Complex, and a 30-m deep outfall located on one of the coral reef promontories (south reef) is recommended as the proposed action. Other alternatives are considered here.

5.4.1 North Reef Outfall

Oceanographic data indicate that currents are adequate to obtain high rates of dilution at the promontories of both the north and south outfalls. An outfall at the south reef, however, is recommended because diver surveys indicate that coral abundance is less at a depth of 100 ft on the south reef promontory, compared to the north reef promontory. Furthermore, habitat values are greater on the north reef, and the north reef is located closer to a coastal fishing community at the mouth of the Banwalan River channel.

5.4.2 Outfall Depth at 20 m

As indicated in Table 4-1, an outfall at a depth of 20 m could result in the plume surfacing under high volume discharge during weak currents (Case 5). Although no model runs were made with a diffuser, the results of Cases 15 and 16 suggest that a minimum of two ports at a depth of 20 m may prevent the plume from surfacing. However, coral habitat is more abundant (less

patchy) at this depth on the south promontory, and adverse effects on corals are likely to be more extensive.

5.4.3 Outfall Depth at 10 m

Discharge at this depth is likely to result in a surfacing plume, and coral habitat is abundant and of good quality at this depth. This alternative is unacceptable from an environmental and public health standpoint.

5.4.4 Discharge at the Waterline

Discharge at the waterline represents an unacceptable health risk to fishermen as a result of viruses and pathogens in the effluent. Discharge at the waterline is likely to result in poor dispersion, with rapid build-up of organic matter in sediments in the immediate area. This will result in odor and aesthetic problems.

5.4.5 Combined Outfall

The plume model was run with the assumption that effluent from the fish port and agro-processing facilities would be commingled before discharge. This represents a significant improvement over discharge to the waterline from the fish port WWTP.

Commingling effluent from the livestock processing WWTP and the agro-processing WWTP will provide a net benefit in that the weaker effluent from the agro-processing facility will help dilute the higher levels of BOD in the livestock effluent prior to discharge to the marine environment. Economies of scale in constructing, operating, and maintaining a single submarine outfall will also be achieved.

5.4.6 Land Application

The Draft EIS (Total Consultancy Services 1991) for the DPWH fish port at General Santos City suggests land application of the effluent as an alternative to marine discharge. Treated wastewater can be a valuable resource for irrigation where supplies of fresh water are limited or soils are poor in nutrients.

The main source of wastewater from the fish port is primarily from the thawing of fish, cleaning of containers, and cleaning of fish stands and the market space. The main source of contaminant in the cleaning operation is fish blood, scales, and fragments of fish tissue. The scales and tissue fragments could be separated by screening and sedimentation. The fish blood is likely to be diluted by the wash water to less than 100 mg/l BOD. The wash water could be used for irrigation without further treatment at little risk to human health. Similarly, large volumes of process water from the fruit processing facility (Table 2-1) could be used for irrigation with little treatment.

The porous sandy soil in Tambler and neighboring barangays covers a total area of 7,000 ha. Given the prevailing temperature and humidity conditions in the area, the average evaporation rate will be 5-6 mm/day. Under these conditions, a 7,000 ha area would be able to accommodate up to 350,000 m^3 of wastewater every day (Total Consultancy Services 1991), far more than the total daily wastewater discharge from the GSAPC complex (Table 2-1).

The sandy soil of the region potentially provides a deep zone of aeration where the residual dissolved organic materials will be degraded and stabilized by the soil bacteria. The suspended organic solids in the effluent will help build up the humus on the topsoil, which improves soil fertility. Increased humus in the topsoils will also improve the soil's water retention capacity and cohesive properties, and will reduce the susceptibility of the soil to erosion.

However, water percolates rapidly through sandy soils, and much of the Tambler area is characterized by karst limestone formations, which are highly fractured and porous. Groundwater is capable of flowing rapidly in both vertical and horizontal directions under these conditions. Therefore, care must be taken to ensure that an adequate depth exists between the soil surface at a land application site and underlying groundwater to ensure that all contaminants are removed before the effluent contacts the groundwater. This need for caution is particularly acute in the Tambler area, where groundwater supplies are the primary source of potable water.

Great care must be taken when land application includes domestic wastewater, because of the presence of pathogens and viruses in even treated wastewater and subsequent concerns regarding public health and worker safety. Such schemes can create problems if they are not well planned and managed. A prime consideration is to ensure that risks of disease transmission are eliminated.

As competition for limited water supplies increases between urban and agricultural uses, urban wastewater reuse is expected to become more commonplace. For example, Israel now reuses 35% of its treated sewage water, mainly for agriculture, and targets 80% reuse by the year 2000 (Brown et al. 1990). Drip and sprinkle irrigation make it easier to apply treated domestic wastewater safely.

The main concern is the public health risk to workers, farmers, and food consumers. To summarize from Shuval et al. (1986):

- infective doses of pathogens remain in effluent after conventional secondary wastewater treatment;
- helminths (intestinal parasitic worms) such as Ascaris, Trichuris, and hookworm are particularly resistant, Ascaris eggs for example can remain infective even after 1 yr in the soil;
- the most likely mode of disease transmission is irrigation of vegetables consumed raw or poorly cooked; and
- the main problem with livestock is spread of beef and pork tapeworms (Taenia saginata and T. solium).

Reducing helminths and pathogenic protozoans, whose eggs and cysts are highly persistent and for whom infective doses are low, is more critical than reducing levels of bacteria and viruses, which tend to have the opposite traits.

The WHO (1989) recommends for application to edible crops, sports fields, and public parks a fecal coliform guideline of 1000 MPN/100 ml to protect human health. As indicated in Section 4.2, this cannot be achieved by the proposed WWTPs. No standard, however, has been recommended for pasture, orchards up to 2 weeks before harvest, fodder crops, and industrial crops.

Table 5-1 shows typical survival times of selected pathogens in soils. As can be seen, there is potential for reinfection within the community. Land application schemes must be carefully planned and monitored by local public health officials.

In addition to concerns regarding public health, land application may entail a significant cost in constructing pipelines and pumping facilities, and providing the power necessary to pump the treated effluent to an appropriate land application site.

Table 5-1. Survival times of selected excreted pathogens in soil on crop surfaces at 20-30°C[a].

Pathogen	Survival time	
	In soil	On crops
Viruses	<100 but usually <20 days	<60 but usually <15 days
Enteroviruses[b]		
Bacteria		
Fecal coliforms	<70 but usually <20 days	<30 but usually <15 days
Salmonella spp	<70 but usually <20 days	<30 but usually <15 days
Vibrio cholerae	<20 but usually <10 days	<5 but usually <2 days
Protozoa		
Entamoeba histolytica cysts	<20 but usually <10 days	<10 but usually <2 days
Helminths		
Ascaris lumbricoides eggs	Many months	<60 but usually <30 days
Hookworm larvae	<90 but usually <30 days	<30 but usually <10 days
Taenia saginata eggs	Many months	<60 but usually <30 days
Trichuris trichiura eggs	Many months	<60 but usually <30 days

a: Source: Reimers et al. 1986

b: Includes polio-, echo-, and coxsackieviruses.

Among the land use considerations arising from land application is the requirement for a relatively large amount of land some distance inland where depth of soils and depth to groundwater are adequate. Although much of this land is now in pastureland, the use of the land for land application of effluent will preclude some future uses of adjacent land as well as the site itself. In particular, adjacent residential use may be precluded to prevent exposure to residents, especially children, who may wish to take advantage of the open space for play and various other activities.

The removal of land from certain forms of productive use to accommodate land application will also represent a loss to the economy until it can be determined that the land can be safely brought back into productive use.

5.5 Alternative Water Supply

5.5.1 Radial Well Collectors

Shallow radial well collectors in the vicinity of the north spring headwaters may be a feasible alternative to constructing a collecting pool in the area. Observations on the site of the headwaters of both springs revealed that a substantial fraction of the total flow was emerging through the channel bed. Construction of a collecting pool may alter the flow pattern, particularly if the hydraulic head of the pool is greater than the artesian pressure. Radial well collectors are successful at the Agrotex facility nearby.

5.5.2 Siguel River

The Siguel River has been mentioned as a potential water source (Appendix A). Preliminary analysis of water quality during the dry flow period (Table 3-8) indicates that the water is treatable. Although the springs on the site appear to be adequate in supply, there is a risk that site preparation may significantly alter groundwater movement. If this proves to be the case, feasibility studies may need to be conducted to examine seasonal flow regimes in the Siguel River, environmentally and economically suitable locations for stream diversions, and costs of piping the water to the project site. Costs are likely to be very high.

5.6 Solid Waste Management

The Singconsult Master Plan assumes that solid wastes, including sludges from the WWTPs, will be disposed of in landfills in the General Santos City area. These do not exist. Solid waste is generally dumped near the banks of the Silway and Makar Rivers and is either burned, blown away, or transported to Sarangani Bay during storm flows.

An alternative is to construct a suitable landfill in the vicinity as part of the infrastructure for the GSAPC site.

The Draft EIS (Total Consultancy Services 1991) for the DPWH fish port at General Santos City recommends that sludges be used as a soil amendment because the wastes from agro-processing operations are primarily organic material; no toxic material or heavy metals are expected. Similar public health concerns, however, exist as for land application of effluent. This is particular true for sewage sludges, as a large fraction of the eggs of helminths is expected to appear in the sludge. Survival times indicated in Table 5-1 for soils are also applicable to sludges. The use of sludge drying beds has been found to be quite effective at inactivating eggs, although a very low moisture content (<5%) is required (Reimers et al. 1986).

5.7 Integrated Site Management

At the present time, development of the fish port and the GSAPC facilities are proceeding on separate tracks. There is a high degree of inefficiency in separate design and construction programs, particularly given the differences in scale of the infrastructure required for the two facilities. Integrated site management is a rational alternative to redundant facilities and conflicts in use of the site.

Chapter 6

ENVIRONMENTAL EFFECTS OF THE NO-ACTION ALTERNATIVE

Under both US and Philippine regulations, the environmental impact assessment must include an evaluation of impacts without the project. The "no-action" alternative in this case is a decision by USAID to not fund construction of the infrastructure for the agro-processing complex. Under this scenario, however, Japanese funding of construction of the fish port complex by DPWH could continue. Therefore, the no-action alternative in this case still includes some development on the site.

6.1 Physical Oceanography

Current, tide, and wave conditions will not change. Impacts of breakwaters on littoral transport of sediments will also remain the same as with the proposed project.

6.2 Water Quality

Discharge to the marine environment from the fish port will continue. If the agro-processing facilities are not built, opportunities are lost for the fish port WWTP to discharge its effluent via the proposed deep outfall for the agro-processing WWTP. Therefore, discharge of effluent to the waterline will prevail and result in poor quality water in the nearshore zone.

A number of squatter families are residing within the proposed project, although PFDA has purchased the land and currently holds title to it. Squatter settlement in the vicinity is encouraged by the presence of freshwater springs, employment opportunities in the nearby factories, and good berthing facilities for small boats. While the area is zoned for industries, prohibition against squatting and building of residences is not strictly enforced.

If the proposed agro-processing project is not implemented, the project site will continue to attract squatter families. The charter of PFDA limits it to projects of a nature similar to the proposed fish port. Hence the likelihood of the rest of the area turning into a squatter settlement without the agro-processing facilities is very high.

In the initial stage of the squatter settlement, the population density will be low. There will be sufficient space for the residents to build toilets and disposal facilities for washing, bathing, and house cleaning. Some families may not care to build pit privies but will use the shoreline and the bushes for defecation and urination. Water quality in the springs is likely to quickly become polluted by human wastes.

The existing stream could turn septic with the waste discharges once the population density reaches 200 persons/ha. Under this condition effluent from septic tanks will be beyond the capacity of the springs to assimilate. Solid waste also will find its way to the springs and sea unless the government provides collection services.

6.3 Marine Resources

It appears that the corals at the site are in a state of recovery from damage caused by dynamiting and poisoning as a fishing method. This is evident in the observed presence of small recruit coral heads. Furthermore, there is a relatively good reef fish population, although a majority of species are of small size.

With the no-action alternative, full recovery of the south reef could be attained since dynamiting has just about ceased to be used for fishing (Garrucho, pers. comm.). Moreover, the retention of the south reef due to the no-action alternative will support the government's thrust to conserve the country's dwindling coral reef resources, of which 70% are reportedly in fair or poor condition (Gomez et al. 1981).

The no-action alternative, however, still entails the loss of the north reef and the coastal mangrove habitat to the DPWH fish port. These are perhaps the two most valuable components of the nearshore habitat on the project site. Therefore, the no-action alternative does not entail a significant benefit in protection of marine resources or sensitive habitats.

Efforts are being undertaken in the area to increase fish production, which has decreased as a result of the destruction of mangroves and coral reefs (McAllister 1988; Myers 1988). These efforts include the setting up of artificial reefs and fish aggregating devices within the bay (Garrucho, pers. comm.).

6.4 Aquatic Resources

The no-action alternative conceivably leaves the south spring and its associated biota untouched. Direct losses, therefore, will be confined to the north spring. However, the south spring ultimately also will be destroyed if land use is not controlled and squatters are allowed to occupy the remaining site. If not destroyed by unsustainable harvests, the aquatic biota of the south spring is likely to be extirpated by increasingly poor water quality as human and solids wastes are improperly disposed of.

6.5 Terrestrial Biota

The entire project site is being subject to various environmental stresses caused by anthropogenic activities. The coconut plantation and other vegetation types in the area are currently being impacted as follows:

- felling of coconut palm for coconut lumber and gathering young coconut (buko) is freely done by the squatters and other inhabitants in the nearby areas;
- gathering of firewood and light construction and fence materials continues in the second growth forest;
- savannah grassland was recently burned, and the remaining trees, shrubs, saplings, and vines have been wilted;
- grass cover in the secondary forest and coconut plantation serves as a pasture area for horses and goats;
- remains of mangroves stumps of big Sonneratia sp. are being sawn for lumber.

Evidence suggests that bitaog (Callophyllum inophyllum), beach pandan (Pandanus tectorius), mangrove saplings, and other plant species along the southern shoreline of the project site and the north end of the deepwater cove were completely eradicated due to firewood gathering and "kaingin."

Unabated destruction of the vegetation in the project area is foreseeable in the future. These activities will lead to the following:

- o overgrazing of the savannah grassland and the ground layer of the coconut plantation, resulting in sheet erosion and loss of soil fertility; and
- o destabilization of the mangrove in terms of its capacity to prevent shoreline erosion and loss of breeding grounds for some marine species.

Intensity of these activities will increase if land use is uncontrolled and squatters arrive on the site in increasing numbers.

6.6 Geology and Soils

Site preparation for the agro-processing facilities will not occur under the no-action alternative. This represents a minor benefit to the extent that existing topsoil and topography will be significantly disturbed only on the fish port site and its access road. Squatters will modify topsoil conditions in some areas, but not to the extent that site preparation would produce.

6.7 Groundwater

The supply of groundwater would probably remain unaffected. However, quality of the groundwater on the site is likely to deteriorate if squatters arrive in large numbers.

From a broader perspective, the population growth in the immediate vicinity of the GSAPC site would be much lower under the no-action alternative. Therefore, impact on groundwater quality in the project vicinity is likely to be less.

6.8 Land Use and Services

The no-action alternative will entail the development of a municipal fish port and relocation of some, if not all, of the activities presently associated with Lion Beach in Dadiangas. A commitment to develop these facilities has been made by the Department of Agriculture and Department of Public Works and Highways, with funding from the Japanese government, irrespective of the decisions made by USAID. This development is in conformance with the City Development Plan, which has identified the site for agro-industrial development. Under existing Philippine government responsibilities, fishing is treated as part of the agricultural sector. Development of only a fish port

would represent a less intensive use of the site than was envisioned under the plan.

Under the no-action alternative, there would be substantially less demand for public facilities and services. Water supply, wastewater treatment, solid waste management, and power services still would be required to meet the needs of the fish port. Although there undoubtedly will be relocation of residences from the Lion Beach area to the fish port, the demand for educational and protective services and housing would be less than that expected for the proposed action. While the magnitude of the demand will be less, it will remain significant in terms of the ability to provide these services, all of which are already in short supply.

6.9 Socioeconomic Conditions

With the no-action alternative, the project will realize a smaller set of economic benefits through construction of a fish port, but significant socio-economic consequences, such as depressed social welfare and economic opportunities, will continue. Industries based on marine products will continue to develop in the area due to the supply of marine products from Celebes Sea and Moro Gulf. The development of the fish port would result in relocation of Lion Beach facilities and replicate many of its conditions, particularly eateries and non-fishing markets. This will bring a smaller measure of economic activity to the Tambler area compared to the proposed action.

Another scenario is that the project site will continue to attract squatter families. Eventually, the area outside the fish port site will be converted to a squatter settlement, unless PFDA uses the site for other purposes, since prohibition against squatting and building of residences is not strictly enforced. The charter of PFDA limits it to projects of a nature similar to the one proposed fish port. Hence the likelihood of the area turning into a squatter settlement without the agro-processing facilities project is very high.

6.10 Energy

If the agro-processing facilities are not built, the increase in energy demand will continue but at a different rate and level. Industries will continue to be built in the area since the area is classified for agro-industrial uses.

6.11 Air Quality

Even if the project is not undertaken, investors may put up additional processing facilities in the area because it has been zoned as industrial. Industries such as fish canning will have boilers, therefore, air pollution will also increase. However, the rate of increase will be much lower than if the agro-processing facilities are built on the site.

6.12 Archaeological Resources

The archaeological resources identified as being present on the site will likely be lost in the absence of conservation measures, even under the no-action alternative. Housing developments in association with the fish port will quickly arise on any remaining open space on the site that is not dedicated to support of the fish port itself.

Chapter 7

CUMULATIVE EFFECTS

Side by side with the project will be projects undertaken by private companies. Also, Tambler has been chosen as the site of the new regional airport, which will be built to international standards. Exporters are likely to build their cold storage facilities in Tambler so as to be close to the airport.

Industries that may be put up in the area may include fish canning factories. With industries sprouting up and with the airport nearby, nearby areas that are zoned as residential will soon be developed. Hotels may also be put up in commercial areas near the airport.

Air pollution from these developments will be mostly from boilers in industry and the vehicle emissions as a result of higher traffic.

Increasing development within General Santos City and along the shores of Sarangani Bay has slowly led to the degradation of the coastal natural resources. These include the destruction of the fringing mangrove forests and coral reefs to give way to the development of prawn and milkfish farms, canneries, processing plants, and wharves.

The proliferation of prawn farms and tuna canneries may have already caused the decline of the milkfish fry which used to abound near the project site. Potential causes of this decline include:

- discharge of pollutants;
- loss of mangroves as spawning and nursery areas; and
- entrainment of milkfish fry in seawater intakes and subsequent death in pumps.

As an example of pollutants as a potential cause, prawn farms flush into neighboring mangroves and coastal waters excess lime, organic wastes, pesticides, chemicals, and disease microorganisms (Primavera 1991). Another important example is the closing down of one of the local tuna canneries due to pollution problems (Ordoñez pers. comm.).

The project, along with the prawn farms and other industries in the area, will use a large volume of groundwater which may induce salt-water intrusion. Increasing population in the Tambler area will pose a risk to groundwater quality if adequate domestic waste collection and treatment facilities are not provided.

Pollution may still occur due to the cumulative dumping of effluent of the various industries around General Santos. This is farther aggravated by the decreased mangrove cover of the coastline. According to Snedaker and Getter (1984), one of the more important role of mangroves is the preservation of water quality because of their ability to extract nutrients from circulating waters, thus minimizing the eutrophication potential of nearshore waters. The anaerobic and saline mangrove sediments also have a small ability to remove and/or detoxify common pollutants such as those of organic origin which are oxidized or decomposed through microbial activity.

The proposal is generally ecologically sound, considering the minimal impact it will cause in the bay if all measures will be taken to reduce the pollution load of the wastewater. The primary adverse cumulative impact of the proposed project on marine resources is the incrementally small loss of mangrove and coral reef habitat in Sarangani Bay.

The availability of the fish resources whose economic viability remains in question should be considered in evaluating the need for tuna canning facilities. According to Silvestre (1989), the Moro Gulf is believed to be heavily fished already and that no possible increase in landings can be expected for the pelagic fisheries. He also reported that the problem of overfishing is believed to be serious in the case of the fishery for yellowfin and skipjack. The problem is compounded by the use of the "payaw" by the purse seiners which is believed to be the cause of catching small-sized skipjacks (Pauly and Floyd 1984, Aprieto 1982).

Chapter 8

MITIGATION MEASURES

Potentially significant adverse impacts that may result from the proposed action have been identified in Chapter 4. These include:

- loss of mangrove and coral reef habitat in the nearshore zone;
- adverse impacts on nearshore water quality and on public health from waste discharges at the waterline;
- adverse impacts on groundwater quality from in-migration of people to the project area;
- lack of suitable solid waste management facilities;
- additional strains on already overburdened public services and allocation of socioeconomic benefits;
- loss of archaeological resources on the site; and
- increased power demand in a region of existing power shortages.

Mitigation measures that may be incorporated into project design and implementation are described in this chapter. These measures will minimize or eliminate the potential for significant adverse impacts, or partially mitigate for unavoidable impacts.

In addition, Chapters 4 and 5 note the following factors that may be considered in improving environmental soundness of the project:

- relocation of the fish port on the site to conserve the coastal mangrove habitat and the north reef;
- conservation of some of the area of second growth forest as open space;
- protection of the south spring as a natural habitat and open space amenity; and
- integration of site development, management, and wastewater treatment.

These are also considered briefly in this chapter either in context of mitigation measures for potential significant adverse impacts or as part of an environmental management plan.

8.1 Mangrove and Coral Reef Habitat

Potentially the most significant adverse impact on the environment is the loss of mangrove and coral reef habitat in the nearshore zone. Although the amount of habitat lost is not great (<2 ha mangrove, for example), it represents an incremental loss of significant contributors to the productivity of Sarangani Bay fisheries. The significance of this incremental loss, particularly with respect to mangroves, is its small contribution to many others just like it that cumulatively have destroyed much of the habitat in Sarangani Bay.

On one hand, the economic benefits of the project that are likely to accrue to society as a whole may be worth yet another small loss. The number of people who will benefit from the project will far outweigh the number of people, for example, who would benefit from conversion of mangrove into shrimp ponds. On the other hand, technically and economically feasible mitigation measures should be considered in project design and implementation.

Two such measures that should be considered are:

- relocation of the fish port on the site to conserve the coastal mangrove habitat and the north reef; and
- off-site rehabilitation and protection of degraded mangrove habitat.

As presently laid out, the proposed DPWH fish port will be built on the north reef and the deepwater cove. It entails extensive dredging of the reef flat to construct harbors, and construction of breakwaters out onto the reef flat to protect the fishing fleet from wave action. The Singconsult Master Plan considered the deepwater cove as suitable for harbor development for large draft purse seiners, and the south shoreline of the site suitable for landing of fishing craft. The feasibility of relocating the proposed fish port to take advantage of the deepwater cove and the southern shoreline should be examined. It may be that unacceptable additional costs in breakwater construction will ensue, but the relative costs should be compared before decisions are made to destroy and occupy the best quality nearshore habitat on the site.

If cost and engineering studies indicate that relocation of the fish port to the deepwater cove and south reef area is undesirable, consideration should be given to offsite purchase and rehabilitation of at least 2 ha of shrimp ponds into mangrove habitat. Rehabilitation would entail restoration of tidal flushing and planting of mangrove seedlings. Preferably this should occur in more rural areas, so that the pressure to develop or harvest the mangrove is small. Protection and management of this offsite mitigation should be under the authority and responsibility of the site manager, perhaps in cooperation with a community PVO or NGO.

Construction of the outfall to a depth of 100 ft on the promontory of the south reef entails installation and anchoring of a pipeline across the reef flat and down the reef slope. Consideration should be given to burying the outfall on the reef flat out to at least MLLW. Tides and currents should be taken into account when determining periods of dredging a trench for pipeline burial. Tidal currents should be able to drive the silt towards the open ocean or towards the deep outer slopes. The construction contractor should be required to present a plan to minimize siltation during marine construction, and site inspections should be carried out to ensure that the plan is being properly implemented. Below the MLLW mark, consideration should be given to using a floating effluent line that is moored to the seabed with heavy concrete weights and strong chains. Measures to protect the outfall from anchor damage should also be considered, e.g., a ban on anchoring within 50 m of the outfall line, with signs in Tagalog and local dialects.

8.2 Marine Water Quality

Wastewater discharges to the waterline from the fish port will result in adverse impacts on nearshore water quality and potential adverse impacts on public health. If separate WWTPs are built for the fish port and the agro-processing facilities, it is recommended that the effluent from the fish port WWTP be discharged with the effluent from the agro-processing WWTP via an outfall at the 100-ft isobath on the promontory of the south reef.

To prevent the irreversible damage that siltation will inflict on the corals during dredging, tides and currents should be taken into account when determining periods of dredging. Tidal currents should be able to drive the silt towards the open ocean or towards the deep outer slopes. The construction contractor should be required to present a plan to minimize siltation during construction, and site inspections should be

carried out to ensure that the plan is being properly implemented.

8.3 Groundwater Protection

Adverse impacts on groundwater quality are likely to ensue from in-migration of people to the project area, unless suitable wastewater collection and treatment facilities are provided. This is discussed in more detail in Section 8.5.3. Improper disposal of solid wastes from the GSAPC site and associated employee housing also potentially will contaminate groundwater. This is discussed in more detail in Section 8.4.

Precautions should be taken to not alter considerably the existing environment of the artesian springs. Constructing a pond at the headwaters of the springs to collect the artesian discharges may not be the best approach. This might create a hydraulic head larger than that of the artesian pressure, thereby forcing groundwater to emerge at another location. Radial collector wells may be an alternative solution for spring water collection.

8.4 Solid Waste Management

Suitable solid waste management facilities do not exist in the region. The project will potentially generate large quantities of solid wastes, primarily putrescible material. Although much of this conceivably could be routed through feed mills constructed as part of the agro-processing facilities, there is no guarantee that these will be built, will continue to operate, or can handle the full volume of organic waste. Furthermore, the problem of proper disposal of inorganic wastes remains.

At minimum, a sanitary landfill (not an open dump) should be considered as part of the project infrastructure, perhaps in the vicinity of the offsite facilities. Consideration should also be given to co-composting organic wastes from the agro-processing facilities and sludges from the WWTPs for potential sale as a soil amendment. In the latter case, however, care should be taken to establish an operation that does not endanger public health from improper exposure to viable eggs of intestinal parasites.

Although scavengers do not ordinarily have social standing, they have an important role in recycling materials and efficiently managing waste streams. Consideration should be

given to legitimizing scavenging operations as part of an overall solid waste management program at the GSAPC site and the associated housing development.

8.5 Public Services and Socioeconomic Benefits

Although the proposed project is consistent with the City Development Plan, evaluation of public services indicates that shortages already exist in availability of key public services. Potential mitigation measures are noted below.

8.5.1 Housing

Provision of housing for project employees during the construction and operational phases should be made. Housing should also be provided to the 24 families currently living on the site. Temporary units could be used initially, but more permanent accommodations would be required as early as possible.

8.5.2 Water Supply

To avoid competition with other demands for groundwater, feasibility of water supply from the Siguel River should be examined.

8.5.3 Residential Wastewater Treatment

Two options should be considered. The first option is to hook up the housing development to one of the WWTPs, perhaps the livestock processing WWTP, as the blending of strong and weak BOD waste streams may be beneficial to the treatment process.

Alternatively, the housing project could have its own Level 1 or 2 rural-type water supply, with "pour-flush" toilets (a toilet flushed with buckets). Such toilets can discharge into tight septic vaults where the solid materials accumulate in the vault and the liquid material overflows into a soakage pit. The solid material must be pumped out annually and disposed of properly, and this should be done routinely under the authority and responsibility of the GSAPC site manager. Furthermore, this type of treatment process should be approved only if necessary geotechnical studies of the soil and groundwater indicate that the site is suitable for this type of waste treatment.

8.5.4 Educational Services

The fiscal impact of meeting the additional demand on educational facilities should be offset through development assistance funds or through advance payment of taxes by project proponents.

8.5.5 Protection Services

Provision of onsite property protection and fire prevention services by the project proponents will offset demand on public resources and provide additional opportunities for employment.

8.5.6 Allocation of Socioeconomic Benefits

Priority should be given to employing persons currently residing on the site, in the Tambler area, and in General Santos City. Employers should coordinate with city officials and the barangay captains to coordinate community needs and employment opportunities.

The use of imported goods and services should be minimized so as to maximize the retention of benefits in the Philippines. The use of local goods and services should be maximized to encourage retention of benefits in the local area.

8.6 Archaeological Resources

A report on archaeological resources on the site has been provided to USAID/Manila Office of Capital Projects under separate cover. It is recommended that Sites No. 2, 3, 4, 5, and 6, as identified in the report prepared by the Philippine National Museum team, be excavated by qualified personnel prior to initiation of site construction to allow recovery of archaeological artifacts.

Prior to initiation of site work, construction crews should undergo a brief seminar on recognition of buried sites and artifacts. If any suspected archaeological site is uncovered during site preparation, all work in the immediate area should be stopped immediately and a qualified archaeologist consulted for preliminary evaluation and recommendations.

8.7 Energy

Electric power should be provided on a dedicated basis to both the GSAPC site and the worker housing.

8.8 Environmental Management Program

8.8.1 Construction Management

The construction contractor should be required to prepare and submit for approval an environmental management program to cover construction operations. Periodic site inspections should be made to verify that this plan is being implemented.

In addition to the key points noted above regarding minimizing siltation during marine construction and training staff in recognition of archaeological resources, the plan should include the following key components:

- The scouring of topsoil and eventual siltation of the aquatic habitats should be offset by provision of temporary silt screens around areas prone to soil erosion. Areas of exposed soils that are not scheduled for immediate facility construction should be revegetated with grasses.

- To minimize dust during construction, the contractor should spray water at the construction site.

- Measures for proper disposal of oily wastes should be identified, along with a program to confine and cleanup spills during refueling operations.

8.8.2 Habitat Conservation

To the extent practical, habitat conservation should be included in site layout and design, not only for conservation of biological values on the site but also as open space amenity. Figure 8-1 identifies two candidate areas for habitat conservation. These include:

- the coastal mangrove community and beach north of the deepwater cove; and

- part of the second growth forest, including the headwaters of the two springs, located on the southwest corner of the site.

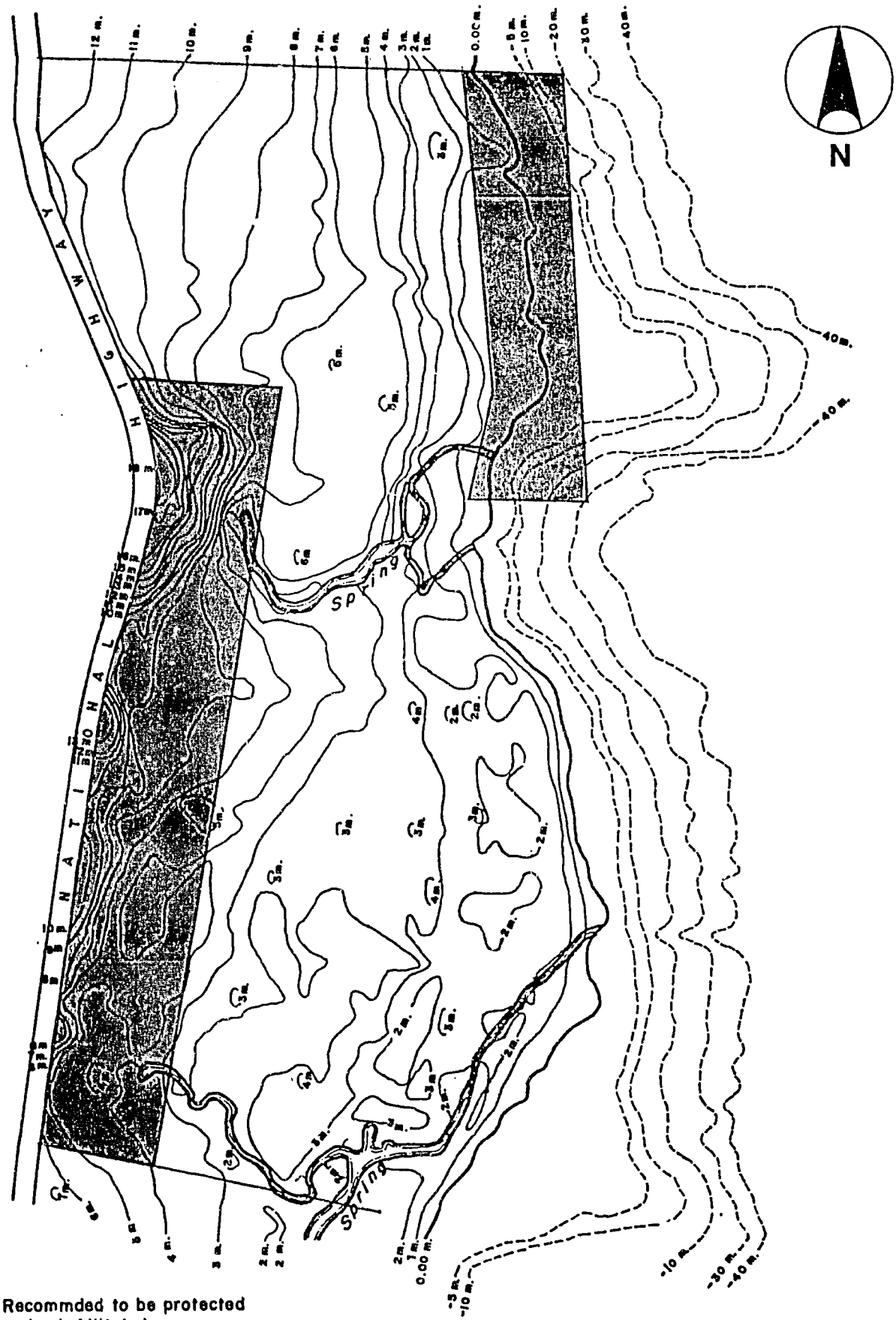


Figure 8-1 HABITAT AREAS RECOMMENDED FOR CONSERVATION

Dames & Moore

In addition, to the extent practical, the south spring, at least down to the southeast corner of the property, should be maintained in its natural condition. This entails protection of the stream channel and a buffer of natural vegetation up to approximately 3 m wide on each bank.

Buffer zones of natural habitat should be set up around the WWTP so as to provide possible habitat for displaced wildlife.

Areas of shoreline which will not be developed by the project should be replanted with mangrove trees to provide new spawning and nursery habitat for marine organisms.

To minimize the expected terrestrial habitat losses in the project area, the rehabilitation of existing vegetation to the extent practical is recommended. The proposed rehabilitation includes the enrichment planting of the second growth forest in as much of the area indicated in Figure 8-1 as possible, as well as mangrove habitat where feasible. For the second growth forest and the adjacent portion of the coconut plantation, tolerant species such as narra (Pterocarpus indicus), raintree (Samanea saman), mahogany (Swientenia macrophylla) and pink shower (Cassia javanica) are recommended. These species not only provide aesthetic values to the environment but also serve as efficient agents against soil erosion. Sonneratia spp. should be planted to enrich existing mangrove stands or to stabilize shoreline that is not developed for the fish port.

8.8.3 Environmental Protection

Sump oil and other oily waste resulting from engine maintenance wastes must be treated separately from other wastes destined for treatment in the WWTP. This waste should be carried in cans to a central holding tank, from where it can be taken for incineration or as fuel for the boiler in the fruit processing factory. More than one holding tank should be installed for waste oil collection to make it easier for people to dump these oily wastes. Three tanks of around 500 liters storage capacity will suffice.

To minimize emissions from the boilers, operators should be encouraged to properly maintain the combustion system as well as the exhaust chimneys.

To minimize odors, proper waste collection and disposal should always be followed. Odors from bone meal and feed meal plants usually result from volatilized fats which escape to the atmosphere, then condense on surfaces and, eventually,

deteriorate and produce a foul odor. A comprehensive exhaust system should be constructed, and the exhaust should be passed through a scrubber. By passing the air exhaust through a scrubber, the volatilized oil is removed.

The successful implementation of environmental protection measures and conservation of natural habitat can only be attained with full cooperation and participation of the community within the project site. It is necessary that proper extension service regarding environmental components of the project should be undertaken to generate awareness and address concerns among the constituents. To this end, the position of Environmental Officer should be created as a senior level staff position in the office of the site manager. Responsibilities should include: community education programs for fishermen, employees, and other users of the site and their families; monitoring performance and maintenance of waste disposal systems; and oversee habitat conservation and rehabilitation programs.

8.8.4 Environmental Monitoring Program

A monitoring program should be implemented to check early signs of pollution in the spring water and the nearshore zone. In particular, the program should focus on bacteriological parameters. The environmental monitoring program should be carried out on a quarterly basis during mid- to late morning hours after most of the fish unloading activities have occurred. Parameters for analysis should include but not be limited to: total and fecal coliforms; oil and grease; and BOD.

Since most agro-processing facilities will be concerned about sanitation and purity of produce, a cooperative arrangement should be established to adequately fund, staff, and maintain an analytical laboratory that can be used both to monitor product and environmental quality.

8.9 Site Management

Establishment of two separate managerial offices for the fish port and the agro-processing facility is inefficient, as is construction and maintenance of two completely different sets of basic infrastructure. Site planning, development, and management should be coordinated and integrated into a single functioning entity as soon as possible.

Establishment of two separate WWTPs for the fish port and the agro-processing facilities is also inefficient. Economies of scale in construction, operation, and maintenance can be achieved by building and operating a single facility capable of handling the wastewater from both complexes. Furthermore, construction of a separate outfall for the livestock complex WWTP is also inefficient. It is recommended that only one WWTP be constructed on the site for facilities on the 32 ha, and that one outfall be designed and installed to carry the effluent from both the on-site WWTP and the livestock complex WWTP.

The on-site WWTP system should take into consideration that processing facilities will not be fully operational for the first few years. The designer should consider a phased program of construction using a modular construction method for the aeration and clarification tank using common walls. The oxidation ditch system as proposed by Singconsult occupies around 4,400 m^2 of land, compared with around 2,500 m^2 for a modular extended aeration system.

To ensure that the future project does not result in significant harm to the environment, USAID may wish to encourage establishment of a set of covenants or guidelines by which project proponents who wish to locate on the site agree to contribute to expansion and make use of the waste treatment facilities, provide pretreatment as necessary, and operate in an environmentally responsible manner.

Chapter 9

RESPONSES TO COMMENTS

This chapter includes comments on the draft EA and respective responses to these comments. Substantive comments requesting clarification or corrections were received from:

- Philippines Fisheries Development Authority;
- Environmental Management Bureau, Department of Environment and Natural Resources; and
- AID/Washington, Asia Bureau Office of Environmental Coordinator.

Minor corrections and clarifications were made directly in the text of the EA. All of the comments from PFDA were addressed in this fashion.

Comments from EMB and USAID/Washington required more detailed responses; this chapter reproduces the questions and the specific responses.

The Environmental Compliance Certificate for the General Santos Agro-Processing Complex and the Fishport is also reproduced in this chapter. At the time of preparation of the final EA, the ECC was available only as a facsimile, and the quality of the copy was not good.

Republic of the Philippines
Department of Agriculture
PHILIPPINE FISHERIES DEVELOPMENT AUTHORITY
MLI Building, 1680 E. Rodriguez Avenue
Quezon City

DEPARTMENT OF AGRICULTURE

PHILIPPINE FISHERIES DEVELOPMENT AUTHORITY

14 June 1991

Mr. Michael Kingery
Project Manager
Mindanao Development Project
U. S. Agency for International Development
Ramon Magsaysay Center
1680 Roxas Boulevard, Manila

Dear Mr. Kingery:

We are submitting herewith the attached list of comments concerning the draft report on the Environmental Assessment for the Agro-processing and Fishport Complex Project.

For your information and perusal.

Very truly yours,

DANILO D. ZAMUDIO
Project Manager

1. p. xi, para. 6 - the last sentence should be read "the construction of the proposed WWTP," or "to construct the . . ." instead of "to construction . . ."

2. p. xiii, last para. - the word employees does not have "o".

3. p. 5, para. 5 - it stated "The Singconsult design includes a tuna cannery . . . The design does not include tuna cannery but open area for lease to investors who would want to put up facility APC.

4. No. 3 was mentioned again in p. 16 para. 2.

5. p. 23, Fig. 2-3 - the figure is not the final Master Plan as envisioned by the Singconsult.

6. p. 24, last para. - the assumption "if purse-seiner docking facilities were economically attractive, it is expected that existing canneries would construct them." is totally unacceptable considering that construction of port facilities and maintaining it by the canneries would entail additional investments on the part of the owners. The purse-seiner docking facilities would not necessary encourage the exploitation of the tuna stocks since the fishing grounds of these fishing vessels are the high seas. This would not also encourage public sector competition considering they are the one requesting for it. (See attached resolution)

7. p. 29, para. 2 - the "8.5 KVA" should be read "8.5 MVA or 8500 KVA." The "1 KVA" should be read "1 MVA" or 1000 KVA."

8. p. 38, para. 2 - the same as No. 1

9. p. 88, para. 1 - it stated "A concrete dam . . . but has since been undermined by water flow." The truth is that it was intentionally undermined by the treasure hunters.

10.	p. 104, last para.	-	"rural" should be put between 14 and barangays. The port facilities of DOLE Philippines and Makar are not part of Tambler but that of Labangal.
11.	p. 111, para. 3	-	include RFM Tuna Canning Plant since it is just beside the Purefoods factory.
12.	p. 132, para. 1	-	"General Santos City" instead of Sarangani Bay.
13.	p. 132 last para.	-	the statement "This loss represents <u>a small increment</u> in the general decline of mangrove habitat area in Sarangani Bay . . ." is conflicting with the last sentence "As such, it is a <u>significant</u> adverse impact on the environment . . ."
14.	p. 137, para. 5	-	the same as No. 3

SOUTH COTABATO PURSE-SEINER'S ASSN.
GENERAL SANTOS CITY

OFFICE OF THE CITY MAYOR
RECEIVED
BY:
DATE

SOCOPA OFFICERS
1990 - 1991

DR. ERNESTO B. SALAZAR, MD.
President

MR. GERONIMO "Oyet" VENERACION
1st Vice-President

MR. FELIX O. PONTINO
2nd Vice-President

MR. RAMSES "Boy" VERANO
Secretary

MRS. CARMEN GRANFON
Treasurer

MR. CIRILO P. ODANGO
Auditor

MR. RENE A. KINTANAR
PRO

BOARD OF DIRECTORS

GREGORIO R. DELA PENA
DOMINICO C. CONGSON
MARFIN Y. TAN
RODRIGO E. RIVERA
DARIO O. LAURON
KAGAWAD OSCAR "Boy" REYES
MRS. ALBINA SUAREZ
MRS. INDAY C. DAMALERIO

Excerpts from SOCOPA Special Meeting
Held at Casa Luisa, Lagao, City of General Santos
On April 29, 1991 at 12:46 p.m.

I. PRESENT

1. Dr. Ernesto B. Salazar - IGF-PGFE
2. Marfin Tan - SAFI
3. Engr. Amor Almaden - Halieus Fishing
4. Col. Emilio Ferolin - 601st Brigade
5. Lt. Ziegfred Sendico - SSAI
6. Lt. Bernard Andico - SSAI
7. Antonio Patnubay - SAFI
8. Lucia Oraiz - SAFI
9. Roberto Garcia - SAFI
10. Joel Kasayan - SAFI
11. Roland Orcullo - SAFI
12. Mario Otudis - SAFI
13. James Respecia - SAFI
14. Isabilo Respecia - SAFI
15. Cresencio Ricana - SAFI
16. Demetrio Respecia - SAFI
17. Helen Granfon - RFI
18. Rene Kintanar - QBRO
19. Doning Congson - SFI
20. Arturo Aguilar - Amarco
21. Generoso Yap - Celebes Canning Corp.
22. Domingo Teng - DTFI
23. Ading Tan - SAFI
24. Boy Lumapas - SAFI
25. William Agatep Jr. - SAFI.
26. Jeremias Dollente - SAFI
27. Elizabeth Lopez - RFI
28. Helpmate General Services
29. Joey Evangelista - MGE
30. Diosdado Araniego - MGE
31. Amelito Gutierrez - VFI
32. Oscar Reyes - QBRO
33. John Rodriguez - QBRO
34. Rose Minao - QBRO
35. Nimfa Fuetes - QBRO
36. Patricia Ruales - QBRO
37. Leilani Rodriguez - QBRO
38. Angelina Oyson - QBRO
39. Eva Reyes - QBRO
40. Concepcion Quintana - QBRO
41. Rolando Mancio - QBRO
42. Gabriel Estocapio - LK Fishing
43. Jover Pontino - PDSFI
44. Jerry Damalerio - DFI
45. Albina Suarez - RS Fishing
46. Dario Lauron - DJL

Resolution No. 04
Series of 1991

WHEREAS, part of our objectives are; to devise programs that will uplift and enhance the livelihood of fishermen

- page 01 -

SOUTH COTABATO PURSE-SEINER'S ASSN.
GENERAL SANTOS CITY

SOCOPA OFFICERS
1990 - 1991

DR. ERNESTO B. SALAZAR, MD.
President

MR. GERONIMO "Oyet" VENERACION
1st Vice-President

MR. FELIX O. PONTINO
2nd Vice-President

MR. RAMSES "Boy" VERANO
Secretary

MRS. CARMEN GRANFON
Treasurer

MR. CIRILO P. ODANGO
Auditor

MR. RENE A. KINTANAR
PRO

BOARD OF DIRECTORS

GREGORIO R. DELA PENA
DOMINICO C. CONGSON
MARFIN Y. TAN
RODRIGO E. RIVERA
DARIO O. LAURON
KAGAWAD OSCAR "Boy" REYES
MRS. ALBINA SUAREZ
MRS. INDAY C. DAMALERIO

and other workers connected with the fishing industry and to promote the involvement and popular participation of its members in the economic and social development of General Santos City and South Cotabato;

WHEREAS, we already learned thru the project briefer presented by PFDA that a Fish Port Complex will be constructed in a 32 hectares at Tambler, General Santos City based on the approved plan prepared and submitted by DPWH, Project Management Office, Manila;

WHEREAS, we have seen the plan of said Fish Port Complex and noted its deficiency in some facilities such as storage, docking and lack of blast and brine facilities;

BE IT RESOLVED THEREFORE as it is hereby resolved that a request be made thru the proper Government agencies concerned for the construction of the following facilities to accomodate or correspond to the actual needs of the local fishing industry:

1. Storage Capacity of 1,500 tons
2. Docking facility for super seiners to accomodate 3 unit at the same time
3. Blast freezer with 30 to 50 tons capacity
4. Brine freezer with 30 to 50 tons capacity

RESOLVED further that copy of this resolution be furnished to the following government offices; PFDA, City Mayor, Cong. Adelbert Antonino, Sec. Senen Bacani of Agriculture, BFAR, BOI and Pres. of the Republic of the Phils.

Done in the City of General Santos on this 30th day of April, 1991.

Prepared by:

The Secretariat

TIRSO G. ABECIA
Executive Secretary

RAMSES Y. VERANO
Secretary

Attested by:

ERNESTO B. SALAZAR, M.D.
President

cc: DPWH, NEDA, Sec. Franklin Drilon, Sec. Fidel Ramos, Mr. Chito Ayala, Mayor Ludovico Badoy.

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP
SUITE A, 5TH FLOOR, ADAMSON CENTER BUILDING, 121 ALFARO STREET, SALCEDO VILLAGE,
MAKATI, 1200, METRO MANILA, PHILIPPINES TEL. No. 817-9491, 818-6808, FAX NO. 817-9491-MANUAL

3 September 1991

Environmental Impact Assessment Division
Environmental Management Bureau, DENR
Philippine Heart Center
Quezon City

RE: EIARC Comments on the Proposed General Santos Agro-Processing Facilities and Fish Port Complex

Dear Colleagues:

Dames & Moore is pleased to have the opportunity to respond to your comments on the Draft Environmental Assessment we prepared for the subject project under contract to the US Agency for International Development.

We appreciate your willingness to review the Environmental Assessment at such an unusually early stage in the project planning process. As explained in our introductory chapter, we were obligated under US regulations to prepare the Environmental Assessment early in the planning process so that decisions regarding project design and implementation could include an environmental analysis of proposed actions and alternatives.

Attached please find our responses to your comments.

Sincerely,
DAMES & MOORE INTERNATIONAL

for

Harvey Van Veldhuizen, Ph.D.
Project Manager

RESPONSES TO COMMENTS

1. A committee to protect the old-growth mangroves should be formed. Should the offsite rehabilitation and protection of degraded mangrove habitat be implemented, details of the plan should be submitted.

When USAID initiated contract work on the Environmental Assessment, no project proponent for the General Santos Agro-Industrial Complex had yet been identified. Furthermore, it was not yet clear whether the fish port would be constructed with Japanese funding assistance. USAID was interested in providing development assistance to the agro-processing complex, and also to the fish port if other funding sources did not come through. Therefore, USAID requested that an Environmental Assessment be prepared on both the agro-processing complex and the fish port.

Since the draft EA was prepared and submitted for review in May, the Department of Agriculture has been identified as the project proponent. Furthermore, it appears that Japanese funding will be available for construction of the fish port at the site.

Under existing site plans, the agro-processing complex will not affect the old-growth mangrove habitat on the northern third of the shoreline. As presently proposed, the fish port will eliminate this habitat. USAID, therefore, is no longer in a position to make decisions regarding the protection or replacement of this old growth mangrove habitat. These decisions properly lie with the Department of Agriculture and the donor for the fish port construction.

2. Statement should be made on health statistics for the site and the vicinity.

The leading cause of morbidity in General Santos City (in 1989) was upper respiratory tract infection (43% of cases), followed by diarrhea (16%) and bronchitis (12%); other causes of morbidity, including influenza, accidents, pneumonia, hypertension, tuberculosis, parasitism, and measles, each represented less than 10% of total cases. In terms of mortality, the leading causes (and their rates) were: pneumonia (27%), accidents (14%), cardio-vascular incidents and other heart diseases (21%), tuberculosis (10%), gastroenteritis (10%), malignant neoplasms (8%), congenital anomaly (5%), septicemia (3%), and typhoid and paratyphoid fever (1%).

3. Assessment of the possible impacts of the project on the thriving community at the mouth of the Banwalan River should be submitted.

The residents currently on the project site, approximately 24 families, have varying degrees of tenure. The longest resident of the site has been there for over 50 years (by his estimate); others have been there for a matter of months to years (between October 1990 and February 1991, the number of residents increased in numbers). To develop the site would require that the current residents be relocated, a move that will disrupt the social patterns that have been established.

The residents would likely be relocated to a nearby site in Tambler that has been designated by the City Government as a relocation site. Housing would be provided as would basic site services (i.e., water, electricity). During and following site development, the former site residents would be given priority and preference for employment.

4. The complex would definitely attract entreprenuers in the vicinity, i.e., jeepney drivers, vendors, carinderias, etc.; impact of these should be assessed.

The EIA recognizes the near certainty that the eateries, market, and people deriving a livelihood from the existing fish markets would relocate to the GSAPC site. To accomodate these activities, two areas within the GSCAPC have been allocated for food shops and one (1) ha. has been designated for commercial development. The impact of these areas represents a relocation of existing activities to a new site with improved site features (i.e., sanitation and services) from the current site. The distance from the center of General Santos City would necessitate that operators/employees of these facilities either commute or relocate to areas more proximate to the GSCAPC. Land use within the GSAPC will be controlled by the Department of Agriculture, as the site developer, to ensure that the site is developed according to a plan. Loss of control of land use within the site could impair the ultimate development of the site and, thus, reduce the level of economic benefit that could be derived. The increased incomes expected to result from development of the Fish Port and Agro-processing Complex would enhance the business opportunities for entrepeneurs serving those elements. This increased level of overall economic activity would also result in increases in the demand for transportation facilities and increase the amount of traffic on the road from General Santos City to Tambler. In light of the existing traffic load between Tambler and the project site and plans to upgrade the road beginning in late 1991, the increase is not expected to have an adverse effect.

5. Local geological map and soils map should be submitted. The soils map should be accompanied with borehole tests for physical and chemical characterisits of subsurface soils/rocks. To

consider groundwater contamination by infiltration and potential sites of liquefaction, the soil map is necessary. Geological structures should appear in the geologic map.

A soil exploration program consisting of 8, 20m to 30m depth borings was initiated as part of the Feasibility Study conducted by Singconsult in 1990. The approximate borehole locations are shown in Figure 1. The subsurface profiles shown on Figures 2 and 3 were developed from data presented in the study report. The numbers appearing in the figures on the left side of each of the boreholes are N-values; N-values are indicative of the resistance to penetration of the layer tested. This is the number of blows used to drive a standard split spoon sampler 30 cm into the soil using a 140 lb hammer dropping 30 in. The site soils consist predominantly of mixtures of sand and gravel with varying amounts of cohesive and non-cohesive materials. There are pockets of cohesive materials encountered, but the consistencies of these cohesive materials are in the stiff to very stiff range and, therefore, are not considered as detrimental to the planned development. The measured consistencies of the predominating deposits are in the range of 2 (very loose) and over 100 blows per foot of penetration (refusal), which is considered very dense.

It is apparent that the denser deposits are encountered in areas further inland. There are also seams of coral formation encountered within the depth explored. This formation is considered weak or highly weathered because no sample could be recovered.

The deposits nearest to the shore apparently have lower consistencies, as can be seen from the figures. This is probably so because these are younger deposits being formed by the processes of erosion or by littoral depositional processes. BH 2 is in a river delta, and it is not unusual to obtain a low consistency since deposits in these areas are continually subjected to alternating erosion and deposition processes.

The distribution of the different surfacial soils (top soil, 15cm to 20 cm) in the general vicinity of the project area is shown in Figure 4. There are seven (7) different types of surfacial soils that cover the mantle of General Santos City. Dadiangas Sandy loam covers about half (50 percent) of the entire land area of General Santos City including the project area. Other types occupy the rest of the area in almost equal proportions except for Buayan Clay Loam which has a much lesser coverage.

The geologic map (Figure 5) shows the distribution of the different deposits that comprise the B-horizon of General Santos City including the project site. Generally, a geologic column of soil is subdivided into three (3) horizons: A-Horizon (Figure 4)

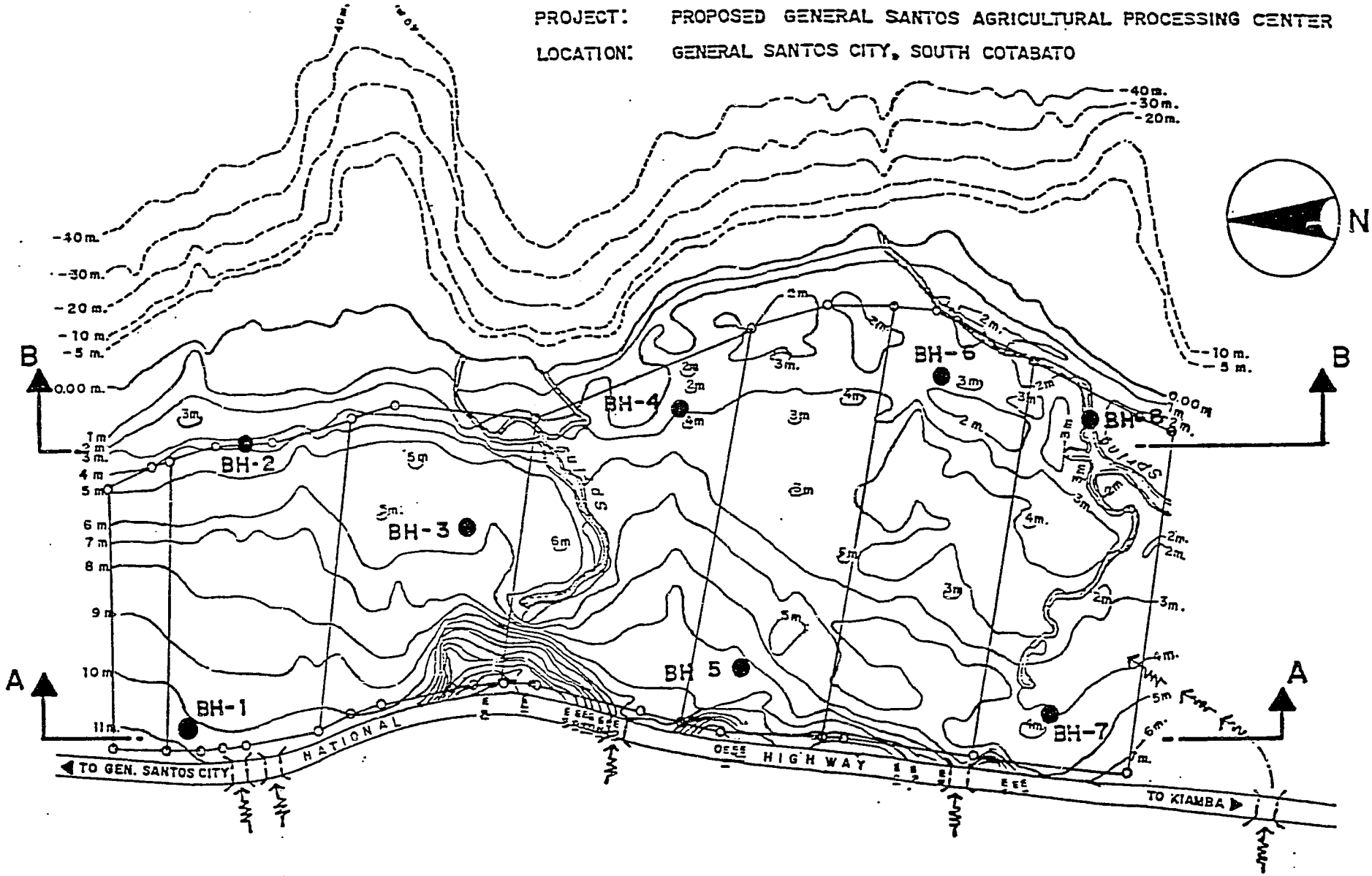


Figure 1 BOREHOLE LOCATION PLAN

Source: Singconsult Report, 1990

Dames & Moore

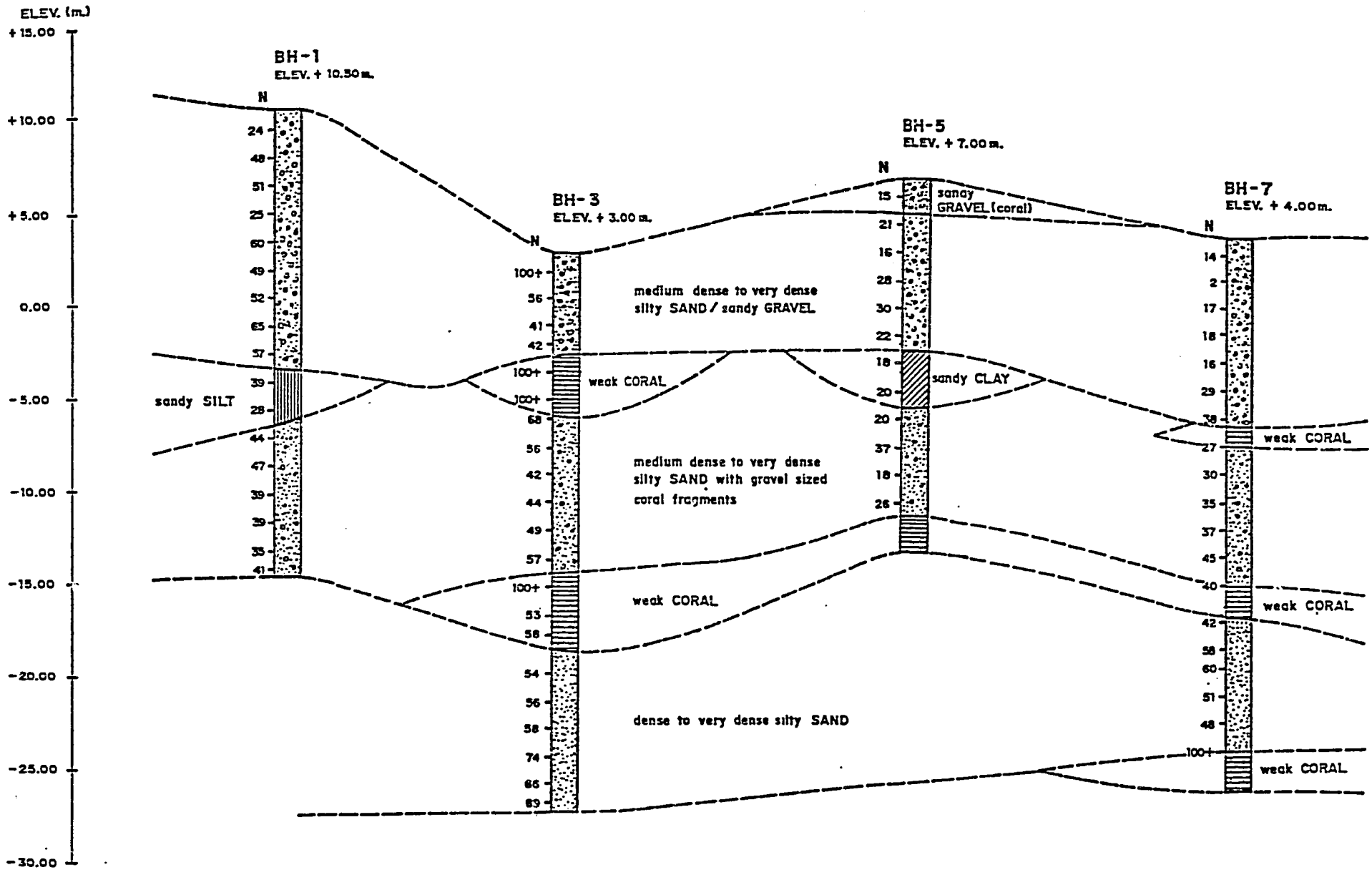


Figure 2 SUBSURFACE PROFILE

SECTION A-A

NOTE:
DATA DRAWN FROM BORING LOGS
PRESENTED IN THE SINGCONSULT REPORT, 1990

Dames & Moore

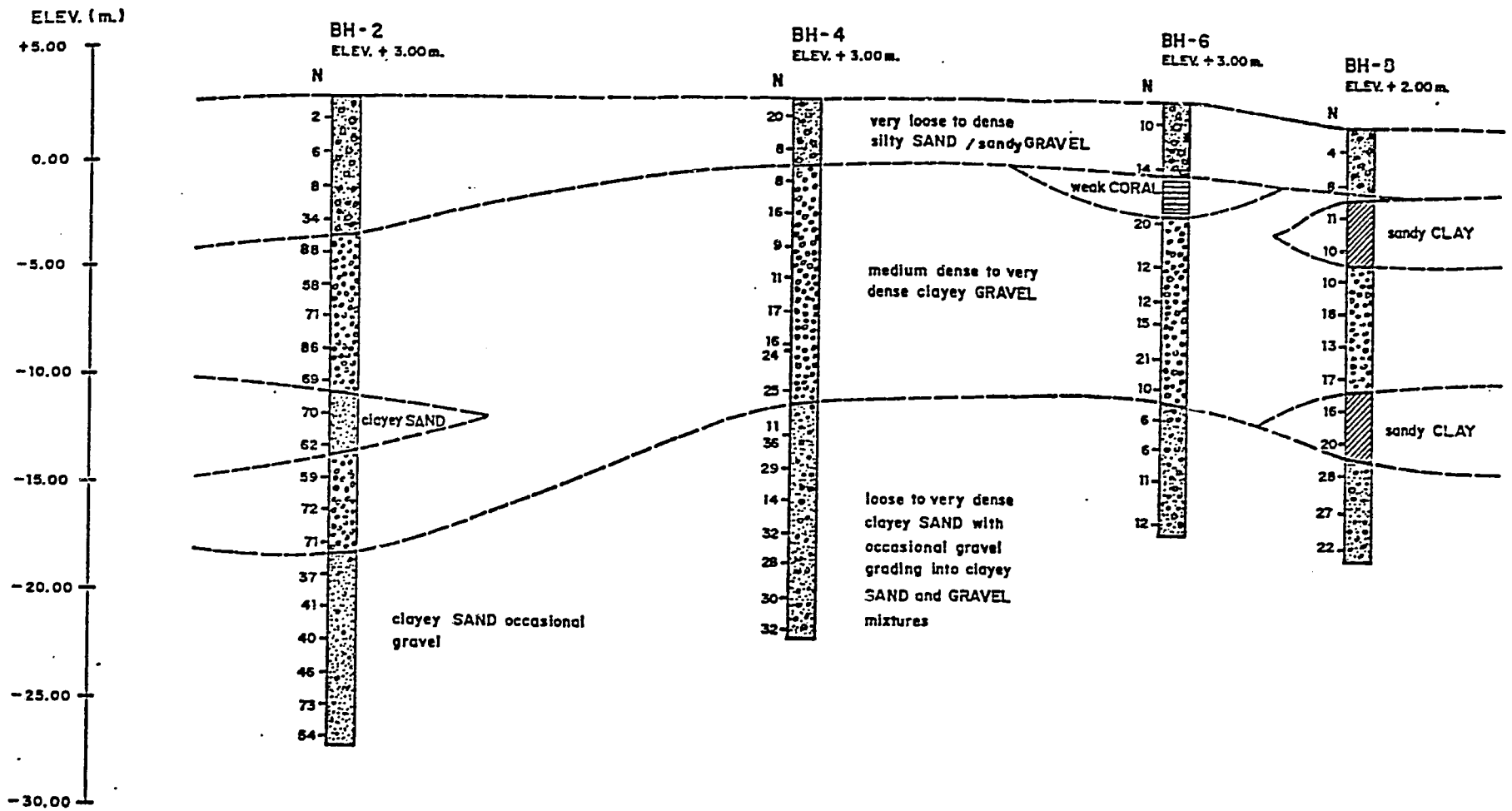


Figure 3 SUBSURFACE PROFILE

SECTION B-B

NOTE:

DATA DRAWN FROM BORING LOGS PRESENTED IN THE SINGCONSULT REPORT, 1990

Dames & Moore

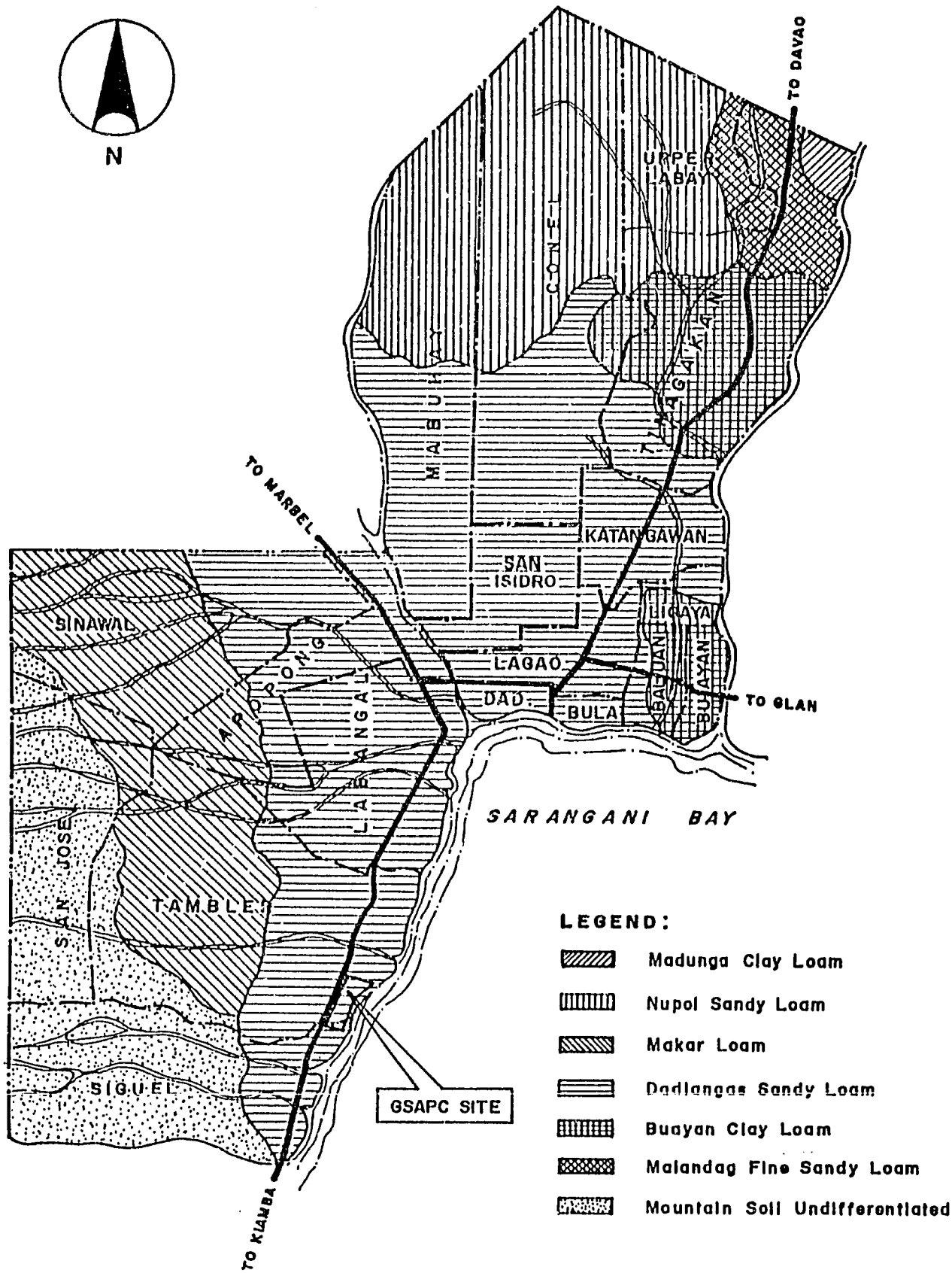


Figure 4 SOIL MAP

Source: Comprehensive Development Plan of General Santos City, 1990

Dames & Moore

is the uppermost layer in the soil profile, B-Horizon, which is beneath A-Horizon, is the subsoil normally described in a geologic map, and C-Horizon is comprised largely of slightly altered parent rock which grades downward into the bedrock.

Liquefaction Hazards

The area appearing to be most susceptible to liquefaction is in the vicinity of BH 2 where the thickness of apparently liquefiable layer is about 6 m. However, this layer consists of mixtures of materials with gravel having the greatest fraction which can be considered as having good permeability. It has been determined that a deposit of good permeability would require a large magnitude of ground acceleration and longer period of shaking before excess pore pressure becomes apparent (H. Bolton Seed, 1979, "Soil liquefaction and cyclic mobility evaluation for level ground during earthquake," Journal of the Geotechnical Division, ASCE).

It has also been established by various researchers on liquefaction, particularly H. Bolton Seed and Izzat M. Idriss (1971, "Simplified procedure for the evaluation of soil liquefaction potential," Journal of the Soil Mechanics and Foundations Division), that materials most susceptible to liquefaction are uniformly graded clean fine to medium sands. The presence of fines in the mass, however, has been found to lessen its susceptibility.

Settlement Hazards

The upper layer of deposits nearest to the shore may not liquefy in the event of earthquake but may settle with sufficient magnitude to be detrimental to structures founded upon spread footings. It is only prudent, therefore, to exercise precaution in selecting the proper foundation systems. Pile foundations may be considered but its selection should be based on economics. Since the depth and thickness of loose deposit that would be the source of most of the settlement is considered, not so great, the area can be improved effectively by a variety of proven ground improvement techniques. Since the materials under consideration are highly permeable, improvement by dynamic compaction may be the most appropriate.

Design Ground Acceleration

The determination of the design ground acceleration is a major concern that requires the involvement of a specialist in this field during more detailed design work. It should be noted that the Mindanao Fault, one of the major earthquake generators (see Figure 6) traverses the project area. It is imperative, therefore, to assess the seismic risk for the area. There has

been ground acceleration of 0.5g recorded. This magnitude has been determined to be at about the epicenter of an earthquake. Its adoption, without careful evaluation, however, may prove very costly if its occurrence is at long period intervals. The Singconsult report suggested a value of 0.3g. This likewise is unrealistic if drawn without qualified basis.

6. Identify and plot in the geologic map the archaeological resources and locate where the engineering structures are to be built.

As indicated in our meeting with EMB on 6 August, USAID is very concerned that if the locations of the archaeological resources are made public, treasure hunters would rapidly destroy the sites before they could be properly investigated. USAID has in its project files the report prepared by the National Museum on its preliminary survey findings. USAID plans to fund an excavation and resource recovery prior to construction at five of the six sites as recommended by the National Museum. The sixth site has already been destroyed by human activity. The consultant is under ethical and contractual obligation to not divulge information deemed confidential by USAID.

A conceptual plan for the agro-processing facility as developed under contract to the Department of Agriculture by Singconsult is attached. It should be emphasized, however, that this environmental assessment was prepared early in the project planning process to ensure that environmental issues were considered in project design and implementation. Therefore, the location of these facilities is illustrative, and the attached figure should not be considered a final decision regarding facility layout.

7. A public hearing should be conducted.

The Department of Agriculture made plans for a public hearing in General Santos on 26 September.

MEMORANDUM

January 14, 1992

TO: Dennis Zvinakis, USAID/Manila/OCP

FROM: Molly Kux, Environmental Coordinator, ASIA/DR

RE: **Review and Comment on Mindanao Development Program Agro-Processing Center and Fish Port Complex (APC) EA**

Before approving the EA for this sub-project Mission response is requested to the questions raised in this memorandum, including a Mission environmental action plan.

The EA's analysis suggests that the fish port sub-project was ill-conceived from the beginning. This raises a number of basic questions:
1. Was an assessment of the fishery resource carried out prior to the design of the sub-project?
2. Given the apparent serious decline in the fishery, in this region, how can the port sub-project be environmentally and economically justified?
3. Would not the monies being proposed for this port be used better in activities which conserve and restore the fishery resource, rather than accelerate its decline?
4. Although the Japanese government is not obviously under any obligation to follow A.I.D.'s recommendations, how are decisions going to be made about which facilities should be included in the port improvement and expansion, the siting of the expansion and whether the sewage treatment system will be combined or separate.

Within the context of the overall sub-project design assessment, the EA has made a number of very good recommendations on the handling of wastes from both the agro-processing center (APC) and the fish port, especially if the DPWH design is chosen. Other recommendations cover the layout and access to the site, archaeological finds management and relocation of site residents. However, they are overshadowed by the fish port component.

Given these very serious concerns, we request Mission response on the following topics:

a) Does the Mission's intend to seek changes in the design of the fish port or abandonment of the sub-project by the GOP and the Japanese?

b) What actions will the Mission take to bring DA, DENR, DPWH, A.I.D. and the Japanese together to discuss the findings of the EA, both with respect to the port and the APC?

c) Is the Mission preparing an environmental action plan on the APC sub-project, with or without the fish port, as the proposed mitigations require a detailed plan that can be followed by the contractor. As the accompanying memo from Tarrant indicates, specific detailing of mitigation and monitoring for some activities will have to await the detailed engineering design stage.

It is our understanding that the Japanese aid agencies (OECF and JICA) are trying to improve their environmental analysis capabilities and performance. If it would be helpful, we could try to use our contacts and possibly Paul White (now that he is in Tokyo) to raise some of these questions. For your information, JICA has expressed interest in being involved in a study we are doing with World resources Institute of implementation of the EIA process in 4-5 Asian countries.

We would appreciate Mission response to the above issues.

Attachment:
Tarrant's memo of 12-11-91

MEMORANDUM

December 11, 1991

TO: Molly Kux, Asia/DR/TR

FROM: Jim Tarrant, Asia/DR/TR

RE: **Review and Comment of Mindanao Development Program Agro-Processing Center and Fish Port Complex (APC) EA**

SUMMARY. The Environmental Assessment (EA) of the General Santos City Agro-Processing Facilities and Fish Port Complex (APC) is recommended to the Asia BEC for approval, subject to receipt of USAID/Manila's comments and plans, as noted in (10) below.

1. The General Santos City Agro-Processing Facilities and Fish Port Complex (APC) is part of the Mindanao Development Program (492-0456). The sub-project proponents are the GOP Departments of Agriculture (DOA), Public Works and Highways (DPWH) and USAID/Manila. The foreign funder for the fish port complex is the Japanese Government. This EA and its recommendations covered both the APC and the fish port complex because, at the time of the EA contract, both were to be funded by USAID. The applicability of the EA recommendations to the fish port complex now that Japan is funding it is discussed below.

2. The draft EA is comprehensive in its investigation of physical, social and economic impacts and description of current and future conditions with and without the proposed facilities and their ancillary development (surrounding settlements, infrastructure needs). The principal environmental issues involved with this sub-project can be grouped into four concerns: 1) the environmental impacts of the agro-processing facility (APC); 2) the environmental impacts of the fish port; 3) common environmental management concerns of the two facilities, and 4) cumulative impacts of development around the site.

3. Significant environmental impacts attributable to the APC are relatively few: the main ones are disposal of the potentially large amounts of solid waste and process wastewater. The EA recommends a combination sanitary landfill and wastewater treatment plant with a deep outfall in Sarangani Bay. I recommend concurrence with both recommendations, especially considering that porous karst formations constitute most of the geology in the area

with the consequent high risk of groundwater contamination (which would jeopardize both sub-projects and surrounding settlements). Another concern for the APC will be the relocation and new housing for 21 families on the site and temporary housing for construction workers. The other major recommendation worth noting is the provision for archaeological excavation of the site if artifacts are discovered during construction. Training is recommended to be provided to crews to recognize such artifacts.

4. The fish port EA included examination of two designs: one with a purse seine wharf and tuna cannery (the Singconsult design) and one without (the DPWH design). The first option would not only lead to generation of more wastes on-site but, more importantly, would contribute to rapid depletion of the regional fishery. One of the principal objectives of the fish port construction, as noted in the EA, is to improve the cleanliness and efficiency of port operations, in order to improve productivity and returns for the sashimi market. Sashimi is made from fresh tuna. Hence, the proposed sub-project is predicated on the existence of an ample, healthy tuna fishery. In and of itself, as the EA notes, this port improvement will not likely increase the pressure on the tuna resource in Saranghani Bay, since the sashimi fishery is primarily a hook and line one. However, because no fishery assessment was undertaken prior to the proposing of this sub-project, the economic justification of this port expansion may rest on a false assumption: the existence of an ample and sustainable tuna fishery.

The fisheries problem is partly an inherent one and partly human-induced. The Philippines has a short continental shelf and few nutrient rich, bottom upwellings, so the natural fishery resource is seriously constrained, in the first place. On top of this, there also has been considerable overfishing by domestic and foreign fleets, well past the point of sustainability, especially in this area (two existing canneries are already shut down due to a lack of fish).

As a result, the EA endorses the DPWH design, (with some modifications as in the WWTP system and no purse seine wharf or tuna cannery). The EA's excellent fish port recommendations, however, may be clouded by the fact that the Japanese have agreed to fund the sub-project. The Japanese would not necessarily be under any obligation to follow the A.I.D. funded EA recommendations. Hence, the onus for implementing those would lie with the sub-project proponents: DOA and DPWH. The main recommendations include hooking up the wastewater treatment plant (WWTP) output with the stream coming from the APC's WWTP in one deep outfall (the present Singconsult design calls for a waterline outfall which is completely unacceptable from health, safety and reef ecology concerns). It should be noted that for the purposes of both economic and environmental efficiency the recommended mitigation is for only one WWTP to service the APC, the livestock complex and the fish port. It also recommends combining other management facilities. Of course, this would greatly simplify the overall management of the sub-project and environmental monitoring of the two sub-projects. I would recommend endorsing that recommendation.

5. The EA also provides good recommendations for re-vegetation and protection of non-built up areas on the site and protection of groundwater and surface waters from contamination. Most of these recommendations would have more than one purpose, i.e. both protection of important ecological functions on site and also health, safety, recreational, soil erosion prevention and other uses. Other common concerns are the inclusion of settlement waste treatment facilities, infrastructure and public services to support the centers and their workforces. These will require the close involvement of GSC government and DENR as well as the sub-project proponents. The sub-project will need to provide a solid monitoring and supervision unit to ensure these recommendations are undertaken.

6. We have a copy of DENR's comments on the EA. They appear to endorse the recommendation to either move the fish port south to protect old growth mangroves and coral reefs or, if this is economically infeasible, to require the purchase of other developed shoreline areas (e.g. milkfish ponds) and convert them to mangroves so as to maintain the no net loss of mangroves policy. It should be emphasized that Saranghani Bay's precarious fishery is closely dependent upon preventing any further destruction of mangroves and indeed reversing that trend. The mangrove conversion, while not large in itself, will add to the progressive loss of mangrove all around Saranghani Bay and contribute still further to the general decline of the Bay's fishery (mangroves provide important spawning grounds and nutrients for a variety of marine fauna). DENR did not comment on the depth of the outfall for the WWTP.

7. I recommend that you urge the Mission to open up a dialogue with the Japanese, the DOA, DPWH and DENR to obtain formal agreement on the WWTP deep outfall for the APC/fish port complex; the re-siting of the fish port south and/or the purchase of new mangrove areas (the total area of mangroves involved is 2 ha.); discussion of the alternative of abandonment of the port expansion, given the state of the regional fishery, and a combined management and environmental action plan for the whole site, based on the EA mitigations.

8. The proposed mitigations suggest the need for a detailed environmental action plan. This is not specifically described in the EA. Partly, this is because a number of decisions concerning the sub-project and its various proponents have to be made about which the EA contractor does not have any information, at this time. Partly, also it is because parts of any action plan would have to await the detailed engineering design stage (which is dependent upon siting, funding and other decisions).

9. Hence, I would recommend that you suggest to the Mission that they re-hire the EA contractor at a later point to track the design stage and, if the Japanese are cooperative, work with DPWH and DOA to develop a detailed environmental management plan and monitoring system for the whole site. This environmental plan would specify what would be mitigated, changed or monitored, how and by whom and whether special training would be

required (for contractors, private APC operators and service providers, local government, etc.). Training funds for these monitoring and management requirements should come at least initially from the sub-project budget. Subsequently, perhaps, management and user fees can be assessed on the users of these facilities to supplement or replace sub-project funds.

10. I would also recommend that you request the Mission to provide a) its comments and reactions to this EA (none have been provided to date), and b) immediate steps it plans to take, particularly opening up a dialogue with the Japanese and the GOP agencies involved in the sub-project and the local GSC government.

UNCLASSIFIED
AID 02/10/92
OD:RAJOHNSON
OCP:KLUEPHANG:EBE
1.ONRAD:BPRIMM (D), 2.OCP:DZVINAKIS (D), 3.OCP:MKINGERY (D)
AID (OCP-3 OD, ONRAD C&R)

KL
BP(D)
DZ(D)
MK(D)
JD(D)
LP(D)

AMEMBASSY MANILA
SECSTATE WASHDC, PRIORITY

AIDAC

FOR MOLLY KUX, ENVIRONMENTAL COORDINATOR, ASIA/DR/TR; INFO THOMAS NICASTRO, ASIA/DR/TR; AND DON CLARK, ASIA/EA/P

E.O. 12356: N/A
SUBJECT: AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX, GENERAL SANTOS CITY, SOUTH COTABATO PROVINCE

SUMMARY: THE ASIA/DR/TR ENVIRONMENTAL COORDINATOR CLEARANCE IS REQUESTED FOR THE FINAL ENVIRONMENTAL ASSESSMENT (EA) OF THE ABOVE SUBJECT PROJECT. AS USAID IS NO LONGER A FINANCIER OF EITHER THE AGRO-PROCESSING FACILITY OR FISHPORT, ENVIRONMENTAL APPROVAL REQUESTED ON JUNE 6, 1991, IS NO LONGER REQUIRED. HOWEVER, THE ENVIRONMENTAL COORDINATOR'S CLEARANCE IS REQUESTED TO INDICATE CONCURRENCE TO WHAT THE MISSION AND THE ENVIRONMENTAL CONTRACTORS BELIEVE IS A MEASURED APPROACH TO SOUND ENVIRONMENTAL DECISION-MAKING PROCESS. THE DEPARTMENT OF AGRICULTURE, AS LEADER OF THE PROJECT BOARD, ALSO IS PERHAPS MOST SENSITIVE TO AND SUPPORTIVE OF THE NEED TO DEVELOP INFRASTRUCTURE IN AN ENVIRONMENTALLY SOUND MANNER. DURING THE CLEARANCE PROCESS, HOWEVER, ENVIRONMENTAL COORDINATOR HAS RAISED SOME RELEVANT QUESTIONS. THE MISSION IS PROVIDING ANSWERS TO THESE QUESTIONS, AS THEY SHOULD PROVIDE A BASIS SATISFACTORY FOR AN ENVIRONMENTAL CLEARANCE ON THE EA REPORT. EA CLEARANCE REQUESTED. END SUMMARY.

1. RESPONSE TO AID/W QUESTIONS: ALTHOUGH USAID PARTICIPATION HAS EVOLVED FROM INITIALLY AS FULL FINANCIAL PARTNER TO PRESENTLY A CONCERNED "FRIEND OF THE COURT," WE WILL ATTEMPT TO ANSWER YOUR INQUIRY OF JANUARY 14, 1992 AND PASS TO THE PROJECT BOARD YOUR

4.OCP:JDAWAY (D), 5.OCP:LPURIFOY (D)

UNCLASSIFIED

INQUIRY AND OUR ANSWERS, WHICH WERE DEVELOPED IN CONJUNCTION WITH DAMES & MOORE (D&M). WE HAVE ALSO TAKEN NOTE OF THE EXCELLENT COMMENTARY OF THE EA AND RECOMMENDATIONS PROVIDED ON DECEMBER 11, 1991 BY JIM TARRANT, ASIA/DR/TR. THESE COMMENTS HAVE ALREADY BEEN PASSED TO THE PROJECT BOARD, AND TO THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES/ENVIRONMENTAL MANAGEMENT BUREAU (DENR/EMB).

A. WAS AN ASSESSMENT OF THE FISHERY RESOURCE CARRIED OUT PRIOR TO THE DESIGN OF THE SUBPROJECT?

THE D&M DRAFT EA FOCUSES ON THE PROPOSED MASTER PLAN DEVELOPED BY SINGCONSULT AND THE ACCOMPANYING DOCUMENTS. D&M EVALUATED THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH) MASTER PLAN FOR THE FISH PORT, AS IT WAS AN ALTERNATIVE ACTION AT THE TIME THE DRAFT EA WAS PREPARED. IT IS OUR UNDERSTANDING THAT WHILE NEITHER A STOCK ASSESSMENT NOR A MARKET ANALYSIS OF THE TUNA CANNERY WAS DONE AS PART OF THE SINGCONSULT REPORT, THE DESCRIPTION IN D&M DRAFT EA REGARDING THE STATUS OF THE REGIONAL TUNA FISHERY IS BASED ON INFORMATION OBTAINED FROM THE BUREAU OF FISHERIES AND AQUATIC RESOURCES (BFAR) IN MANILA, AND INTERVIEWS IN GENERAL SANTOS WITH LOCAL STAFF OF THE PHILIPPINE FISHERIES DEVELOPMENT AUTHORITY (PFDA) AND LOCAL FISHERMEN. ALTHOUGH THE RESULTING DESCRIPTION OF THE TUNA STOCK IS NOT BASED ON RIGOROUS SCIENTIFIC ANALYSIS, THE DATA ARE SUFFICIENTLY ADEQUATE TO ASSESS THE LIKELY IMPACT OF THE PURSE SEINE FLEET ON THE FISHERY. AS IS EXPLAINED BELOW IN PARA 1-B, ALL ASPECTS OF THE FISH PORT ARE JUSTIFIABLE ON ENVIRONMENTAL AND ECONOMICAL GROUNDS.

B. GIVEN THE APPARENT SERIOUS DECLINE IN THE FISHERY IN THIS REGION, HOW CAN THE PORT SUBPROJECT BE ENVIRONMENTALLY AND ECONOMICALLY JUSTIFIED?

THE SINGCONSULT REPORT INDICATED THAT "GENERAL SANTOS CITY, SITUATED AT THE HEAD OF SARANGANI BAY, SOUTHERN PHILIPPINES, PROVIDES AN IDEAL DEEP WATER PORT IN A FAIR WEATHER ZONE NOT SUBJECT TO DEVASTATIONS BY TYPHOONS OR SEASONAL WEATHER PATTERNS UNSAFE FOR SHIPPING. IT PROVIDES AN EXCELLENT BASE FOR TUNA PURSE SEINE VESSELS SHIPPING WITHIN A 1,500 NAUTICAL MILE ARC IN THE WESTERN PACIFIC OCEAN, WHERE THE TUNA AND SKIPJACK RESOURCE IS REPUTED TO BE VERY ABUNDANT AND NOT THREATENED BY OVEREXPLOITATION." THE REPORT CONTINUES THAT "RECENT

SKIPJACK ASSESSMENT SURVEYS CONDUCTED BY THE SOUTH PACIFIC COMMISSION (SPC) REVEALED THAT THE SOUTHWEST PACIFIC IS CURRENTLY UNDEREXPLOITED WITH REGARD TO ITS SKIPJACK RESOURCE." IN CONCLUSION, THE SINGCONSULT REPORT RECOMMENDED THAT "TO ENSURE THAT THE NEEDS OF THE VARIOUS GROUPS IN THE AREA ARE MET, IT IS PROPOSED THAT THE FISHING PORT COMPLEX BE DESIGNED TO PROVIDE ALL THE FACILITIES REQUIRED BY THE SASHIMI TUNA FISHERMEN, THE COASTAL MUNICIPAL FISHERMEN, AND THE COMMERCIAL DEEP-SEA PURSE SEINE FISHERMEN."

D&M AGREES WITH THE RECOMMENDATIONS OF THE SINGCONSULT REPORT, AND BELIEVES ALL ASPECTS OF THE FISH PORT ARE JUSTIFIABLE ON ENVIRONMENTAL AND ECONOMICAL GROUNDS. THE CURRENT LANDING AREAS FOR THE SMALL-SCALE FISHERMEN AND FOR THE SASHIMI (HOOK-AND-LINE) FISHERMEN ARE PRESENTLY UNSANITARY AND ENVIRONMENTALLY UNSOUND. FURTHERMORE, NECESSARY SERVICES AT THE EXISTING SITES ARE LACKING, AND THERE APPEARS TO BE NO SPACE AT THE EXISTING LANDING SITE FOR SMALL-SCALE FISHERMEN TO PUT IN THE NECESSARY SERVICES. IMPROVEMENT OF SERVICES AND SANITARY CONDITIONS, AS PROPOSED IN THE EA REPORT, IS EXPECTED TO SIGNIFICANTLY ADD TO THE VALUE OF THESE FISHERIES.

C. WOULD NOT THE MONIES BEING PROPOSED FOR THIS PORT BE USED BETTER IN ACTIVITIES WHICH CONSERVE AND RESTORE THE FISHERY RESOURCE, RATHER THAN ACCELERATE ITS DECLINE?

BY THIS QUESTION, WE INTERPRET THAT MONIES, MEAN USAID FUNDS. AS PREVIOUSLY STATED, EXCEPT FOR THE EA, THERE ARE NO ANTICIPATED LARGE FINANCIAL PARTICIPATION OF USAID IN THESE TWO SUBPROJECTS. HOWEVER, DEPARTMENT OF AGRICULTURE (DOA) AND USAID HAVE ALWAYS AGREED TO A NEED FOR LONG-TERM COMMITMENTS TO CARRY OUT NECESSARY MEASURES TO RESTORE FISHERY RESOURCES. THERE IS, HOWEVER, ALSO AN IMMEDIATE NEED AS THE EA RECOMMENDED, TO IMPROVE SANITARY CONDITIONS AT THE FISH LANDING SITES, WHICH WOULD IMPROVE MARKET VALUE OF THE PRODUCT AND, THEREFORE, FISHERMEN'S INCOMES. THE SMALL-SCALE FISHERMEN'S ASSOCIATION AND DOA, SINCE THE DRAFT EA WAS SUBMITTED, HAVE BEEN TAKING MEASURES TO RESTORE THE FISHERY INSIDE SARANGANI BAY. THE HOOK-AND-LINE FISHERY FOR TUNA, IN ITSELF, WOULD BE A SUSTAINABLE FISHERY. THE EA RECOMMENDATION TO PROVIDE A NEW LANDING AREA WITH SANITARY FACILITIES AND ADEQUATE SUPPORT SERVICES IS NOT EXPECTED TO ACCELERATE THE DECLINE OF THESE TWO FISHERIES.

D. HOW ARE DECISIONS GOING TO BE MADE ABOUT WHICH FACILITIES SHOULD BE INCLUDED IN THE PORT IMPROVEMENT AND EXPANSION, THE SITING OF THE EXPANSION, AND WHETHER THE SEWAGE TREATMENT SYSTEM WILL BE COMBINED OR SEPARATE?

THE GOVERNMENT OF THE PHILIPPINES (GOP) OVERALL RESPONSIBILITY FOR THE SOUTH COTABATO/GENERAL SANTOS CITY AREA DEVELOPMENT PROJECT LIES WITH THE PROJECT OFFICE COMPOSED OF A PROJECT BOARD AND A MANAGEMENT UNIT. THE CHAIRMAN OF THE PROJECT BOARD, HEADED BY THE PHILIPPINE CENTRAL GOVERNMENT'S SECRETARY OF AGRICULTURE, AND A FULL TIME PROJECT DIRECTOR, SUPERVISES A STAFF OF AROUND 14 FULL-TIME AND SECONDED PERSONS. AMONG THE BOARD MEMBERS ARE REGIONAL DIRECTORS OF VARIOUS GOP AGENCIES, (INCLUDING THE DENR/EMB REGIONAL DIRECTOR), THE PROVINCIAL GOVERNOR, THE CITY MAYOR AND TWO REPRESENTATIVES OF THE PRIVATE SECTOR - NGOS. ADVISORS INCLUDE THE THREE CONGRESSMEN IN THE PROVINCE, MEMBERS OF THE LOCAL COMMUNITY WHO HEAD OR LEAD BUSINESS, CIVIC, RELIGIOUS, ACADEMIC INSTITUTIONS AND ENVIRONMENTAL GROUPS. THE BOARD MEETS MONTHLY IN GENERAL SANTOS. DECISIONS REGARDING PROJECT DESIGN AND IMPLEMENTATION WILL BE MADE AND CARRIED OUT WITH INPUT FROM THE BOARD, THE ADVISORS AND THE GENERAL PUBLIC. PROJECT SPECIFIC ENVIRONMENTAL QUESTIONS WILL BE HANDLED BY THE DENR/EMB BOARD MEMBER. THE SEVENTH MONTHLY BOARD MEETING ON JANUARY 23, 1992, DISCUSSED VARIOUS MEANS OF IMPLEMENTING THE AGRO-PROCESSING CENTER (APC) BY THE PRIVATE SECTOR AND THE FISH PORT (BY JAPAN'S OECF 17TH YEN LOAN PACKAGE). NO ADDITIONAL MAJOR ASSISTANCE WAS ANTICIPATED TO BE PROVIDED BY USAID FOR THESE TWO SUBPROJECTS.

THE EA RECOMMENDS A COMBINATION SANITARY LANDFILL AND WASTEWATER TREATMENT PLANT WITH A DEEP OUTFALL IN SARANGANI BAY FOR DISPOSAL OF THE POTENTIALLY LARGE AMOUNTS OF SOLID WASTE AND PROCESS WASTEWATER. THE MISSION CONCURS WITH BOTH RECOMMENDATIONS, ESPECIALLY CONSIDERING THAT POROUS KARST FORMATIONS CONSTITUTE MOST OF THE GEOLOGY IN THE AREA WITH THE CONSEQUENT HIGH RISK OF GROUNDWATER CONTAMINATION (WHICH WOULD JEOPARDIZE BOTH SUBPROJECTS AND SURROUNDING SETTLEMENTS).

THE EA'S FISH PORT ENVIRONMENTAL RECOMMENDATIONS INCLUDE HOOKING UP THE WASTEWATER TREATMENT PLANT (WWTP) OUTPUT WITH THE STREAM COMING FROM THE APC'S WWTP IN ONE DEEP OUTFALL, FOR HEALTH, SAFETY AND REEF ECOLOGY CONCERNS.

THE MISSION CONCURS WITH THE EA RECOMMENDATION SINCE THIS WOULD GREATLY SIMPLIFY THE OVERALL MANAGEMENT OF THE SUBPROJECT AND ENVIRONMENTAL MONITORING OF THE TWO SUBPROJECTS.

E. DOES THE MISSION INTEND TO SEEK CHANGES IN THE DESIGN OF THE FISH PORT OR ABANDONMENT OF THE SUBPROJECT BY THE GOP AND THE JAPANESE?

THE PROJECT BOARD IS WELL AWARE OF THE ENVIRONMENTAL SENSITIVITY OF THE FISH PORT AS WELL AS THE DETAILS OF SOME OF THE DESIGNS AND THEIR EFFECTS TO THE MANGROVES AND CORALS IN THE NORTHERN PORTIONS OF THE SITE. THE DEVELOPMENT CONCEPT ENVIRONMENTAL COMPLIANCE CERTIFICATE (ECC) ISSUED BY THE ENVIRONMENTAL MANAGEMENT BUREAU (EMB) REFLECTS THESE CONCERNS AND DIRECTED FACILITIES BE REDESIGNED TO THE SOUTHERN PORTION OF THE SITE.

WHILE IT HAS BEEN ANTICIPATED THAT THE FISHPORT WOULD BE DEVELOPED USING JAPANESE DEVELOPMENT ASSISTANCE FUNDS, AT PRESENT THERE IS NO FIRM COMMITMENT BY THE JAPANESE TO DO SO. IF THE PROJECT DOES GO FORWARD, THE PROPONENT WILL BE REQUIRED TO OBTAIN AN ECC FROM THE DENR/ENVIRONMENTAL MANAGEMENT BUREAU. AN ECC WILL ONLY BE GRANTED AFTER THE PREPARATION OF AN ENVIRONMENTAL IMPACT ASSESSMENT BY THE PROPONENT IS REVIEWED BY EMB, AND A PUBLIC HEARING HAVING BEEN HELD. WHILE THE EA PREPARED FOR THE GEN. SANTOS APC AND FISHPORT COMPLEX HAS BEEN SUBJECT TO SUCH A REVIEW AND PUBLIC HEARING, THE ECC GRANTED FOR THAT FACILITY PROVIDES APPROVAL ONLY FOR THE DEVELOPMENT CONCEPT AND WILL STIPULATE THAT EACH OF THE FACILITY COMPONENTS WILL BE REQUIRED TO OBTAIN AN ECC. THIS PROVIDES FOR CONTINUED OVERSIGHT BY EMB OF THE ENVIRONMENTAL IMPACTS ASSOCIATED WITH EACH OF THE INDIVIDUAL DEVELOPMENTS.

F. WHAT ACTIONS WILL THE MISSION TAKE TO BRING DA, DENR, DPWH, A.I.D. AND THE JAPANESE TOGETHER TO DISCUSS THE FINDINGS OF THE EA, BOTH WITH RESPECT TO THE PORT AND THE APC?

THE APPROPRIATE FORUM FOR COORDINATING DEVELOPMENT PROJECTS IN GEN. SANTOS CITY IS THE PROJECT BOARD, AS DESCRIBED IN D. ABOVE.

AS PREVIOUSLY MENTIONED, USAID/MANILA (REPRESENTATIVES OF OFFICE OF CAPITAL PROJECTS AND OFFICE OF NATURAL

RESOURCES, AGRICULTURE AND DECENTRALIZATION) PARTICIPATES REGULARLY WITH THE COUNCIL IN ITS DELIBERATIONS ON DEVELOPMENT PROJECTS AND WILL CONTINUE TO DO SO IN THE FUTURE. THE COUNCIL PROVIDES A FORUM WHEREIN PROJECTS IN THE GEN. SANTOS CITY AREA CAN BE CONSIDERED WITH REGARD TO POTENTIAL ECONOMIC AND ENVIRONMENTAL IMPACT. THE DENR/EMB REGIONAL DIRECTOR IS A BOARD MEMBER AND OVERSEE THAT MITIGATION MEASURES GIVEN FOR THE APC BE IMPLEMENTED.

THE BOARD IS WELL AWARE OF THE DRAFT EA AND ITS CONTENTS AND HAVE MADE THE EA CONTENTS AVAILABLE TO ANY POTENTIAL CLIENTS IN THE FISH PORT OR THE APC. SINCE THERE ARE NO DEFINITIVE INDUSTRIAL PLANTS PROPOSED FOR THE APC SITE, THERE CAN BE NO CONDITIONALITY OF THE ECC ISSUED TO A PROJECT SPECIFIC PROPONENT. THE ECC WILL CONTAIN AN ACTION PLAN FOR MONITORING.

G. IS THE MISSION PREPARING AN ENVIRONMENTAL ACTION PLAN ON THE APC SUBPROJECT, WITH OR WITHOUT THE FISH PORT, AS THE PROPOSED MITIGATIONS REQUIRE A DETAILED PLAN THAT CAN BE FOLLOWED BY THE CONTRACTOR? AS THE DECEMBER 11, 1991 MEMO FROM JIM TARRANT INDICATES, SPECIFIC DETAILING OF MITIGATION AND MONITORING FOR SOME ACTIVITIES WILL HAVE TO AWAIT THE DETAILED ENGINEERING DESIGN STAGE.

THE MISSION AGREES WITH JIM TARRANT. THE DENR/EMB IS PREPARING AN ENVIRONMENTAL ACTION PLAN. THE MECHANISM HAS BEEN SET IN PLACE FOR REVIEW, APPROVAL OF MITIGATIVE MEASURES, MONITORING AND LEGAL COMPLIANCE OF ENVIRONMENTAL REQUIREMENTS BY THE PROJECT BOARD. AS NO SUCH REQUIREMENT (I.E., THAT THE MISSION IS TO PREPARE AN ENVIRONMENTAL ACTION PLAN) IS NECESSARY ACCORDING TO USAID ENVIRONMENTAL PROCEDURES 22 CFR PART 216, WE FEEL DENR'S ACTION AND THE PROJECT BOARD'S DEMONSTRATED CONCERN OF WHICH DENR IS A MEMBER, MEETS THE REASONABLE CONCERNS OF MONITORING ENVIRONMENTAL IMPACT.

IT IS ANTICIPATED THAT DEVELOPMENT OF THE APC WILL BE UNDERTAKEN BY THE PRIVATE SECTOR IN THE SAME MANNER AS DEVELOPMENT OCCURS WITHIN AN INDUSTRIAL ESTATE. IT IS NOT ANTICIPATED THAT USAID WILL PROVIDE MAJOR ASSISTANCE WITH REGARD TO THE DEVELOPMENT OF THE PROCESSING FACILITIES. AS NOTED ABOVE, EACH OF THE PROCESSING FACILITIES WILL BE REQUIRED TO SEEK AND OBTAIN AN ECC PRIOR TO THE DEVELOPMENT OF FACILITIES. THIS WILL

ENTAIL THE PREPARATION OF MITIGATION PLANS FOR EACH OF THE UNDERTAKINGS AND THEIR APPROVAL BY DENR/EMB.

2. CONCLUSION: THE DRAFT EA IS COMPREHENSIVE IN ITS INVESTIGATION OF PHYSICAL, SOCIAL AND ECONOMIC IMPACTS AND DESCRIPTION OF CURRENT AND FUTURE CONDITIONS WITH AND WITHOUT THE PROPOSED FACILITIES AND THEIR ANCILLARY DEVELOPMENT (SURROUNDING SETTLEMENTS, INFRASTRUCTURE NEEDS). THE MISSION BELIEVES THAT THE EA ADDRESSES SATISFACTORILY, THE PRINCIPAL ENVIRONMENTAL ISSUES INVOLVED WITH THIS SUBPROJECT. THOSE ISSUES CAN BE GROUPED INTO FOUR CONCERNS: (1) THE ENVIRONMENTAL IMPACTS OF THE AGRO-PROCESSING FACILITY; (2) THE ENVIRONMENTAL IMPACTS OF THE FISH PORT; (3) COMMON ENVIRONMENTAL MANAGEMENT CONCERNS OF THE TWO FACILITIES, AND (4) CUMULATIVE IMPACTS OF DEVELOPMENT AROUND THE SITE.

AS STATED IN THE AGENCY ENVIRONMENTAL PROCEDURES 22 CFR PART 216.1, INTRODUCTION, (A) PURPOSE: "TO ENSURE THAT ENVIRONMENTAL FACTORS AND VALUES ARE INTEGRATED INTO THE A.I.D. DECISION MAKING PROCESS." THE ABOVE RESPONSE TO THE ASIA ENVIRONMENTAL COORDINATOR'S QUESTIONS AND THE DRAFT EA BY D&M MEET THE PURPOSE AND INTENT OF THE USAID ENVIRONMENTAL PROCEDURES. THESE EFFORTS INCLUDE NOT JUST THE APC/FISH PORT COMPLEX BUT ALSO THE ONGOING GLOBAL ENVIRONMENTAL CONCERNS BUILT INTO THE DEVELOPMENT OF THE MASTER PLAN AS WELL AS IN EACH MAJOR SUBPROJECT SUPPORTED BY USAID FUNDS.

3. AUTHORITY: UNDER SECTION CFR 216.3 (A)(6)(I) THE BUREAU ENVIRONMENTAL OFFICER IS AUTHORIZED TO CLEAR THE EA.

4. RECOMMENDATION: THAT THE BUREAU ENVIRONMENTAL OFFICER CLEAR THE EA FOR THE AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX, GENERAL SANTOS CITY, SOUTH COTABATO PROVINCE. WISNER##

Department of Environment and Natural Resources

Environmental Management Bureau

9104-004-052C
03 December 1991

DEPARTMENT OF AGRICULTURE/
DEPARTMENT OF PUBLIC WORKS
AND HIGHWAYS
Fort Area, Manila

Gentlemen:

This has reference to your proposed Agro-Processing Facilities and Fish Port Complex to be located in Barangay Tambler, General Santos City.

After evaluation of the documents submitted on the aforesaid project, this Office has decided to grant the same an Environmental Compliance Certificate (ECC)

You may proceed with project implementation after securing all the necessary permits from the pertinent government agencies. Please be advised, however, that this Office will be monitoring the project periodically to ensure your compliance with the stipulations cited in the attached Environmental Compliance Certificate (ECC). Further, any expansion of currently approved operations will be subject to the Environmental Impact Assessment (EIA) requirement.

Very truly yours,

DELFIN J. GANAPIN, JR.
OIC, Office of the Undersecretary
for Environment and Research

cc: Environment Sector
DENR - Region XI

/ESD/SET/CSS/cb*

CERTIFIED XEROX COPY OF ORIGINAL
DATE: 28 Jan. 1992

'92-02-18 08:28 632 8195909 TOTAL CONSULTANCY SERVICES INC. 001 P01

Department of Environment and Natural Resources

Environmental Management Bureau

ENVIRONMENTAL COMPLIANCE CERTIFICATE

The Environmental Management Bureau hereby grants this Environmental Compliance Certificate (ECC) to the proposed Agro-Processing Facilities and Fish Port Complex of DEPARTMENT OF AGRICULTURE/DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS to be located in Barangay Tambler, General Santos City, after complying with the Environmental Impact Assessment (EIA) requirement as prescribed in the promulgated guidelines implementing Section 3 (b) of P.D. 1121 and 1586.

This Certificate is being issued subject to the following conditions:

1. That this Certificate shall cover the construction of Agro-Processing Facilities (APF) and Fish Port Complex (FPC) in a thirty two (32) hectare lot at Barangay Tambler, General Santos City;

2. That the APF shall contain the facilities such as livestock complex and crop processing complex to process agricultural commodities and adequate wastewater treatment plant;

3. That the FPC shall contain the facilities described in the Department of Public Works and Highways' Master Plan, to wit:

   a) Refrigeration building consisting of 30 MT/day capacity ice plant, 10 MT ice storage, four (4) 270 kg capacity contact freezers, 240 square meter processing room; and 60 MT cold storage facility with NH_3 as refrigerant;

   b) Five thousand twenty five (5,025) square meters fish market with five thousand eight hundred (5,800) square meters parking area;

   c) Four hundred twenty (420) square meters administration building;

   d) Maintenance shop, fish gear mending shed, fish container storage, public toilet, guard house, dormitory and guest house;

   e) Reinforced concrete wharf consisting of a three hundred seventy five (375) meters long landing wharf with handling capacity of thirty eight thousand (38,000) metric ton fish; a two hundred eighty (280) meters long preparation wharf and a two hundred fifty three (253) meters long lay-by wharf;

   f) Armored rock breakwater with a design wave height of 1.14 meter from the SSE and frequency period of 3.4 seconds;

   g) Navigation aid consisting of light beacons at each end of the breakwater;

6th Floor, Philippine Heart Center Bldg., East Avenue, D[illegible]an, Quezon City, 3008 Metro Manila, Philippines
phone nos. 97-32-64, 97-56-98, 97-56-09 or 98-04-21 locals 2[illegible] [illegible]32, 2653 Cable: ENVIRON Manila, Telex 2507NEPC PU

4. That the fuel depot shall be provided with embankment and catch basin to prevent leaks and oil spillage;

5. That wastewater and washwater generated by the complex shall be sewered and treated prior to disposal into the sea;

6. That solid wastes generated by the complex and sludge from the Wastewater Treatment Plant (WTP) shall be collected and disposed of properly in the area approved by the city government;

7. That a water supply system shall be developed/provided utilizing the Siquel Spring to insure continuous water supply of the complex;

8. That mitigating measures for dust, noise and air emissions be effected from construction to project operation;

9. That mitigating measures to prevent siltation and erosion during construction and operation shall be effected at all times;

10. That effluent both from the WTPs of agro-processing and fishport complex shall conform with the standards set forth by EMB-DENR;

11. That the old growth mangrove in the project site shall be preserved and conserved;

12. That exposed areas resulted from construction shall be vegetated and covered immediately to prevent erosion and siltation. Terrestial habitats lost in the project site shall be rehabilitated;

13. That sewerage systems shall be provided to channel washwaters into the wastewater treatment plant;

14. That the plan for the relocation of 21 affected families duly approved and committed through a memorandum of agreement with the affected families and the project proponents shall be submitted within sixty (60) days from release of this ECC. Said relocation shall be undertaken prior to project implementation. Any damage to properties resulting from construction and operation shall be properly compensated;

15. That the shoreline area which will not be developed by the project shall be replaced with mangrove trees to provide new spawning and nursery grounds for marine organisms;

16. That medical clinic shall be established in the project site to ensure maintenance of health and sanitation of the area;

17. That an environmental monitoring unit shall be created to monitor and assess the impact and to ensure that mitigating measures are properly undertaken during the construction and operation of the project;

18. That permit from other Government agencies shall be secured prior to project implementation;

19. That on the spot monitoring and inspections can be initiated by the EMB-DENR Region XI anytime in coordination with concerned groups;

20. That transfer of ownership of this project carries the same conditions in this ECC for which written notification shall be made within fifteen (15) days from such transfer.

Non-compliance with any of the above stipulations will be sufficient cause for the suspension or cancellation of this Certificate and/or a fine in an amount not to exceed Fifty Thousand Pesos (P50,000.00) for every violation thereof, at the discretion of the Bureau (Section 9 of P.D. 1586).

Given this 3rd of December, Nineteen Hundred and Ninety One.

DELFIN J. GANAPIN, JR.
OIC, Office of the Undersecretary
for Environment and Research

/ESD/SET/CSS/ob*

REFERENCES

Aprieto, V.L. 1982. Philippine tuna fishery management. Fish. Res. J. Philippines, 7:38-50.

Barut, N. and F. Arce. 1990. The Philippine Tuna Fisheries: Industry & Research. Unpubl. report, Bureau Fisheries and Aquatic Resources, Quezon City.

Brayton, P., D. Roszak, S.A. Huq, L.M. Palmer, D.J. Grimes and R.R. Colwell. 1984. Public health significance of human pathogens in the ocean. Proc. Oceans '84, Marine Tech. Soc., pp. 263-267.

Brown, L., A. Durning, C. Flavin, H. French, J. Jacobsen, M. Lowe, S. Postel, M. Renner, L. Starke and J. Young. 1990. State of the World 1990. W.W. Norton & Co., New York.

Bureau of Labor and Employment Statistics. Current (November 1990) Labor Statistics. BLES, Manila.

Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. EPA 600/1-80-031, US Environmental Protection Agency, Cincinnati, OH.

Cabelli, V.J. 1989. Swimming-associated illness and recreational water quality criteria. Water Sci. Tech. 21:13-21.

Chou, L.M. 1988. Community structure of sediment-stressed reefs in Singapore. Galaxea 7:101-111.

El Sharkawi, F. 1986. The pollution of the beaches of Alexandria due to the discharge of sewage: A case study. Water Sci. Tech. 18:273-278.

Fattal, B., E. Peleg-Olevsky, Y. Yoshipe-Purer and H.I. Shuval. 1986. The association between morbidity among bathers and microbial quality of seawater. Water Sci. Tech. 18:56-69.

Floyd, J.M., and D. Pauly. 1984. Smaller size tuna around the Philippines - can fish aggregating devices be blamed? Info-Fish Marketing Digest 5/84:25-27.

Ganaden, R.A., and S.M. Ali, Jr. 1983. Observations on the handline fisheries of South Cotabato. Fish. Newsletter, 12:24-27.

General Santos City Planning and Development Office. Comprehensive Development Plan (1990-2000) of General Santos City.

_____. Socioeconomic Profile (1989) of General Santos City.

Gomez, E.D., A.C. Alcala and A.C. San Diego. 1990. Status of the Philippine coral reefs. Proc. 4th Intl. Coral Reef Symp., Manila 1:275-282.

Louis Berger International, Inc. 1991. Makar Wharf Draft Environmental Assessment. Prepared for USAID, Manila.

Lowe-McConnell, R.A. 1987. Ecological Studies in Tropical Fish Communities. Cambridge Univ. Press, London. 382 pp.

Marshall, N. 1982. Coral reef dynamics and coastal zone management. p 37-42 in: Man, land and sea: Coastal resource use and management in Asia and the Pacific. C. Soysa, C. Sien, and W. Colier (Eds.) Agricultural Development Council, Bangkok.

McAllister, D.E. 1988. Environmental, economic and social costs of coral reef destruction in the Philippines. Galaxea, 7:161-178.

Mearns, A.J. and C.S. Greene. 1976. Comparison of the benthos at several wastewater discharge sites. Pp. 211-216 In: Coastal Water Research Project Annual Report 1976. Southern California Coastal Water Research Project, El Segundo, CA.

Muellenhoff, W.P., A.M. Soldate, Jr., D.J. Baumgartner, M.D. Schuldt, L.R. Davis, and W.E. Frick. 1985. Initial Mixing Characteristics of Municipal Ocean Discharges. Report EPA-600/3-85-037a. USEPA Office of Research and Development, Newport, OR. 90 pp.

Myers, N.M.A. 1988. Environmental degradation and some economic consequences in the Philippines. Environmental Conservation, 15:205-214.

National Census and Statistics Office (1985).

NAMRIA. 1990. Tide and Current Tables, 1991. Coast and Geodetic Surveys Department, National Mapping and Resource Information Authority, Department of Environment and Natural Resources. Manila, Philippines.

National Statistical Coordination Board. (data for 1986, cited in Singconsult report)

National Economic Development Authority. Updated Regional Development Plan of Southern Mindanao (1990-1992). Regional Development Council/NEDA XI, Davao City.

Pacific Consultants International. 1990. Master Plan Report for the Nationwide Fishing Port Development Project (Fishing Port Package II). Unpubl. report prepared jointly by Pacific Consultants International and Basic Technology and Management Corporation for the Department of Public Works and Highways, Republic of the Philippines. May 1990.

Payment, P. 1989. Virus removal by drinking water treatment processes. Critical Reviews in Environmental Control 19:15-31.

Primavera, J.H. 1991. Intensive prawn farming in the Philippines: ecological, social and economic implications. Ambio 20:28-33.

Reimers, R.S., D.B. McDonell, M.D. Little, D.D. Bowman and A.J. Englande. 1986. Effectiveness of wastewater sludge treatment process to inactivate parasites. Water Sci. Tech. 18:397-404.

Rose, J.B. 1986. Microbial aspects of wastewater reuse for irrigation. Critical Reviews in Environmental Control 16:231.

Salas, H.I. 1986. History and application of microbiological water quality standards in the marine environment. Water Sci. Tech. 18:47-57.

Salvat, B. 1987. Dredging in coral reefs. p. 165-184 in: Human impacts on coral reefs - facts and recommendations. B. Salvat (Ed.). Antenne Museum E.P.H.E., French Polynesia.

Sano, M., M. Shimizu and Y. Nose. 1984. Changes in structure of coral reef fish communities by destruction of hermatypic corals: Observational and experimental views. Pacific Sci. 38:51-79.

Seng, L.T., et al. 1987. Effects of a crude oil terminal on tropical benthic communities in Brunei. Mar. Poll. Bull., 18(1):31-35.

Shuval, H.I., A. Adin, B. Fattal, E. Rawitz and P. Yekutiel. 1986. Wastewater Irrigation in Developing Countries: Health Effects and Technical Solutions. World Bank Tech. Paper No. 51.

Siew-Moi, P. 1988. The effect of siltation on algal biomass production at a fringing coral reef flat, Port Dickson, Peninsular Malaysia. Wallaceana 51:3-5.

Silvestre, G.T. 1989. Philippine marine capture fisheries - Exploitation, potential and options for sustainable development. FSA/CRSP/WPS/XII:87 p.

Singconsult. 1990. General Santos Agricultural Processing Center Feasibility Study. Volumes 1-7. Unpubl. report for Department of Agriculture, Republic of the Philippines.

Snedaker, S., and C. Getter. 1984. Tropical coastal resources management: A guidebook for coastal resources conservation and development. (draft manuscript).

Tilmant, J.T. 1987. Impacts of recreational activities on coral reefs. Pp. 195-2114 in: Human impacts on coral reefs - facts and recommendations. B. Salvat (Ed.). Antenne Museum E.P.H.E., French Polynesia.

Total Consultancy Services, Inc. 1991. Environmental Impact Assessment, General Santos City Fishing Port. Unpubl. (draft) report to Project Management Office, Fishing Ports Project Package II, Department of Public Works and Highways.

USAID. 1990. Philippine Assistance Strategy: US Fiscal Years 1991-1995. USAID/Philippines. 86 pp.

USEPA. 1986. Ambient Water Quality Criteria for Bacteria - 1986. EPA 440/5-84-002, Office of Water Regulations and Standards, US Environmental Protection Agency, Washington, DC.

White, A.T. 1987. Effects of construction activity on coral reef and lagoon systems. Pp. 185-194 in: Human impacts on coral reefs - facts and recommendations. B. Salvat (Ed.). Antenne Museum E.P.H.E., French Polynesia.

Word, J.Q., A.J. Mearns and B.L. Myers. 1977. Animals that are indicators of marine pollution. Pp. 199-206 In: Coastal Water Research Project Annual Report 1977. Southern California Coastal Water Research Project, El Segundo, CA.

World Bank. 1989. Philippines Environment and Natural Resource Management Study. World Bank Country Study. World Bank, Washington, D.C., U.S.A.

World Health Organization. 1989. Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture. Tech. Rept. Ser. 778. World Health Organization, Geneva, Switzerland.

Yap, H.T., and E.D. Gomez. 1985. Coral Reef Degradation and Pollution in the East Asian Seas Region. Pp. 185-207 in: UNEP Regional Seas Reports and Studies No. 69. UNEP, Nairobi, Kenya.

Yap, H.T., R.M. de la Paz, and L.T. McManus. 1988. Oil Pollution and Its Control in the East Asian Seas Region. UNEP Regional Seas Reports and Studies No. 96. UNEP, Nairobi, Kenya.

LIST OF PERSONS CONTACTED

Abiera, Mrs. Dean, College of Fisheries, Mindanao State University, General Santos City. Meeting, 15 February 1991.

Acharon, Jacinto. President, Association of Barangay Captains, General Santos City. Meeting, 24 January 1991.

Alabanza, Dorcas. National Housing Authority, General Santos City. Meeting, 24 January 1991.

Albotra, Del. Lingkod Tao-Kalikasan, Manila. Meeting, 5 February 1991.

Andres, Norberto P. Mindanao State University, General Santos City. Meeting, 24 January 1991.

Angeles, Vicente. Mulmac Industrial Construction Corp., Manila. Meeting, 10 April 1991.

Antonino, Adelbert. Congressman, Province of South Cotabato, General Santos City. Meeting, 16 February 1991.

Astique, Aurelio B. Dept. of Agriculture, General Santos City.

Ati, Macabangkit. Mindanao State University, Narawu, Meeting, 24 January 1991.

Bona, Carmelo. Philippines Port Authority, General Santos City. Meeting, 24 January 1991.

Cabanlit, Jr., Epimaco. Mindanao State University, General Santos City. Meeting, 24 January 1991.

Calik, Manuel M. Coast and Geodetic Survey Dept., DENR, Manila. Meeting, 5 February 1991.

Chiew, Azela. Bishop's Businessmen Conference, General Santos City. Meeting, 24 January 1991.

Cruspero, Nael. Civil Engineering Dept., Mindanao State University, General Santos City. Meeting, 24 January 1991.

Cruz, Merly. Provincial Director, Dept. of Trade and Industry, General Santos City. Meeting, 24 January 1991.

Daniel, Jick. City Councilor, Office of the Vice Mayor, General Santos City. Meeting, 24 January 1991.

Depra, Jr., Eliseo. Dept. of Agriculture/Fisheries, General Santos City. Meeting, 24 January 1991.

Encarnacion, Eric. Dept Public Works and Highways, Manila. Meeting, 18 February 1991.

Estrada, Gregorio T. DENR Region XI, Davao City. Meeting, 5 February 1991.

Eturma, Zenaida G. CEMO, General Santos City. Meeting, 24 January 1991.

Falgui III, Tomas. City Councilor, General Santos City. Meeting, 24 January 1991.

Gacal, Jing. City Councilor, General Santos City. Meeting, 24 January 1991.

Garrucho, T. South Cotabato Foundation, Inc., Marbel, South Cotabato. Meeting, 25 February 1991.

Gellangarin, Arn. Water District, General Santos City. Meeting, 24 January 1991.

Gesmundo, Marcia. Chief, Energy Supply Development Divison, Office of Energy Affairs, Government of the Philippines, Manila, Philippines. Meeting, 3 April 1991; Memorandum to H. Van Veldhuizen, Dames & Moore, 11 April 1991.

Grana, Antonio. Dept. of Interior and Local Governments, General Santos City. Meeting, 24 January 1991.

Granfon, Carmen. President, Umbrella Small-Scale Fishermens Association, General Santos City. Meeting, 19 February 1991.

Guioguio, Patricia. PHS, General Santos City. Meeting, 24 January 1991.

Jimenez, Ernesto. Philippine Fisheries Development Authority, General Santos City. Meeting, 24 January 1991.

Juanday, William. City Councilor, General Santos City. Meeting, 24 January 1991.

Lacay, Ampy. City Ecological Council, General Santos City. Meeting, 24 January 1991.

Lagare, Cesar. General Santos City. Meeting, 24 January 1991.

Lagare, D.A. City Councilor, General Santos City. Meeting, 24 January 1991.

Lagare, Emely. Bishop's Businessmen Conference, General Santos City. Meeting, 24 January 1991.

Leonor, Charlie. Dole Philippines, Polomolok. Meeting, 22 February 1991.

Llido, Mark. General Santos City. Meeting, 24 January 1991.

Llido, Rodolfo. City Councilor, General Santos City. Meeting, 24 January 1991.

Mabanglo, Romeo. San Miguel Corporation, General Santos City. Meeting, 24 January 1991.

Mariano, Mario. City Councilor, General Santos City. Meeting, 24 January 1991.

Mascardo, Jun. General Santos City Ecological Council, General Santos City. Meeting, 24 January 1991.

McLachlan, Roderick. General Manager, Seafood Division, Dole Philippines, General Santos City. Meeting, 19 February 1991.

Natividad III, Jose. City Councilor, General Santos City. Meeting, 24 January 1991.

Nuñez, Rosalita T. Mayor, General Santos City. Meeting, 24 January 1991.

Ordonez, Jose A. Dept. of Agriculture, Bureau of Fisheries and Aquatic Resources, Manila. Meeting, 10 February 1991.

Pascua, Manuel. Dean, Department of Civil Engineering, Mindanao State University, General Santos City. Meeting, 24 January 991.

Pico, Evangeline Q. Philippine Fisheries Development Authority, General Santos City. Meeting, 24 January 1991.

Posadas, Alice. City Councilor, General Santos City. Meeting, 24 January 1991.

Razavi, H. World Bank, Washington, DC. Telephone conv., 23 April 1991.

Reyna, Salvador. Philippines Port Authority, General Santos City. Meeting, 24 January 1991.

Rogan, Nards. DXRE, General Santos City. Meeting, 24 January 1991.

Sales, Jr., Manuel. Planning Dept., General Santos City.

Tama, Lasid S. City Councilor, General Santos City. Meeting, 24 January 1991.

LIST OF PREPARERS

Harvey Van Veldhuizen, Ph.D.	Project Manager, Marine Ecology, Water Quality
Lee Fausak	Oceanography, Water Quality
Geoff Waite	Land Use, Public Services
Willy Palarca	Socioeconomics, Land Use
Naniel Aragones	Marine Ecology, Aquatic Ecology
Artemio Bernardino	Water Quality, Air Quality, Energy
Ely A.R. Ouano	Water Quality
Roger Wellner	Water Quality, Waste Treatment
Virgilio Cabanting	Geology, Soils, Groundwater
Emiliano Sotalbo	Vegetation
Julito Baldisimo	Terrestrial Ecology
Marianne Strange	Oceanography
Philippine National Museum	Archaeology

APPENDIX A

REPORT ON SCOPING MEETINGS

SCOPING REPORT

ENVIRONMENTAL ASSESSMENT OF THE AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX IN GENERAL SANTOS CITY

Department of Environment and Natural Resources
US Agency for International Development

INTRODUCTION

The US Agency for International Development in Manila (USAID/Manila) is proposing to fund the construction of an Agricultural Processing and Fish Port Complex in Barangay Tambler of General Santos City, South Cotabato as part of its commitment under the Multi-Lateral Assistance Initiative (Philippine Aid Plan). The proposed project is intended to promote economic development in southern Mindanao Island, the Philippines.

The proposed agro-processing facilities include a wide range of operations to process agricultural commodities from the region. The fish port facilities will include a tuna processing center to serve the export market for sashimi. The proposed project is designed to stimulate and diversify economic opportunities in the region, therefore, it is expected to benefit the human environment. However, construction and operation of the facilities may modify other aspects of the environment, with potential adverse effects. Thus, the environmental effects of the Agro-Processing Facilities and Fish Port Complex need to be examined through an Environmental Assessment (EA).

An Environmental Assessment (EA) is a procedural requirement of USAID on all projects it funds that have potentially significant impacts on the environment. This assessment will address the wide range of environmental issues associated with the construction and operation of the Agro-Processing Facilities and Fish Port Complex.

The EA is just one element of a multi-faceted project appraisal process. Other important elements include technical soundness analysis, economic and financial analysis, and social soundness analysis. Through the EA, information regarding the proposed project, the existing environment, environmental impacts of the project, alternatives and mitigative measures, and environmental monitoring requirements will be provided. This

information will be used by decision-makers regarding the course of action of USAID with respect to project design and implementation.

As part of preparation of the EA, scoping meetings were held in General Santos City on 24 January 1991 and in Manila (Quezon City) on 5 February 1991. The purpose of the scoping meetings was to bring together all parties with an interest in the proposed Agro-Processing Facilities and Fish Port Complex to assist in identifying environmental issues that should be addressed by the EA. Participants were invited to voice their concerns, questions, and comments regarding environmental aspects of the proposed project. Participants were further invited to submit comments in writing to the Mayor's office in General Santos City or to the office of Dames & Moore in Makati, Metro Manila.

This scoping report summarizes oral and written comments received for the Agro-Processing Facilities and Fish Port Complex. A list of attenders at the scoping meetings in General Santos City and Manila is attached.

PROJECT DESCRIPTION

Site Location

The project site is 32 hectares located in barangay Tambler in south General Santos City on the shores of Sarangani Bay. The site, located approximately 7 km south of the built-up urban area of General Santos City, offers a water frontage of approximately 1 km. The site was selected by the Department of Agriculture for development of agro-processing and fish processing facilities. The land rises gradually from sea level to a general elevation of 13 m at the west boundary of the property.

Proposed Facilities

Four main groups of facilities have been proposed in a Feasibility Study prepared by Singconsult for the Department of Agriculture. The proposed facilities include the following:

1) Fish Port Complex
   - Fish landing sites for sashimi, wet fish, and purse seiners
   - auction and market halls
   - ice plants and cold storage
   - support facilities for provisions, refueling, and equipment repair

226

2) Livestock Complex
   - o two abattoirs
   - o meat processing plant
   - o bone meal plant
   - o feed mill

3) Crops Processing
   - o corn oil plant
   - o fruit and vegetable processing plant

4) Support Infrastructure
   - o wastewater treatment plant
   - o roads
   - o power supply
   - o administrative facilities.

The Feasibility Study by Singconsult recommends that the livestock complex, with the exception of the feed mill, be located off-site, perhaps directly across the road (west) of the 32-hectare site. It was also recommended that the livestock complex should have its own wastewater treatment plant.

ENVIRONMENTAL CONSIDERATIONS

As part of the scoping process, Dames & Moore, the contractor for preparation of the EA, conducted preliminary site surveys. Based on a review of the Singconsult Feasibility Study and observations made during preliminary site surveys, potential environmental issues that may need to be addressed by the EA include:

- o change in land use and topography;
- o destruction or modification of coral reef habitat;
- o loss of mangrove and other vegetated areas;
- o increased risk of fuel spills;
- o wastewater discharge with high biochemical oxygen demand, oil and grease, and high temperature;
- o impacts on water supply and groundwater quality;
- o loss of freshwater fauna in springs on the site; and
- o air emissions (odor, hexane, construction and power equipment).

227

COMMENTS RECEIVED

General Santos City Scoping Meeting

A scoping meeting was held in General Santos City on 24 January 1991 at 0900 in the Sessions Hall at City Hall. Approximately 30-40 people from the local community and local agency representatives attended. After welcoming remarks by Mayor Nunez and a brief description of the proposed project by Dames & Moore, comments were provided by the meeting attenders.

The issue of most concern at the scoping meeting was the proposed plan for the Fish Port Complex. Meeting attenders expressed concern that the plan proposed by Singconsult was developed with significant input and discussion by local officials and fishermen prior to preparation of the preliminary plan, whereas an alternative plan under consideration by the Philippine Fisheries Development Authority did not include consultation with local interests until after a preliminary proposal had been prepared. As a result, there was much concern regarding the final design of the Fish Port Complex.

Other issues discussed at the scoping meeting were as follows:

- Ecological balance: Several individuals expressed concern about the ecological balance of the region, particularly in reference to forest denudation and the subsequent impacts of erosion and siltation on regional fisheries. Attenders encouraged the EA to address environmental conditions and problems at the regional level and not just specific to the project site and its immediate vicinity.

- Oil spills: A few individuals noted that oil spills would be an important problem at the fish port, and customary practices of cleaning boats at fish landing sites causes waste dumping and water pollution problems.

- Wastewater treatment: It was suggested that the EA note that all industries operating at the facilities should be obligated to minimize waste output and be required to use wastewater treatment and waste management facilities at the site.

- Water quality: Concern was expressed for the quality of wastewater effluent, dispersion and dilution of the effluent, and its effect on seawater intakes of nearby shrimp farms.

228

- Water supply: Concern was expressed that groundwater withdrawal could lead to subsidence in the area. It was noted that fish ponds and other industries in the area are using groundwater supplies. The Siguel River, located a few kilometers south, was recommended as an alternative source of water, with added benefits potentially accruing with respect to power generation and irrigation. It was also noted that earlier work on the quality of water from springs on the site indicated that one of the streams was reported to have unacceptable levels of bacteria. It was recommended that additional water quality analyses be conducted of groundwater and spring water on the site.

- Air quality: It was noted that odors from the feed mill could have adverse effects on worker health, including workers at nearby locations.

- Housing: Several comments were raised regarding housing at the site and near the site, and the tendency for informal housing to arise near the site as a result of people offering services to workers and to farmers and fishermen who are selling their harvests to be processed at the site. Concern was also expressed regarding the provision of housing for poor fishermen.

- Mitigation: It was recommended that an educational program be put in place and implemented to inform transient fishermen and other transient users of the facility regarding proper waste management and environmental protection measures.

- Monitoring: A few comments were raised regarding commitment of USAID to the project after construction, particularly with reference to environmental monitoring and management.

These comments and concerns will be considered and addressed in the EA. Although the EA will address environmental impacts in the context of overall environmental conditions in the region, it is not expected that the EA can address issues such as regional deforestation or restoration of fishery resources of Sarangani Bay in detail.

Manila Scoping Meeting

A scoping meeting was held in Quezon City (Metro Manila) on 5 February 1991 at 0930 in the Sulo Hotel. Six people from the local community and local agency representatives attended. After welcoming remarks by USAID and a brief description of the

229

proposed project by Dames & Moore, comments were provided by the meeting attenders.

The issue of most concern at the scoping meeting was the economic feasibility of the project, particularly with reference to tuna processing. It was noted that three existing tuna canneries in the General Santos City area currently are closed or are not operating at capacity. Along these same lines, it was noted that strong evidence indicates that the tuna resource in the region is severely over-exploited and cannot support the existing fishery. Development of the tuna processing facility would encourage additional exploitation of the resource or result in an economically unsound project.

Other issues raised at the scoping meeting included:

- Groundwater supply and quality: Questions arose regarding the Singconsult report on groundwater quality, water supply demands, and availability and quality of both groundwater and surface water supplies. It was recommended that the EA examine these issues.

- Housing: It was noted that squatters already occupied the proposed site, and that more could be expected before the project is finally constructed. These people are likely to have expectations regarding housing, jobs, or compensation for relocation. It was also noted that provision of housing in the vicinity of the project site would have an adverse effect on the environment if water supply and waste management are not adequately addressed.

- Worker health and safety: Hexane is highly flammable and explosive, and use of hexane in corn oil processing can be dangerous if not handled properly. It was recommended that the EA address methods to ensure that private sector processors on the site are managing their facilities in accordance with environmentally sound and safe practices.

- Cumulative effects: A request was made that the EA examine cumulative effects of this and other major development projects in the area.

These comments and concerns will be considered and addressed in the EA.

Written Comments

Three written comments, two letters and one memorandum, were received as of the date of submittal of this scoping report.

230

These are attached. One written comment that had not previously been raised at the scoping meetings was a concern expressed in two letters about the apparent lack of solid waste management facilities. The memorandum, attached as a translation from the original in German, summarizes the views of a marketing specialist with extensive commodities market development experience in the Philippines regarding potential strengths and weaknesses of the various commodity markets considered in the Singconsult Feasibility Study.

These comments and concerns will be considered and addressed in the EA.

Summary

Judging from comments received in the scoping meetings and preliminary survey work conducted by the EA team, the following appear to be priority issues for impact assessment:

- Socioeconomic impact of the project: There are questions regarding the economic viability of some components of the project, particularly tuna canning. Construction of facilities that are not economically viable has an adverse impact on the local community in that resources are allocated inefficiently and expectations are not met. Housing opportunities for fishermen who use the fish port, employees, and entrepreneurs seeking to provide services may be limiting, resulting in potential growth of informal housing and concomitant degradation of environmental quality because of a lack of services.

- Wastewater discharge: Dispersion and dilution of effluents and their impact on marine resources and adjacent industries are of concern.

- Groundwater supply and quality: Availability and quality of groundwater and surface water supplies are identified as issues that have not been adequately addressed in the feasibility studies.

- Modification of marine and aquatic habitat: Primary issues of concern from a biological standpoint include destruction or modification of coral reef habitat, mangrove habitat, and freshwater habitat provided by springs on the site.

- Solid waste management: An adequate solid waste management plan is needed to protect adverse impact on aesthetics, public health and safety, and groundwater and surface water quality.

WORK PLAN

A tentative outline for the EA is attached. The issues of primary concern will be addressed in appropriate detail in the EA. The EA will build on an EA prepared by Singconsult for the Feasibility Study. The latter will be a useful source of information in describing impacts within the regional context (South Cotabato, North Cotabato, Sultan Kuderat, and Maguindanao Provinces). However, the Singconsult EA includes only minimal site-specific information in certain areas, with the most detail in geotechnical and social sciences.

Alternatives

Alternatives that will be evaluated include:

- the site plan developed by Singconsult after extensive consultation with local fishermen and officials,
- the Singconsult site plan without the docking facilities for tuna purse seiners and the tuna cannery,
- the fish port complex site plan as proposed by Philippines Fisheries Development Authority, and
- the no-action alternative.

The site plan developed by Singconsult will be evaluated in detail in the EA as the proposed alternative.

Field Studies

Dispersion and dilution of wastewater effluent discharged to Sarangani Bay will be evaluated with data collected by mooring current meters for one lunar tidal cycle (1 month) in the nearshore zone of the project site at a depth of approximately 45 ft. Profiling current meters and profiling CTD meters will also be deployed to generate information on water column characteristics and changes in current patterns with depth. The resulting data will be used to model dilution and dispersion of the effluent, evaluate its conformance to standards established by DENR, and its potential impact on seawater intakes operated by nearby shrimp farms. The Singconsult EA lacks basic information on currents and water column in the nearshore zone.

Biological surveys will be conducted of the nearshore coral reefs and the freshwater springs on the site. Terrestrial ecologists will conduct detailed site evaluations of the 32-hectare site, including the mangrove habitats. The terrestrial ecologists will also conduct a preliminary site survey of the

232

property on the west side of the highway as a candidate site for the off-site livestock processing facilities. These marine and terrestrial biological surveys will be designed to characterize the character and quality of the habitat and determine whether rare or uncommon species are found in the project area. The Singconsult EA lacks site-specific information on biological resources.

Social scientists will examine neighboring land uses, relocation and in-migration, community social structure, economic activity and development objectives, and housing requirements. The project will also be evaluated in relation to overall development strategy and regional land use plans for General Santos City and its environs.

Evaluation of groundwater supplies will be based primarily on the use of data from existing sources, including preliminary studies conducted by Singconsult. Preliminary review of these data indicate they are adequate for evaluation of potential impacts of the project, but probably not adequate for detailed design and construction of infrastructure and facilities. Evaluation of potential sources of surface water supply will include discussions with local officials and brief site visits to potential water sources suggested by local officials. Water quality data will be collected from the springs on the site, at least one existing well on the site, and from the Siguel River as a preliminary indicator of treatment requirements.

Because there are springs on the site that flow even during periods when nearby rivers are generally dry, fishermen regularly stop at the site to obtain potable water supplies. This practice may date back many generations, and it is possible that the area could have been occupied or used as a water source into antiquity. Therefore, archaeologists will conduct a preliminary site survey to determine the probability of archaeological resources on the site.

Schedule of Performance

Following is a proposed schedule of deliverables and other milestones in the EA.

Scoping Report	8 February 1991
Field Work Completed	15 March 1991
Draft EA Submitted	30 April 1991
USAID Review Completed	31 May 1991
Final EA Submitted	21 June 1991

SCOPING MEETING
GENERAL SANTOS AGRO-PROCESSING COMPLEX
LIST OF ATTENDERS

General Santos City
24 January 1991

NAME	AFFILIATION
Rosalita T. Nunez	Mayor, General Santos City
Carmelo Bona	Phil. Port Authority
Salvador Reyna	Phil. Port Authority
Zenaida G. Eturma	CEMO
Eng. Nael Cruspero	Civil Engineering Dept., Mindanao State University - General Santos City (MSU - GSC)
Mario Mariano	City Councilor
Ampy Lacay	DXGS (City Ecological Council)
Dorcas Alavanza	National Housing Authority
D.A. Lagare	City Councilor
Aurelio B. Astique	Dept. of Agriculture
Antonio Grana	Dept. of Interior and Local Governments
Eliseo Depra, Jr.	Dept. of Agriculture/Fisheries
Manuel Sales, Jr.	Planning Dept., General Santos City
Emely Lagare	Bishop's Businessmen Conference (NGO)
Romeo Mabanglo	San Miguel Corporation
Jun Mascardo	General Santos City Ecological Council
Merly Cruz	Provincial Director, Dept. of Trade and Industry
Alice Posadas	City Councilor
Azela Chiew	Environmental Activist (BBC)
Eng. Manuel Pascua	Dean, MSU - GSC
Patricia Guioguio	PHS
Tomas Falgui III	City Councilor
Jose Natividad III	City Councilor
Arn Gellangarin	Water District, General Santos City
Jick Daniel	City Councilor, Office of the Vice Mayor
Rodolfo Llido	City Councilor
Jacinto Acharon	President, Association of Barangay Captains
William Juanday	City Councilor
Evangeline Q. Pico	Phil. Fisheries Development Authority
Ernesto Jimenez	Phil. Fisheries Development Authority
Jing Gacal	City Councilor
Epimaco Cabanlit, Jr.	MSU-GSC
Macabangkit Ati	MSU-Marawi City
Norberto P. Andres	MSU-GSC
Cesar Lagare	
Mark Llido	Gen. Santos
Lasid S. Tama	City Councilor
Nards Rogan	DXRE

234

SCOPING MEETING
GENERAL SANTOS AGRO-PROCESSING COMPLEX
LIST OF ATTENDERS

Manila
5 February 1991

NAME	AFFILIATION
Gregorio T. Estrada	DENR Region XI, Davao City
Jose A. Ordonez	Dept. of Agriculture, Bureau of Fisheries and Aquatic Resources
Del Albotra	Lingkod Tao-Kalikasan (NGO)
Manuel M. Calik	Coast and Geodetic Survey Dept., DENR
Michael I. Kingery	US Agency for International Development (USAID)
Kevin Rushing	USAID

235

APPENDIX B

OCEANOGRAPHIC DATA REPORT

APPENDIX B

OCEANOGRAPHIC FIELD STUDIES DATA REPORT

This appendix provides a description of the measurement methodology, and reduced and plotted data for coastal currents and water column parameters near the proposed site for the General Santos City Agro-Processing Center (GSAPC) and associated fisheries port planned for barangay Tambler.

DATA COLLECTION METHODS AND EQUIPMENT

The oceanographic data described here were collected between 19 January and 23 February 1991. The total data set comprises: 1) approximately four weeks of current measurements at two nearshore stations, 2) 18 vertical current profiles, and 3) 19 vertical profiles of seawater temperature and conductivity (from which were derived salinity and density) and dissolved oxygen concentration.

Water currents were measured with electromagnetic current meters (InterOcean models S4); these solid-state, programmable meters have low measurement thresholds and no moving parts to foul or corrode. Data are recorded internally in solid-state memory, and are periodically downloaded to a micro-computer for conversion to engineering units and for analysis. These meters have a speed range of 0-350 cm/sec, and and an accuracy of 2% of the reading ± 1 cm/sec; direction accuracy is ± 2° magnetic. All of the meters were factory calibrated prior to this deployment. Two of the three meters used were deployed on taut moorings and collected data as a function of time; the meters were programmed to take measurements every 0.5 sec, average 120 of these readings, and record the resultant value every 5 minutes. The third meter was used from a survey boat for over-the-side profiling.

Water column characteristics were measured with an STD (salinity-temperature-depth meter), to which was added a galvanic-cell dissolved oxygen probe; the instrument (an Applied Microsystems, Ltd model STD-12) with all sensors was calibrated by the manufacturer immediately prior to this field effort. In addition, the dissolved oxygen sensor was calibrated daily using standard air calibration techniques. As with the current meters, data is recorded internally on solid-state memory, and downloaded to a micro-computer for subsequent conversion and processing. System accuracies of the STD-12 are as follows:

237

Salinity	calculated from measured conductivity and temperature with system accuracy of ± 0.01 psu.
Temperature	measured by a precision thermistor with an accuracy of 0.01 C°.
Depth	calculated from measured pressure with an accuracy of 10 cm.
Density	calculated from measured temperature and salinity with an accuracy of ± 0.01 sigma-t units.
Oxygen	galvanic cell with accuracy 0.75 mg/l.

The locations of the measurement stations are shown on Figure B-1. Moored current meters were located on the submerged coral promontories at the deepwater cove near the center of the GSAPC (designated North station), and in the deepwater cove at the southern property boundary (designated South station). The current meter moorings were located on the reef slope in 18 m of water; the meters were suspended on taut moored lines at 14 m water depth, approximately 4 m above the sea floor. Midway through the current metering program, both North and South stations were relocated from their initial positions deep in the coves to more exposed locations on the eastern tips of the promontories.

Current and STD-DO profiles were measured primarily at three stations: a North station located off the mouth of the Banwalan River (immediately north of the project site), a Middle station located offshorfe of the deepwater embayment near the center of the project site, and a South station located ofshore of the south property boundary. Note that the North and South stations for the moored current monitoring and the vertical profiling are not coincident. These profiling stations were located in 80 to 100 m of water; most profiles did not reach the seafloor, but were limited to about 70 m by sensor ranges on the current meters and STD. STD profile 19 is an exception to that pattern; it was taken (without the oxygen sensor) in deeper water approximately 1.5 km offshore of the GSAPC site.

RESULTS

Current flows are presented as a function of time (from the moored stations) and a function of depth (vertical profiles). The moored station data is identified by the file name (each with an S4B filename extension); these are SOUTH2, SOUTH3, SOUTH4, SOUTH5, and SOUTH6 for the southern station, and NORTH1, NORTH2, and NORTH3A for the northern station. (Usable data were not recovered from deployment SOUTH1.) Both north and south moored stations were relocated on February 13 from their initial deployment sites on the south sides of the coral promontories to more exposed sites near the seawardmost tips of the promontories. Thus, data sets SOUTH2 and SOUTH3, and NORTH1 and NORTH2, were

230

collected at the original sites, while subsequent data sets were collected at the relocated sites. Moored current meter data are shown in Figures B-2 to B-17 as polar histograms (with eavh measurement plotted as a vector quantity) and as 24-hour time-series plots with speed an direction plotted against time.

Vertical current profiles are shown in Figures B-18 to B-23. No usable profile data was recovered from casts one through six, and cast ten. The current profiles were taken at the time time as the STD profiles, and their identifier numbers correspond.

Plotted STD-DO profiles are shown on Figures B-24 to B-41 for profiles 1 through 19, with the exception of profile 9 which was omitted because of battery failure in the instrument. Each is identified along the left margin by a profile number, station location, and date.

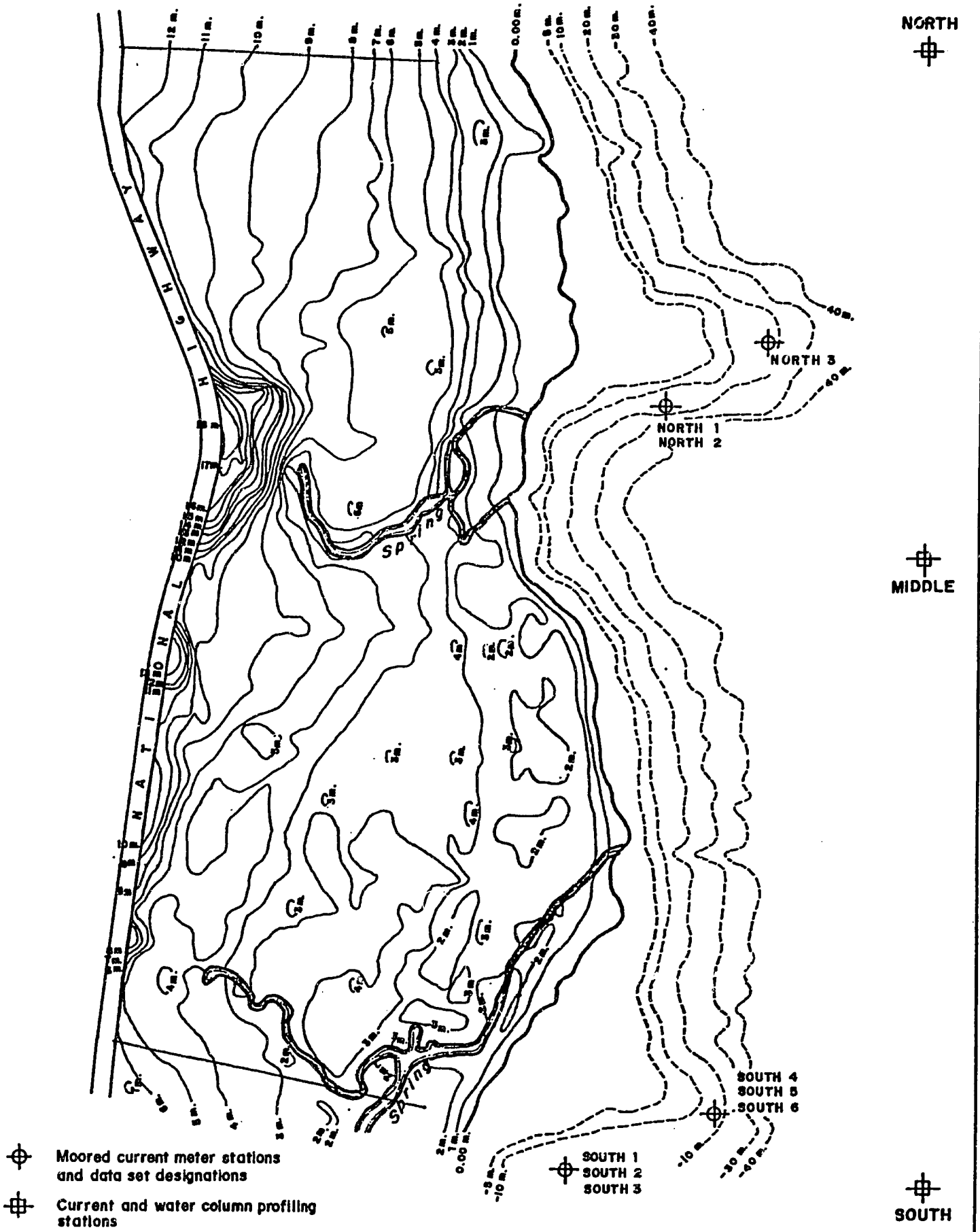


Figure B-1 LOCATIONS OF CURRENT METER AND WATER COLUMN PROFILING STATIONS, JANUARY-FEBRUARY 1991

Dames & Moore

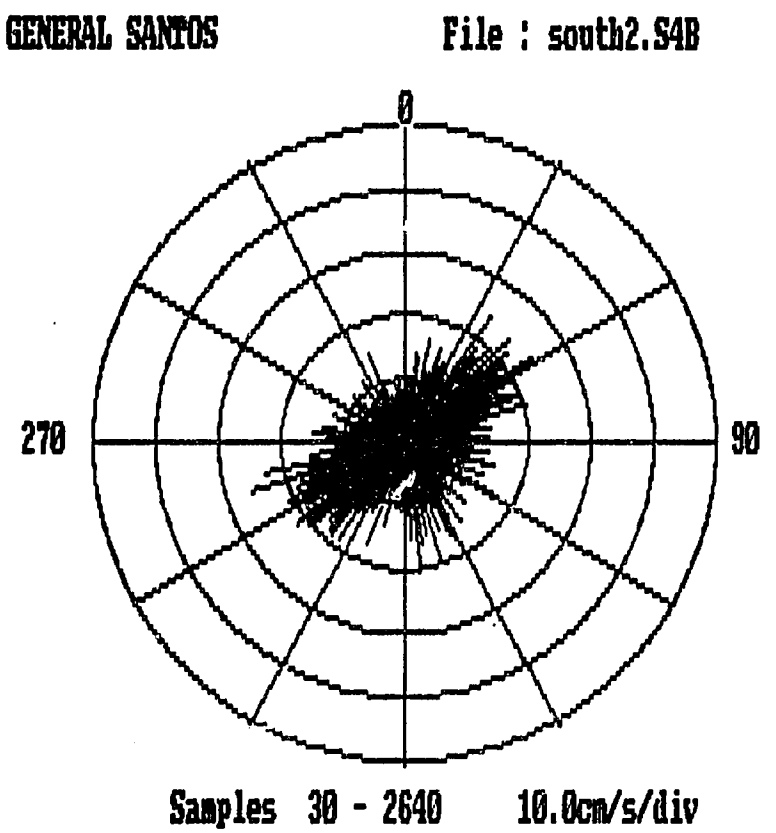
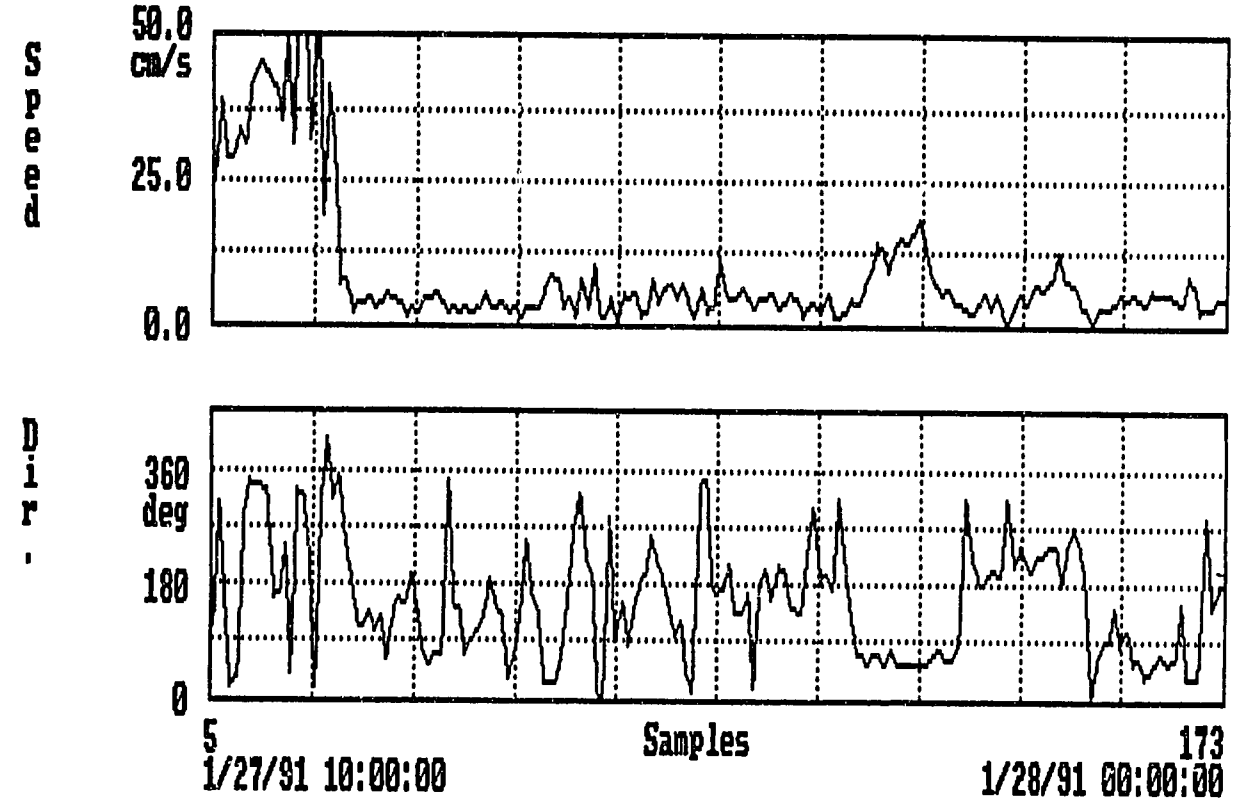


Figure B - 2. Polar histogram of current speed and direction data set SOUTH 2 27 January - 5 February 1991.



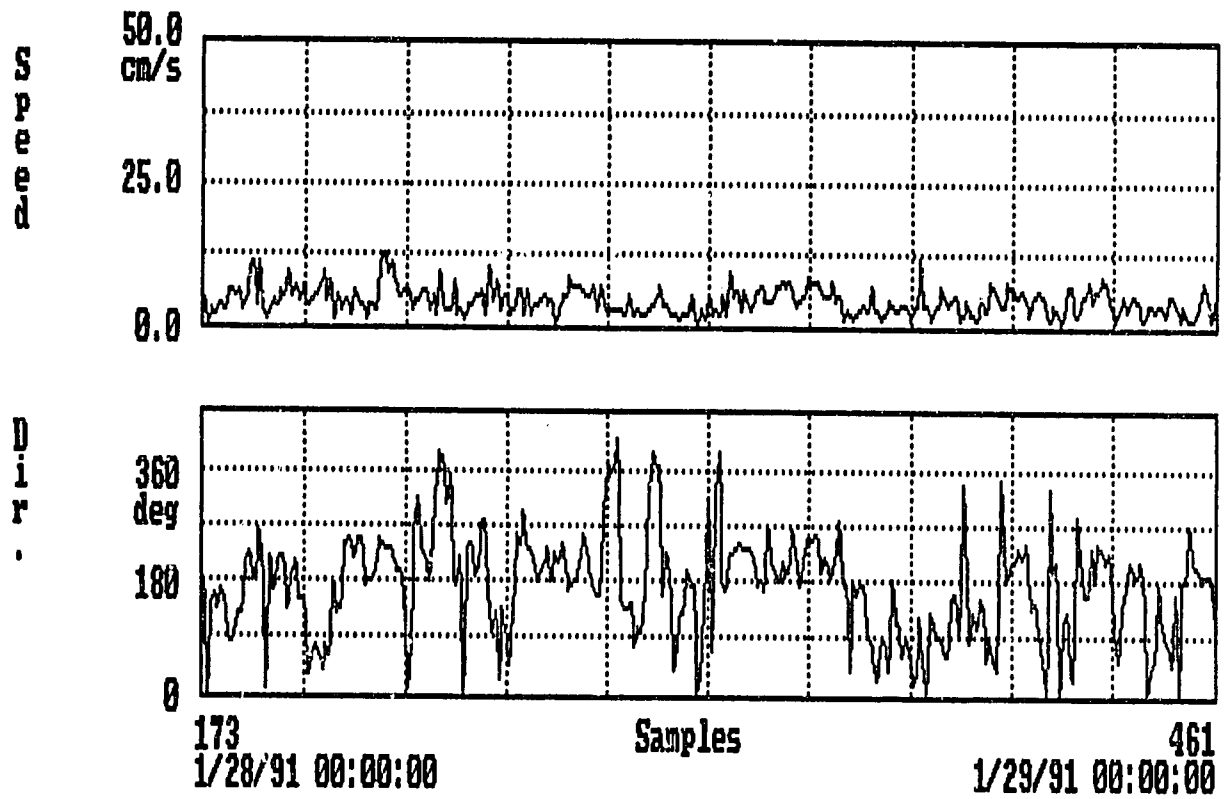
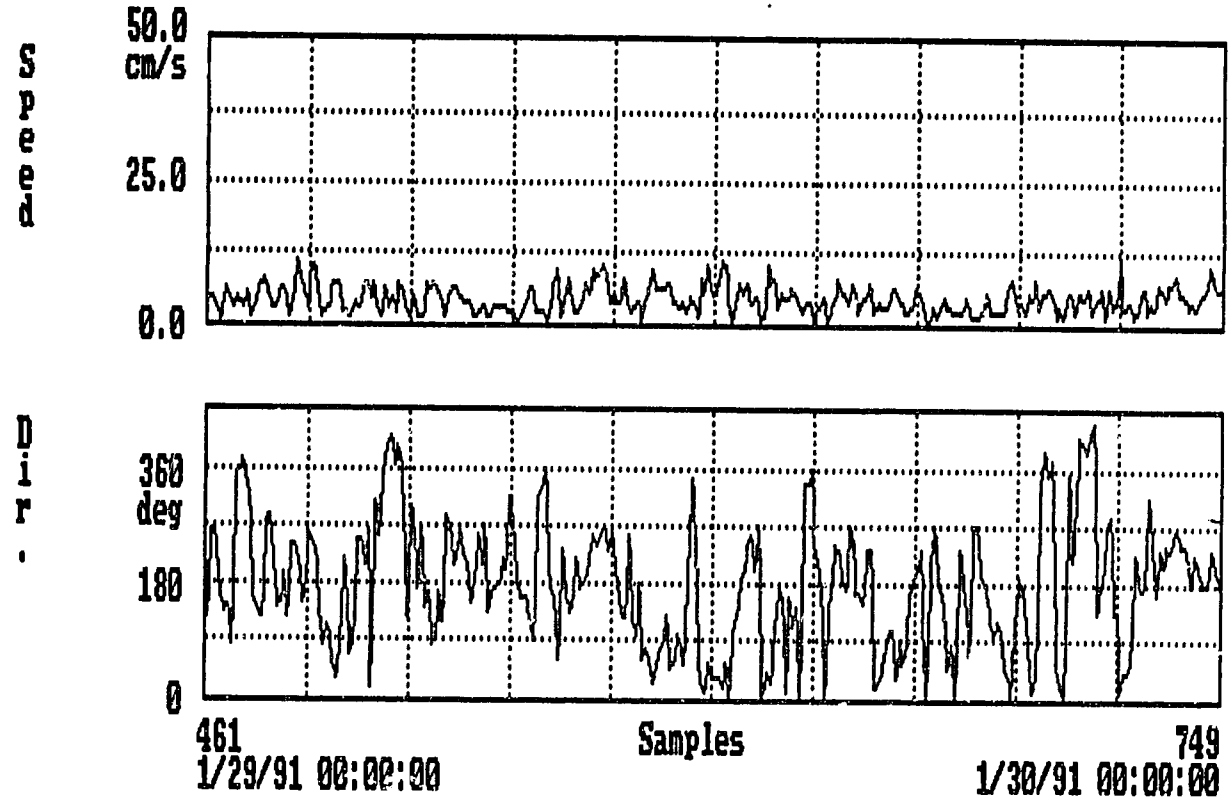


Figure B-3a. Current speed and direction, data set SOUTH 2.



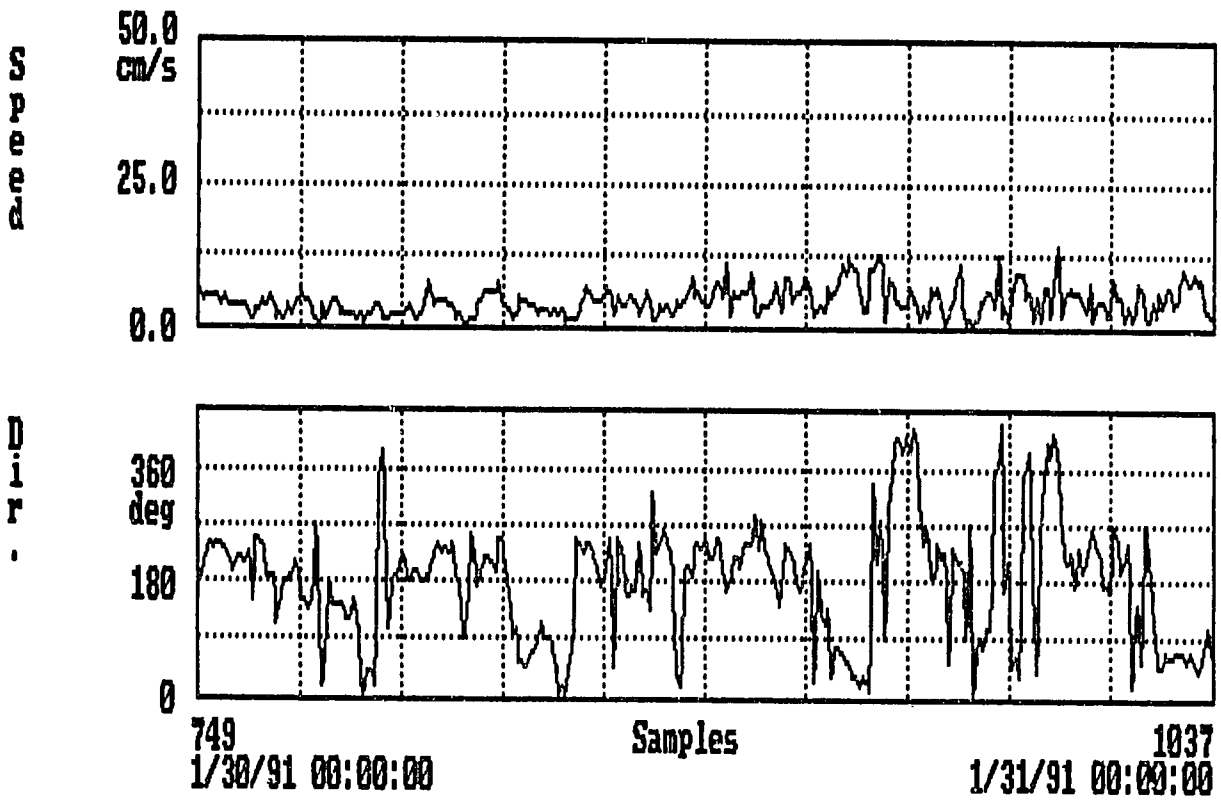
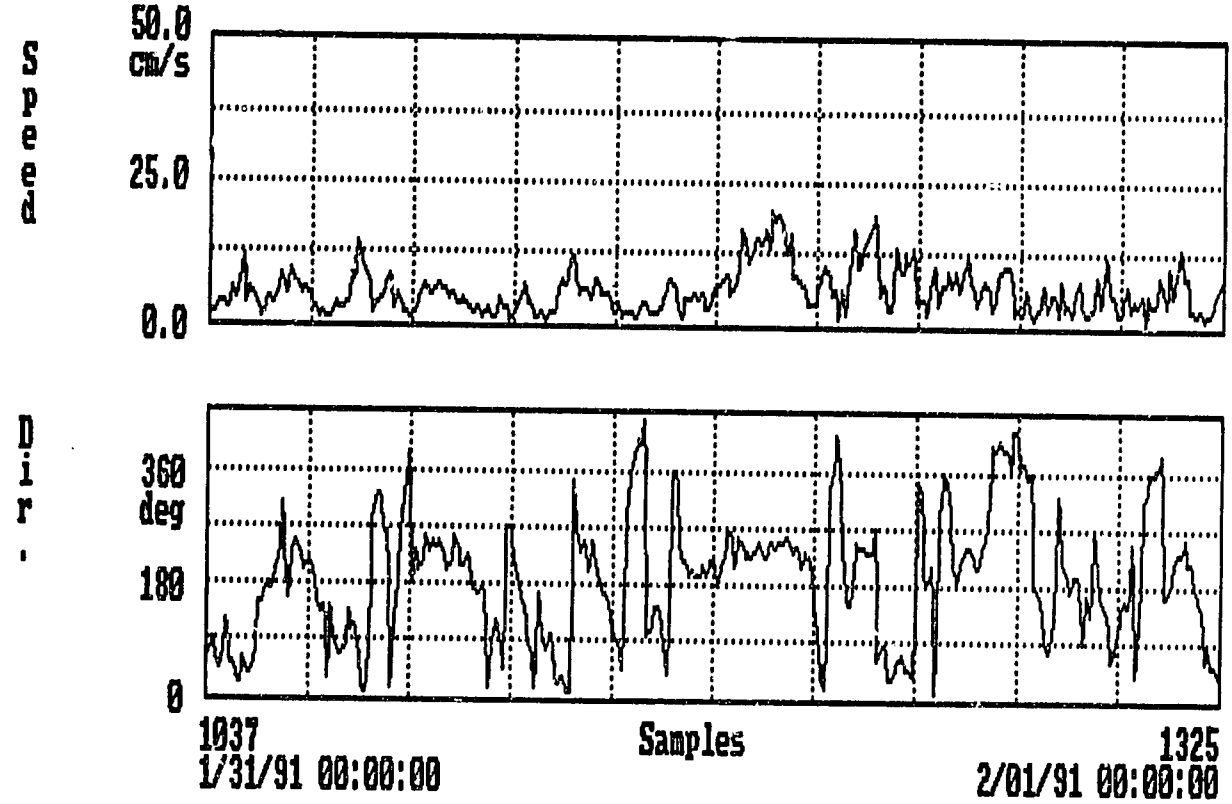


Figure B-3b. Current speed and direction, data set SOUTH 2.



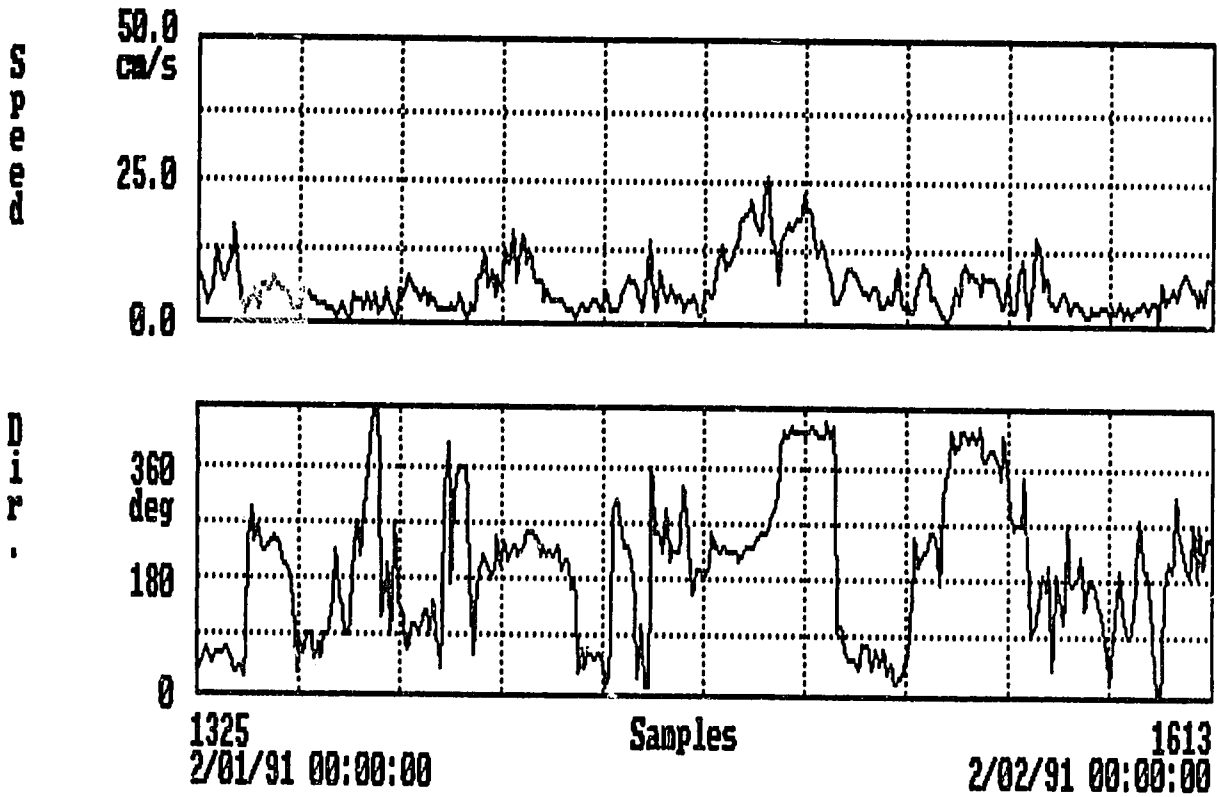
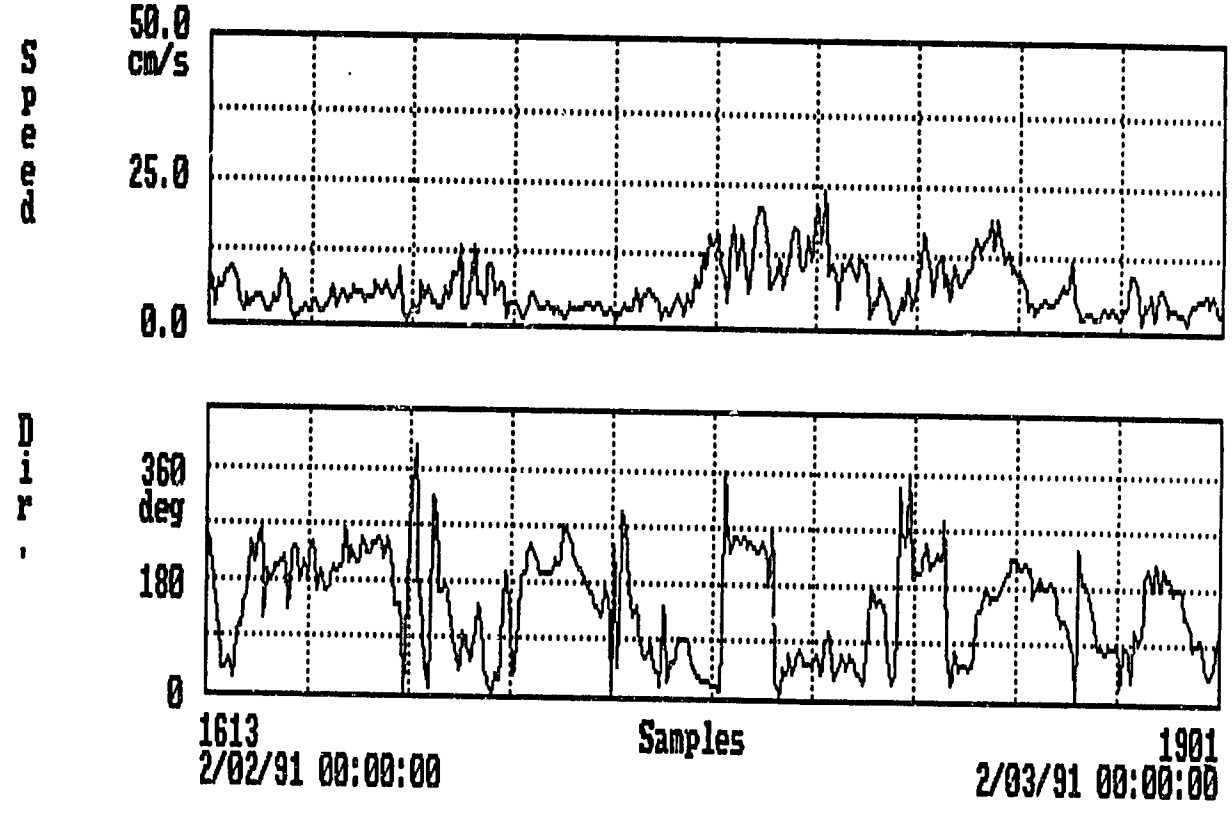


Figure B-3c. Current speed and direction, data set SOUTH 2.



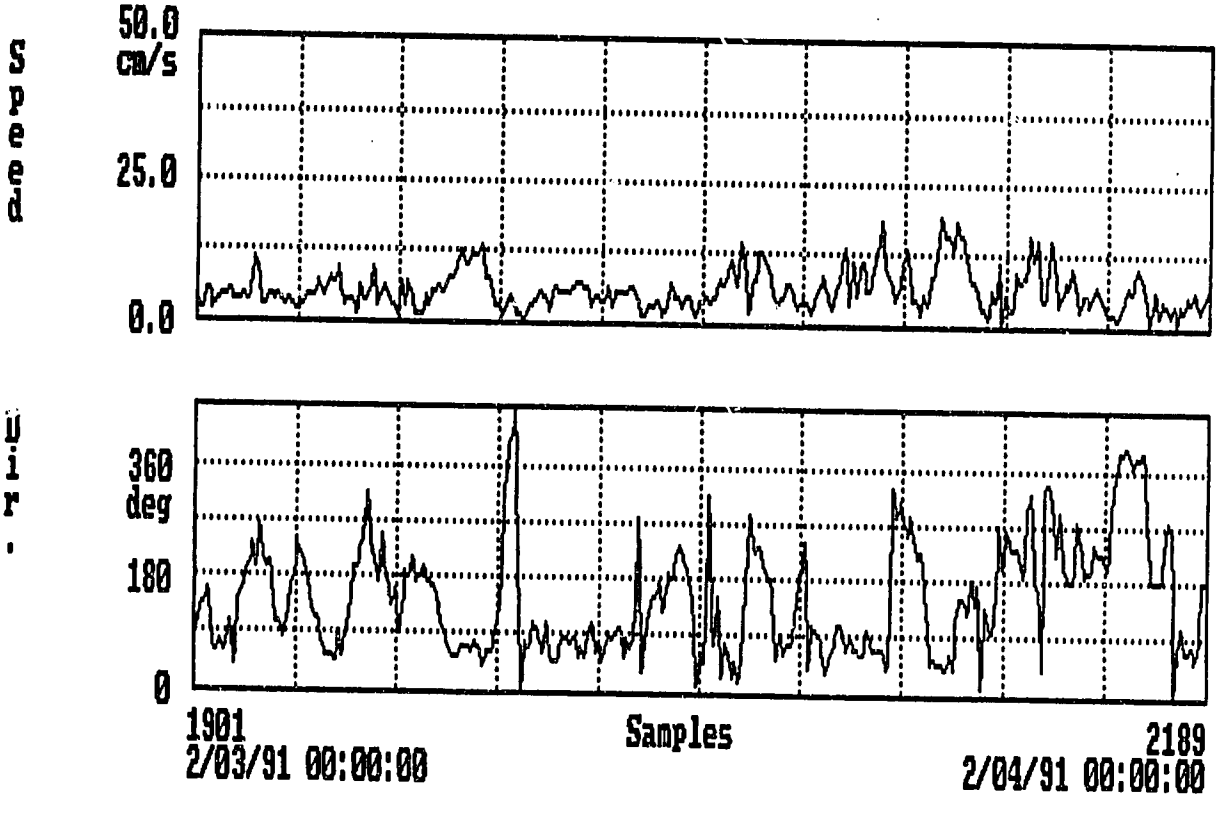
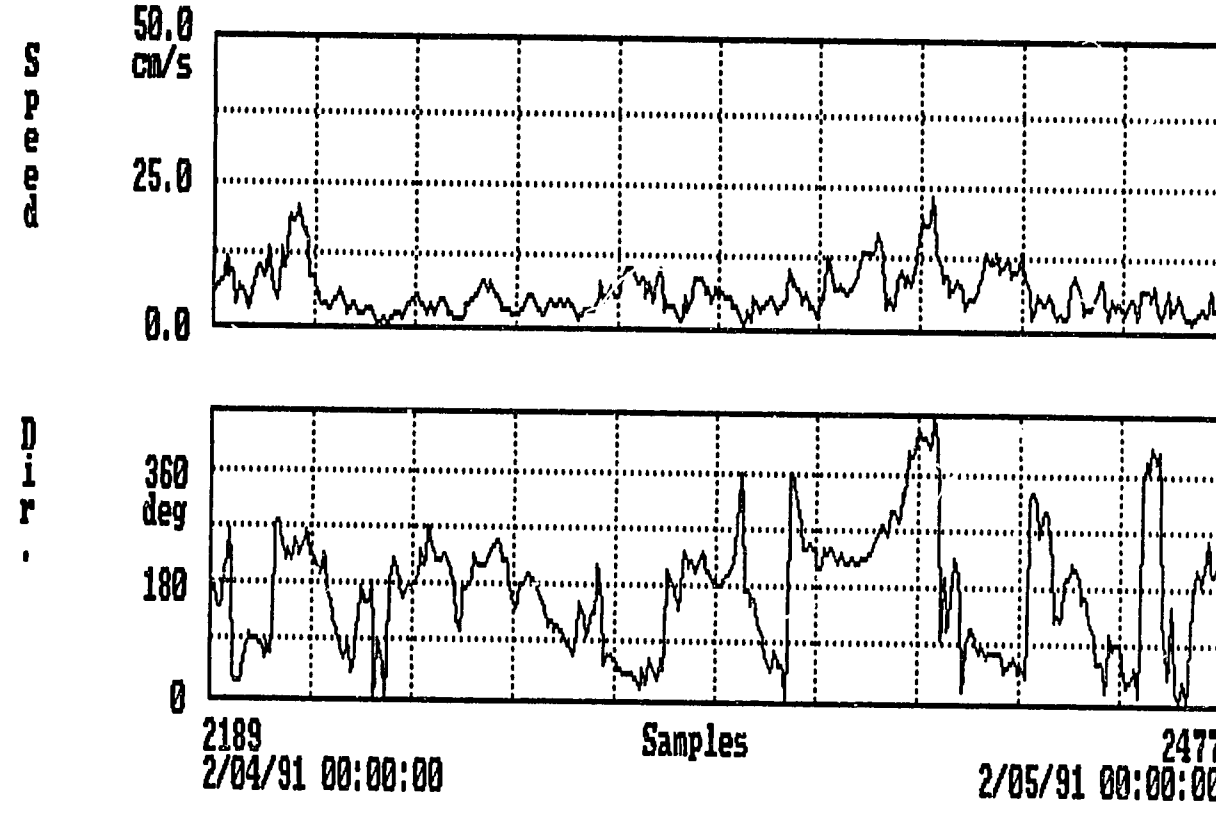


Figure B-3d. Current speed and direction, data set SOUTH 2.



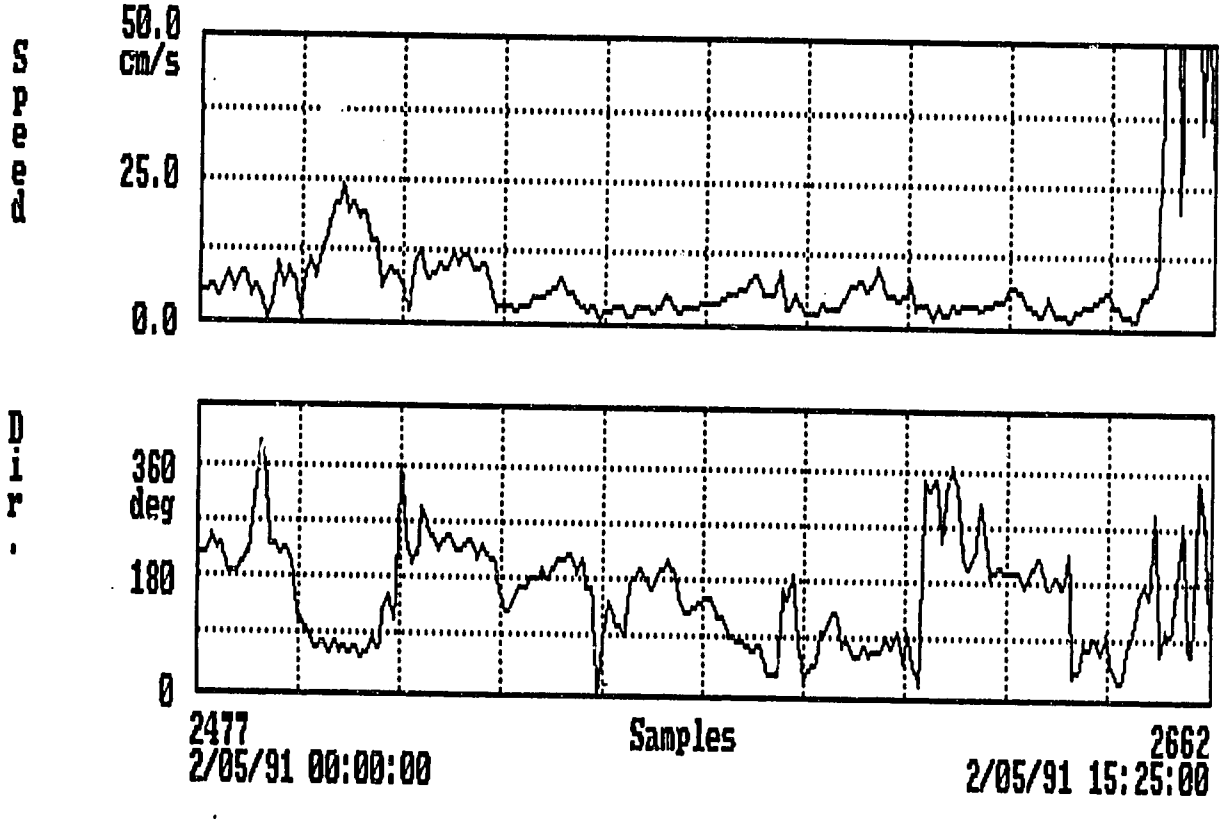


Figure B-3e. Current speed and direction, data set SOUTH 2.

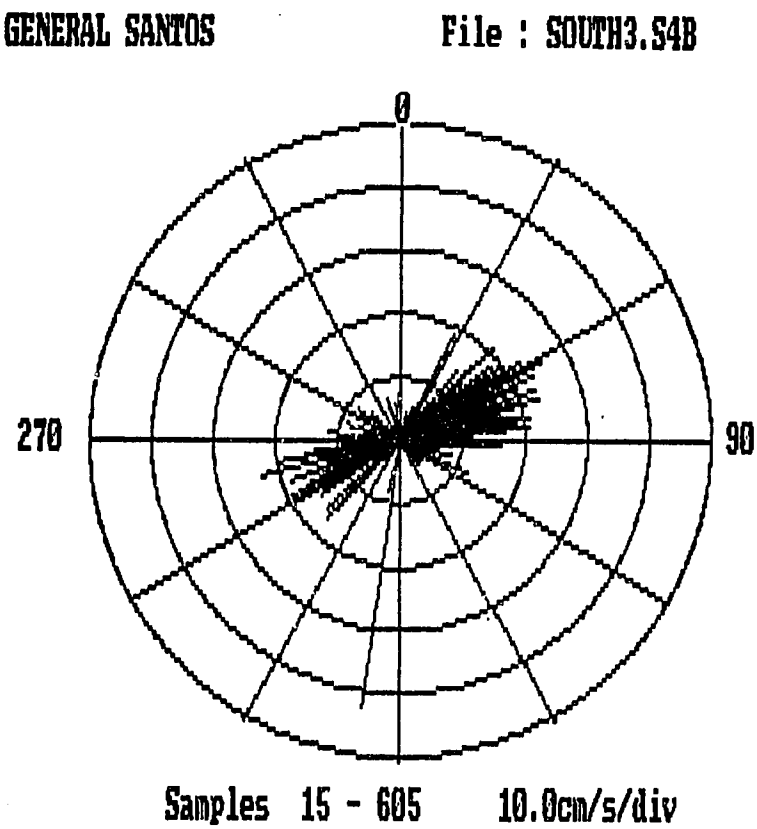
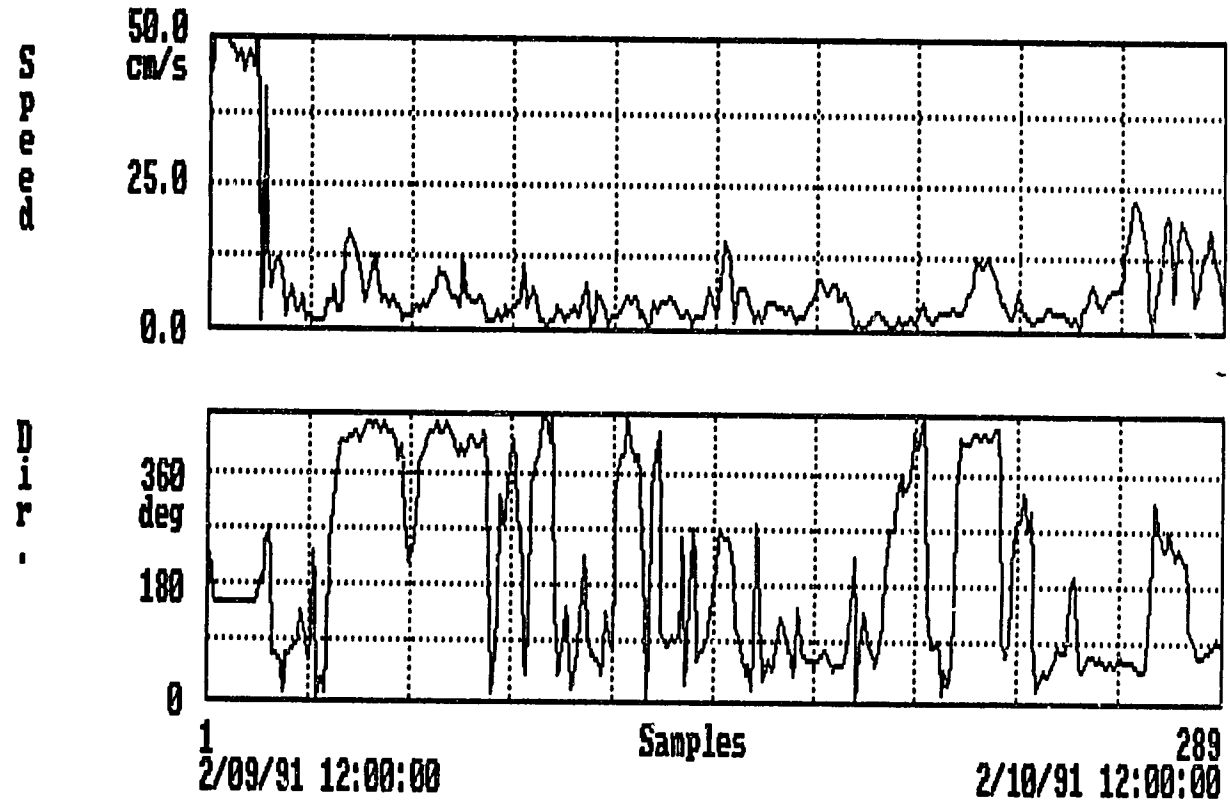


Figure B-4. Polar histogram of current speed and direction, data set SOUTH 3, 9 - 11 February 1991.



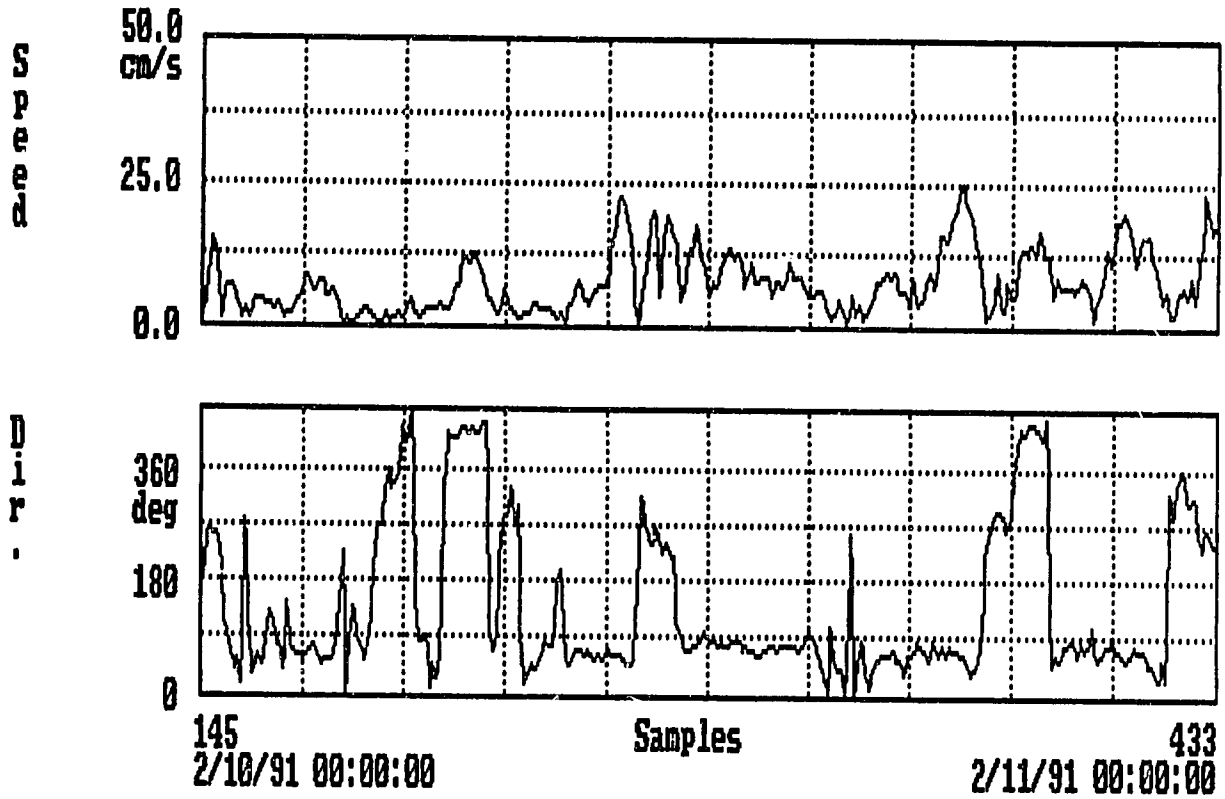


Figure B-5a. Current speed and direction, data set SOUTH 3.

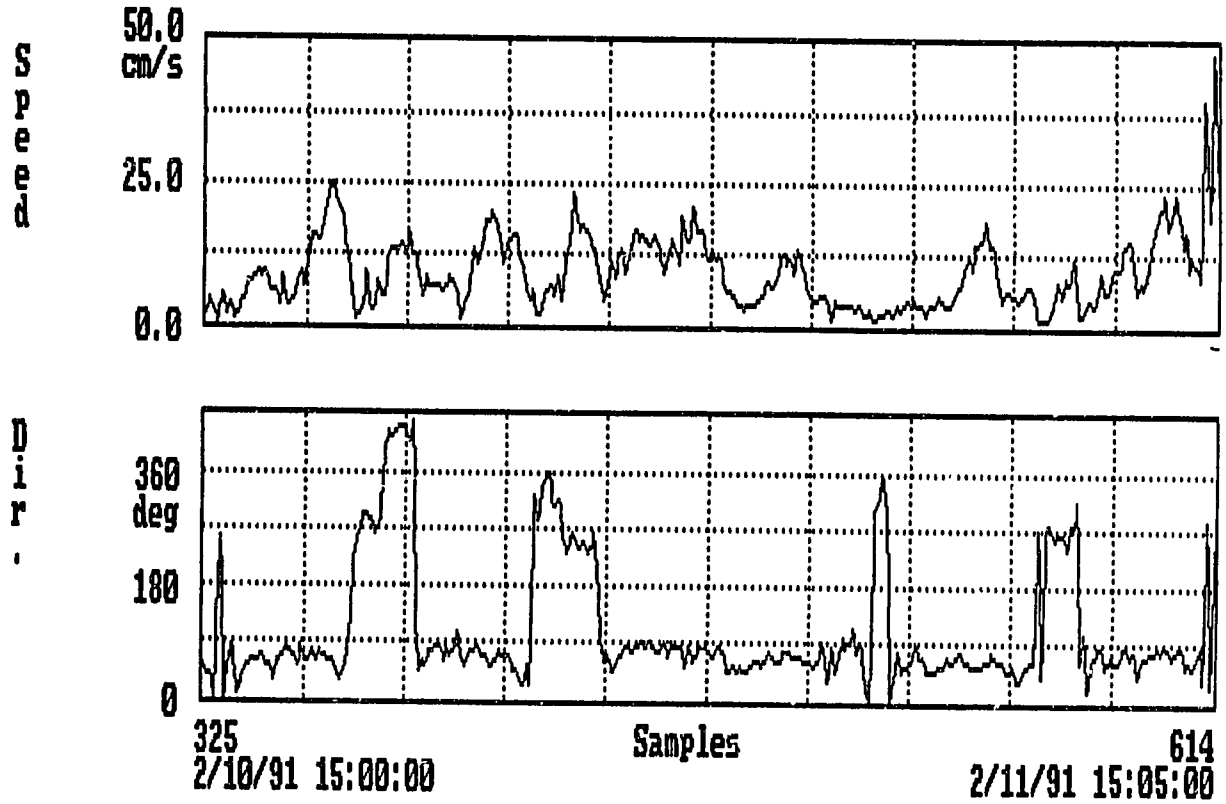


Figure B-5b. Current speed and direction, data set SOUTH 3.

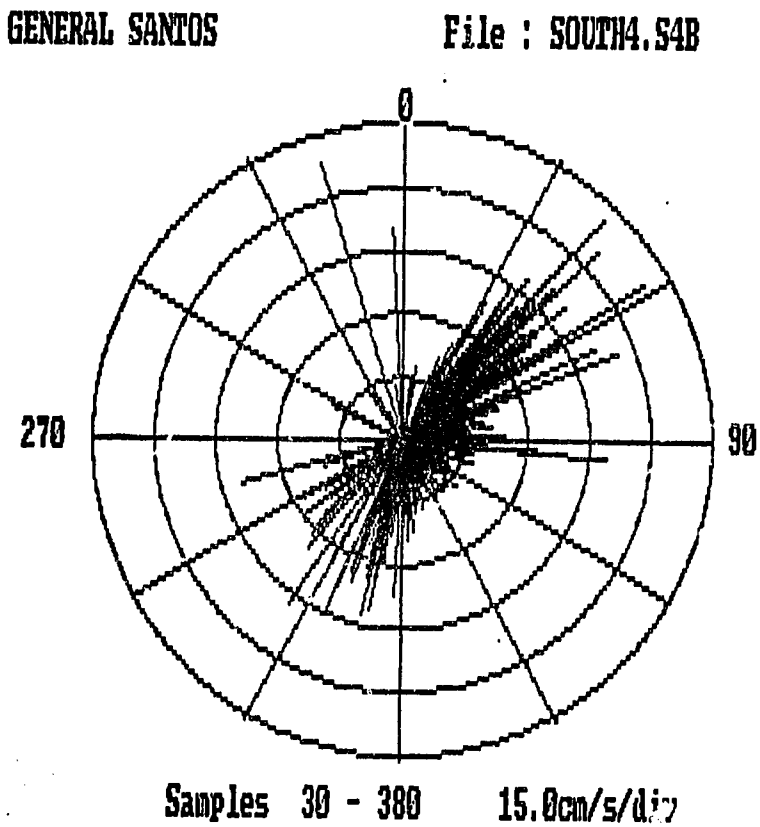
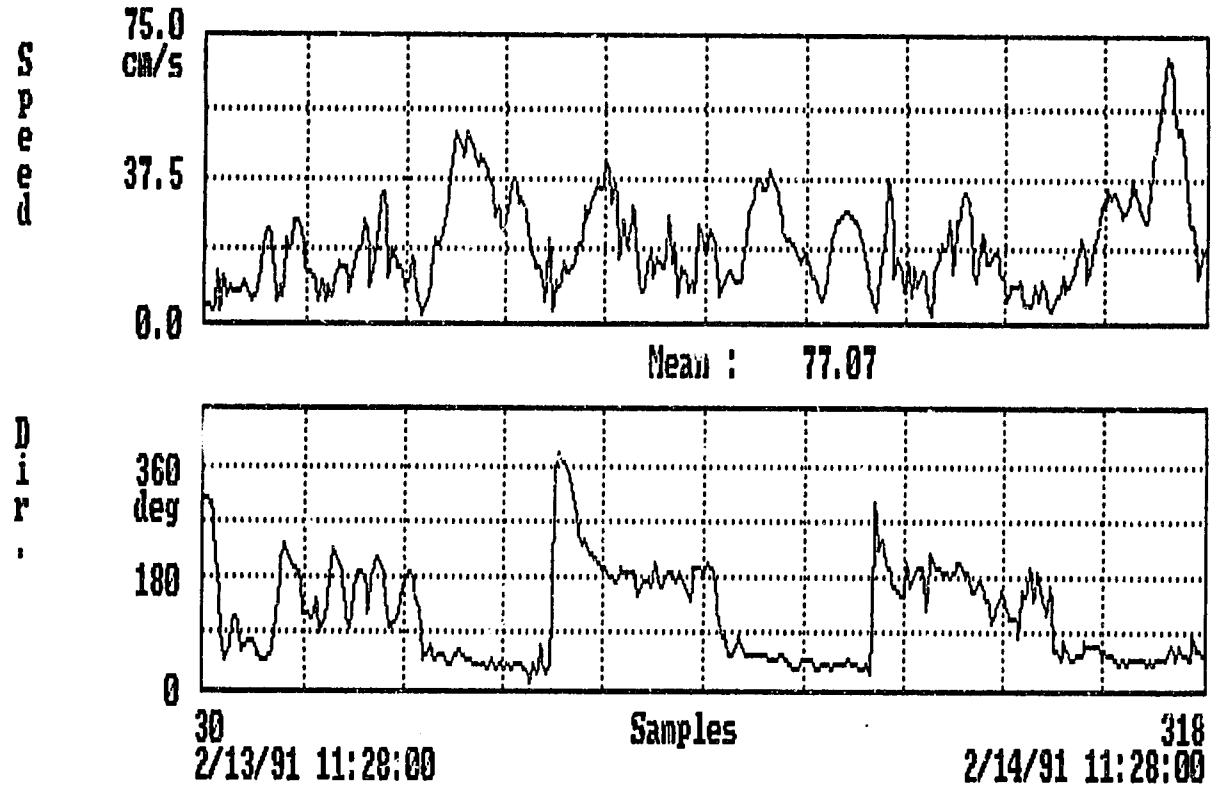


Figure B-6. Polar histogram of current speed and direction, data set SOUTH 4, 13-14 February 1991.



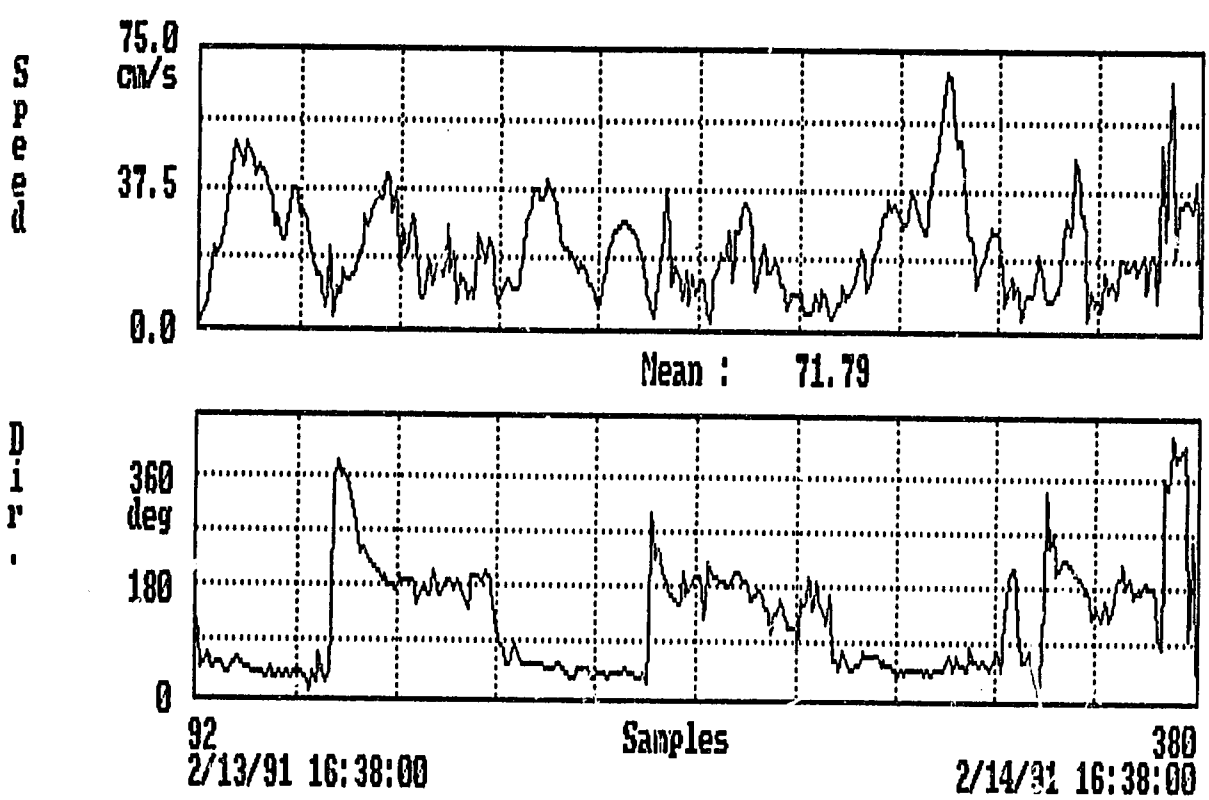


Figure B-7. Current speed and direction, data set SOUTH 4.

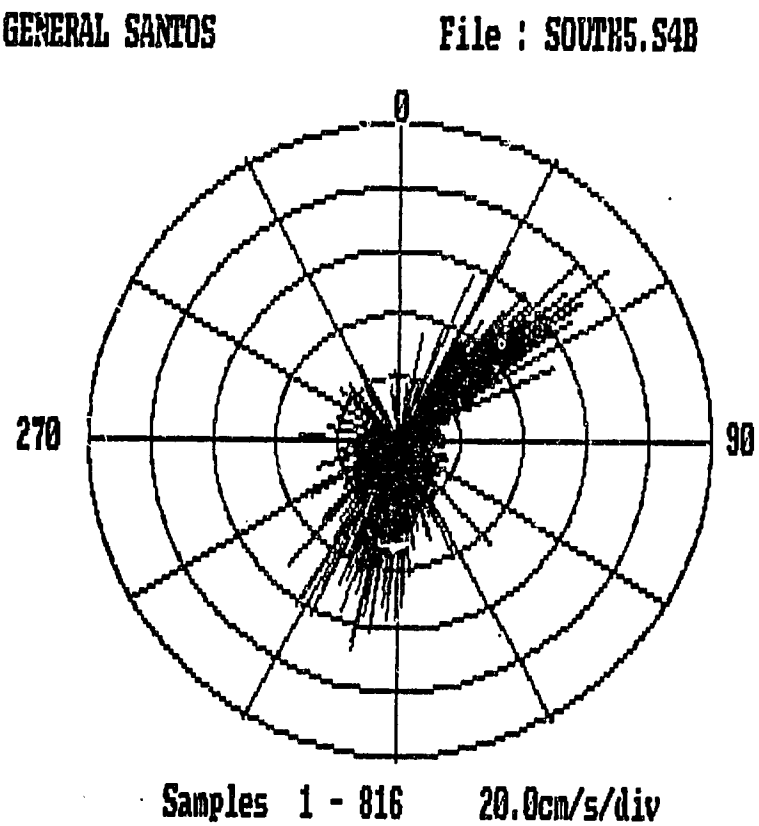
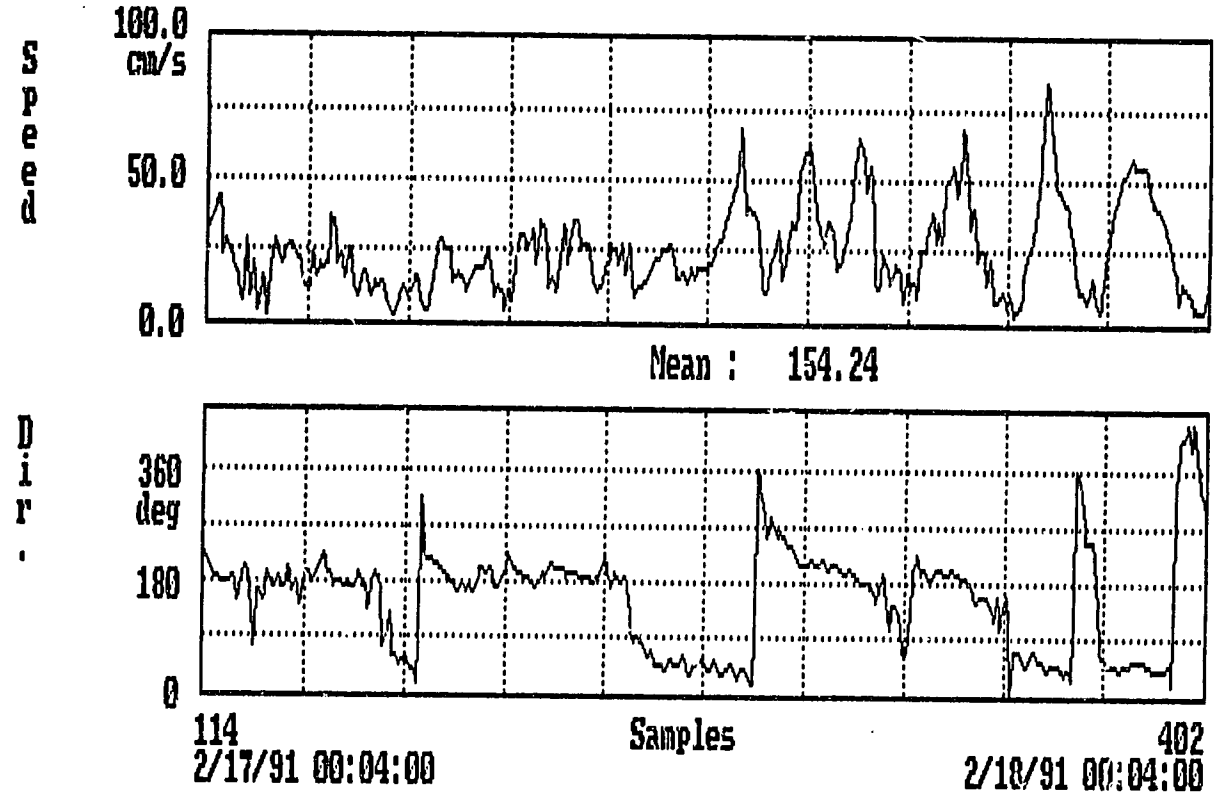


Figure B-8. Polar histogram of current speed and direction, data set SOUTH 5, 17-19 February 1991.



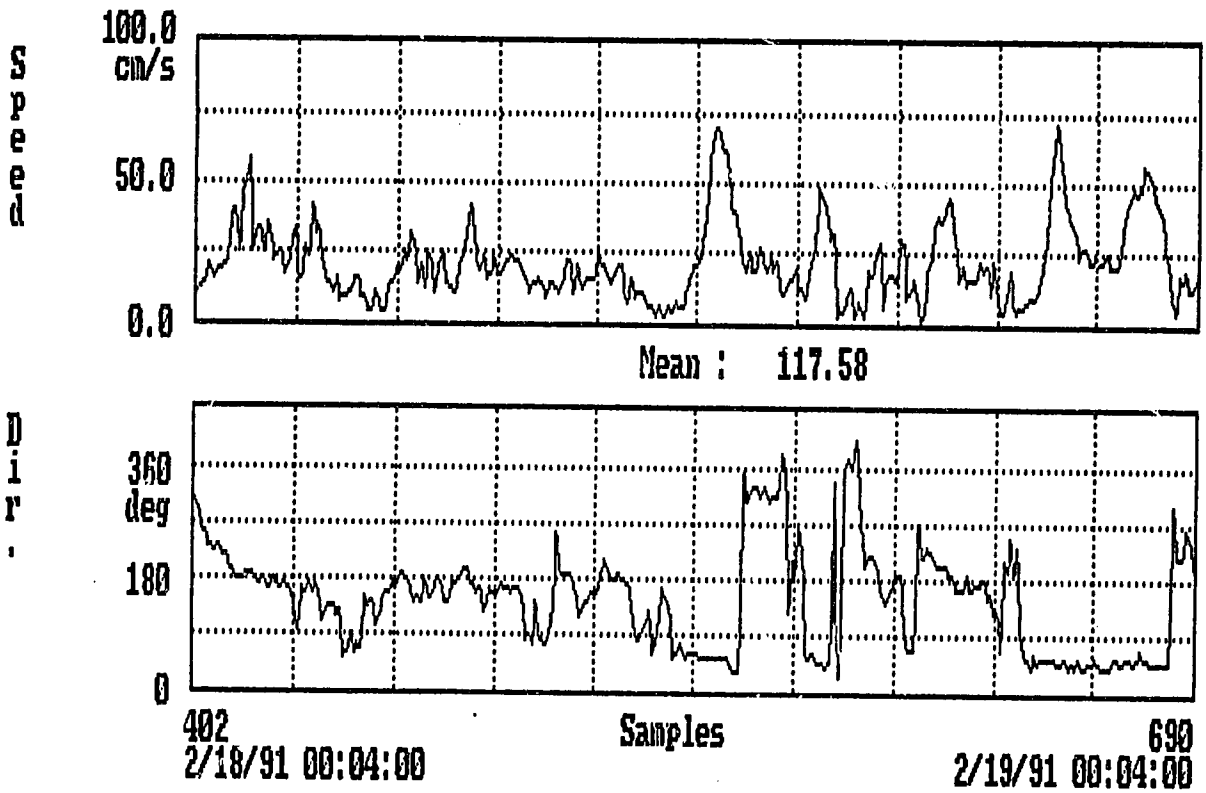


Figure B-9. Current speed and direction, data set SOUTH 5.

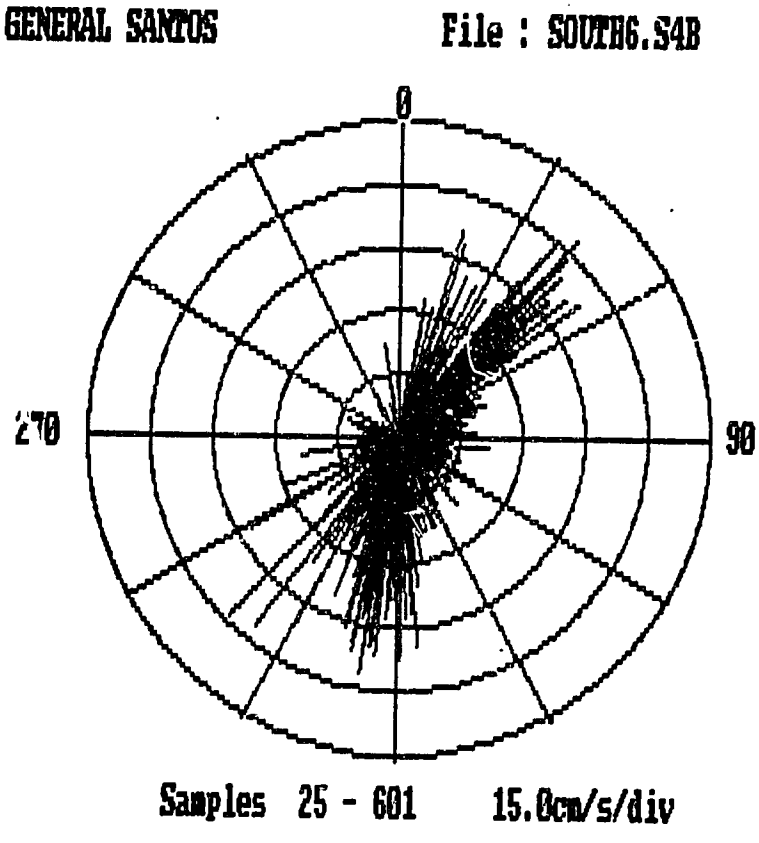
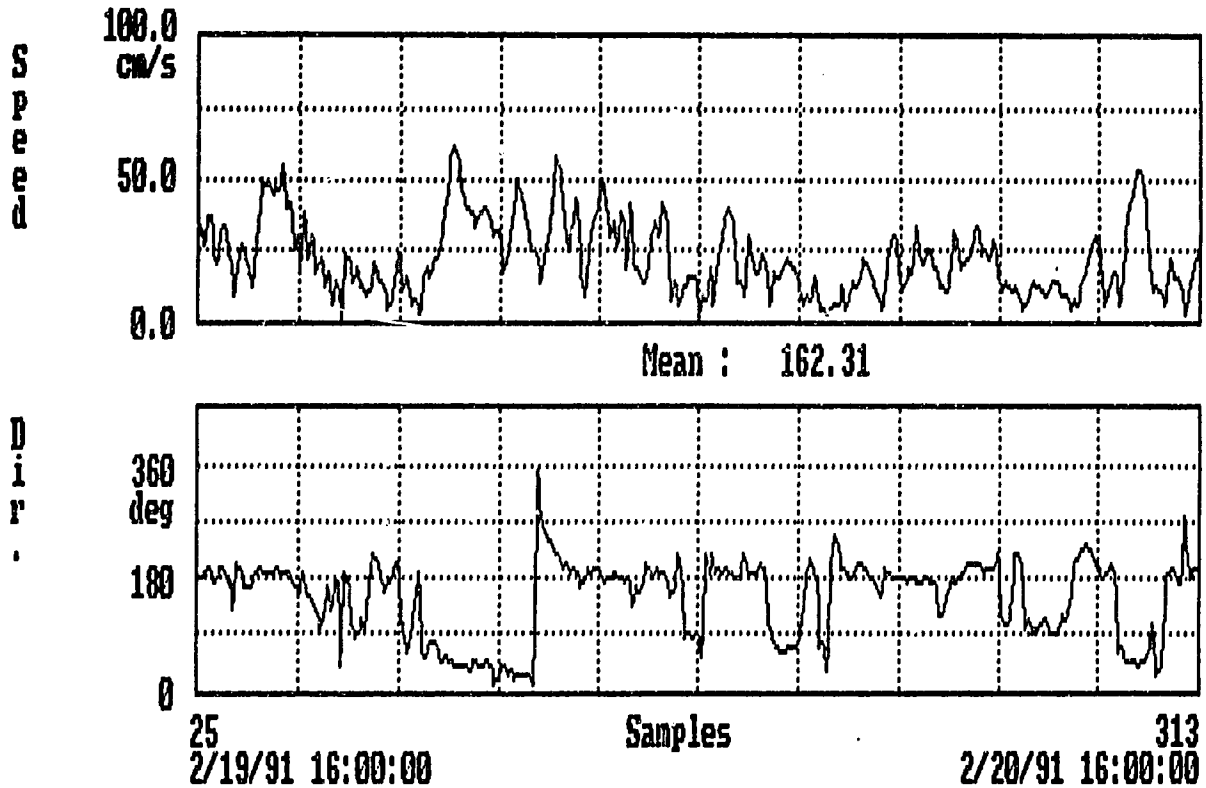


Figure B-10. Polar histogram of current speed and direction, data set SOUTH 6, 19-21 February 1991.



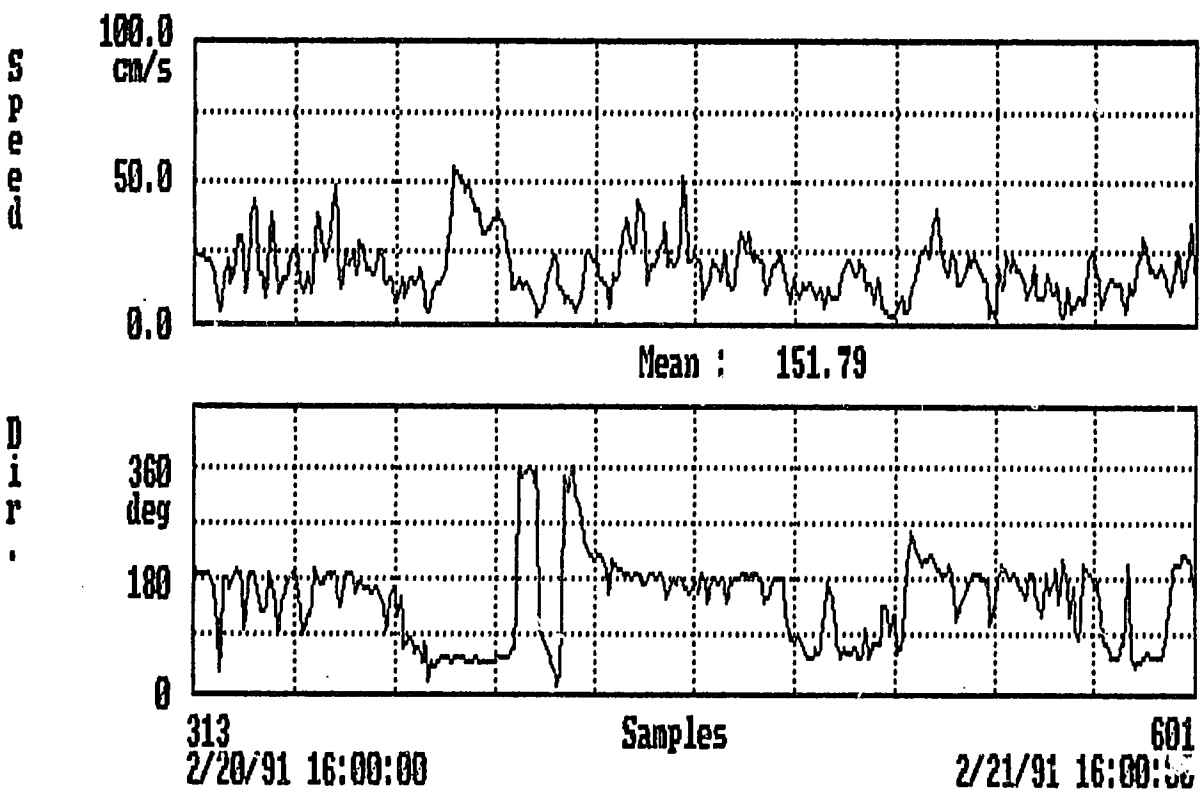


Figure B-11, Current speed and direction, data set SOUTH 6.

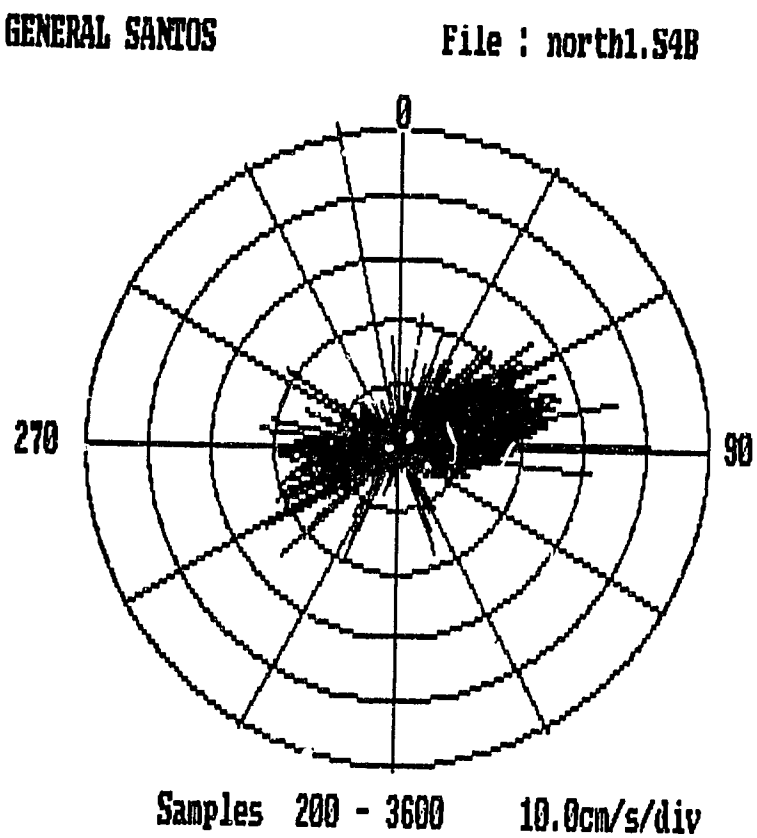


Figure B-12. Polar histogram of current speed and direction, data set NORTH 1, 21 January - 3 February 1991.

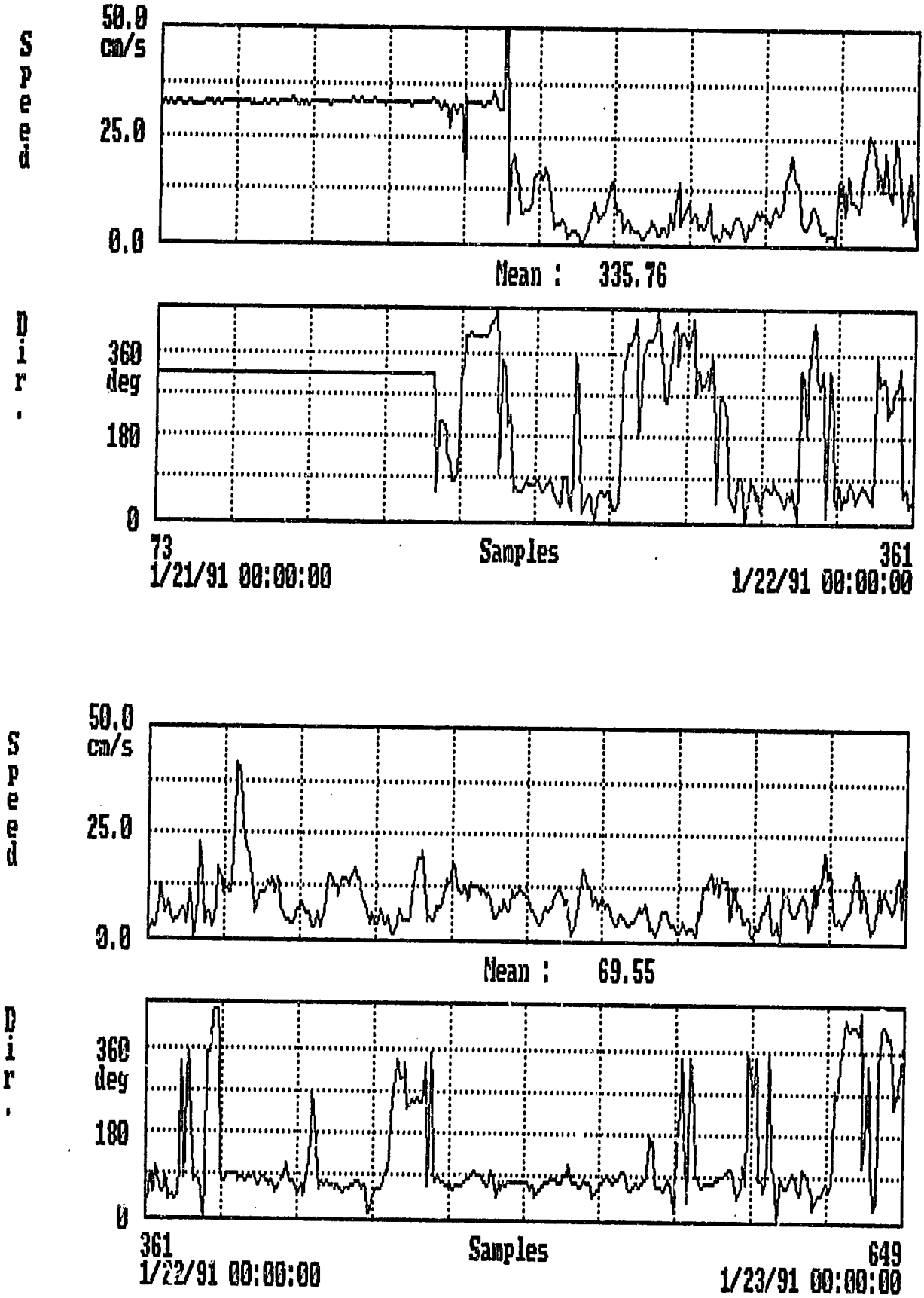
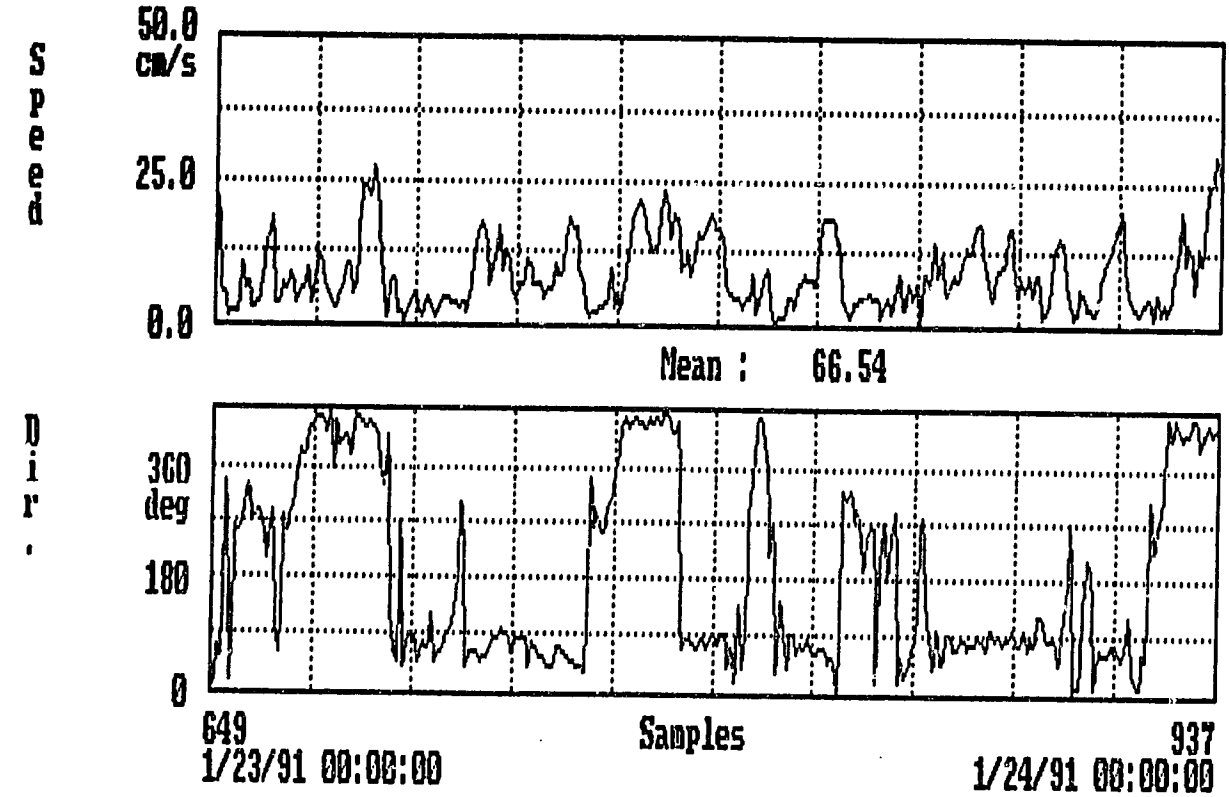


Figure B-13a. Current speed and direction, data set NORTH 1.



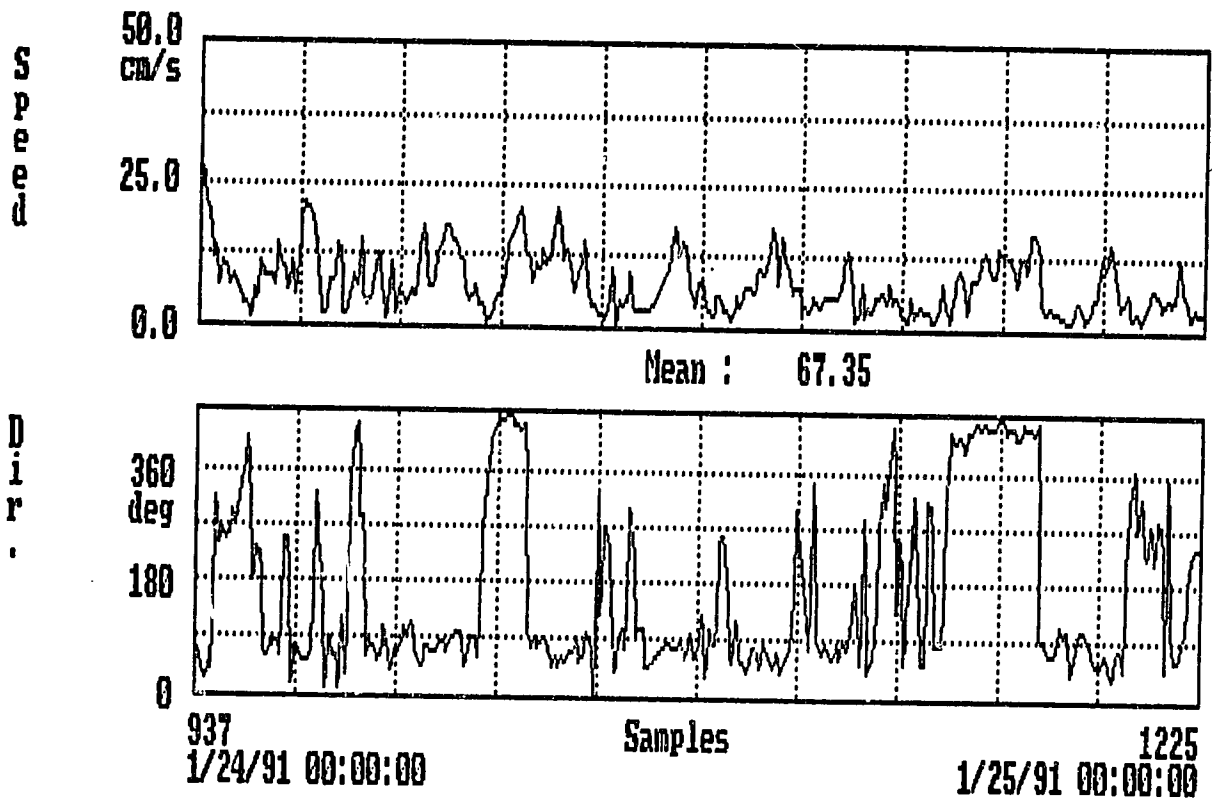
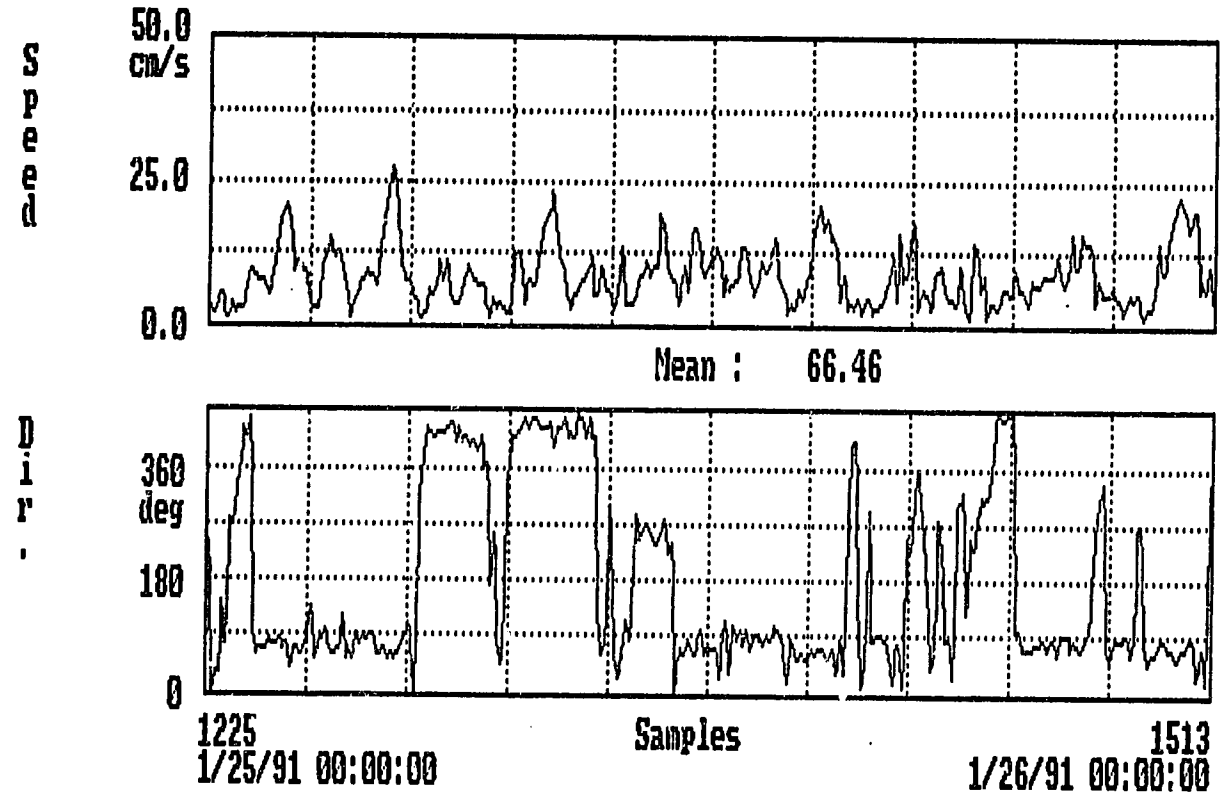


Figure B-13b. Current speed and direction, data set NORTH 1.



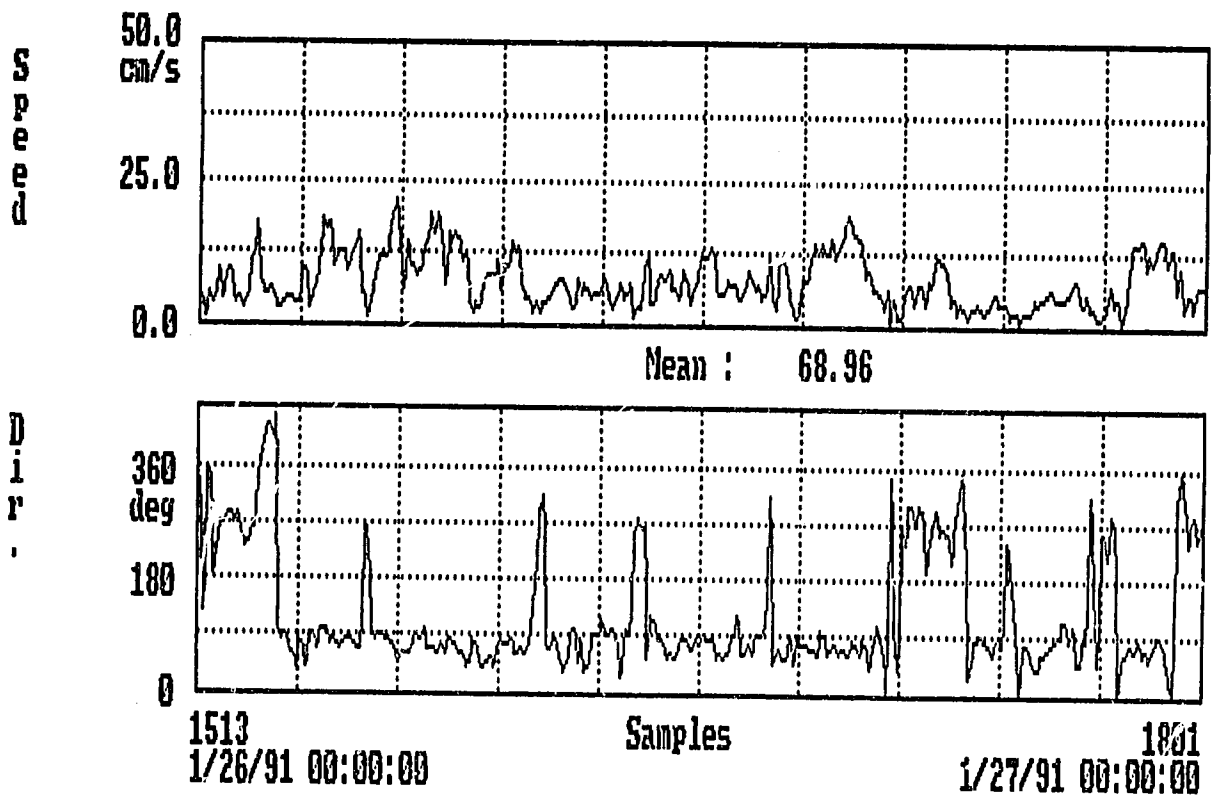
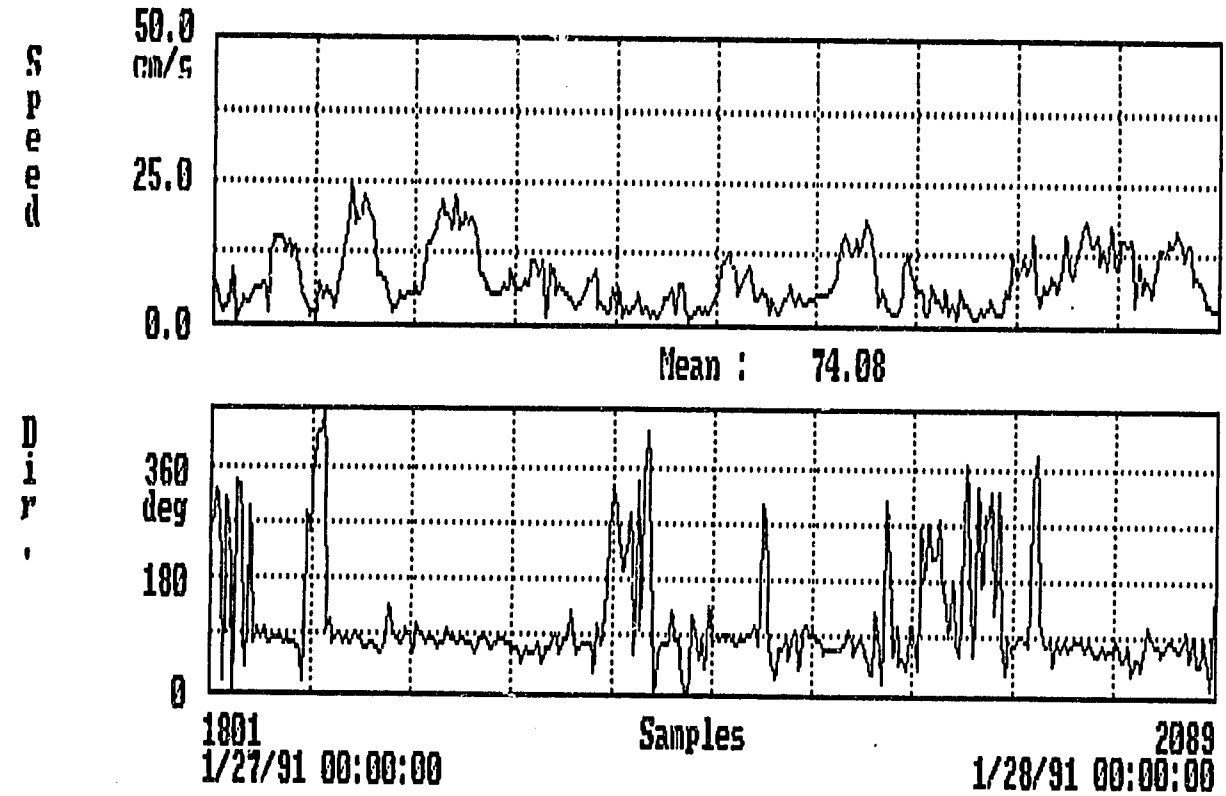


Figure B-13c. Current speed and direction, data set NORTH 1.



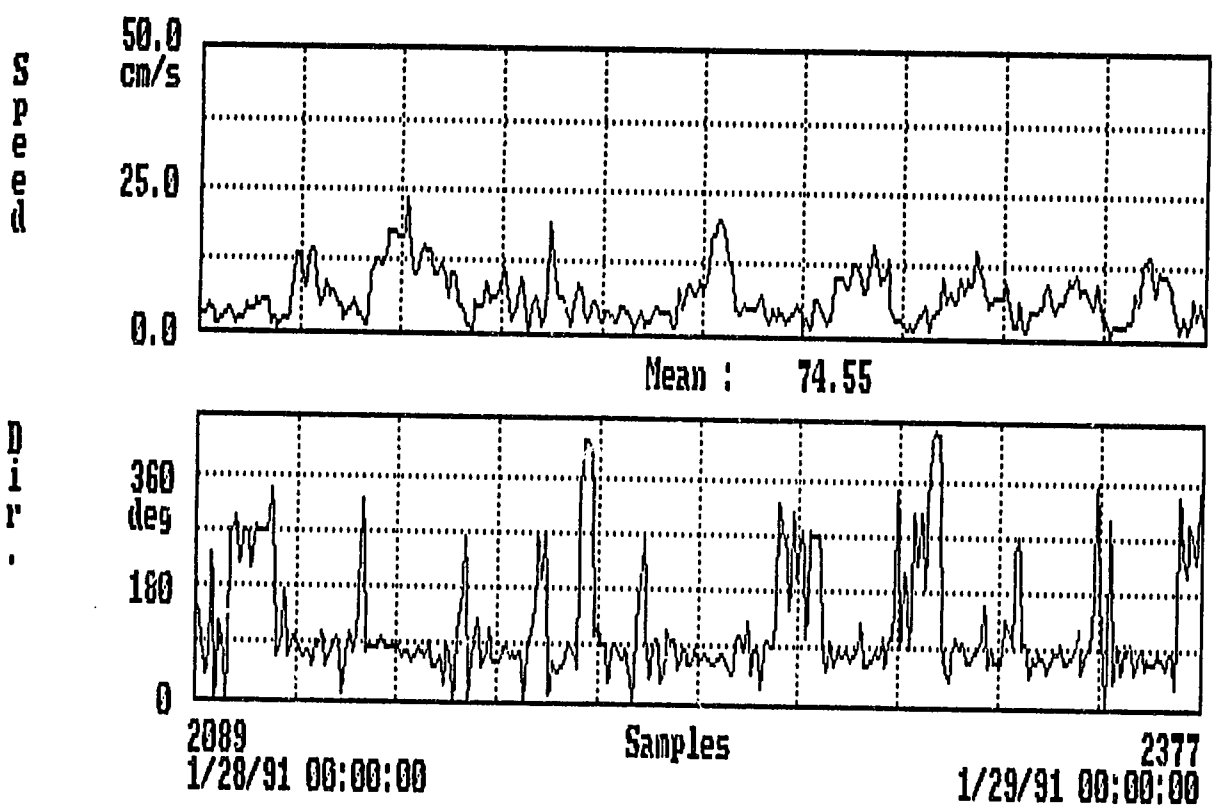
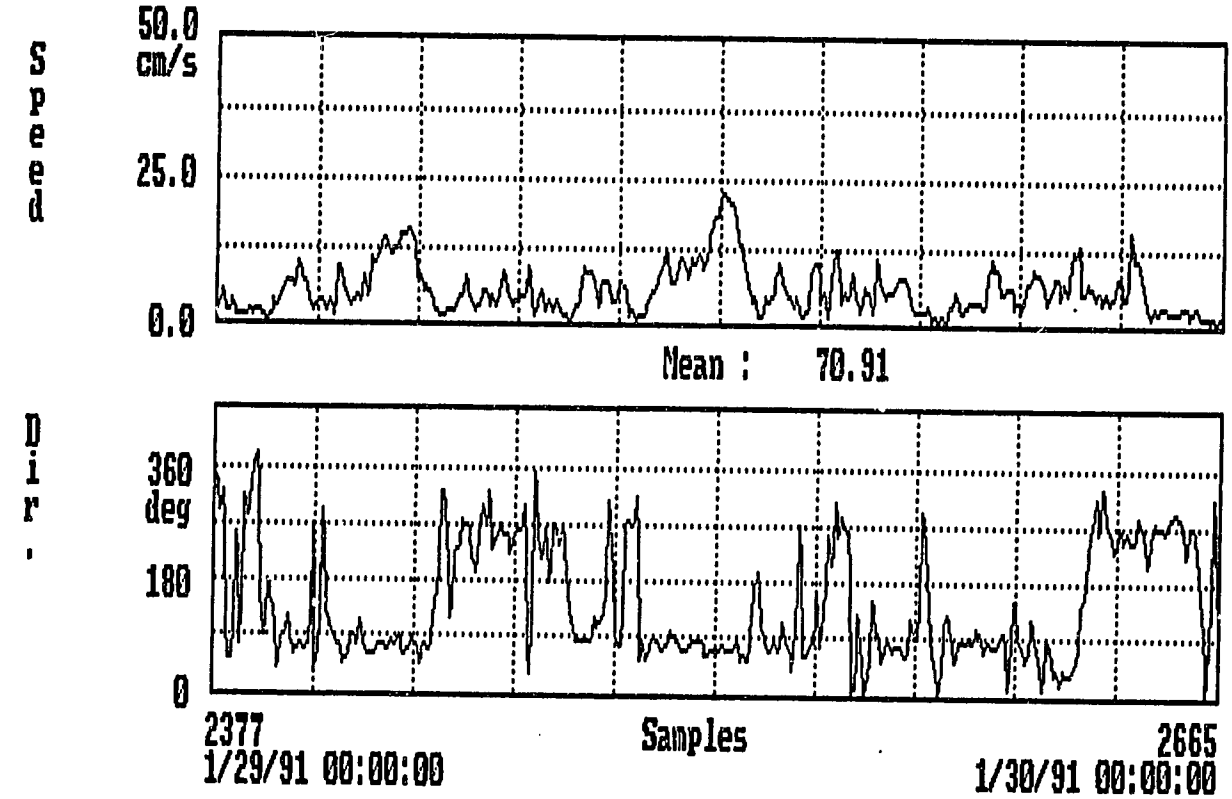


Figure B-13d. Current speed and direction, data set NORTH 1.



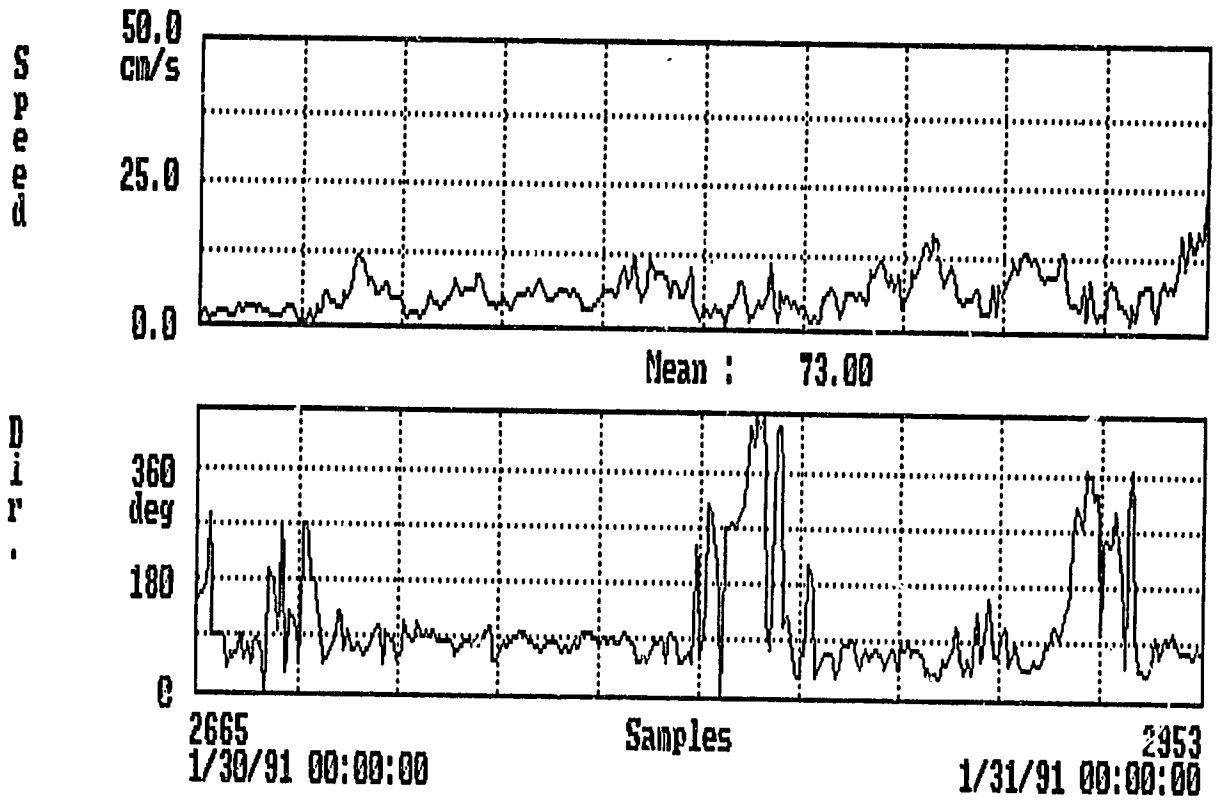
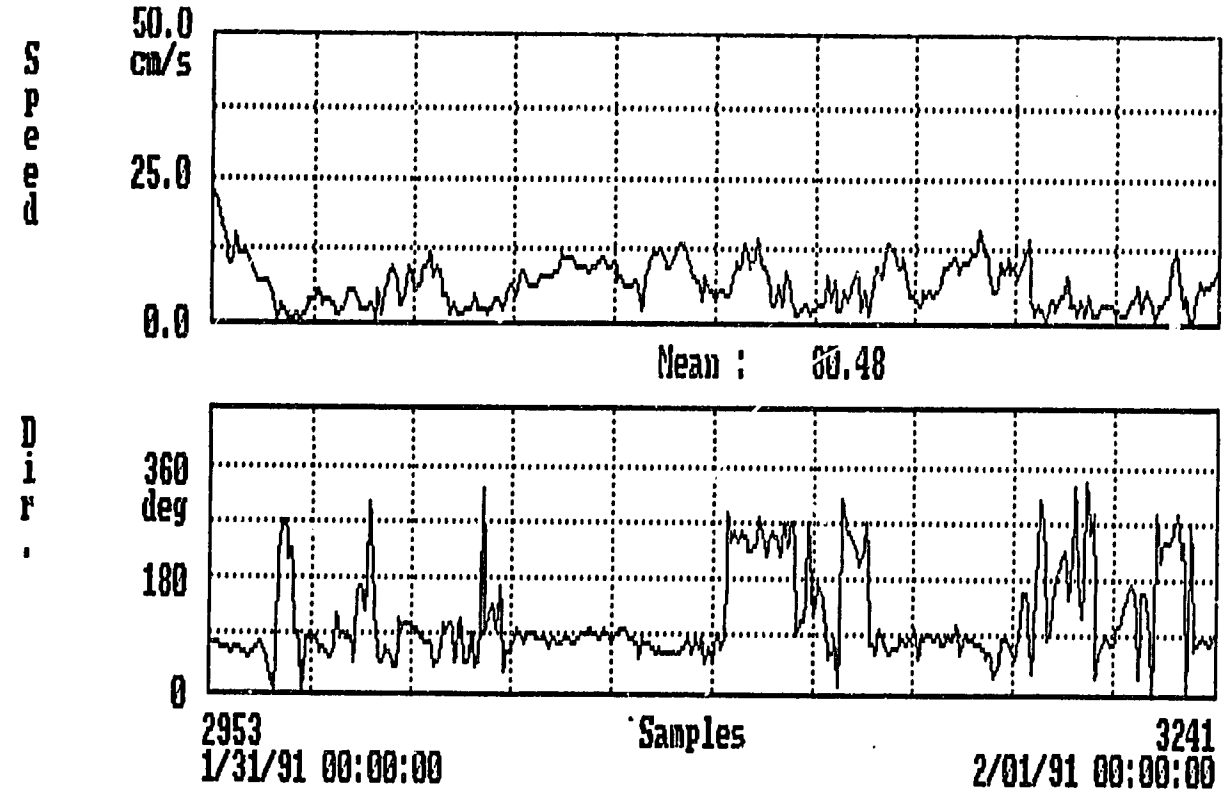


Figure B-13e. Current speed and direction, data set NORTH 1.



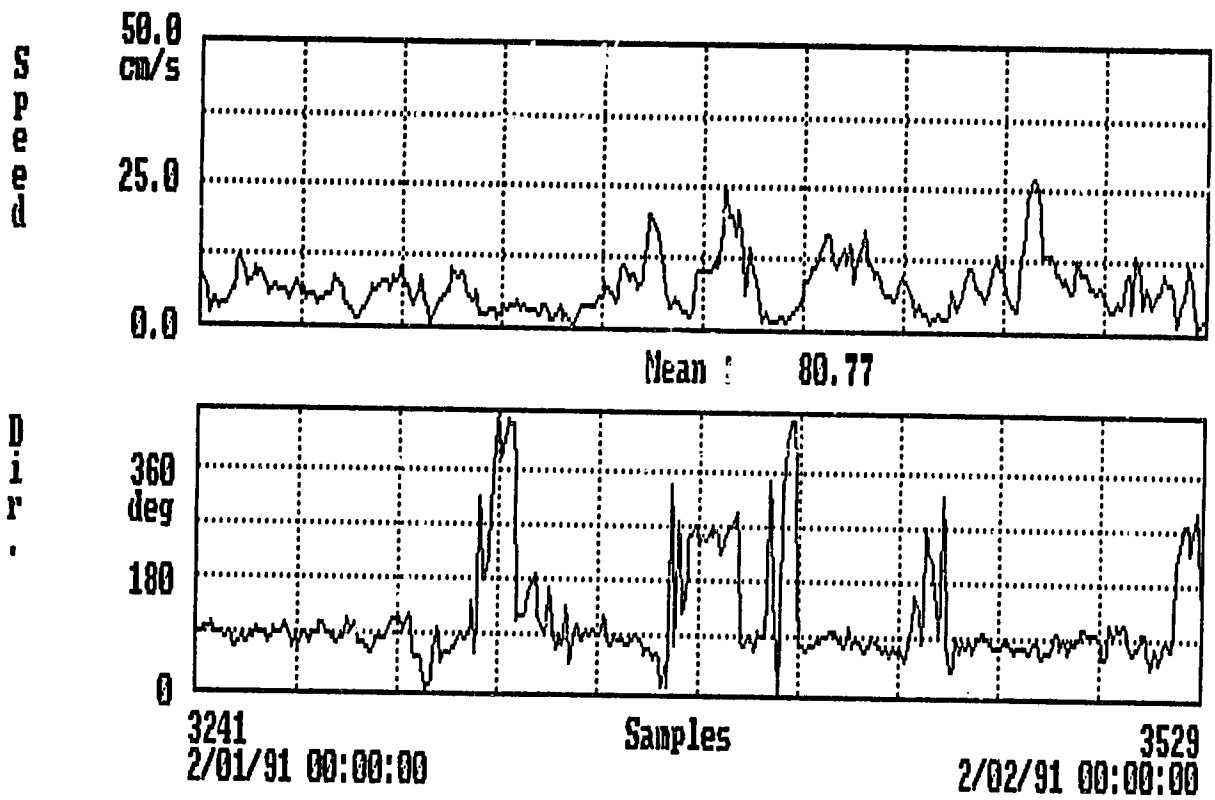


Figure B-13f. Current speed and direction, data set NORTH 1.

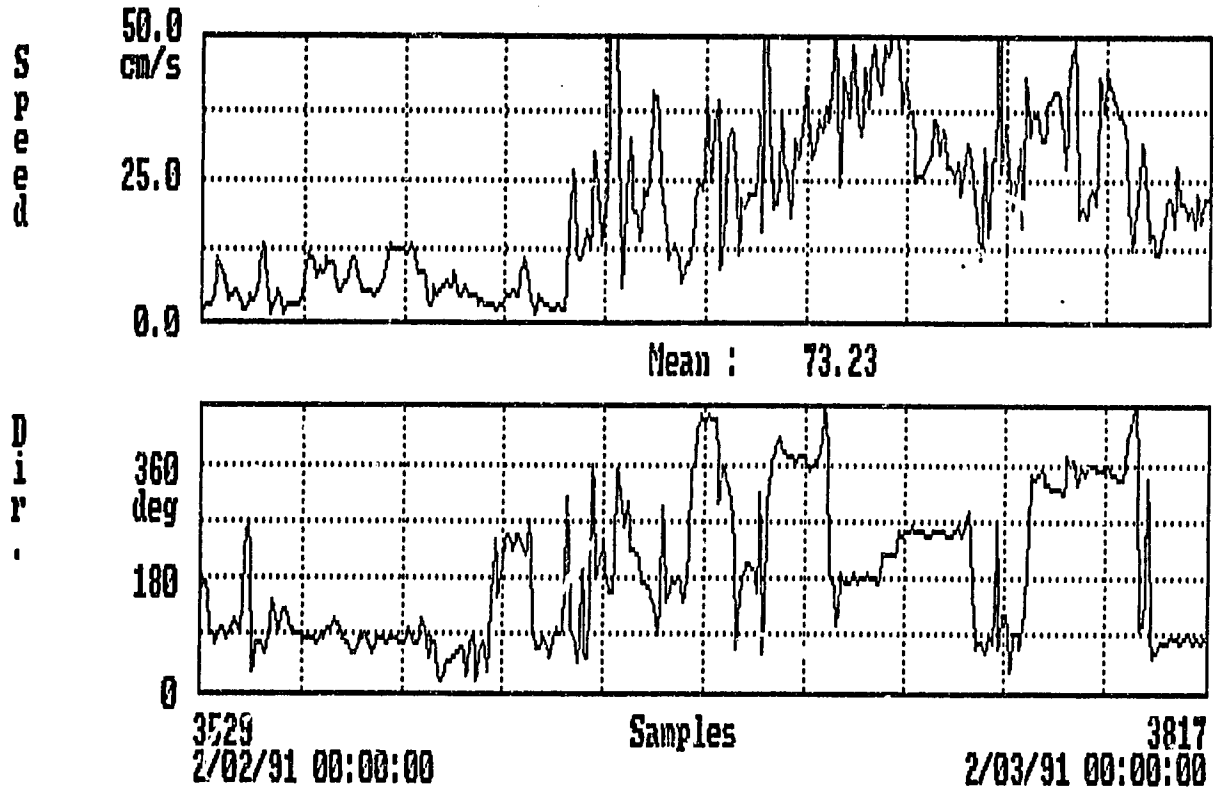


Figure B-13g, Current speed and direction, data set NORTH 1.

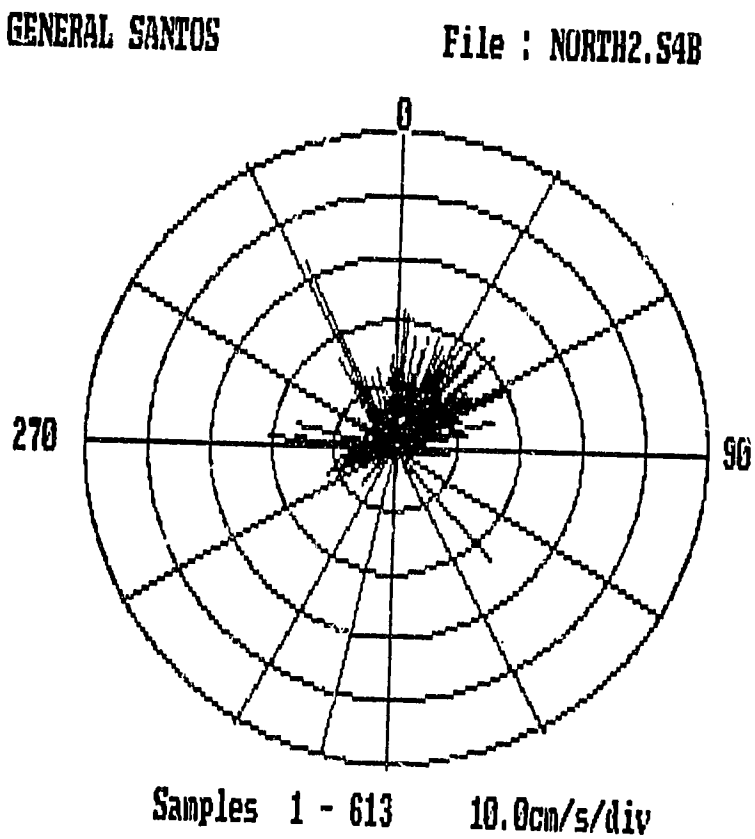
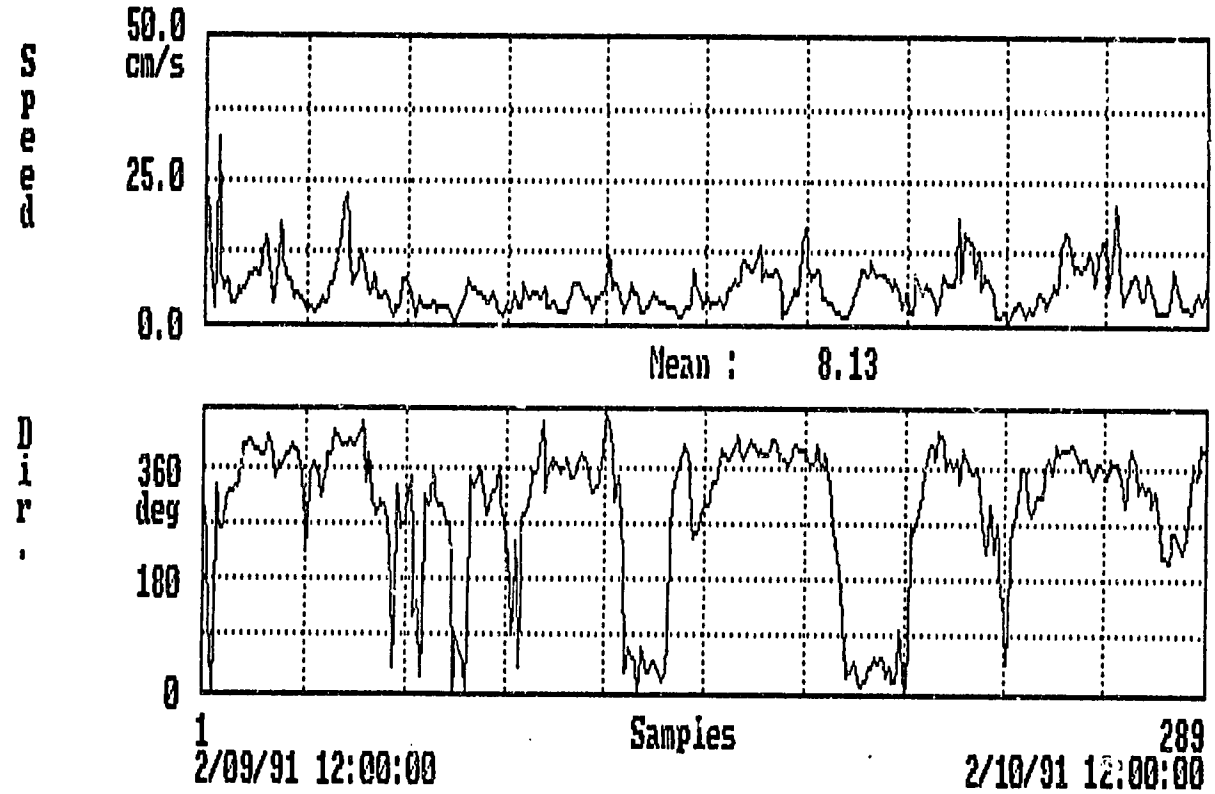


Figure P-14. Polar histogram of current speed and direction, data set NORTH 2, 10-11 February 1991.



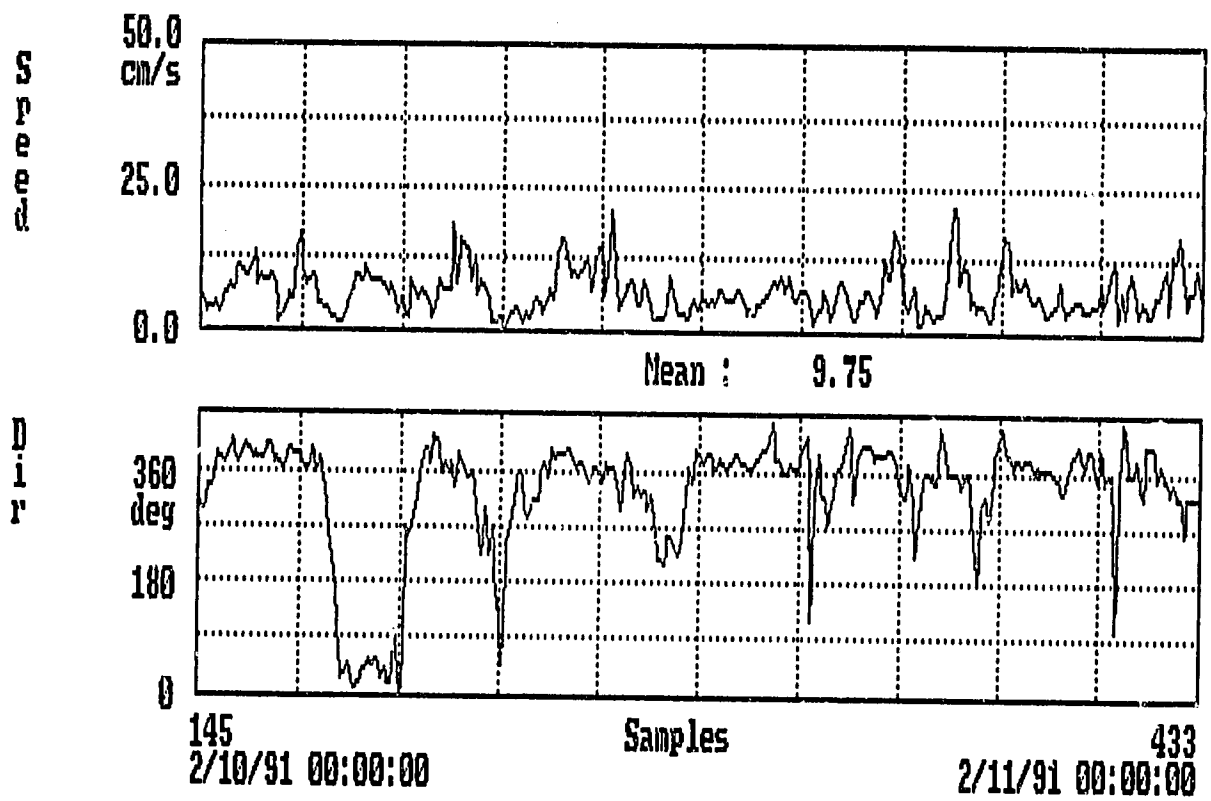


Figure B-15a. Current speed and direction, data set NORTH 2.

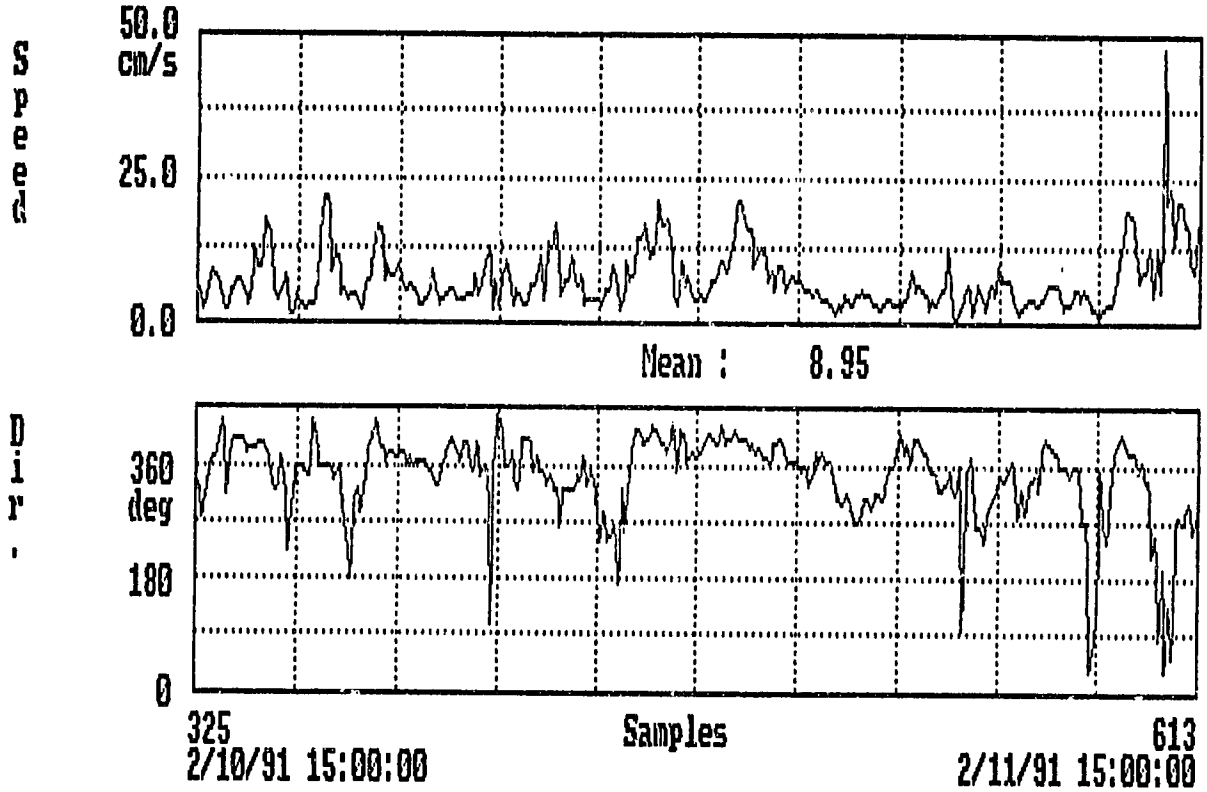


Figure B-15b. Current speed and direction, data set NORTH 2.

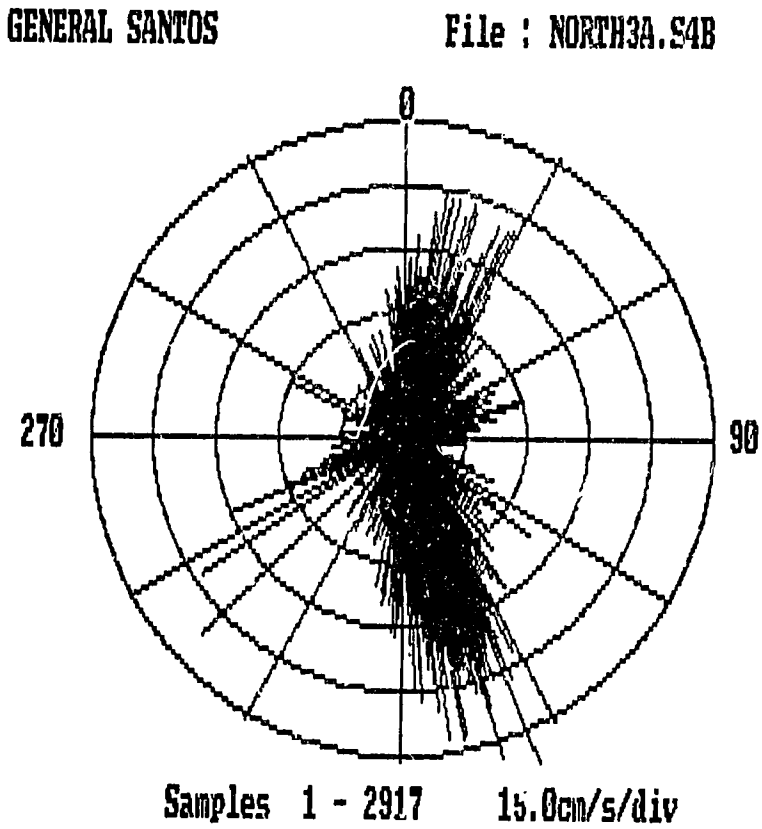


Figure B-16. Polar histogram of current speed and direction, data set NORTH 3 11-21 February 1991.

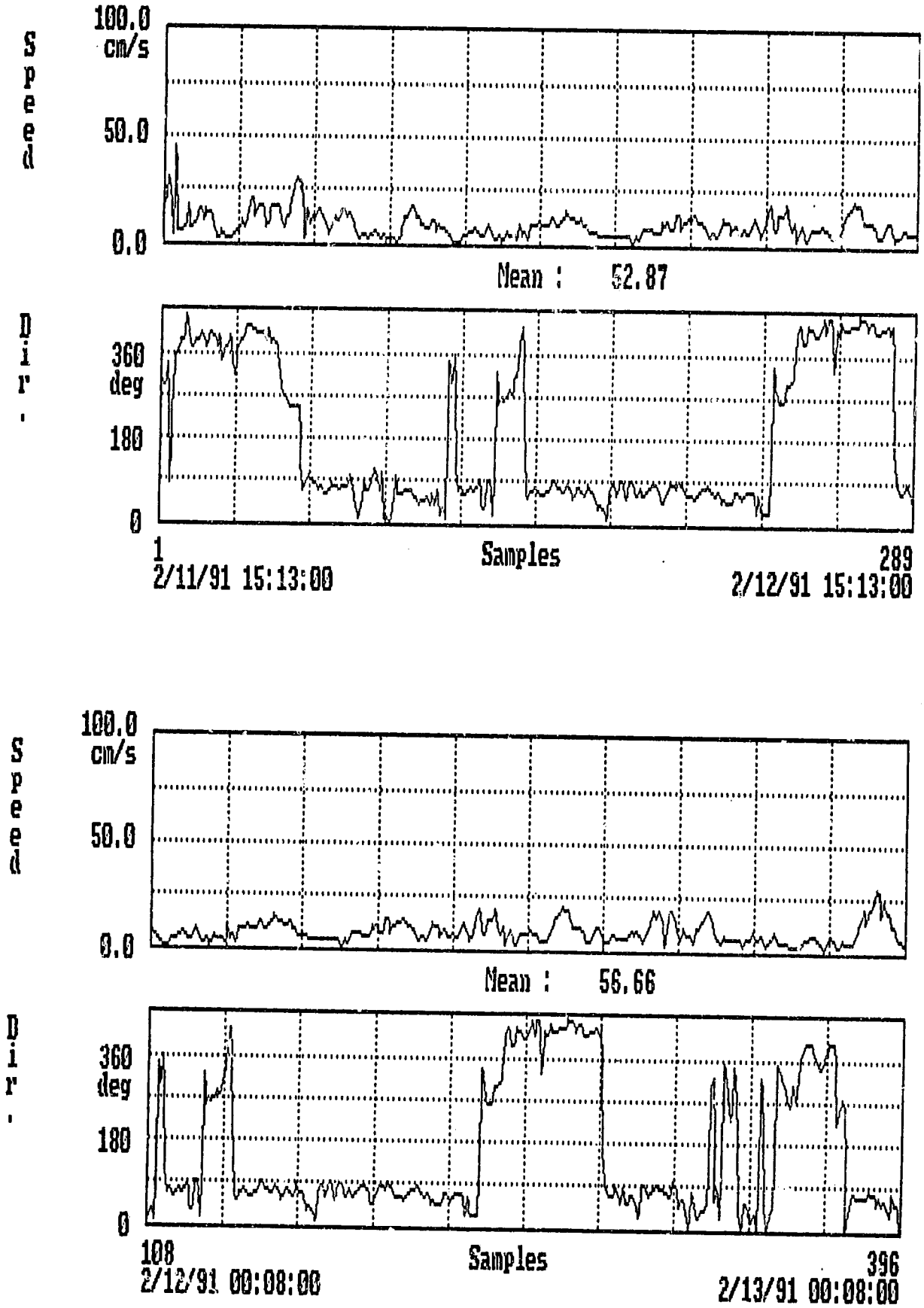


Figure B-17a. Current speed and direction, data set NORTH 3.

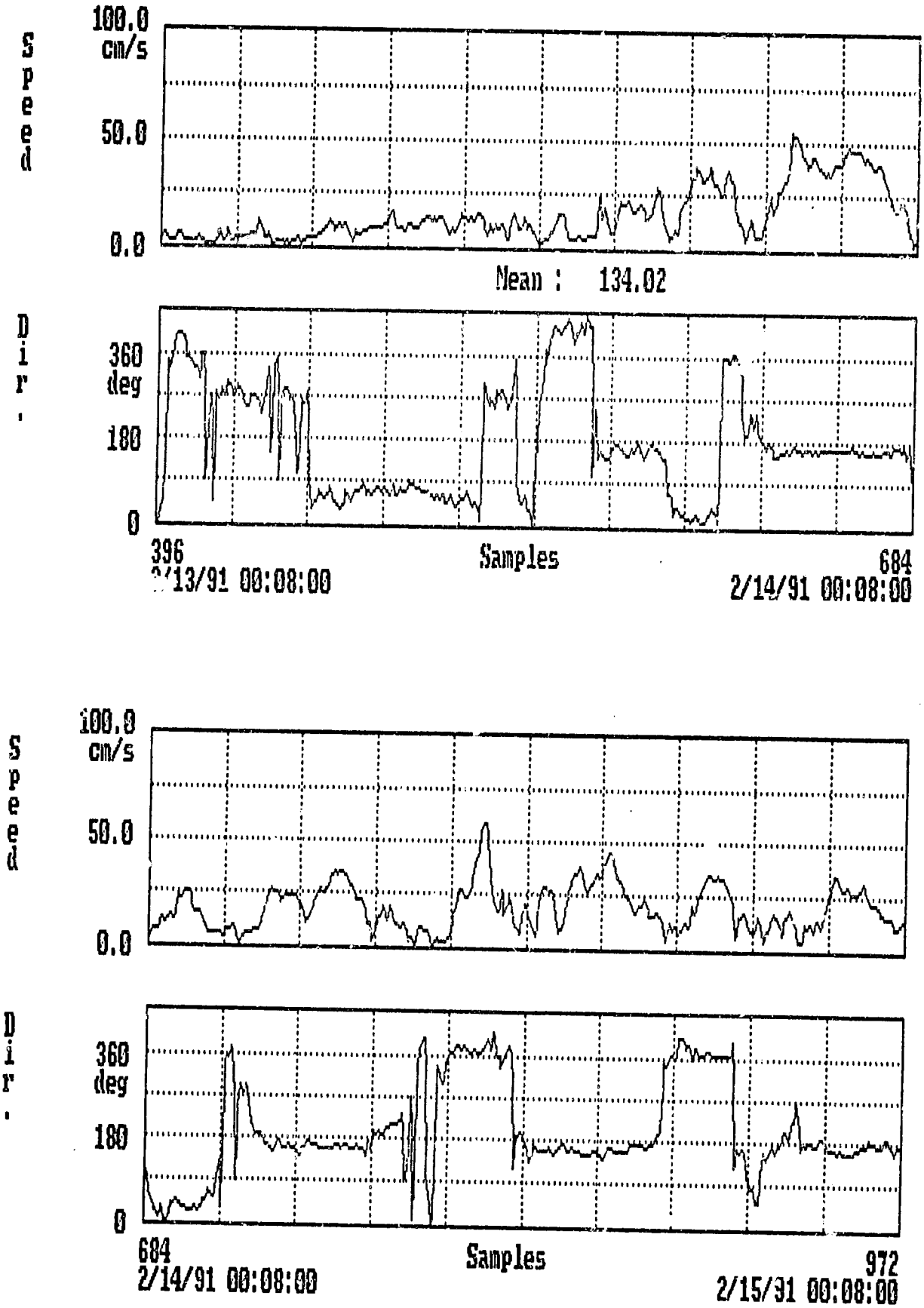
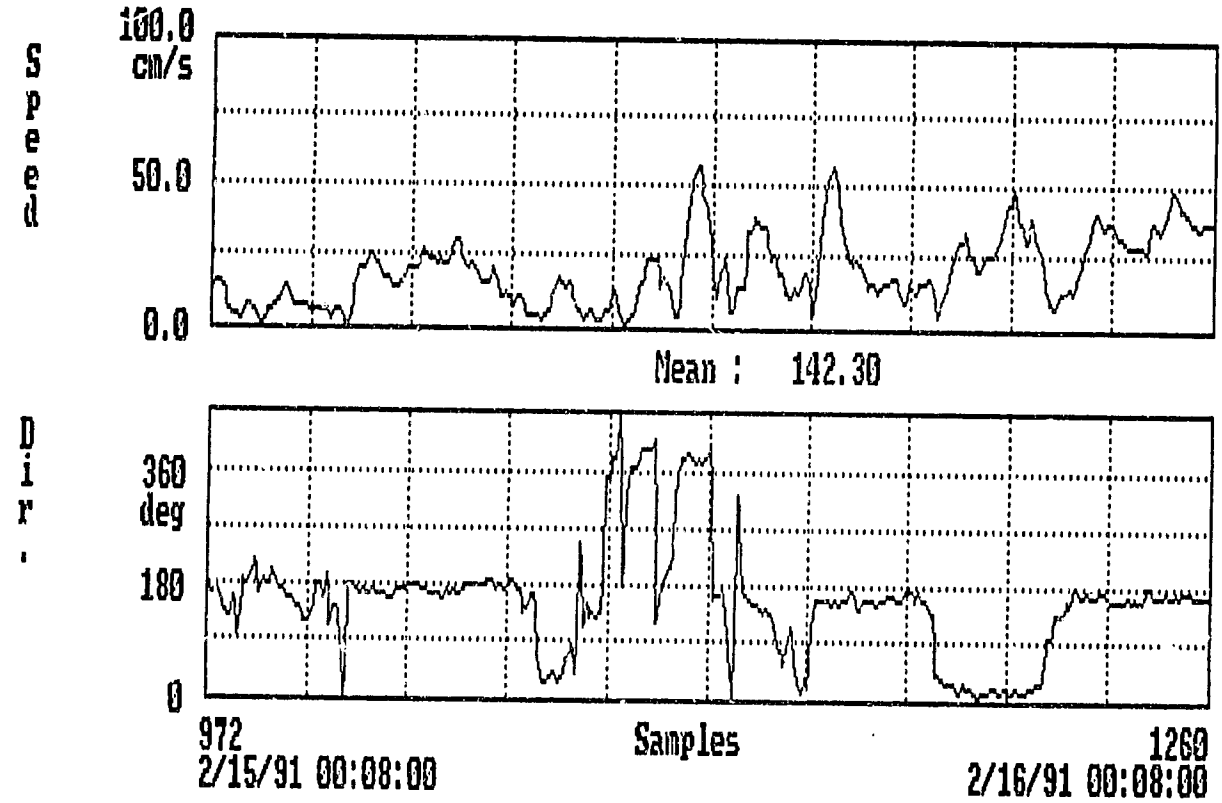


Figure B-17b. Current speed and direction, data set NORTH 3.



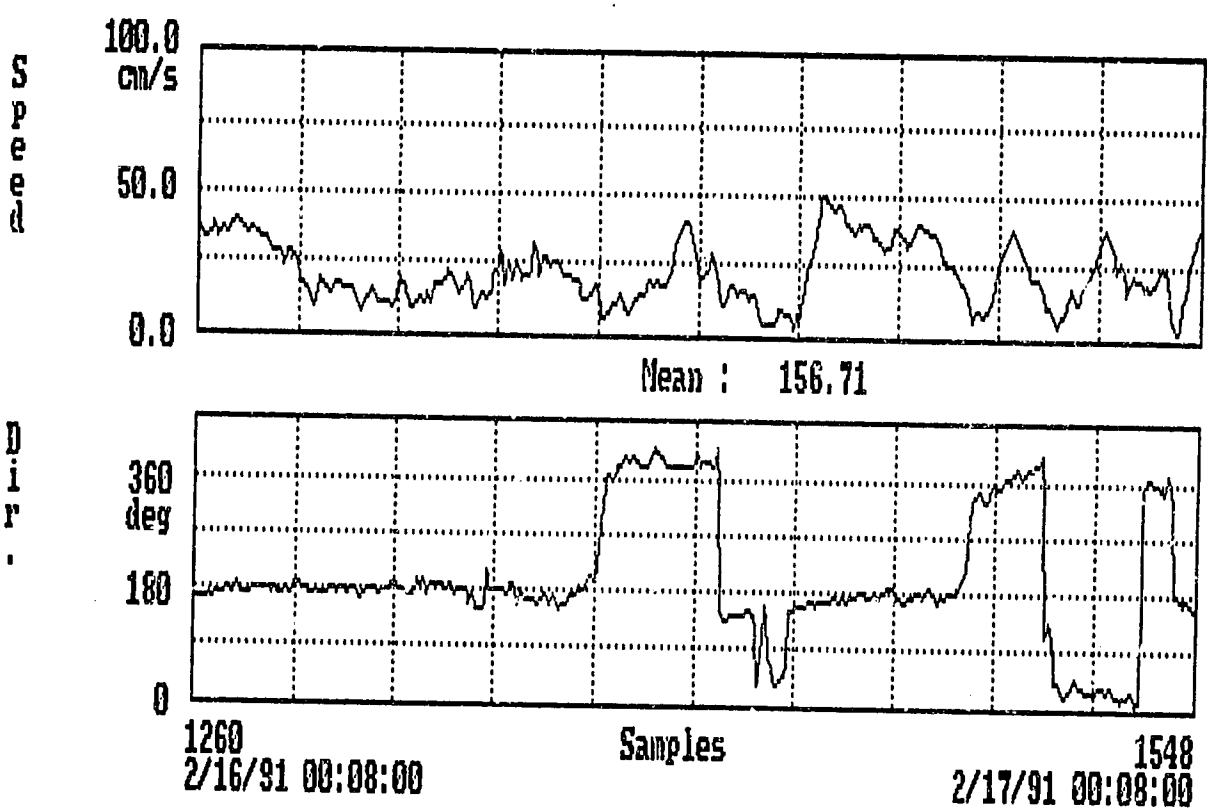
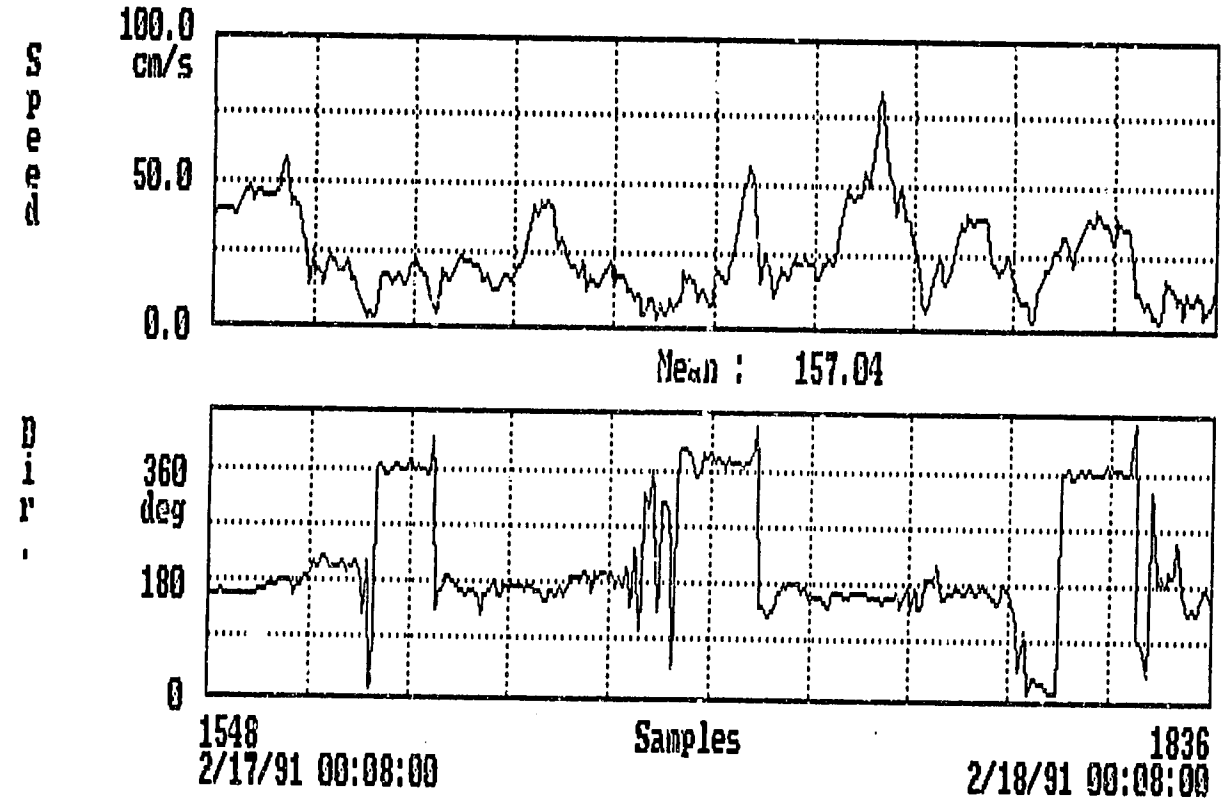


Figure B-17c. Current speed and direction, data set NORTH 3.



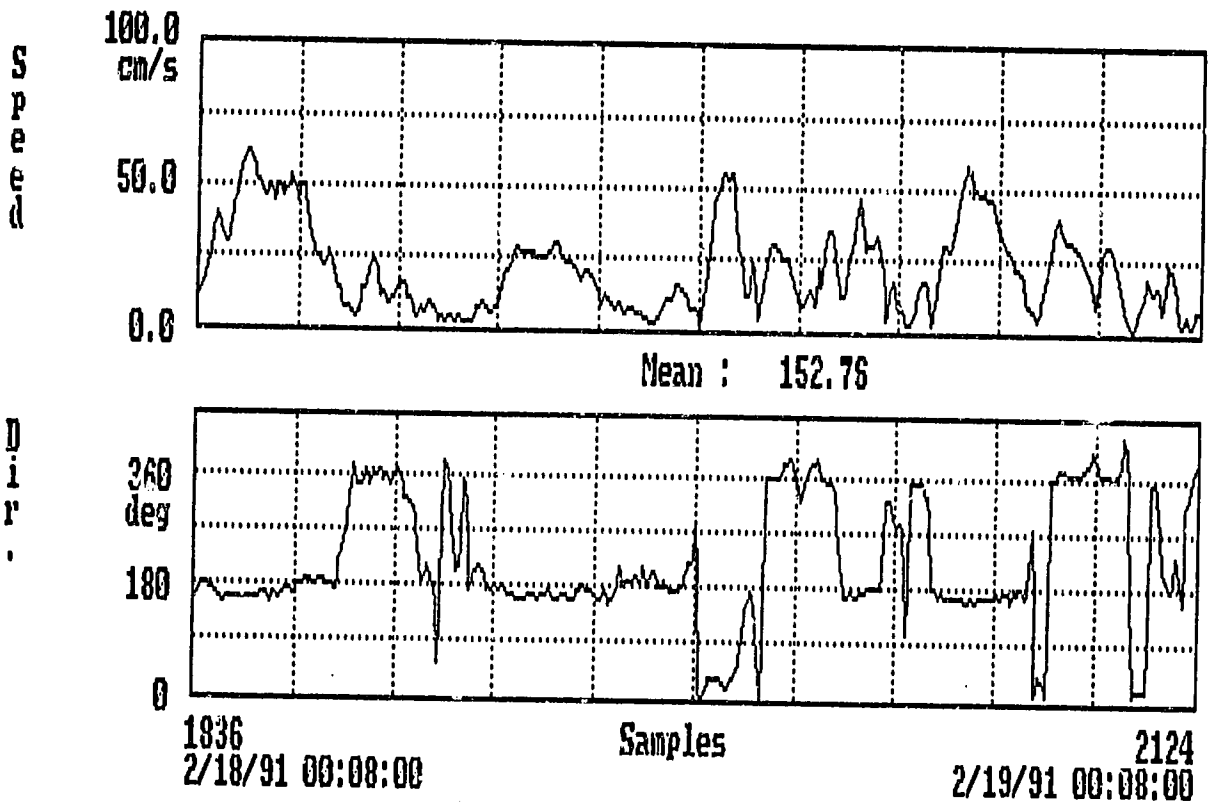
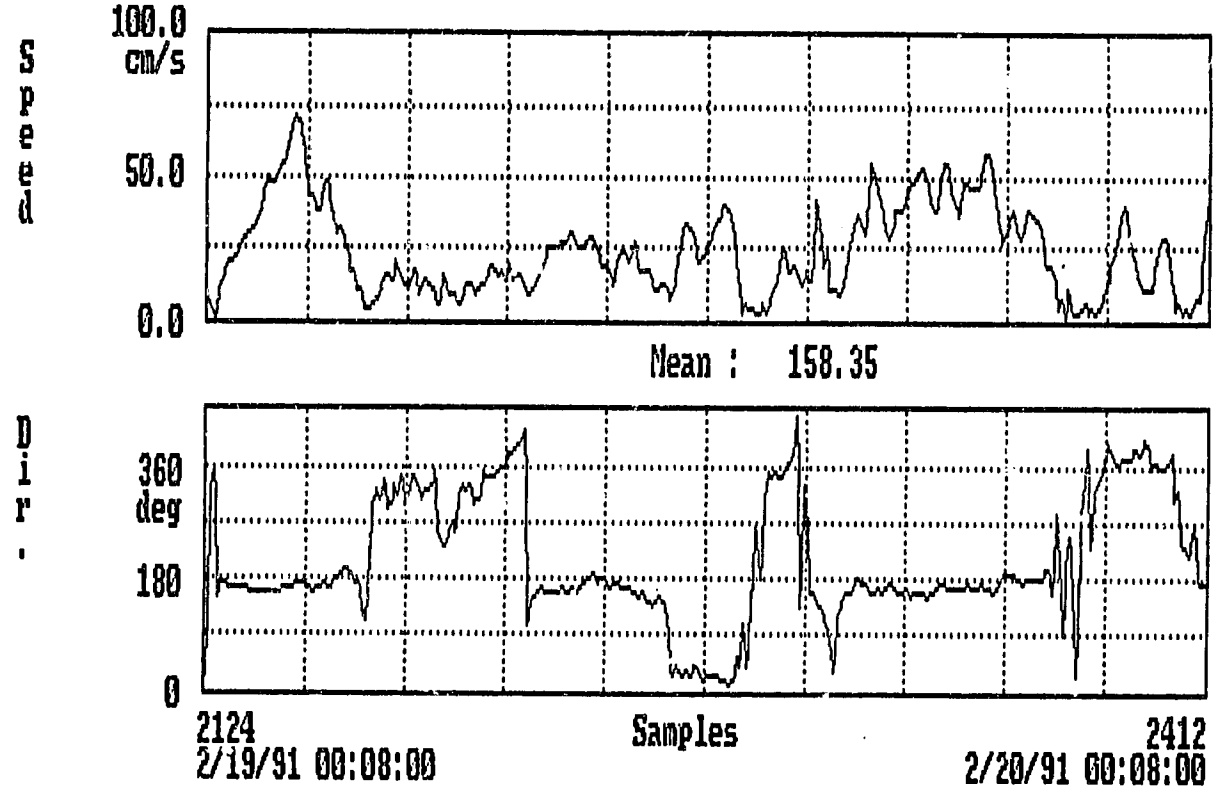


Figure B-17d. Current speed and direction, data set NORTH 3.



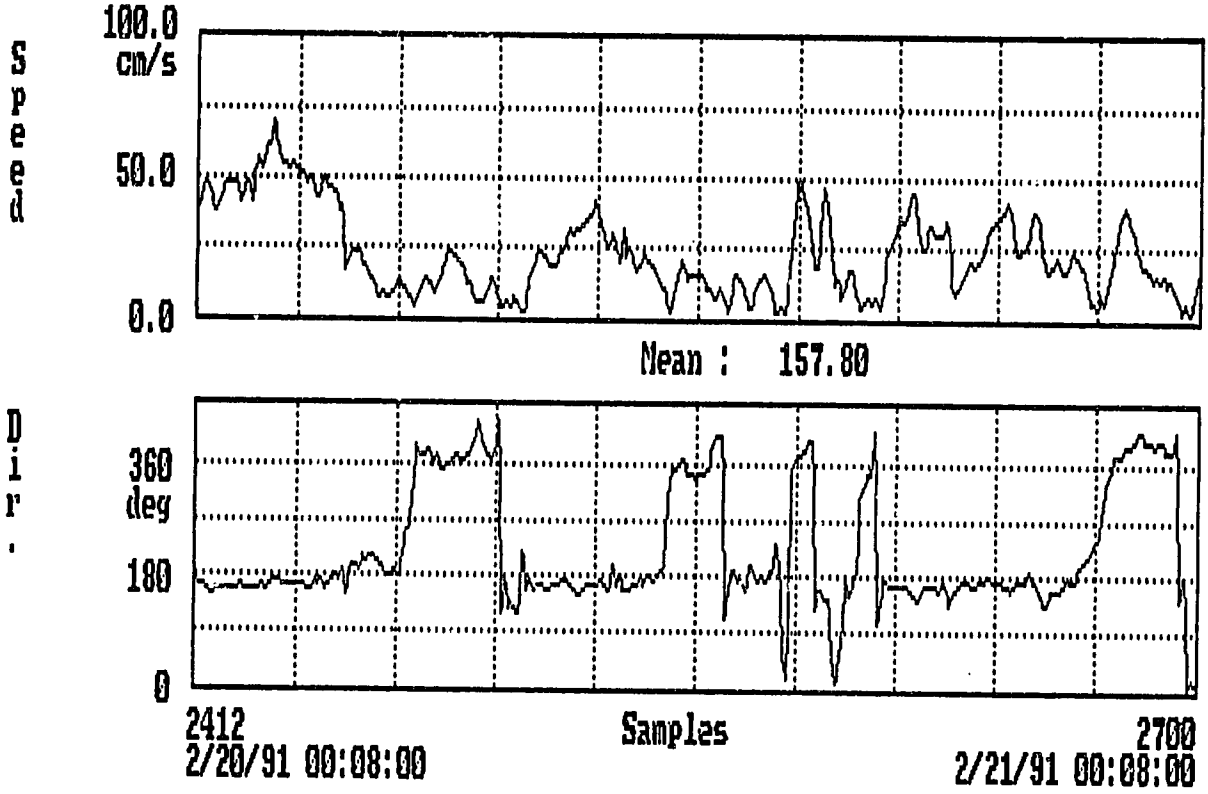


Figure B-17e. Current speed and direction, data set NORTH 3.

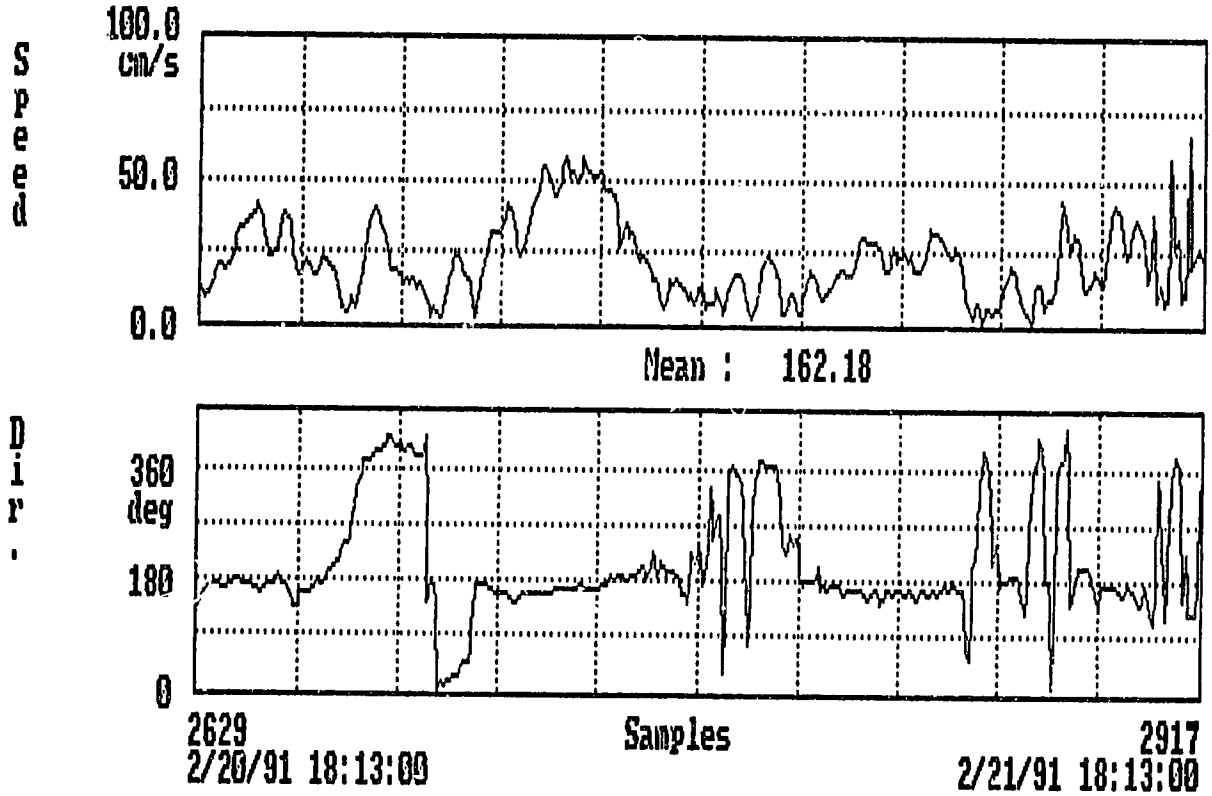
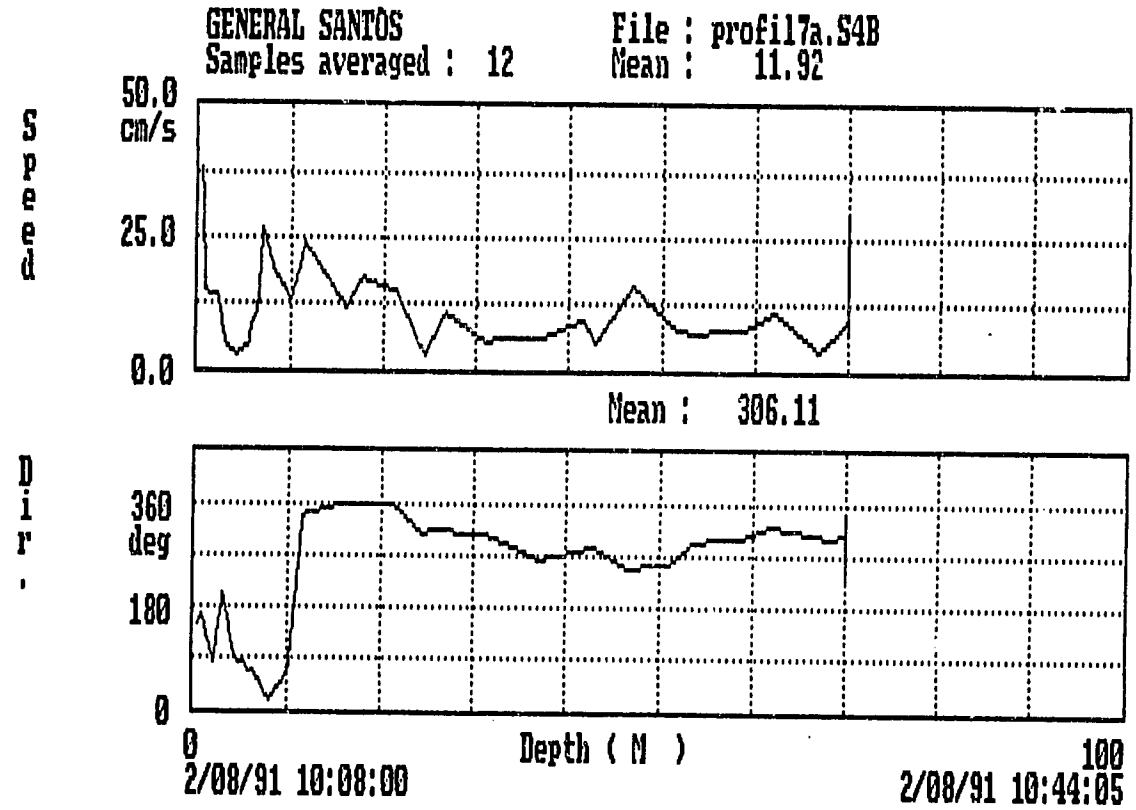


Figure B-17f. Current speed and direction, data set NORTH 3.



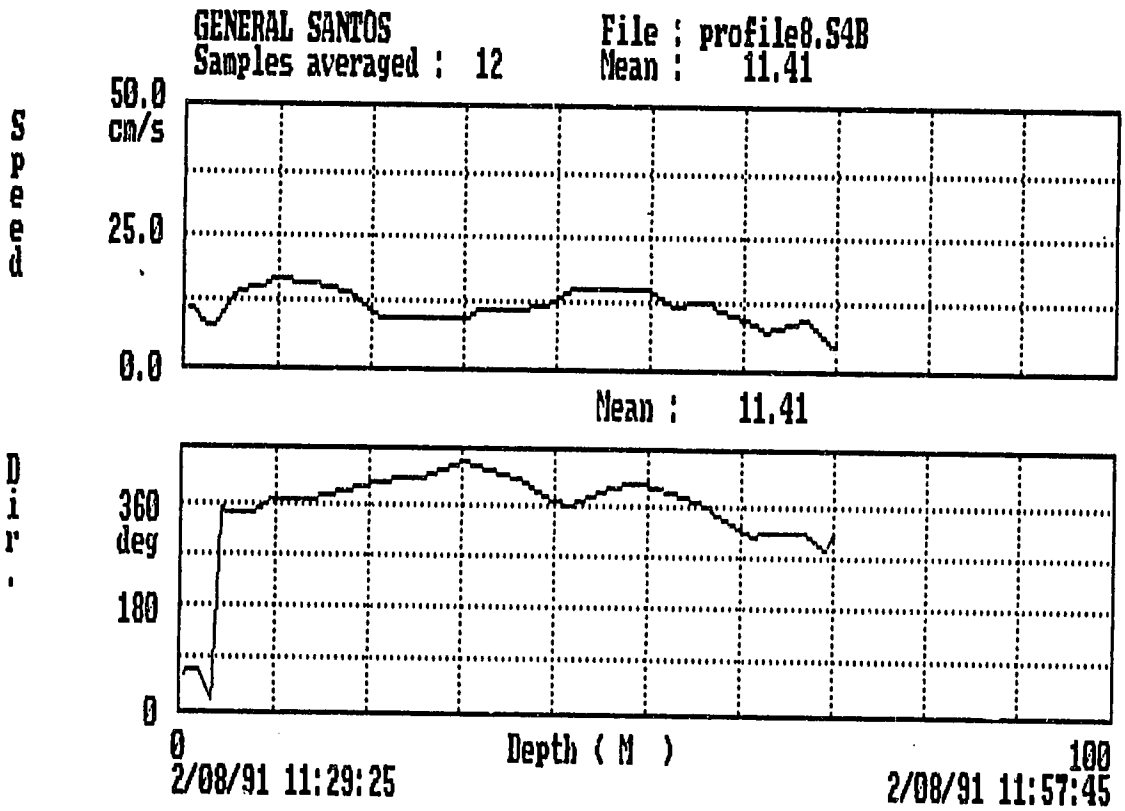
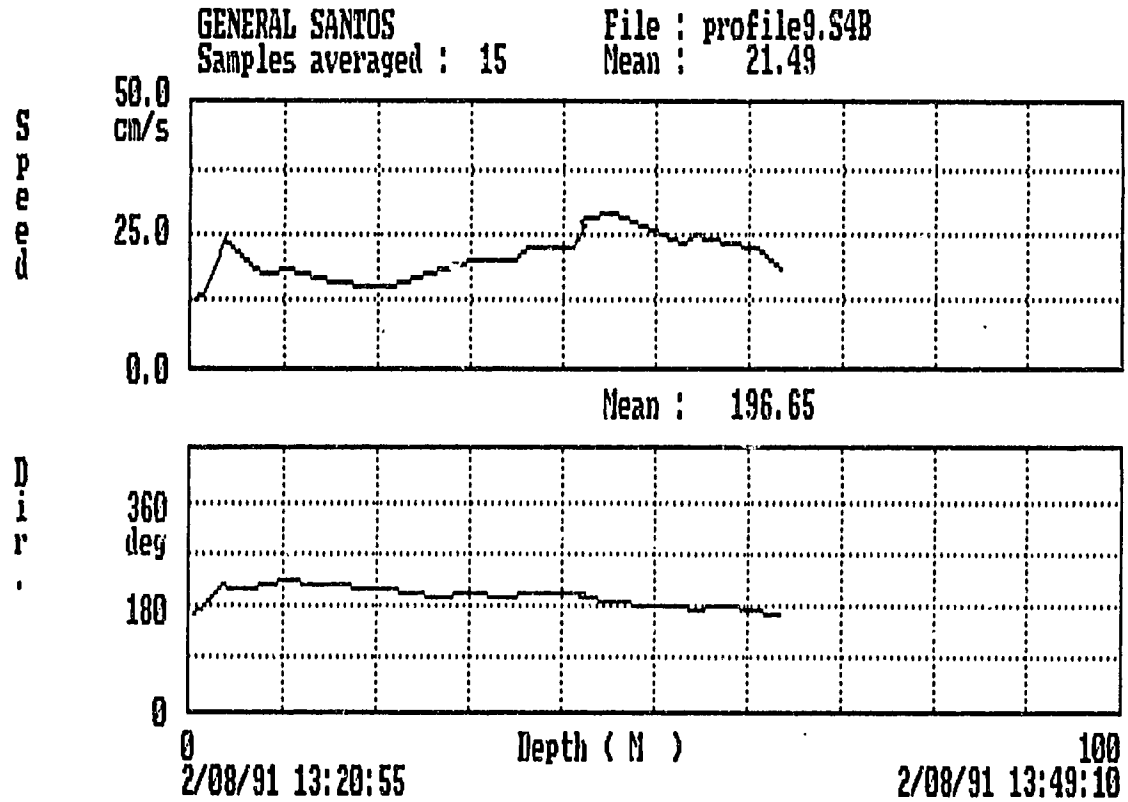


Figure B-18. Current speed and direction profiles 7 and 8.



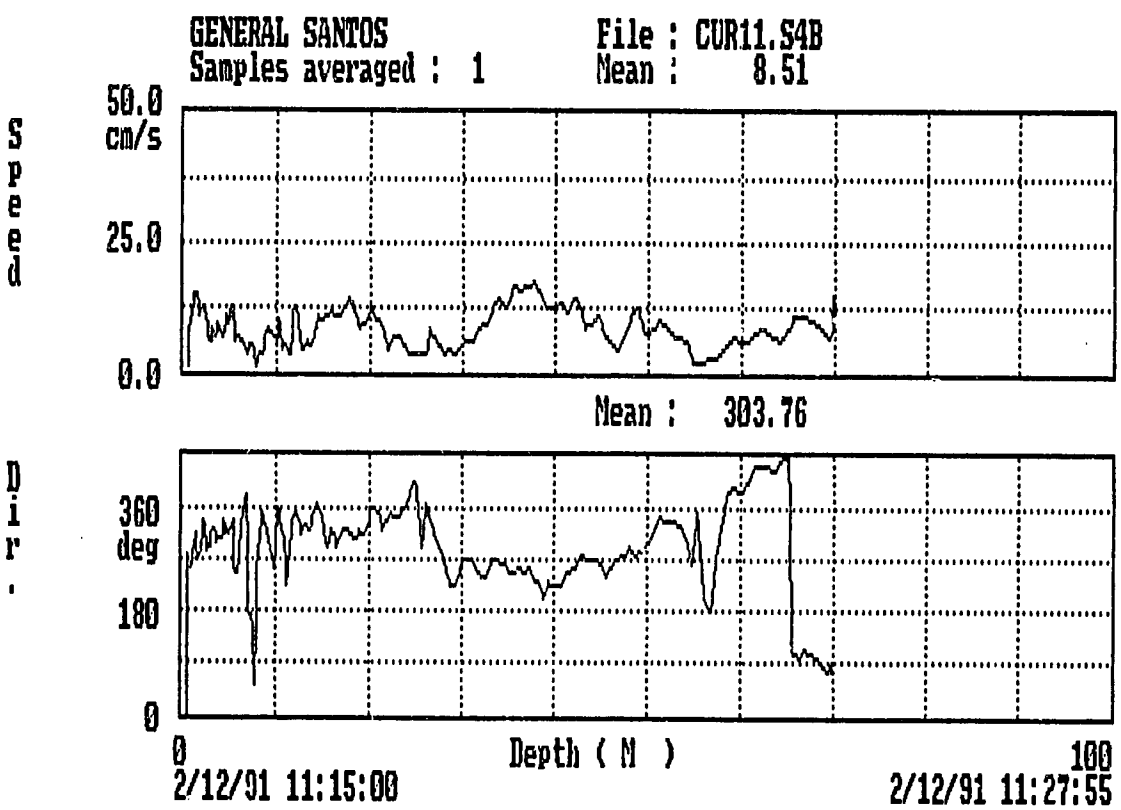
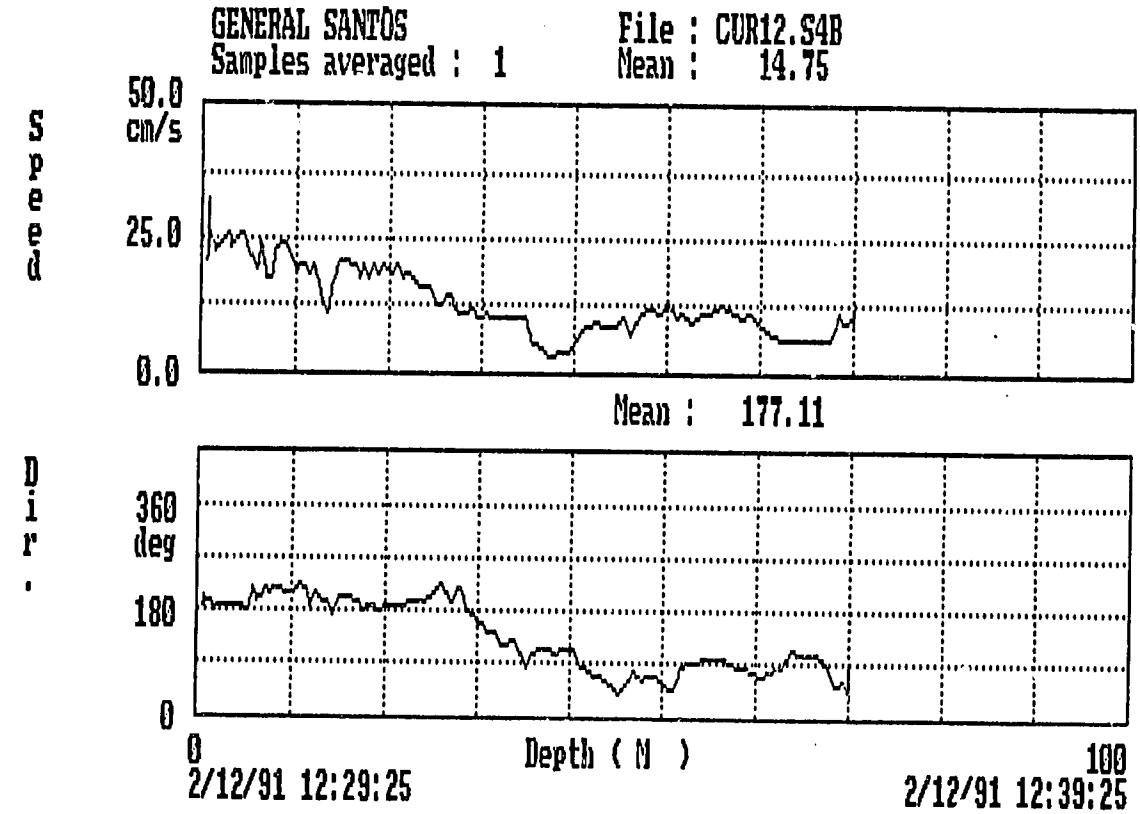


Figure B-19. Current speed and direction profiles 9 and 11.



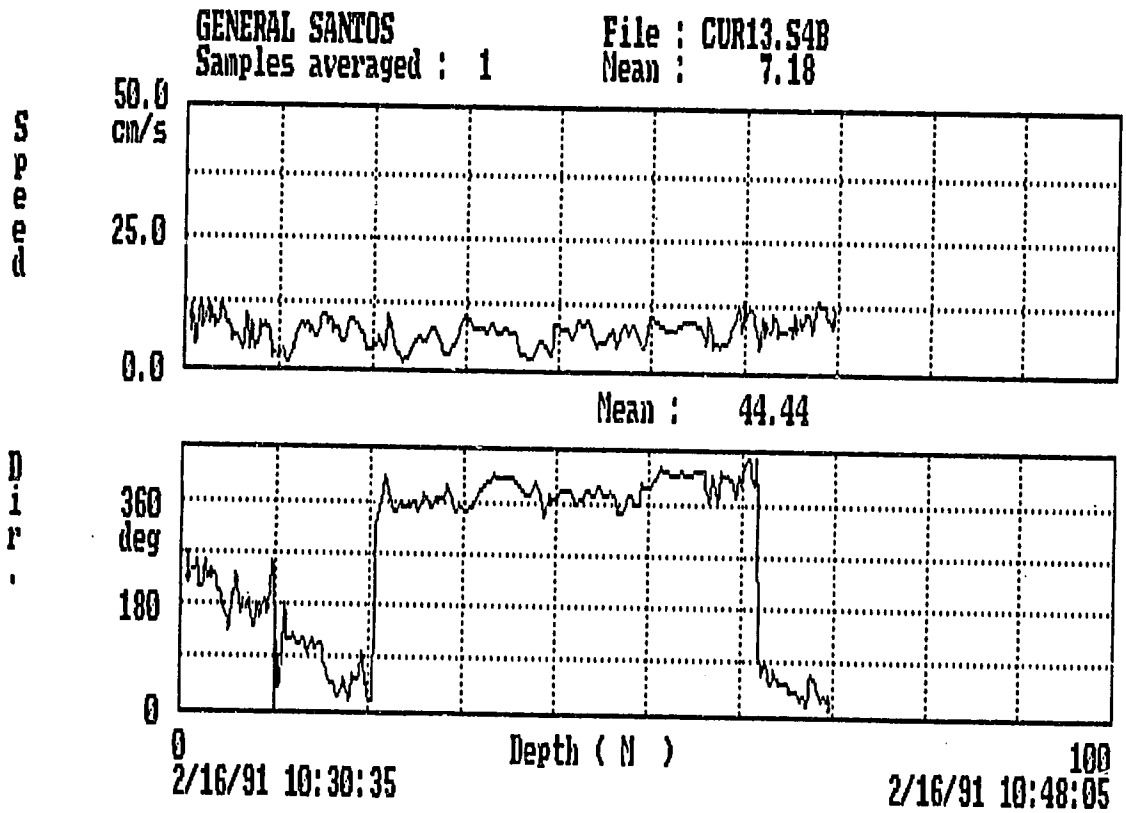
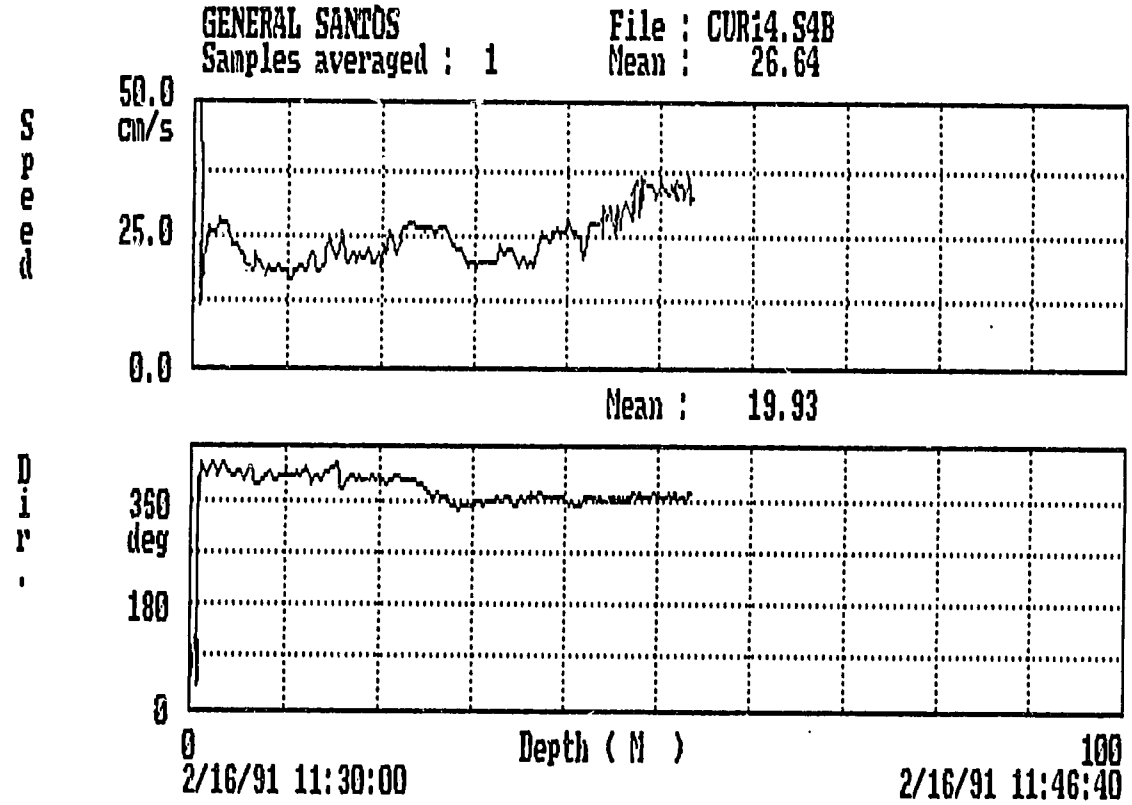


Figure B-20. Current speed and direction profiles 12 and 13.



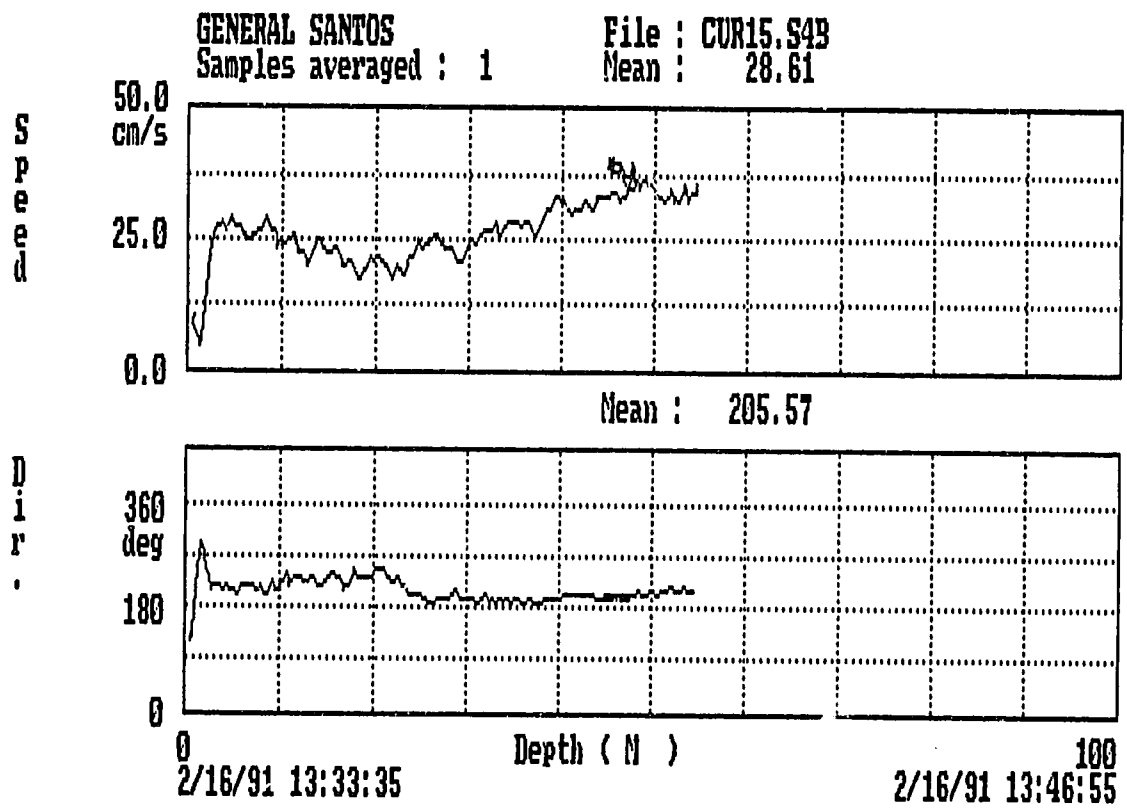
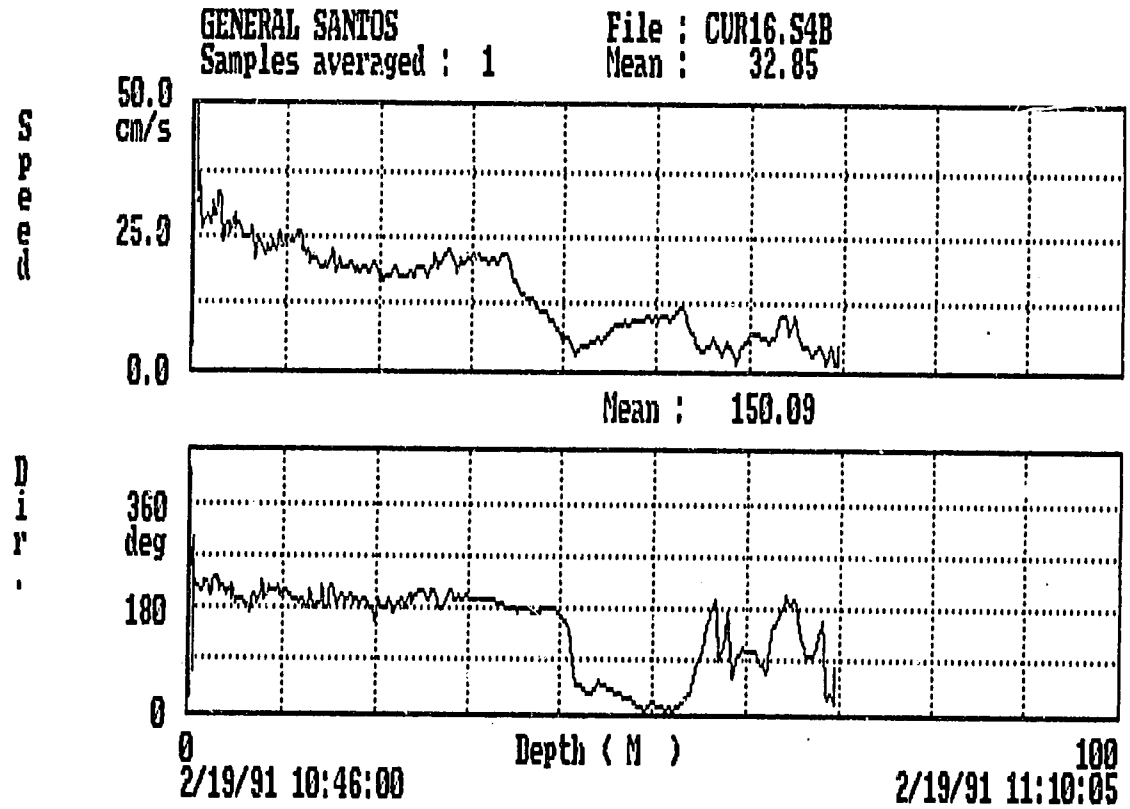


Figure B-21. Current speed and direction profiles 14 and 15.



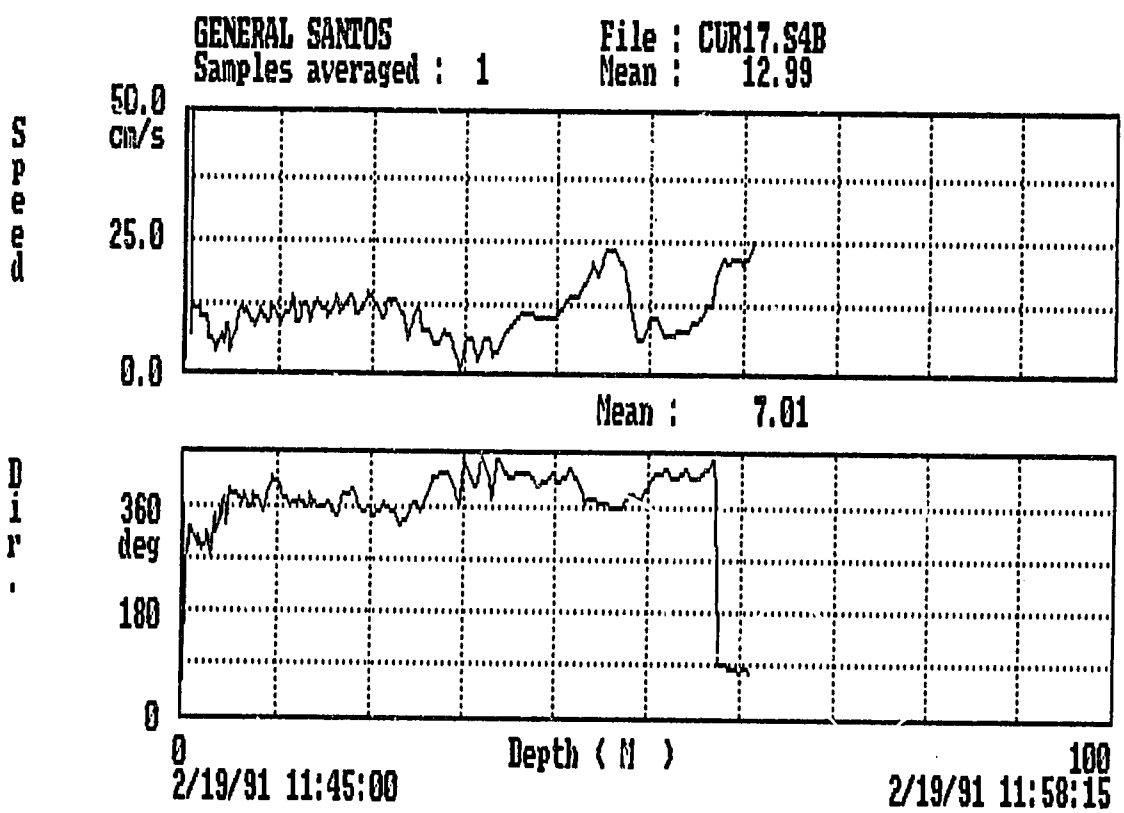


Figure B-22. Current speed and direction profiles 16 and 17.

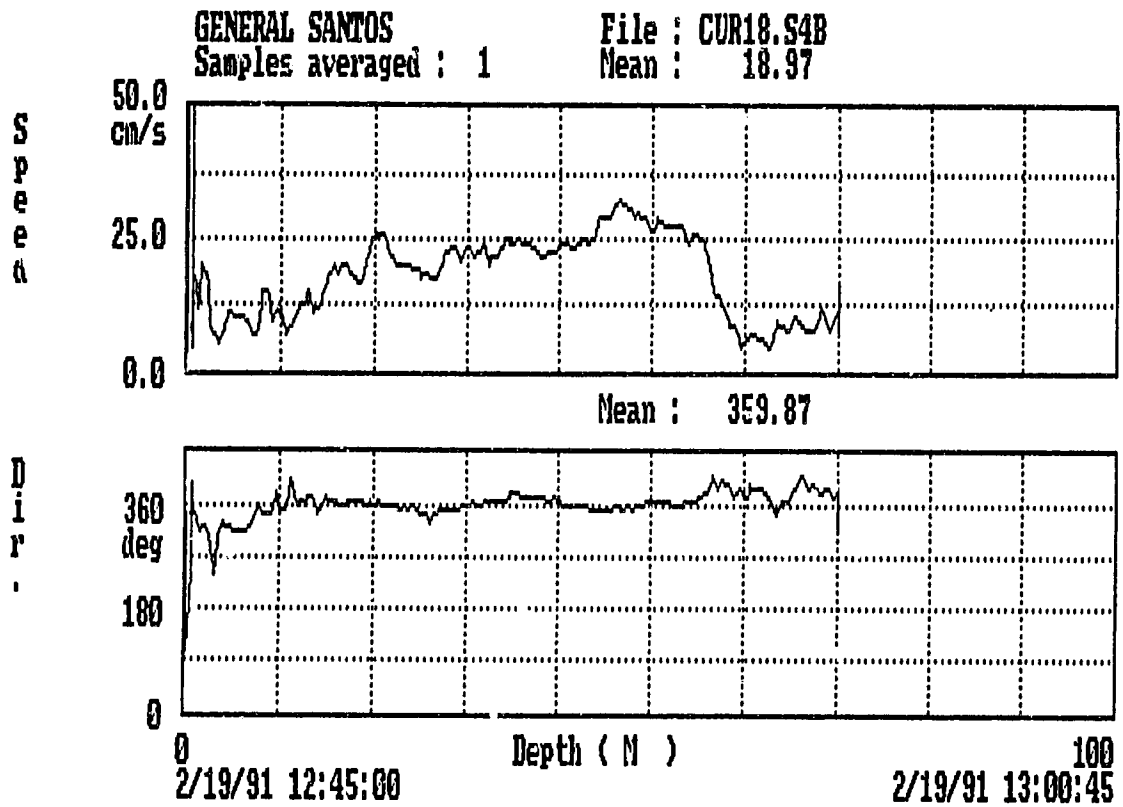
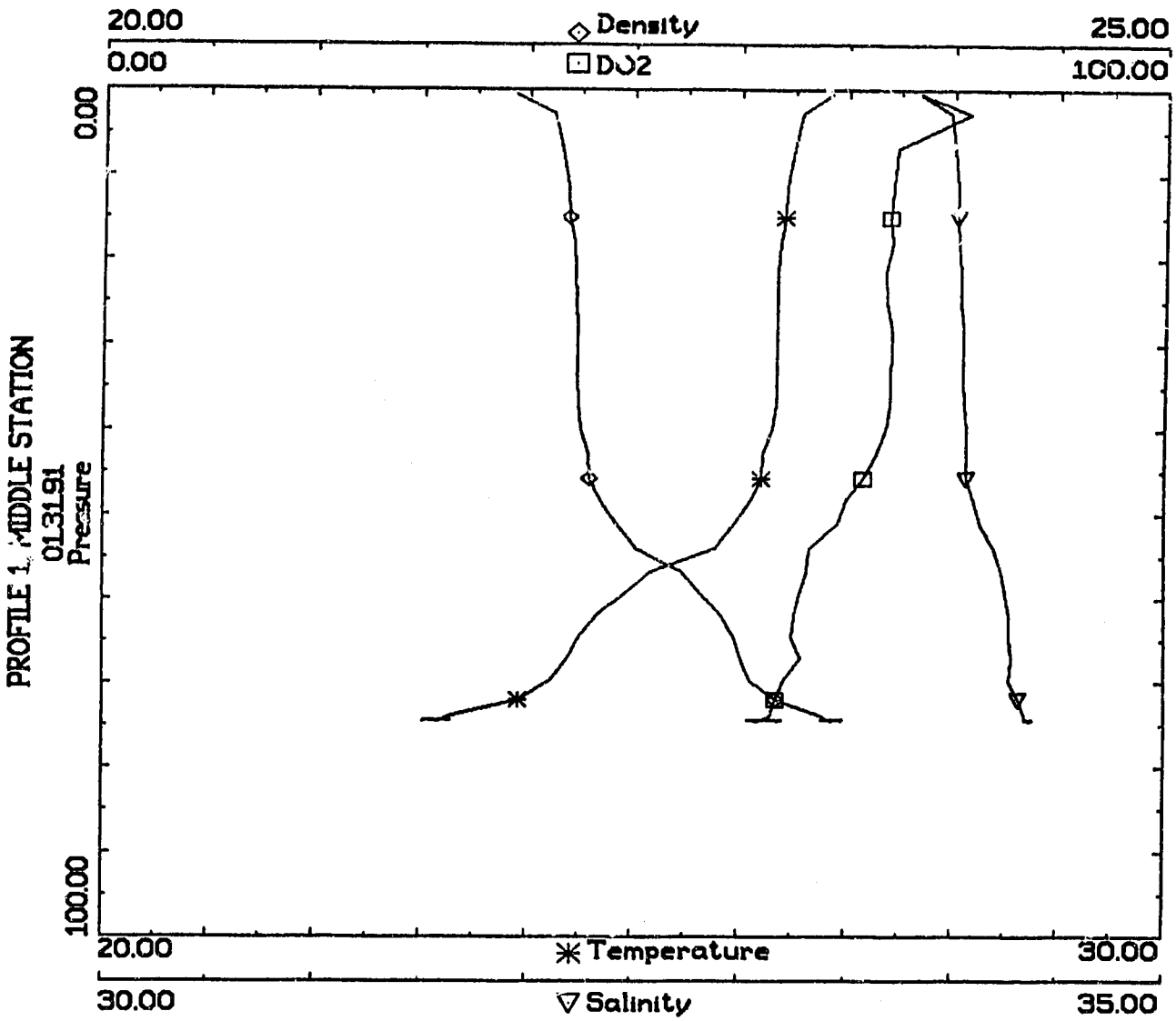
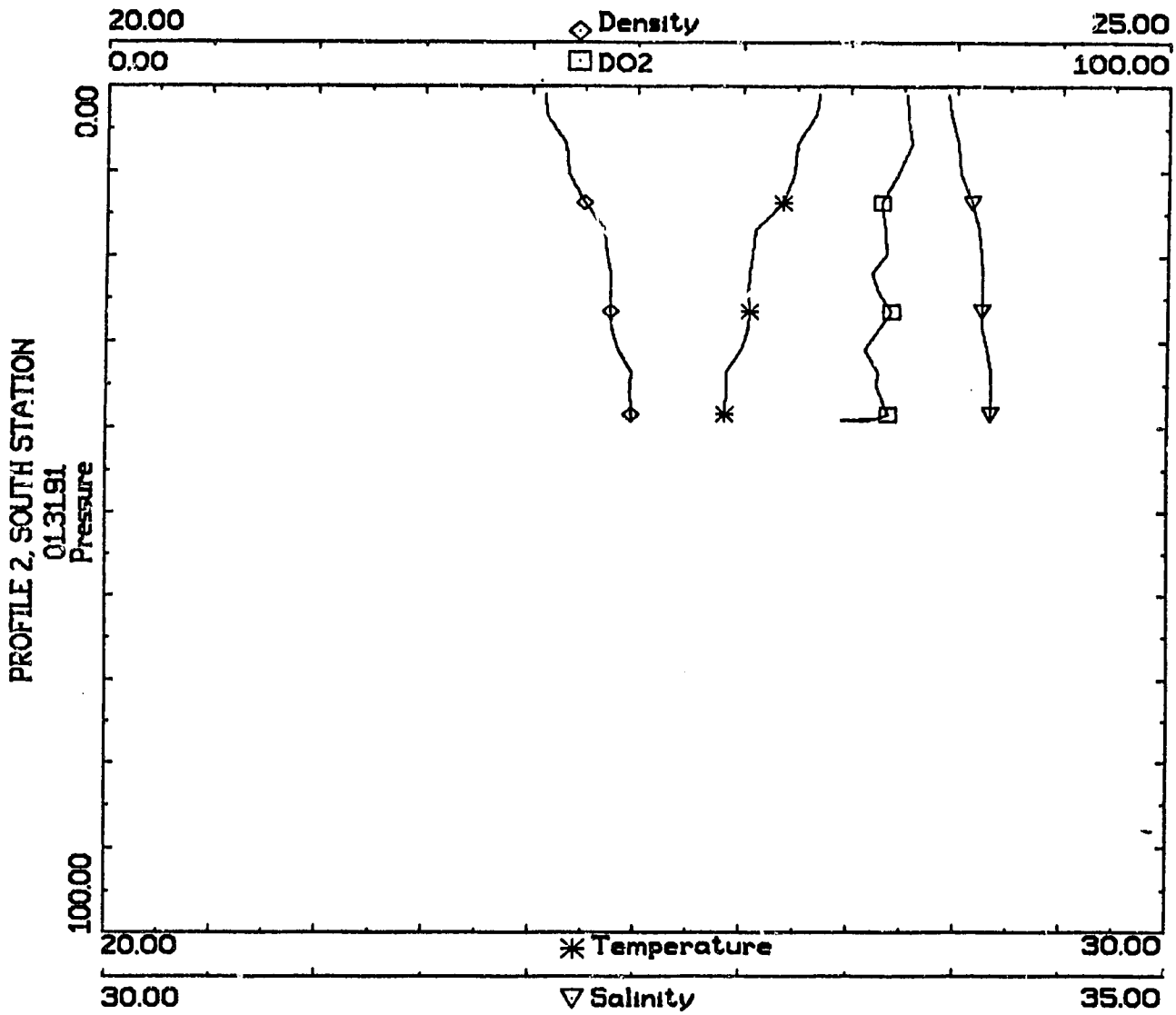


Figure B-23. Current speed and direction profile 18.



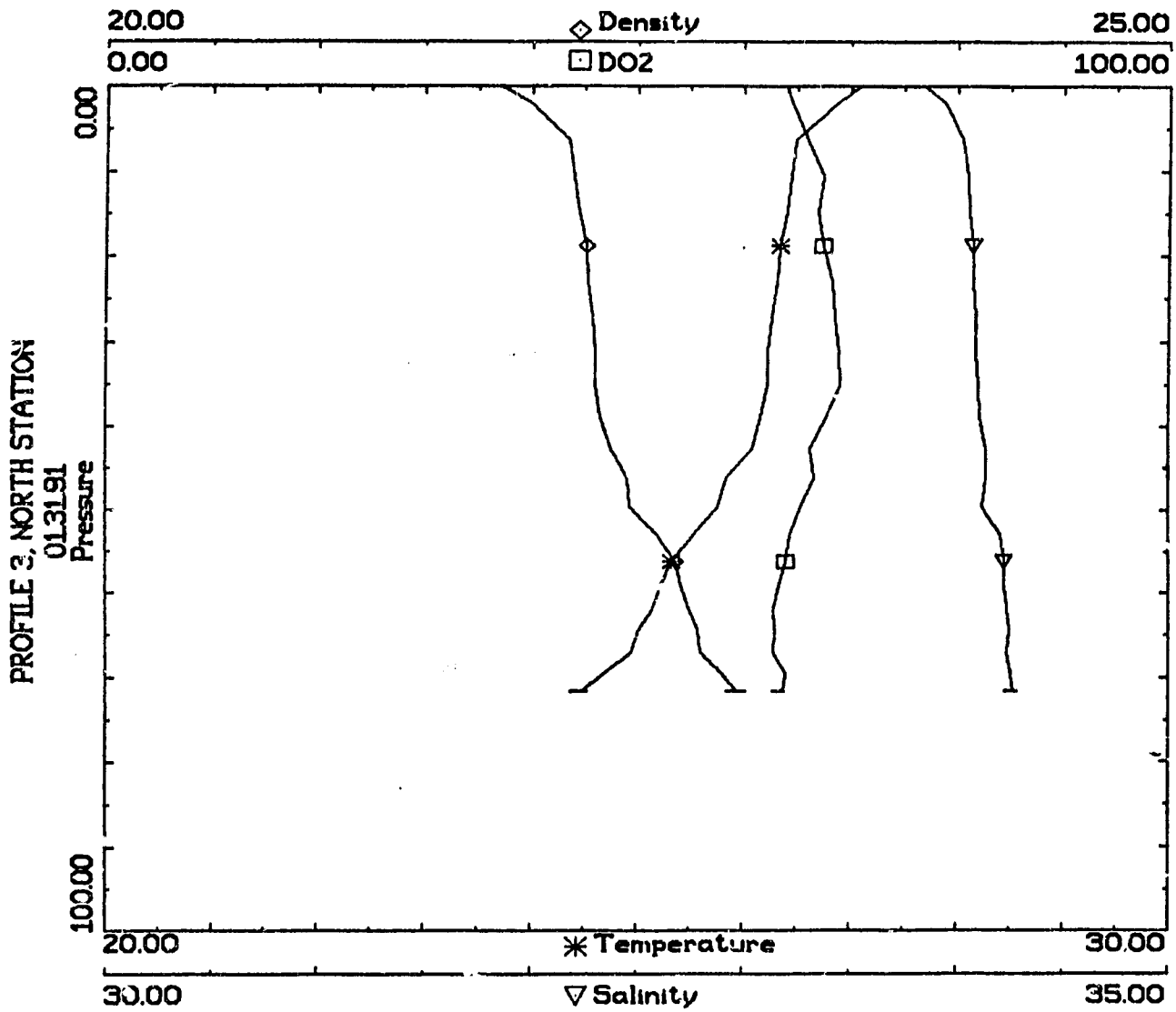
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-24. STD-DO profile 1, 31 January '91, Middle station.



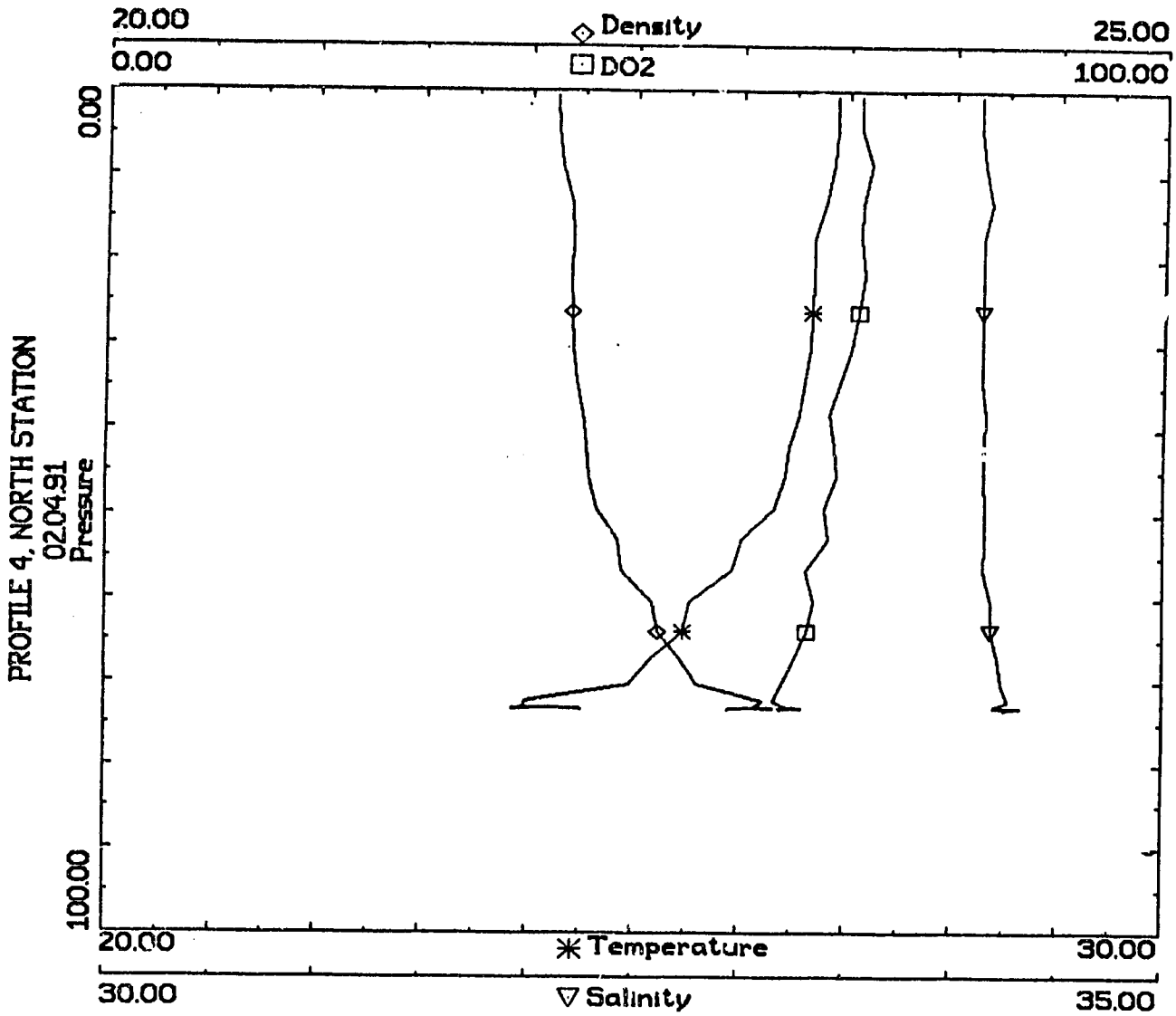
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-25. STD-DO profile 2, 31 January '91, south station.



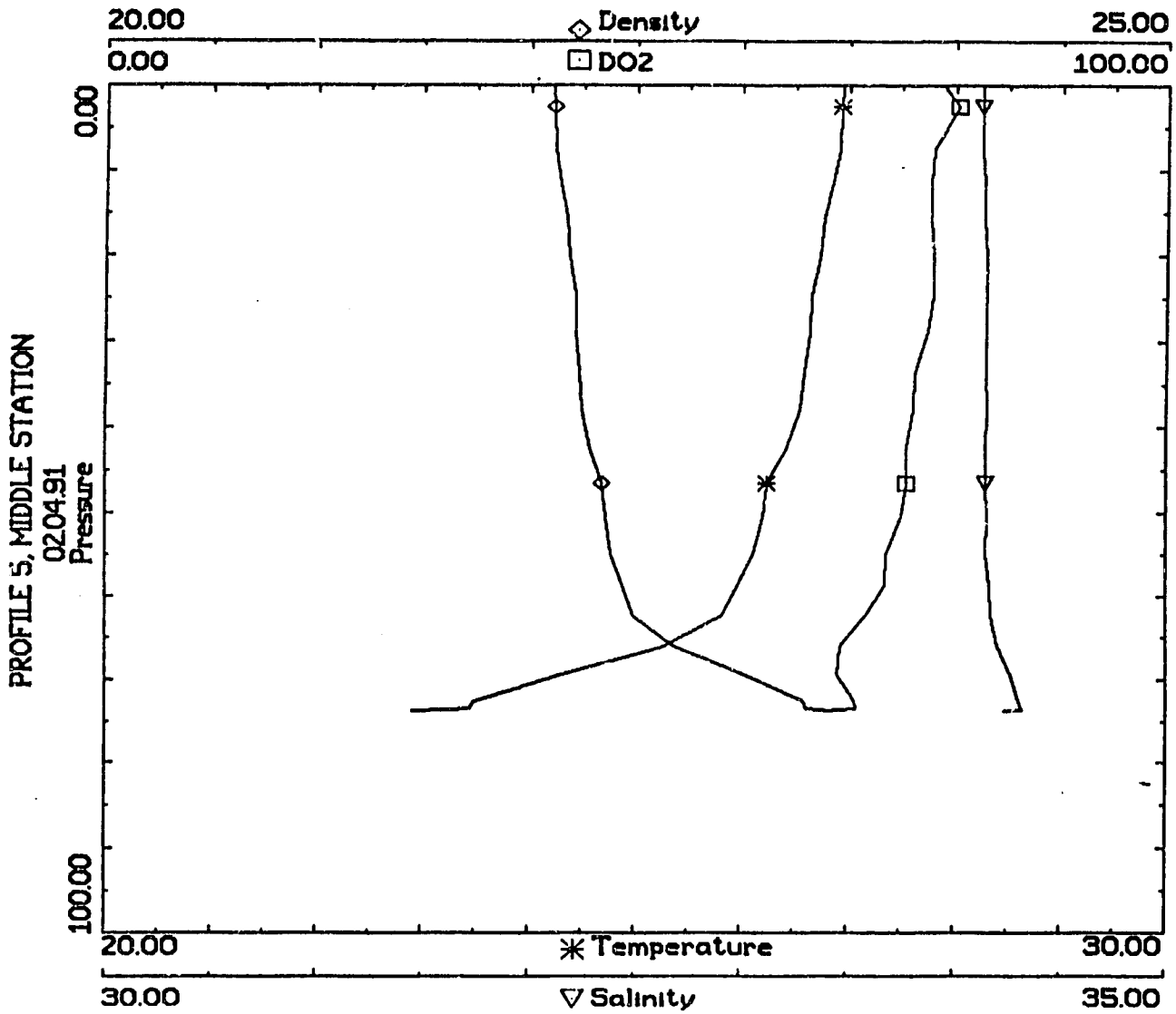
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-26, STD-DO profile 3, 31 January 1991, north station.



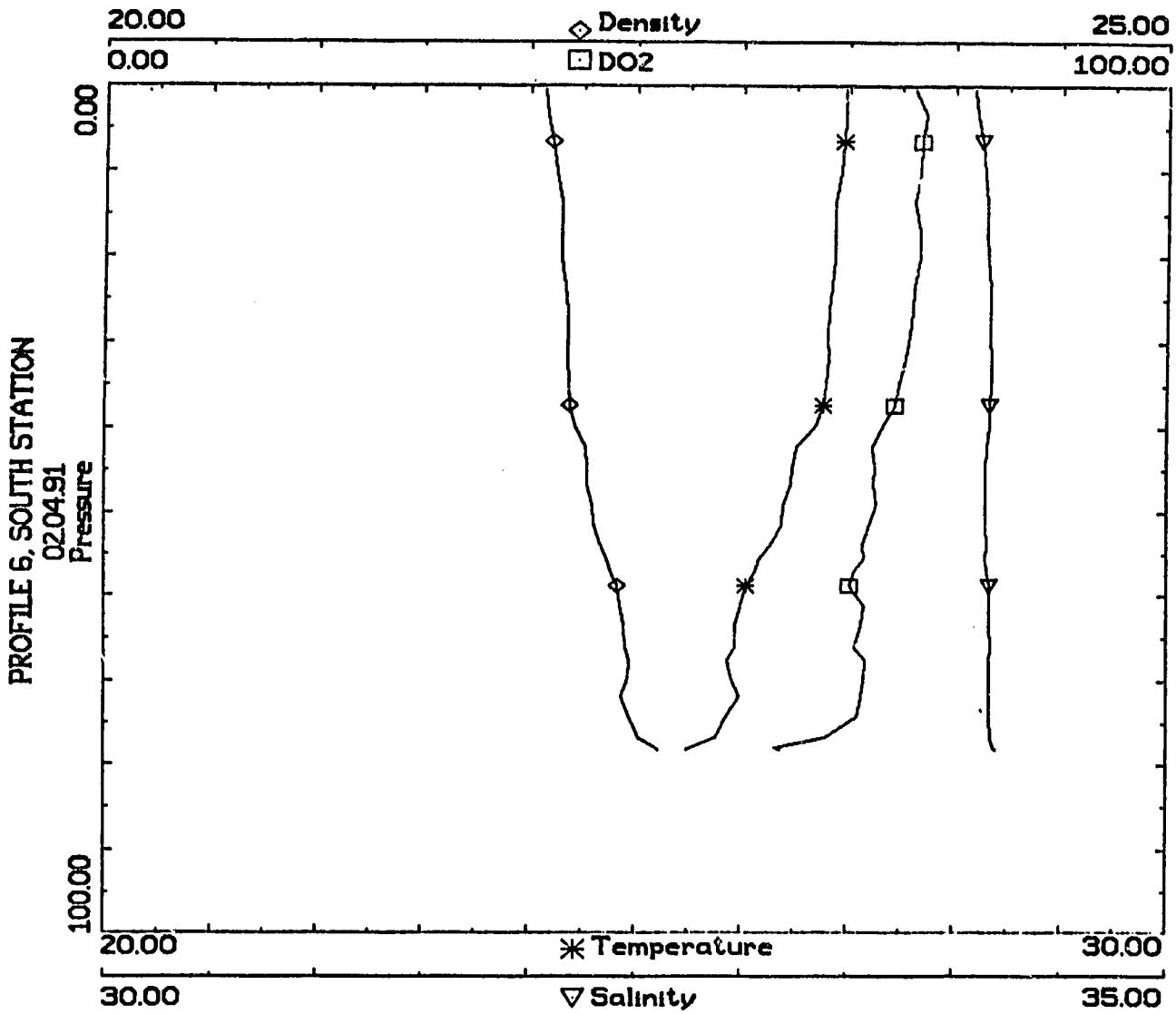
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-27. STD-DO profile 4, 4 February '91, north station.



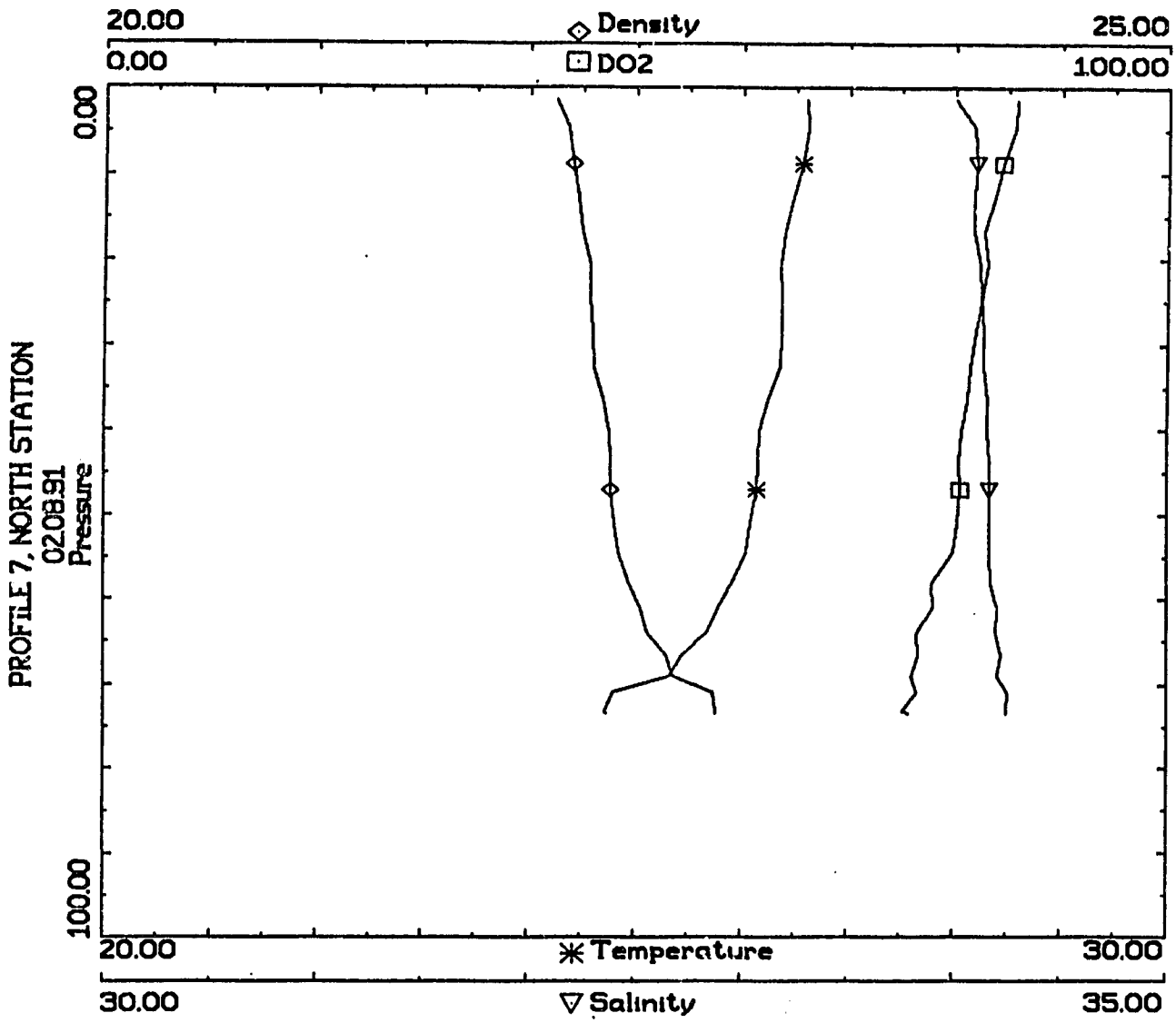
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-28. STD-DO profile 5, 4 February '91, middle station.



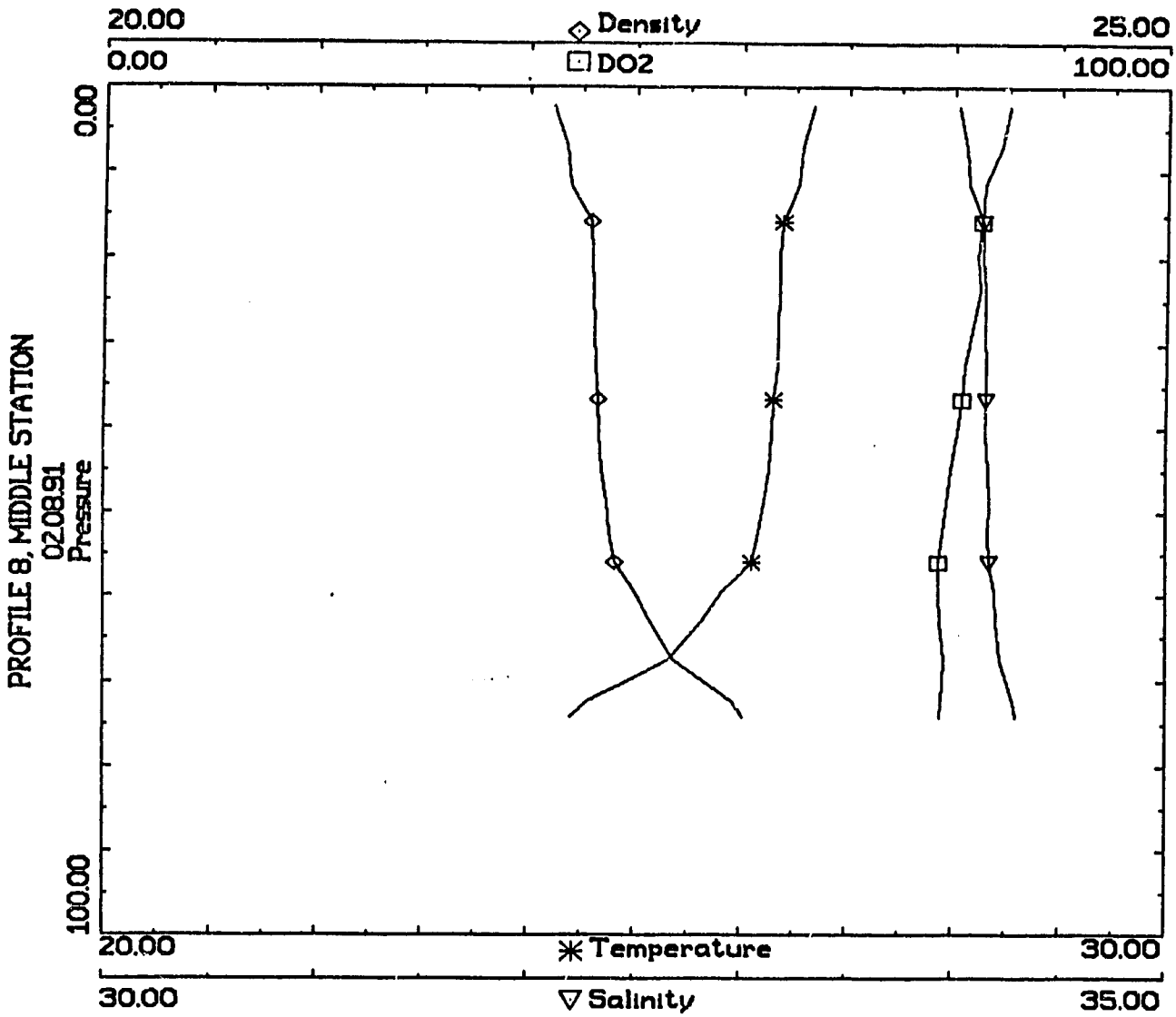
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-29. STD-DO profile 6, 4 February '91, south station.



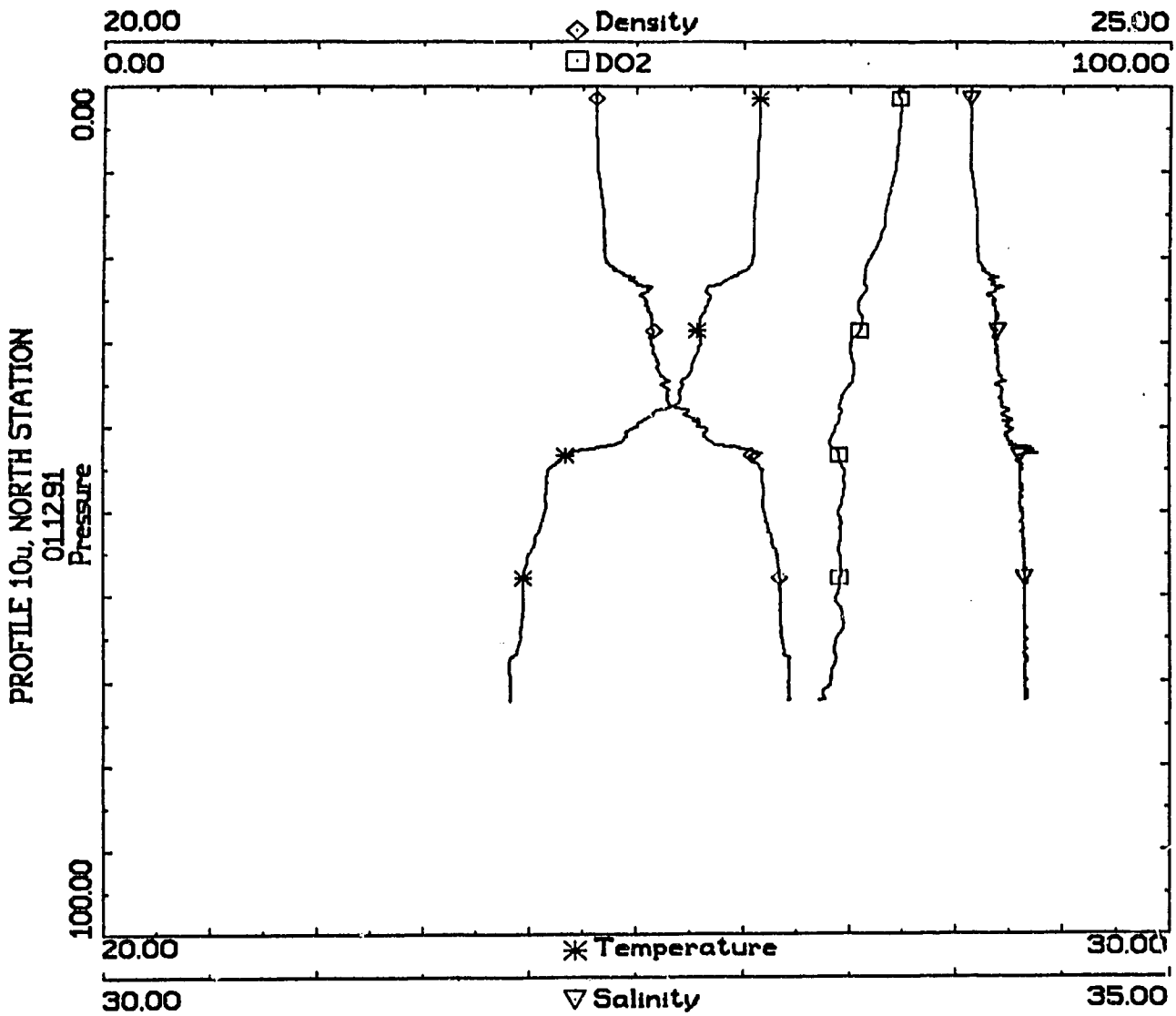
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-30. STD-DO profile 7, 8 February '91, north station.



Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

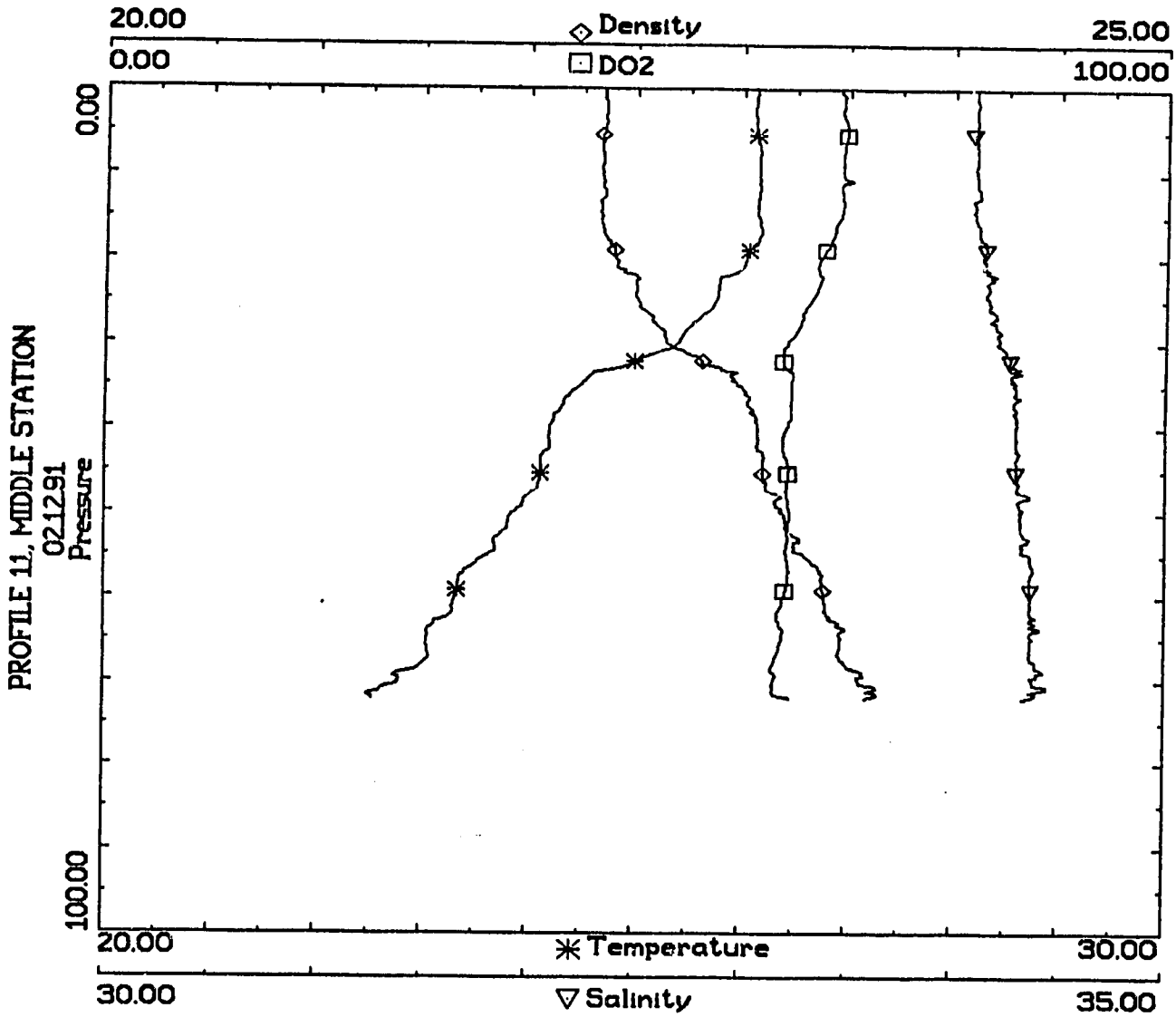
Figure B-31. STD-DO profile 8, 8 February '91, middle station.



Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-32. STD-DO profile 10, 12 February '91, north station.

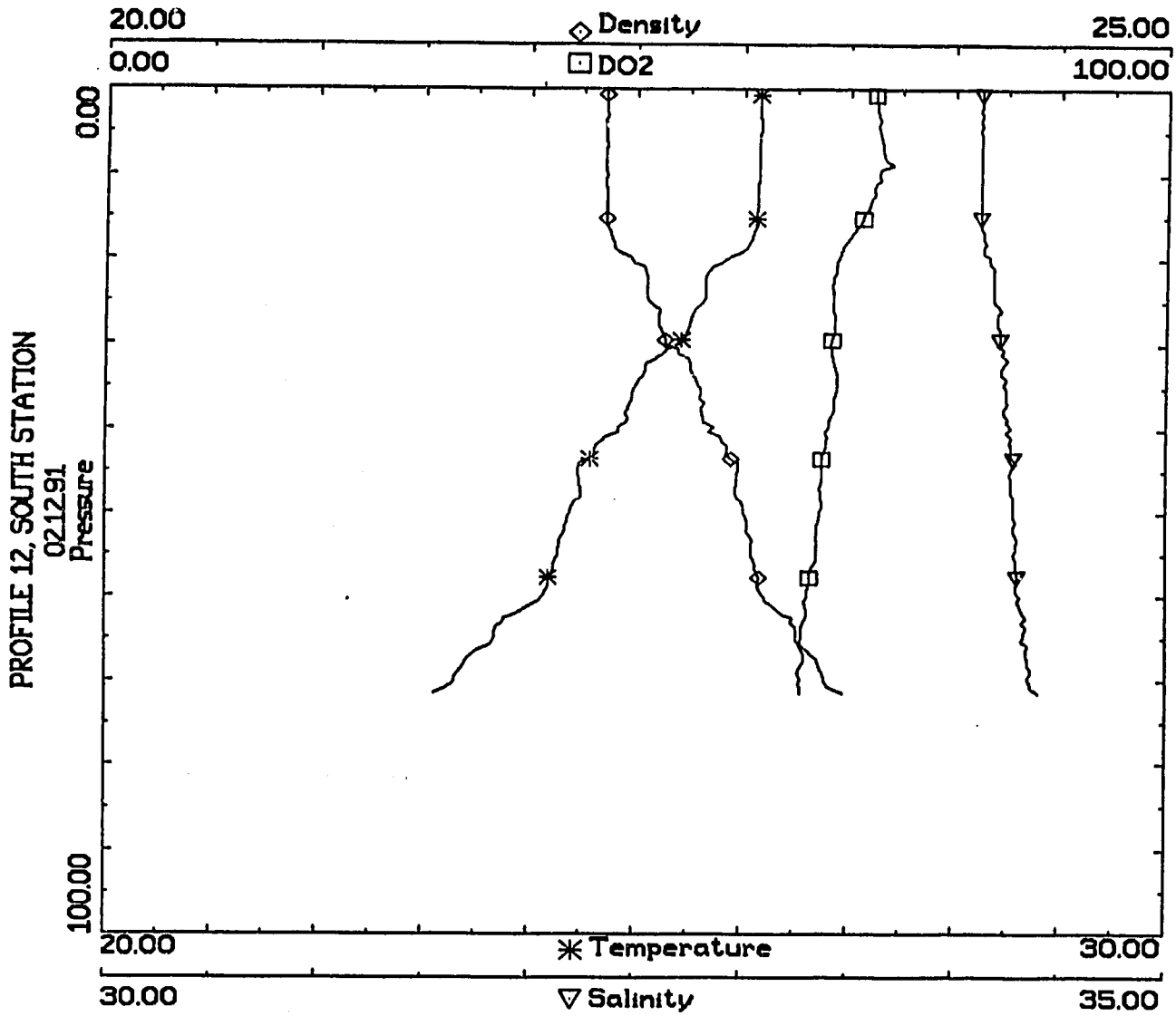
02.12.91



Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

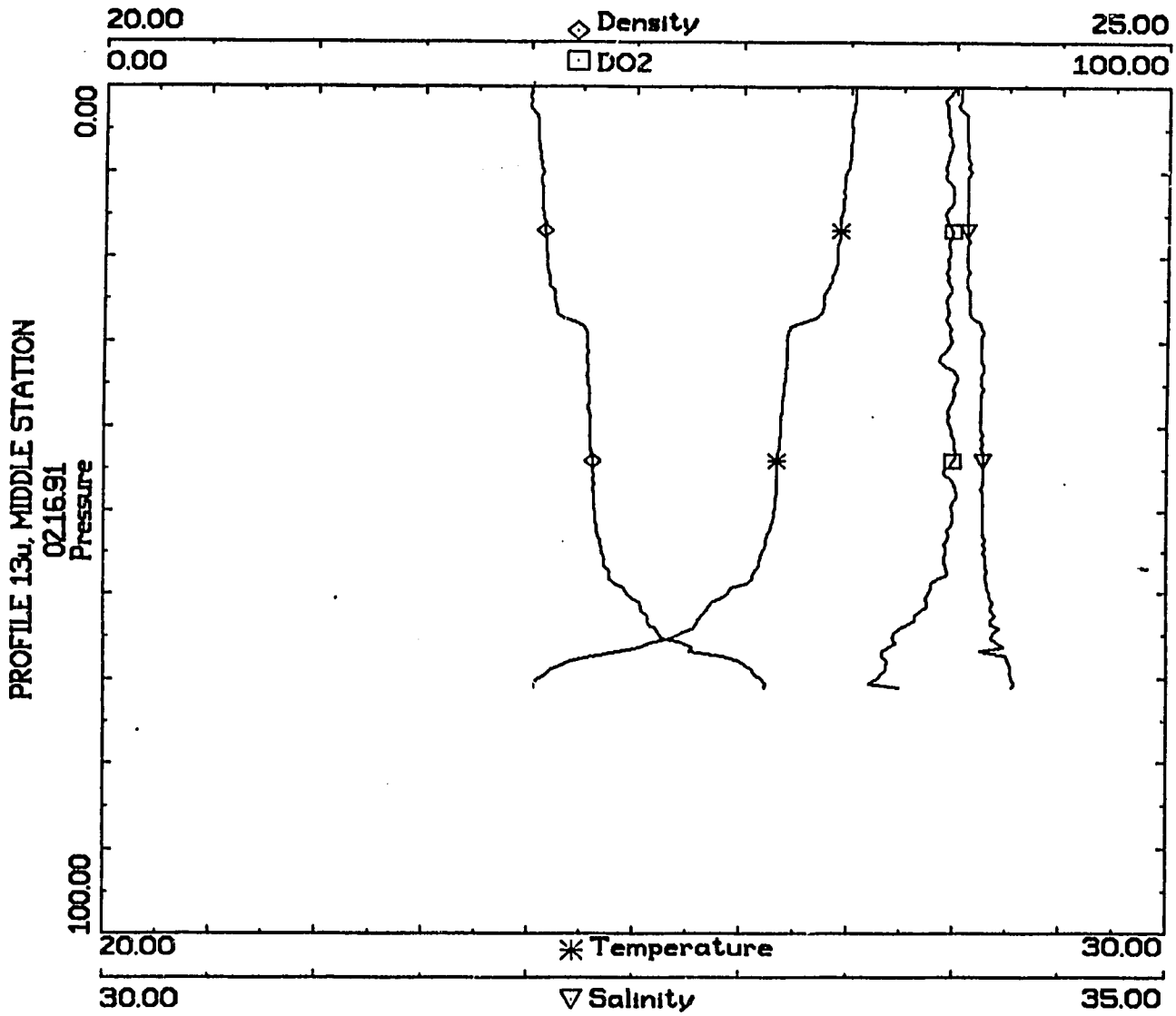
Figure B-33. STD-DO profile 11, 12 February '91, middle station.

02 12.91



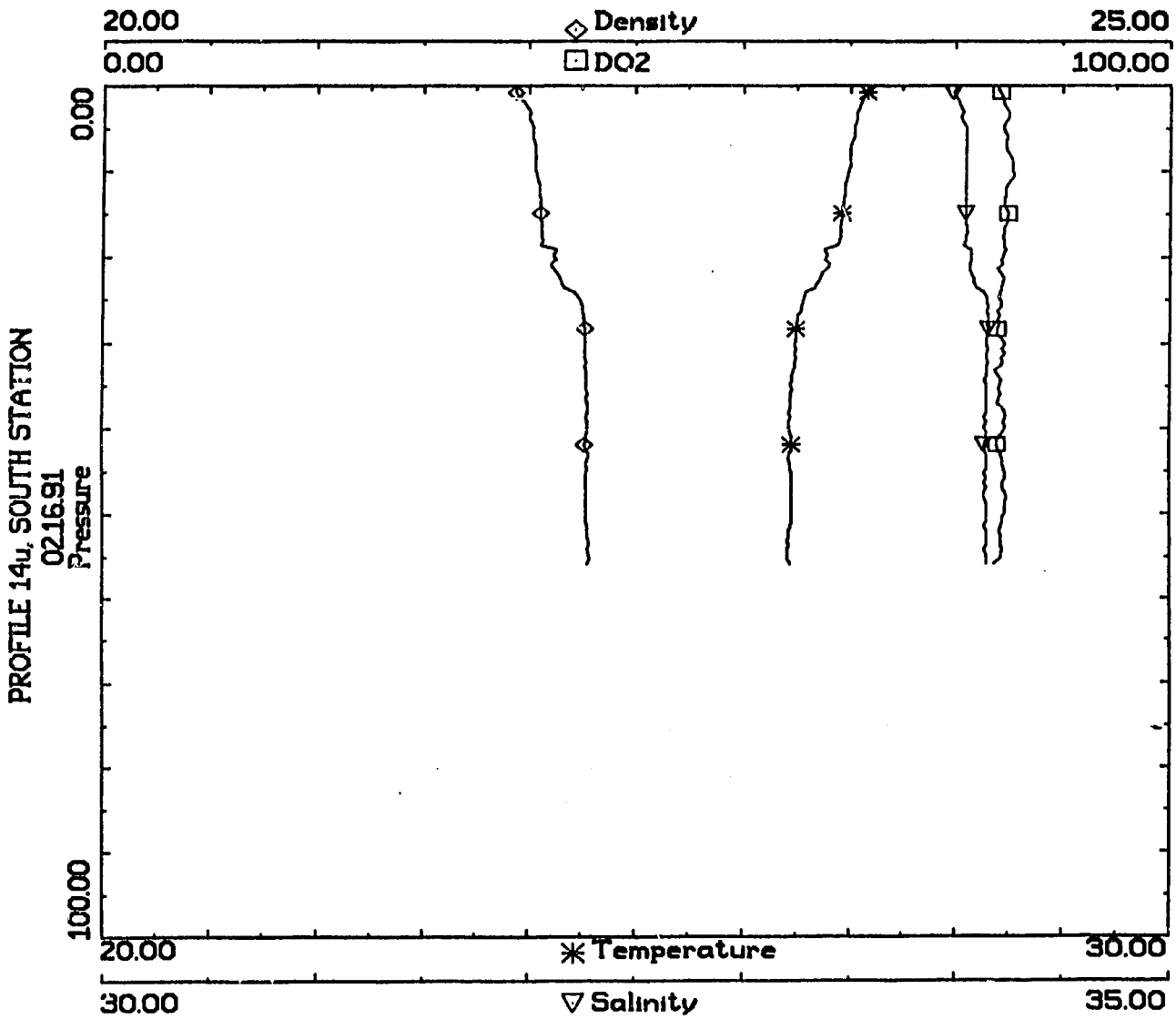
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-34. STD-DO profile 12, 12 February '91, south station.



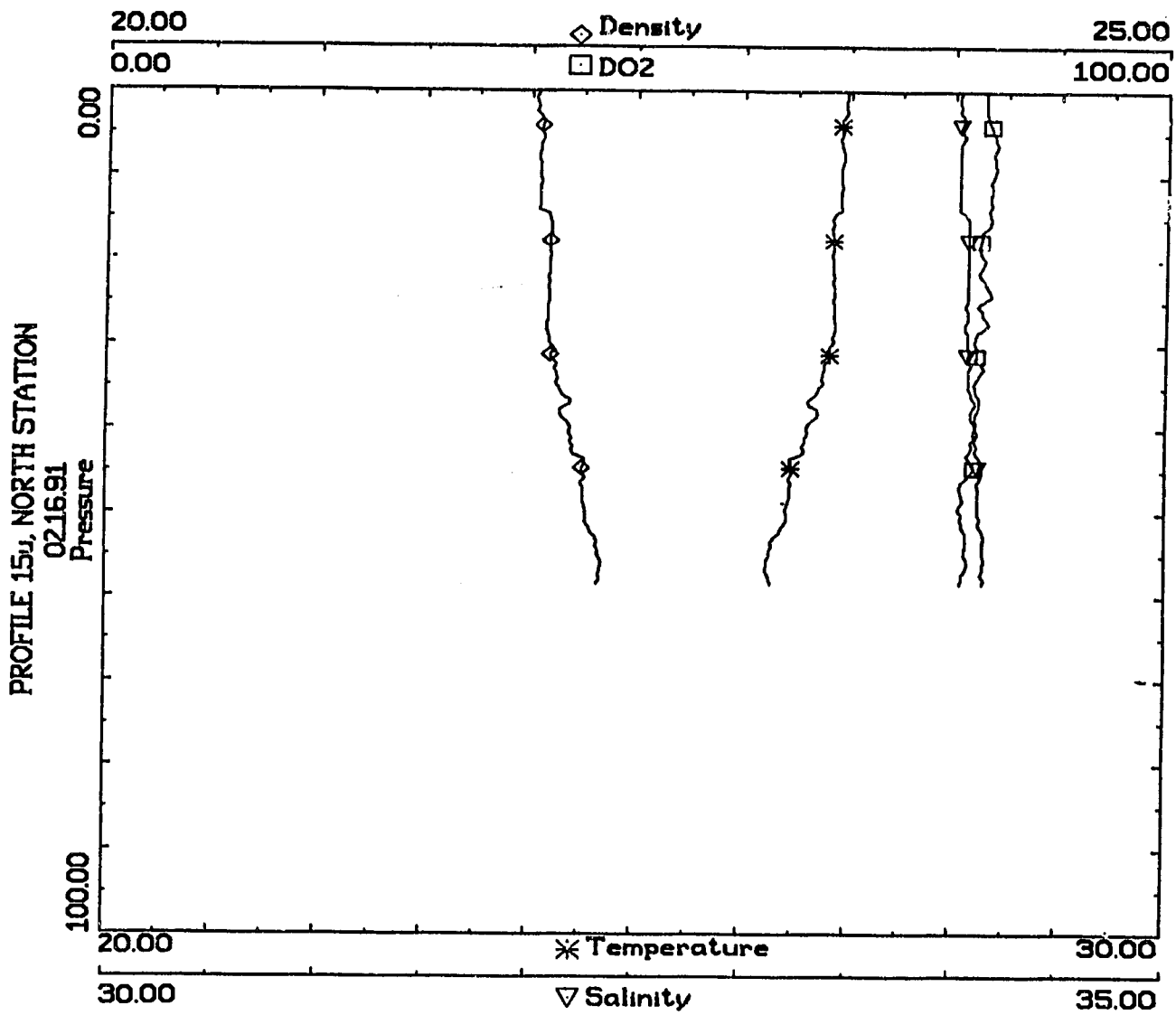
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-35. STD-DO profile 13, 16 February '91, middle station.



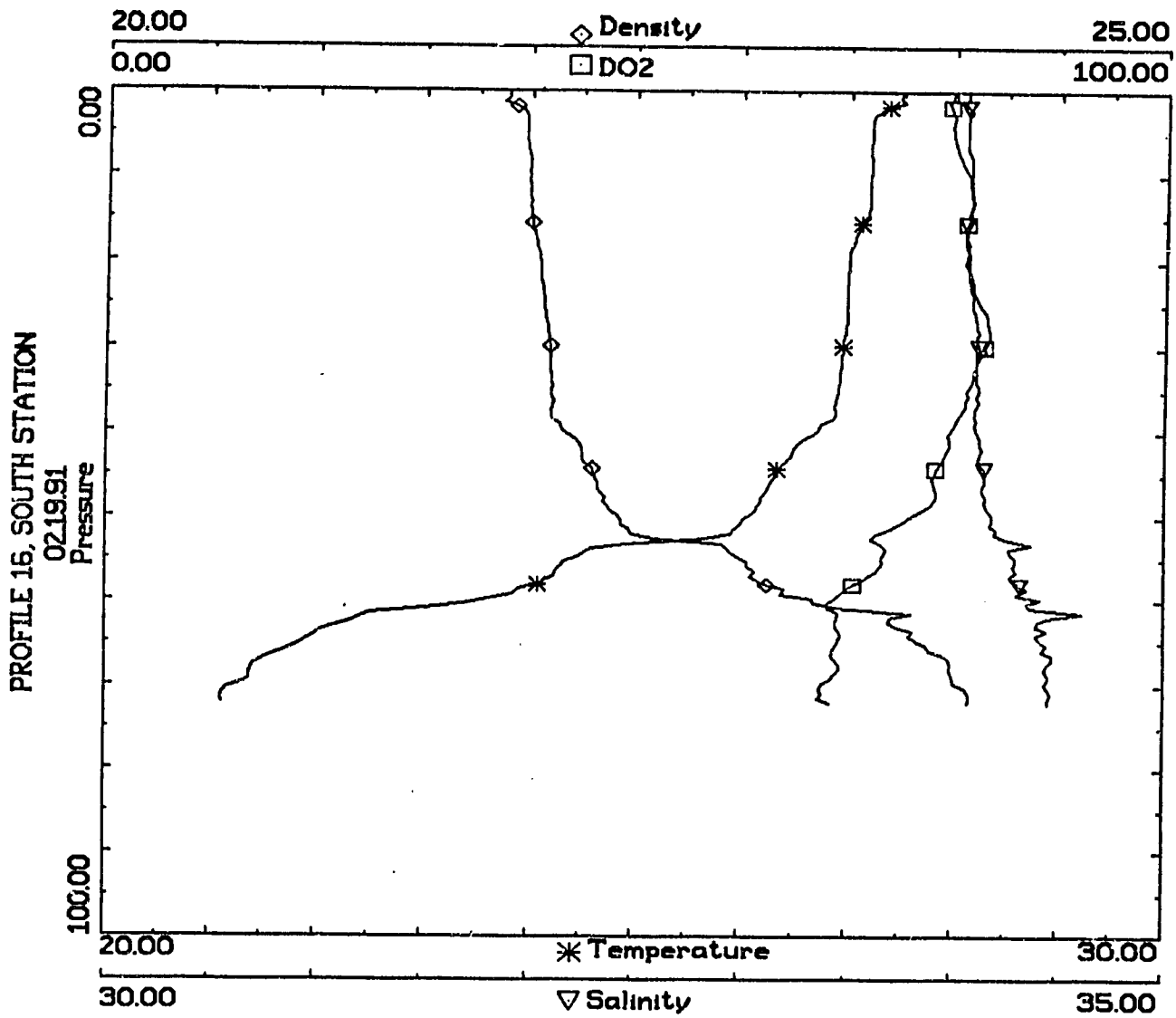
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-36. STD-DO profile 14, 16 February '91, south station.



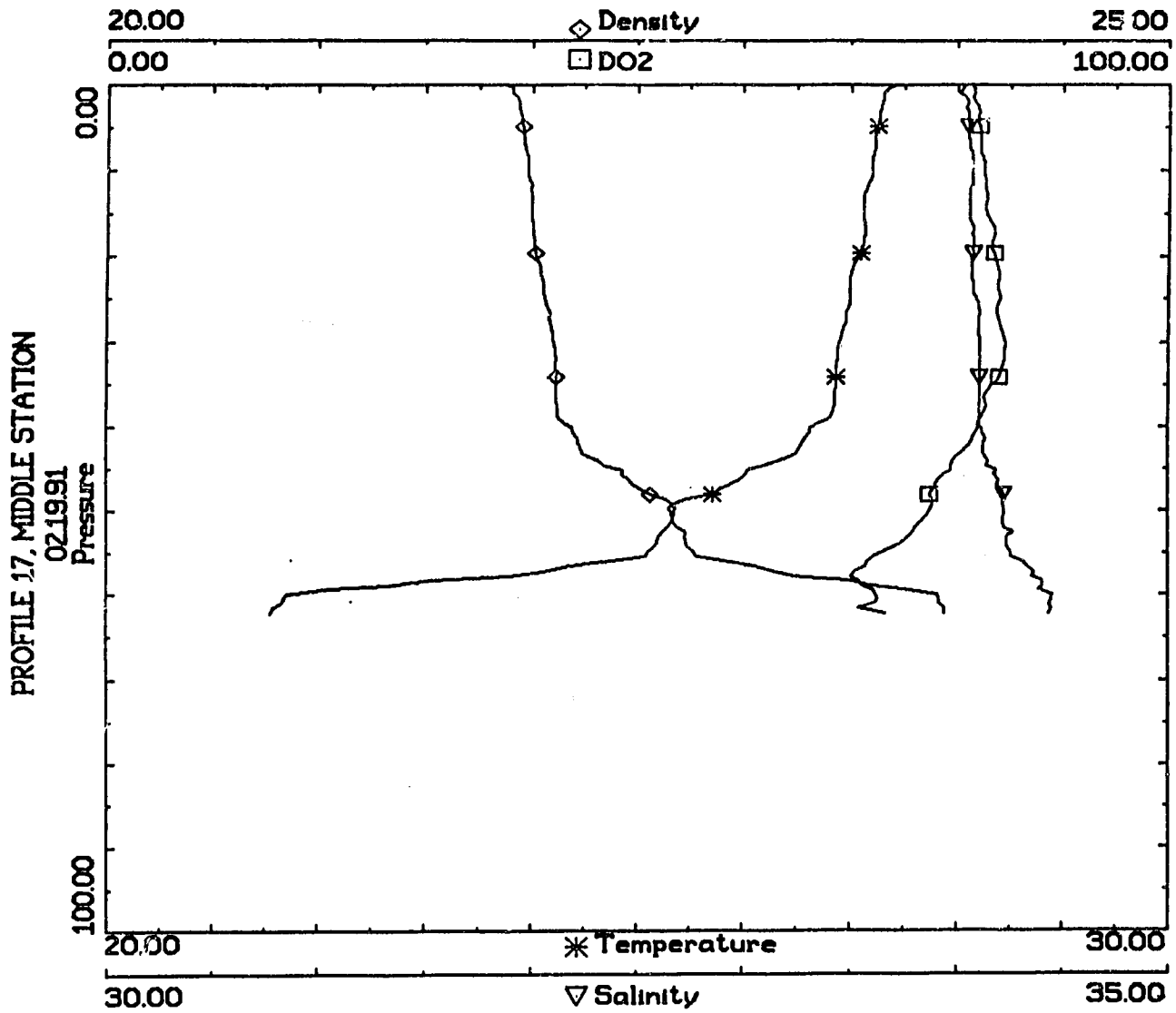
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-37. STD-DO profile 15, 16 February '91, north station.



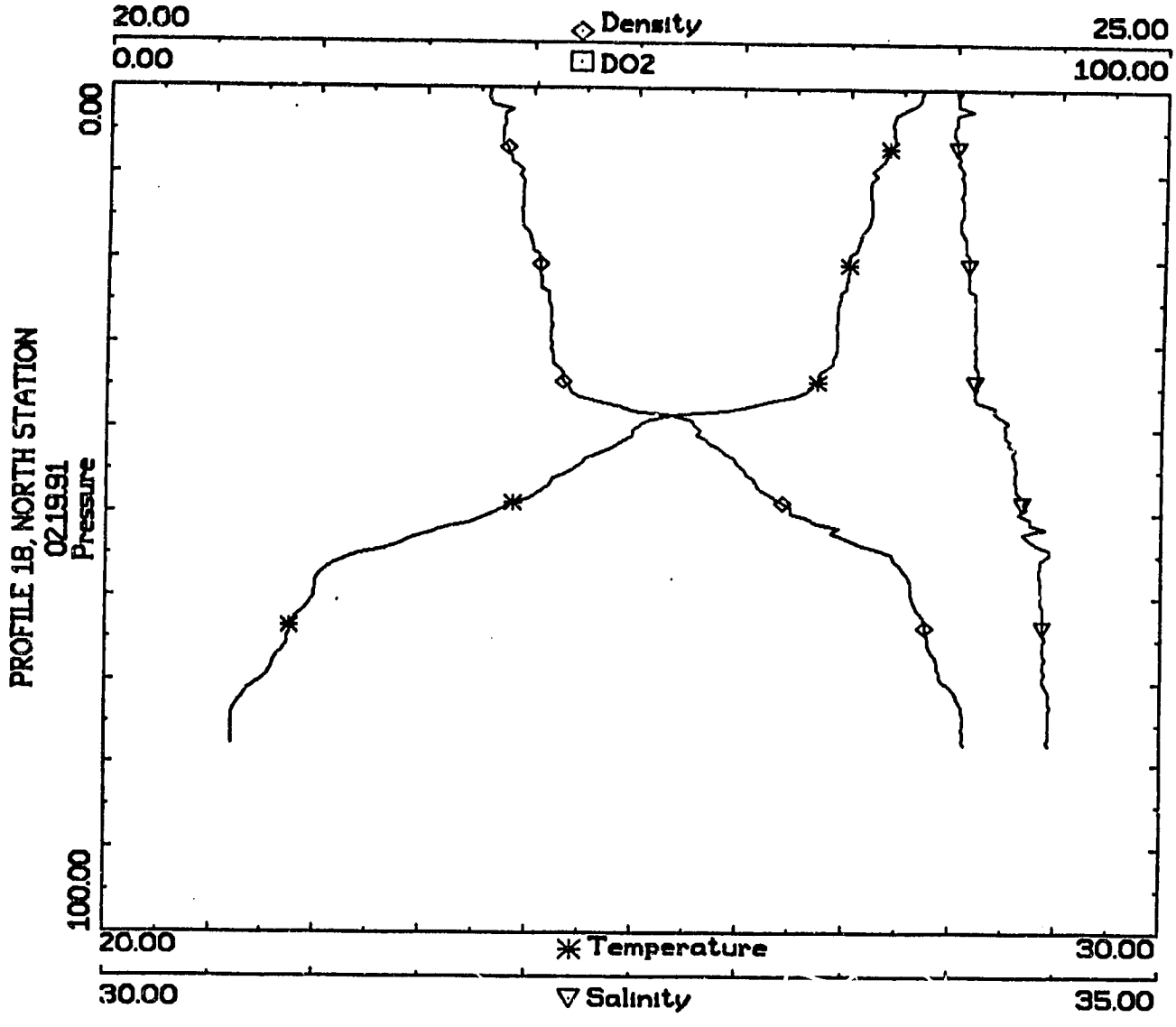
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-38. STD-DO profile 16, 19 February '91, south station.



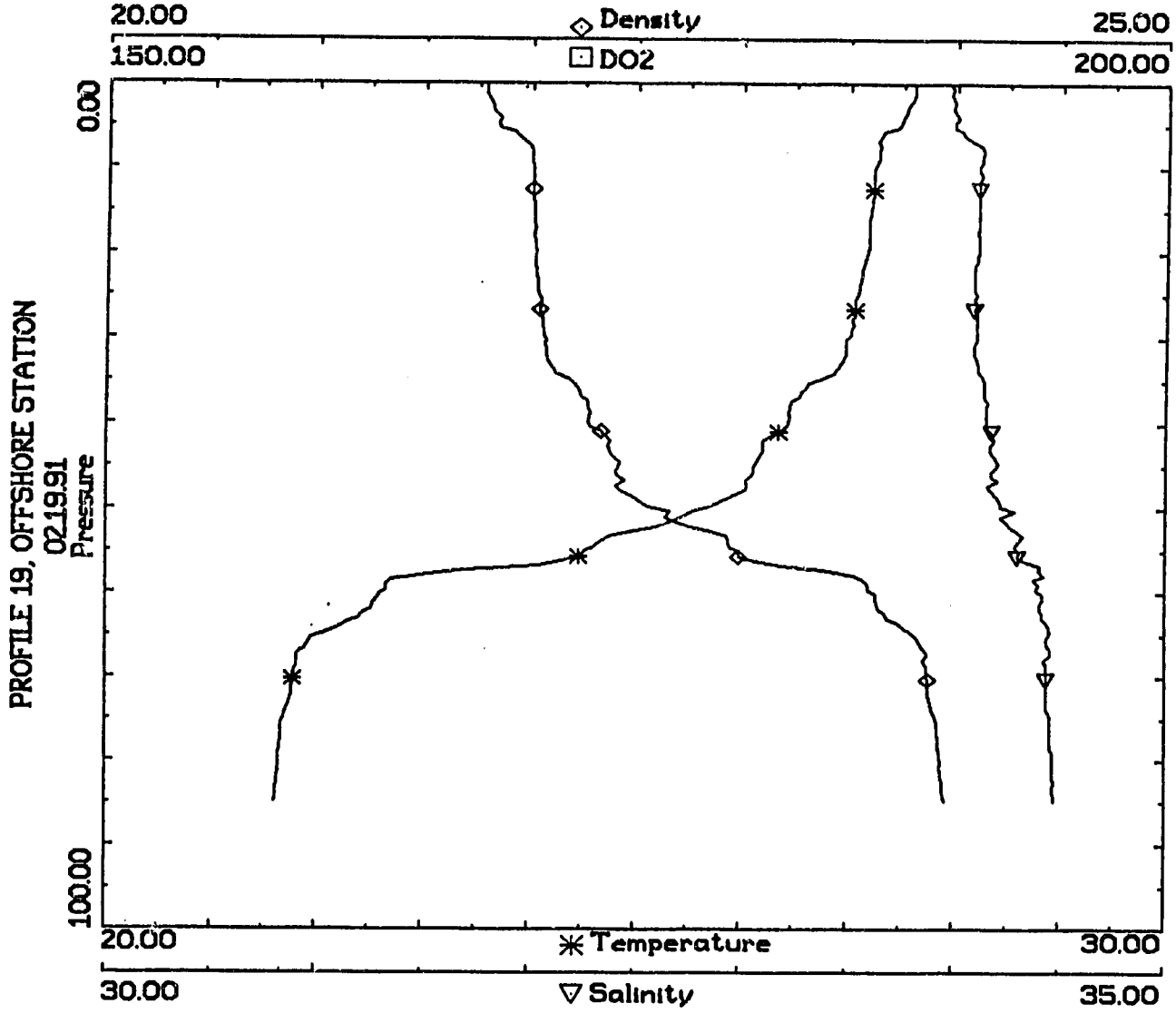
Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-39. STD-DO profile 17, 19 February '91, middle station.



Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-40. STD profile 18, 19 February '91, north station.



Pressure given in decibars (1 decibar = 1 m of seawater depth).
Density given as sigma-t.
Dissolved oxygen concentration given as percent saturation.
Temperature in degrees Celsius.
Salinity given in Practical Salinity Units (approximately equal to parts per thousand).

Figure B-41. STD profile 19, 19 February '91, offshore station.

APPENDIX C

BIOLOGICAL FIELD STUDIES DATA REPORT

Marine Survey Methods

The marine survey was conducted from 13-26 February 1991. A preliminary field reconnaissance was conducted by swimming on the surface the length of the project site to observe the general bottom conditions and reef habitat to a depth discernible from the surface. This reconnaissance occurred approximately along the 15 ft (5 m) isobath.

Succeeding reconnaissance level surveys were conducted using SCUBA. The length of the project site was surveyed at the 40 ft (14 m) and 60 ft (20 m) isobaths.

Transect stations to assess benthic habitat type and the reef fish community were established midway between the 0.0 tide line and the reef promontories at the 20 and 40 ft isobaths on the north and south slopes of the north and south reefs. A total of eight 50-m transect stations were surveyed.

The survey of benthic habitat type was conducted using the point intercept method, with a record made every 50 cm of the type of benthic life form intercepted by the transect. The reef survey is a modification of the approach recommended by Dahl (1978) and Dartnall and Jones (1986). In this method, the observer records on an underwater slate the different forms of hard coral, soft corals, sponges, anemones, plants, sand, coral rubble, and other bottom types.

Common invertebrates were counted in a band approximately 1 m wide on either the upslope or downslope side of the transect. Thus, numbers of individuals are reported per 50 m^2. Counts were divided in the field into 10-m segments of the transect. When individual counts reached 25/segment, it was determined that the individuals were probably too numerous to count, and an estimate was made based on estimated abundances in each 10-m segment.

Fish species were identified and recorded along the same 50-m transects in a band extending to 5 m on both sides of the observer, and extending up into the water column.

A dive to a depth of 100 ft was made on each of the coral promontories to determine the approximate depth distribution of coral on the promontories.

Table C-1. Species list of fishes recorded off the GSAPC site.

SPECIES NAME	FAMILY
ACANTHURUS LINEATUS	ACANTHURIDAE
ACANTHURUS MATA	ACANTHURIDAE
ACANTHURUS PYROFERUS	ACANTHURIDAE
CTENOCHAETUS BINOTATUS	ACANTHURIDAE
CTENOCHAETUS STRIATUS	ACANTHURIDAE
NASO BREVIROSTRIS	ACANTHURIDAE
PARACANTHURUS HEPATUS	ACANTHURIDAE
ZEBRASOMA FLAVESCENS	ACANTHURIDAE
CHEILODIPTERUS QUINQUELINEATUS	APOGONIDAE
AULOSTOMUS CHINENSIS	AULOSTOMIDAE
BALISTAPUS UNDULATUS	BALISTIDAE
BALISTES SP.	BALISTIDAE
BALISTOIDES UNDULATUS	BALISTIDAE
BLENNY SP.	BLENNIIDAE
MEIACANTHUS GRAMMISTES	BLENNIIDAE
CAESIO PISANG	CAESIONIDAE
CANTHIGASTER SOLANDRI	CANTHIGASTERIDAE
CANTHIGASTER VALENTINI	CANTHIGASTERIDAE
CARANX SEXFASCIATUS	CARANGIDAE
ELAGATIS BIPINNULATUS	CARANGIDAE
CHAETODON BARONESSA	CHAETODONTIDAE
CHAETODON CITRINELLUS	CHAETODONTIDAE
CHAETODON KLEINI	CHAETODONTIDAE
CHAETODON LUNULA	CHAETODONTIDAE
CHAETODON TRIFASCIATUS	CHAETODONTIDAE
CHAETODON VAGABUNDUS	CHAETODONTIDAE
CHAETODON XANTHURUS	CHAETODONTIDAE
CORADION CHRYSOZONUS	CHAETODONTIDAE
FORCIPIGER LONGIROSTRIS	CHAETODONTIDAE
GENICANTHUS LAMARK	CHAETODONTIDAE
HENIOCHUS ACUMINATUS	CHAETODONTIDAE
HENIOCHUS VARIUS	CHAETODONTIDAE
CIRRHITICHTHYS APRINUS	CIRRHITIDAE
DIODON HYSTRIX	DIODONTIDAE
DIODON LITUROSUS	DIODONTIDAE
FISTULARIA PETIMBA	FISTULARIIDAE

291

PLECTORHINCHUS CHAETODONTOIDES	HAEMULIDAE
POMADASYS MACULATUS	HAEMULIDAE
MYRIPRISTIS MURDJAN	HOLOCENTRIDAE
SARGOCENTRON SAMMARA	HOLOCENTRIDAE
CHEILINUS CELEBICUS	LABRIDAE
CHEILINUS FASCIATUS	LABRIDAE
CHEILINUS TRILOBATUS	LABRIDAE
CHEILIO INERMIS	LABRIDAE
CIRRHILABRUS CYANOPLEURA	LABRIDAE
CIRRHILABRUS TEMMINCKI	LABRIDAE
CORIS GAIMARD	LABRIDAE
HALICHOERES CHRYSUS	LABRIDAE
HALICHOERES HARTZFELDI	LABRIDAE
HALICHOERES MELANURUS	LABRIDAE
HOLOGYMNOSUS DOLIATUS	LABRIDAE
LABROIDES BICOLOR	LABRIDAE
LABROIDES TRIMACULATUS	LABRIDAE
MACROPHARYNGODON NEGROSENSIS	LABRIDAE
THALASSOMA HARDWICKI	LABRIDAE
THALASSOMA LUNARE	LABRIDAE
PARACAESIO XANTHURUS	LUTJANIDAE
ALUTERUS MONOCEROS	MONACANTHIDAE
PARAPERCIS CLATHRATA	MUGILOIDIDAE
PARUPENEUS BARBERINUS	MULLIDAE
PARUPENEUS BIFASCIATUS	MULLIDAE
PARUPENEUS INDICUS	MULLIDAE
PARUPENEUS TRIFASCIATUS	MULLIDAE
SCOLOPSIS BILINEATUS	NEMIPTERIDAE
OSTRACION SP.	OSTRACIIDAE
CENTROPYGE BICOLOR	POMACANTHIDAE
CENTROPYGE MESOLEUCUS	POMACANTHIDAE
CENTROPYGE TIBICEN	POMACANTHIDAE
PYGOPLITES DIACANTHUS	POMACANTHIDAE
AMBLYGLYPHIDODON LEUCOGASTER	POMACENTRIDAE
ABUDEFDUF VAIGIENSIS	POMACENTRIDAE
ACANTHOCHROMIS POLYACANTHUS	POMACENTRIDAE
AMBLYGLYPHIDODON AUREUS	POMACENTRIDAE
AMBLYGLYPHIDODON CURACAO	POMACENTRIDAE
AMPHIPRION CLARKII	POMACENTRIDAE
AMPHIPRION FRENATUS	POMACENTRIDAE
AMPHIPRION OCELLARIS	POMACENTRIDAE
AMPHIPRION PERIDERAION	POMACENTRIDAE
CHROMIS LEPIDOLEPIS	POMACENTRIDAE
CHROMIS RETROFASCIATUS	POMACENTRIDAE

CHROMIS WEBERI	POMACENTRIDAE
CHROMIS XANTHURUS	POMACENTRIDAE
CHRYSIPTERA CYANEA	POMACENTRIDAE
CHRYSIPTERA HEMICYANEA	POMACENTRIDAE
DASCYLLUS ARUANUS	POMACENTRIDAE
DASCYLLUS RETICULATUS	POMACENTRIDAE
DASCYLLUS TRIMACULATUS	POMACENTRIDAE
PARAGLYPHIDODON MELAS	POMACENTRIDAE
POMACENTRUS ALEXANDERAE	POMACENTRIDAE
POMACENTRUS AMBOINENSIS	POMACENTRIDAE
POMACENTRUS MOLUCCENSIS	POMACENTRIDAE
POMACENTRUS VAIULI	POMACENTRIDAE
SCARUS GHOBBAN	SCARIDAE
SCARUS SP.	SCARIDAE
PTEROIS VOLITANS	SCORPAENIDAE
ANTHIAS RANDALLI	SERRANIDAE
ANTHIAS SQUAMIPINNIS	SERRANIDAE
CEPHALOPHOLIS PACHYCENTRON	SERRANIDAE
CROMILEPTIS ALTIVELIS	SERRANIDAE
EPINEPHELUS FASCIATUS	SERRANIDAE
SIGANUS VERMICULATUS	SIGANIDAE
SIGANUS VIRGATUS	SIGANIDAE
SYNODUS VARIEGATUS	SYNODONTIDAE
AROTHRON NIGROPUNCTATUS	TETRAODONTIDAE
ZANCLUS CORNUTUS	ZANCLIDAE

Table C-2

PLANTS IDENTIFIED AT THE PROPOSED
AGRO-PROCESSING AND FISHPORT COMPLEX
AT BARANGAY TAMBLER, GENERAL SANTOS CITY

Trees, shrubs, vines, herbs/grasses and agricultural crops

FAMILY SCIENTIFIC NAME	COMMON NAME
I. Trees	
Anacardiaceae	
Buchanania arborescens	Balinghasai
Annonaceae	
Annona muricata*	Guayabano
Apocynaceae	
Cerbera manghas***	Baraibai
Thevetia peruviana	Campanilla
Wrightia sp.	Laneti
Arecaceae (Palmae)	
Cocos nucifera	Niyog
Bombaceae	
Camptostemon philippinensis***	Gapas-gapas
Boraginaceae	
Cordia dichotoma	Anonang
Clusiaceae (Guttiferae)	
Calophyllum inophyllum	Bitaog
Combretaceae	
Terminalia catappa	Talisay
Euphorbiaceae	
Glochidion littorale*	Kayong
Macaranga taparius	Binunga
Mallotus sp.	
Ricinus communis	Tangan-tangan
Lauraceae	
Litsea sp.	
Leguminosae (divided into 3 families)	
Caesalpiniaceae	
Fabaceae	
Erythrina orientalis	Dapdap
Gliricidia sepium	Kakawate
Pongamia pinnata***	Bani
Mimosaceae	
Albizia sp.	
Enterolobium cf. cyclocarpum	
Leucaena leucocephala	Ipil-Ipil
Pithecellobium dulce	Camachili
Samanea saman	Raintree

-290

Malvaceae	
Thepasia sp.	
Moraceae	
Ficus spp.	Balete
Rhizophoraceae	
*Rhizcphora apiculata****	Bakawan lalake
Bruguera sp.***	
Rubiaceae	
Neonuclea sp.	
Morinda bracteata	Niño
Sonneratiaceae	
Sonneratia alba	Pagatpat
S. caseolaris	Pedada
Sapotaceae	
Chrysophyllum cainito	Caimito
Ulmaceae	
Trema cf. *cannabina*	Anagdong
Verbenaceae	
Premna integrifolia	Alagao dagat

II. Shrubs

Apocynaceae	
Ervatamia pandacagui	Pandakaki
Caricaceae	
Carica papaya	papaya
Myrtaceae	
Syzygium sp.	
Pandanaceae	
Pandanus tectorius	Beach pandan
P. amaryllifolius	Pandan baguhan
Phamnaceae	
Zyzyphus sp.	

III. Vines

Convolvulaceae	
Ipomea batatas	Kamote
I. pes-carpae	Lambayog
Flagellariaceae	
Flagellaria indica	Baling uai
Leguminosae (Caesalpiniaceae, Fabaceae and Mimosaceae)	
Abrus precaturius	Kansasaga
Calapogonium sp.	
Derris sp.	
Caesalpinia nuga	Sapinit
Lauraceae	
Cassytha filiformis	-
Piperaceae	
Piper sp.	Litlit
Schizaeceae	
Lygodium circinnatum	Nitong puti

30

Vitaceae	
Columella trifolia	Alangigi

IV. Herbs

Amaranthaceae	
Achyranthes aspera	Hangod
Araceae	
Alocasia macrorrhiza	Biga
Colocasia esculenta	Gabi
Asteraceae (Compositae)	
Chrolaena odorata	Hagonoy
Cyperaceae	
Cyperus malaccensis	Balangot
Cyperus sp.	
Fimbristylis ferruginea	
Fimbristylis sp.	
Malvaceae	
Sida acuta	Walis-walisan
Urena lobata	Kolut-kolutan
Poaceae (Graminae)	
Axonopus compresus	Carabao grass
Chloris barbata	Koros-korosan
Imperata cylindrica var. *major*	Cogon
Themada triandra	Samong-samong
Panicum maximum	Guinea grass
Phragmites australis	Tambo
Pennisetum purpureum	Napier's grass
Saccharum spontaneum	Talahib
Spinifex littoreus	Beach grass
Zoysia matrella var *matrella*	Manila grass
Polypodiaceae	
Microsorium cf. *palmatum*	(fern)
Pteridaceae	
Acrostichum aureum	Lagolo (fern)
Typhaceae	
Tyhpa angustifolia	Cat-tail
Verbenaceae	
Stachytarpheta jamaicensis	Kandi-kandilaan

-202

APPENDIX D

AIR QUALITY DATA REPORT

AIR QUALITY DATA REPORT

On March 13-14 1991, air sampling and analysis was carried out at four stations in Tambler. The purpose of the air sampling was to establish the background concentration of air pollutants at the site. The following were the constraints in the sampling program:

- The Department of Environment and Natural Resources, Regional Office in Davao City was the only one in the area with the necessary equipment to take air samples and analyze it. However, DENR in Davao City could only analyze for sulfur dioxide and particulates.

- The equipment available needed a 220 V power line. Because a generator was not available, the choice of the sampling points were limited to areas with available electrical power. The use of a generator was also discounted because the generator itself will be an air pollutant source and therefore will affect the results.

- There was only one set of equipment so that simultaneous measurements at different sites was not possible.

Based on the above constraints, the sampling points chosen were as follows:

Station A - located in front of Agrotex and 3 m east of the national highway.

Station B - located at the back of Agrotex and around 10 m west of the shoreline.

Station C - located in front of Sancanco Tuna Canning Factory and 3 m east of the National Highway.

Station D - located at the back of Sancanco Tuna Canning Factory and around 10 m west of the shoreline.

Agrotex is adjacent to the proposed project site and as such it is believed that samples collected there will be more or less representative of the conditions at the site. It is to be noted that although Agrotex is a recently completed factory, it was not yet operating at the time of sampling.

At present, the worst conditions at the site should occur when the wind is blowing from the north, because air pollutants

-204-

from factories north of the site will be carried to the site. It should be noted that there were no operational factories within 1 km from the site in the east, west, and south directions at the time of sampling. The prevailing wind during the sampling period was northerly. This prevailing wind direction is in agreement with the historical data, which shows the prevailing wind in the month of March is northerly. The samples taken from Agrotex will therefore give a good approximation of the worst present condition at the project site.

For the two other stations at Sancanco, the following generalized statements may hold true.

- The effect of stack emissions at Sancanco may not be detected at these two stations because the wind was blowing from the north and the sampling stations were located west and east of the plant. Also, because of the height of the stack, the nearest area where the plume may strike the ground is already outside the Sancanco Factory compound.

- The possible source of pollutants in these sampling stations are the vehicular traffic at the national highway and Purefoods Canning Factory. However, Purefoods is more than 2 km away, and is too far to significantly affect the sampling points. Therefore, we could say that the sampling points at Sancanco will only show the effect of vehicular traffic and therefore gives a condition similar to the project site.

Unfortunately, the sample analyses for sulfur dioxide were not successful. It is highly unlikely, however, that significant quantities of sulfur dioxide would be found in this presently rural area.

APPENDIX E

NUMERICAL MODELING OF DISCHARGE PLUME

APPENDIX E

NUMERICAL MODELING OF DISCHARGE PLUME

Numerical modeling was performed for a number of representative test cases to investigate the range of behavior that the GSAPC wastewater treatment plant plume might exhibit if discharged through a submarine outfall into the waters of Sarangani Bay. The numerical model employed was the UOUTPLM variant of the PLUME model set developed by the US Environmental Protection Agency, described by Muellenhoff et al. (1985).

The PLUME models provide the initial dilution and rise-height of a buoyant plume for a variety of discharge, diffuser, and receiving water conditions. Dilution is defined as a volume of receiving water divided by the volume of effluent contained within it. Initial dilution is defined as the average dilution when the rising plume reaches an equilibrium level in the water column or when it encounters the sea surface. The UOUTPLM model used in this analysis allows selection of single or multiple discharge ports, varying profiles of temperature and salinity, and varying current speeds.

A single temperature-salinity profile was used for all model runs, and was based on a number of measured profiles collected near the site in January and February 1991. The profile used was:

Depth (m)	Temperature (°C)	Salinity (ppt)
0.0	26.5	34.05
5.0	26.5	34.09
10.0	26.5	34.11
15.0	26.5	34.13
20.0	26.4	34.15
25.0	26.4	34.17
30.0	26.4	34.20

Other variable input parameters were as follows:

Effluent flow	0.01 or 0.03 $m^3 \cdot sec^{-1}$
Effluent temperature	30°C
Effluent salinity	0 or 1 ppt
Number of ports	1, 2, or 4
Port diameter	0.15 m
Vertical angle of discharge	90 degrees (vertical)

307

Depth of discharge	10, 20 or 30 m below sea surface
Ambient current speed	10 or 25 $cm \cdot sec^{-1}$
Port spacing	10 m

Eighteen model runs were done using combinations of the input variables listed above. The objective of modeling the plume behavior was to assess possible environmental impacts of representative discharge scenarios, not to design an outfall structure. The test cases were therefore designed to be indicative, rather than exhaustive. The following table lists parameters used for each of the test cases (indicated by case number):

Case	Ambient Current Speed	Effluent Salinity	Effluent Flow	Discharge Depth	Number of Ports
1	10	1	0.01	10	1
2	10	1	0.01	20	1
3	10	1	0.01	30	1
4	10	1	0.03	10	1
5	10	1	0.03	20	1
6	10	1	0.03	30	1
7	25	1	0.01	10	1
8	25	1	0.01	20	1
9	25	1	0.01	30	1
10	25	1	0.03	10	1
11	25	1	0.03	20	1
12	25	1	0.03	30	1
13	10	0	0.01	30	1
14	25	0	0.01	30	1
15	10	1	0.01	10	2
16	25	1	0.01	30	2
17	10	1	0.01	30	4
18	25	1	0.01	30	4

Results for the 18 test cases are given on the following pages. The output parameters are:

X	Horizontal distance of plume from port orifice
Z	Depth of plume below surface
PLUME RADIUS	Plume radius
DILUTION	Plume dilution
DENDIFF	Density of plume minus ambient density (sigma-t units)
HORIZ VEL	Horizontal component of plume's velocity
VERT VEL	Vertical component of plume's velocity
TOTAL VEL	Magnitude of plume's velocity

Final dilution values are provided at the bottom of each listing for dilutions at the sea surface (if the plume rose to the surface) or at a subsurface trapping level (where the plume reaches neutral buoyancy)

309

CASE I.D. CASE #1 - 10 m discharge, current 10 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	10.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	10.00	0.08	1.0	25.78	0.00	0.57	0.57
0.00	10.00	0.08	1.0	25.61	0.00	0.56	0.56
0.01	9.85	0.10	1.4	18.25	0.03	0.45	0.45
0.02	9.66	0.13	2.0	12.92	0.05	0.38	0.38
0.07	9.40	0.16	2.8	9.15	0.06	0.33	0.34
0.13	9.11	0.20	3.9	6.48	0.07	0.29	0.30
0.23	8.79	0.25	5.5	4.58	0.08	0.26	0.27
0.35	8.43	0.32	7.8	3.24	0.09	0.23	0.25
0.51	8.05	0.40	11.1	2.29	0.09	0.20	0.22
0.72	7.62	0.50	15.6	1.62	0.09	0.18	0.20
0.98	7.16	0.62	22.1	1.14	0.10	0.16	0.18
1.31	6.66	0.77	31.2	0.81	0.10	0.14	0.17
1.72	6.12	0.95	44.1	0.57	0.10	0.12	0.15
2.24	5.53	1.17	62.4	0.40	0.10	0.11	0.14
2.88	4.89	1.44	88.3	0.28	0.10	0.09	0.14
3.70	4.19	1.76	124.8	0.19	0.10	0.08	0.13
4.73	3.40	2.15	176.5	0.13	0.10	0.07	0.12
6.06	2.53	2.60	249.6	0.09	0.10	0.06	0.12
7.78	1.54	3.15	352.9	0.06	0.10	0.05	0.11
10.02	0.42	3.80	499.1	0.04	0.10	0.05	0.11

PLUME HITS WATER SURFACE; PLUMES DID NOT TRAP OR MERGE
PLUME SURFACES, DILUTION = 562.96

-310

CASE I.D. Case #2 - 20 m discharge, current 10 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	20.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	20.00	0.08	1.0	25.85	0.00	0.57	0.57
0.00	20.00	0.08	1.0	25.67	0.00	0.56	0.56
0.01	19.85	0.10	1.4	18.30	0.03	0.45	0.45
0.02	19.66	0.13	2.0	12.96	0.05	0.38	0.38
0.07	19.40	0.16	2.8	9.17	0.06	0.33	0.34
0.13	19.11	0.20	3.9	6.49	0.07	0.29	0.30
0.22	18.79	0.25	5.5	4.59	0.08	0.26	0.27
0.35	18.43	0.32	7.8	3.25	0.09	0.23	0.25
0.51	18.04	0.40	11.1	2.29	0.09	0.20	0.22
0.72	17.62	0.50	15.6	1.62	0.09	0.18	0.20
0.98	17.16	0.62	22.1	1.14	0.10	0.16	0.18
1.31	16.66	0.77	31.2	0.80	0.10	0.14	0.17
1.72	16.12	0.95	44.1	0.56	0.10	0.12	0.15
2.24	15.54	1.17	62.4	0.39	0.10	0.10	0.14
2.88	14.90	1.44	88.2	0.27	0.10	0.09	0.13
3.70	14.20	1.77	124.8	0.19	0.10	0.08	0.13
4.74	13.42	2.15	176.5	0.13	0.10	0.07	0.12
6.07	12.54	2.61	249.6	0.09	0.10	0.06	0.12
7.80	11.55	3.15	352.9	0.06	0.10	0.05	0.11
10.06	10.43	3.80	499.1	0.04	0.10	0.05	0.11
13.03	9.14	4.57	705.8	0.02	0.10	0.04	0.11
17.03	7.68	5.49	998.1	0.01	0.10	0.03	0.11
22.67	6.03	6.60	1411.6	0.00	0.10	0.03	0.10
*****NORMAL TRAPPING LEVEL REACHED							
31.74	4.19	7.93	1996.3	-0.01	0.10	0.02	0.10
44.81	3.22	8.78	2423.9	-0.01	0.10	0.00	0.10

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 5.84 M BELOW WATER SURFACE, DILUTION = 1464.75

-311

CASE I.D. Case #3 - 30 m discharge, current 10 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	0.57	0.57
0.00	30.00	0.08	1.0	25.70	0.00	0.56	0.56
0.01	29.85	0.10	1.4	18.31	0.03	0.45	0.45
0.02	29.66	0.13	2.0	12.97	0.05	0.38	0.38
0.07	29.40	0.16	2.8	9.18	0.06	0.33	0.34
0.13	29.11	0.20	3.9	6.50	0.07	0.29	0.30
0.22	28.79	0.25	5.5	4.60	0.08	0.26	0.27
0.35	28.43	0.32	7.8	3.25	0.09	0.23	0.25
0.51	28.04	0.40	11.1	2.30	0.09	0.20	0.22
0.72	27.62	0.50	15.6	1.63	0.09	0.18	0.20
0.98	27.16	0.62	22.1	1.15	0.10	0.16	0.18
1.31	26.66	0.77	31.2	0.81	0.10	0.14	0.17
1.72	26.12	0.95	44.1	0.57	0.10	0.12	0.16
2.24	25.53	1.17	62.4	0.40	0.10	0.11	0.14
2.88	24.88	1.44	88.2	0.28	0.10	0.09	0.14
3.70	24.18	1.76	124.8	0.20	0.10	0.08	0.13
4.73	23.39	2.14	176.5	0.14	0.10	0.07	0.12
6.06	22.50	2.60	249.5	0.10	0.10	0.06	0.12
7.77	21.50	3.14	352.9	0.06	0.10	0.06	0.11
9.99	20.35	3.78	499.1	0.04	0.10	0.05	0.11
12.88	19.05	4.56	705.8	0.02	0.10	0.04	0.11
16.70	17.63	5.49	998.1	0.00	0.10	0.03	0.11
*****NORMAL TRAPPING LEVEL REACHED							
22.39	16.08	6.63	1411.5	-0.01	0.10	0.02	0.10
34.52	14.81	7.75	1888.5	-0.02	0.10	0.00	0.10

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 17.19 M BELOW WATER SURFACE, DILUTION = 1104.39

312

CASE I.D. Case #4 - 10 m discharge, current 10 cm/sec, 0.03 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	10.00	M

X (M)	Z (M)	FLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	10.00	0.08	1.0	25.78	0.00	1.70	1.70
0.00	10.00	0.08	1.0	25.60	0.00	1.69	1.69
0.00	9.85	0.10	1.4	18.24	0.03	1.22	1.22
0.01	9.64	0.15	2.0	12.92	0.05	0.89	0.89
0.03	9.34	0.20	2.8	9.15	0.06	0.66	0.67
0.08	8.94	0.27	3.9	6.48	0.07	0.51	0.52
0.18	8.39	0.35	5.5	4.58	0.08	0.42	0.42
0.34	7.67	0.45	7.8	3.24	0.09	0.35	0.36
0.58	6.80	0.57	11.1	2.29	0.09	0.31	0.32
0.89	5.83	0.72	15.6	1.62	0.09	0.27	0.29
1.29	4.77	0.91	22.1	1.14	0.10	0.24	0.26
1.79	3.61	1.14	31.2	0.80	0.10	0.21	0.23
2.42	2.35	1.43	44.1	0.56	0.10	0.18	0.21
3.21	0.98	1.78	62.4	0.39	0.10	0.16	0.19

PLUME HITS WATER SURFACE; PLUMES DID NOT TRAP OR MERGE
PLUME SURFACES, DILUTION = 78.89

CASE I.D. Case #5 - 20 m discharge, current 10 cm/sec, 0.03 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
NUMBER OF STEPS ALLOWED	=	5000	(DEFAULT)
PRINTOUT INTERVAL	=	50	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	20.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	20.00	0.08	1.0	25.84	0.00	1.70	1.70
0.00	20.00	0.08	1.0	25.66	0.00	1.69	1.69
0.00	19.85	0.10	1.4	18.29	0.03	1.22	1.22
0.01	19.64	0.15	2.0	12.95	0.05	0.89	0.89
0.03	19.34	0.20	2.8	9.17	0.06	0.66	0.67
0.08	18.94	0.27	3.9	6.49	0.07	0.51	0.52
0.18	18.39	0.35	5.5	4.59	0.08	0.42	0.42
0.34	17.67	0.45	7.8	3.24	0.09	0.35	0.36
0.58	16.80	0.57	11.1	2.29	0.09	0.31	0.32
0.89	15.83	0.72	15.6	1.61	0.09	0.27	0.29
1.29	14.77	0.91	22.1	1.13	0.10	0.24	0.26
1.79	13.61	1.14	31.2	0.80	0.10	0.21	0.23
2.42	12.35	1.43	44.1	0.56	0.10	0.18	0.21
3.21	10.99	1.78	62.4	0.39	0.10	0.16	0.19
4.20	9.52	2.22	88.2	0.27	0.10	0.14	0.17
5.41	7.93	2.76	124.8	0.19	0.10	0.12	0.16
6.92	6.23	3.41	176.5	0.13	0.10	0.10	0.14
8.80	4.40	4.21	249.6	0.09	0.10	0.09	0.13
11.14	2.46	5.18	352.9	0.05	0.10	0.08	0.13
14.09	0.41	6.36	499.1	0.03	0.10	0.06	0.12

PLUME HITS WATER SURFACE; PLUMES DID NOT TRAP OR MERGE
PLUME SURFACES, DILUTION = 533.86

CASE I.D. Case #6 - 30 m discharge, current 10 cm/sec, 0.03 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	1.70	1.70
0.00	30.00	0.08	1.0	25.70	0.00	1.69	1.69
0.00	29.85	0.10	1.4	18.31	0.03	1.22	1.22
0.01	29.64	0.15	2.0	12.97	0.05	0.89	0.89
0.03	29.34	0.20	2.8	9.18	0.06	0.66	0.67
0.08	28.94	0.27	3.9	6.50	0.07	0.51	0.52
0.18	28.39	0.35	5.5	4.60	0.08	0.42	0.42
0.34	27.67	0.45	7.8	3.25	0.09	0.35	0.36
0.58	26.80	0.57	11.1	2.30	0.09	0.31	0.32
0.89	25.83	0.72	15.6	1.62	0.09	0.27	0.29
1.29	24.77	0.91	22.1	1.14	0.10	0.24	0.26
1.79	23.61	1.14	31.2	0.81	0.10	0.21	0.23
2.42	22.34	1.42	44.1	0.57	0.10	0.18	0.21
3.21	20.97	1.78	62.4	0.40	0.10	0.16	0.19
4.19	19.49	2.22	88.2	0.27	0.10	0.14	0.17
5.40	17.91	2.76	124.8	0.18	0.10	0.12	0.16
6.88	16.25	3.43	176.5	0.12	0.10	0.10	0.14
8.72	14.51	4.25	249.5	0.07	0.10	0.09	0.13
11.08	12.67	5.24	352.9	0.05	0.10	0.07	0.12
14.17	10.65	6.40	499.1	0.03	0.10	0.06	0.12
18.32	8.42	7.79	705.8	0.01	0.10	0.05	0.11
24.05	5.97	9.44	998.1	0.00	0.10	0.04	0.11
*****NORMAL TRAPPING LEVEL REACHED							
32.50	3.34	11.44	1411.6	-0.01	0.10	0.02	0.10
46.77	1.56	13.20	1824.3	-0.02	0.10	0.00	0.10

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 4.96 M BELOW WATER SURFACE, DILUTION = 1141.28

315

CASE I.D. Case #7 - 10 m discharge, current 25 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	10.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	10.00	0.08	1.0	25.78	0.00	0.57	0.57
0.00	10.00	0.08	1.0	25.60	0.00	0.56	0.56
0.01	9.92	0.10	1.4	18.24	0.07	0.43	0.43
0.02	9.86	0.13	2.0	12.92	0.12	0.33	0.35
0.05	9.80	0.17	2.8	9.15	0.16	0.25	0.30
0.09	9.75	0.22	3.9	6.48	0.19	0.19	0.27
0.16	9.69	0.26	5.5	4.58	0.21	0.15	0.25
0.28	9.62	0.31	7.8	3.24	0.22	0.12	0.25
0.47	9.52	0.37	11.1	2.30	0.23	0.11	0.25
0.74	9.41	0.44	15.6	1.62	0.23	0.09	0.25
1.11	9.27	0.53	22.1	1.15	0.24	0.08	0.25
1.62	9.11	0.63	31.2	0.81	0.24	0.07	0.25
2.28	8.91	0.74	44.1	0.57	0.24	0.07	0.25
3.16	8.68	0.88	62.4	0.40	0.25	0.06	0.25
4.30	8.41	1.05	88.2	0.29	0.25	0.06	0.25
5.79	8.08	1.25	124.8	0.20	0.25	0.05	0.25
7.73	7.70	1.49	176.5	0.14	0.25	0.05	0.25
10.25	7.25	1.77	249.6	0.10	0.25	0.04	0.25
13.53	6.71	2.11	352.9	0.07	0.25	0.04	0.25
17.81	6.07	2.51	499.1	0.05	0.25	0.04	0.25
23.43	5.31	2.99	705.8	0.03	0.25	0.03	0.25
30.85	4.41	3.56	998.2	0.02	0.25	0.03	0.25
40.94	3.35	4.23	1411.6	0.01	0.25	0.02	0.25
*****NORMAL TRAPPING LEVEL REACHED							
55.73	2.11	5.04	1996.3	0.00	0.25	0.02	0.25
83.68	0.67	5.99	2823.2	-0.01	0.25	0.01	0.25
102.79	0.36	6.25	3068.1	-0.01	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 2.28 M BELOW WATER SURFACE, DILUTION = 1910.58

043091/1529

-316'

CASE I.D. Case #8 - 20 m discharge, current 25 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
ASPIRATION ENTRAINMENT COEFFICIENT	=	0.10	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	20.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	20.00	0.08	1.0	25.84	0.00	0.57	0.57
0.00	20.00	0.08	1.0	25.66	0.00	0.56	0.56
0.01	19.92	0.10	1.4	18.29	0.07	0.43	0.43
0.02	19.86	0.13	2.0	12.95	0.12	0.33	0.35
0.05	19.80	0.17	2.8	9.17	0.16	0.25	0.30
0.09	19.75	0.22	3.9	6.49	0.19	0.19	0.27
0.16	19.69	0.26	5.5	4.60	0.21	0.15	0.25
0.28	19.62	0.31	7.8	3.25	0.22	0.12	0.25
0.47	19.52	0.37	11.1	2.30	0.23	0.11	0.25
0.74	19.41	0.44	15.6	1.63	0.23	0.09	0.25
1.11	19.27	0.53	22.1	1.15	0.24	0.08	0.25
1.62	19.11	0.63	31.2	0.81	0.24	0.08	0.25
2.28	18.91	0.74	44.1	0.57	0.24	0.07	0.25
3.16	18.68	0.88	62.4	0.40	0.25	0.06	0.25
4.30	18.41	1.05	88.2	0.28	0.25	0.06	0.25
5.79	18.08	1.25	124.8	0.20	0.25	0.05	0.25
7.74	17.70	1.49	176.5	0.14	0.25	0.05	0.25
10.28	17.25	1.77	249.5	0.09	0.25	0.04	0.25
13.62	16.71	2.11	352.9	0.06	0.25	0.04	0.25
18.04	16.07	2.51	499.1	0.04	0.25	0.03	0.25
23.98	15.32	2.99	705.8	0.02	0.25	0.03	0.25
32.21	14.43	3.56	998.1	0.01	0.25	0.02	0.25
43.90	13.37	4.23	1411.6	0.01	0.25	0.02	0.25
61.14	12.12	5.04	1996.2	0.00	0.25	0.02	0.25
*****NORMAL TRAPPING LEVEL REACHED							
90.24	10.66	5.99	2823.1	0.00	0.25	0.01	0.25
136.83	9.81	6.63	3451.6	-0.01	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 11.96 M BELOW WATER SURFACE, DILUTION = 2081.01

- 317 -

CASE I.D. Case #9 - 30 m discharge, current 25 cm/sec, 0.01 mc/sec flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	0.57	0.57
0.00	30.00	0.08	1.0	25.70	0.00	0.56	0.56
0.01	29.92	0.10	1.4	18.31	0.07	0.43	0.43
0.02	29.86	0.13	2.0	12.97	0.12	0.33	0.35
0.05	29.80	0.17	2.8	9.18	0.16	0.25	0.30
0.09	29.75	0.22	3.9	6.50	0.19	0.19	0.27
0.16	29.69	0.26	5.5	4.60	0.21	0.15	0.25
0.28	29.62	0.31	7.8	3.26	0.22	0.12	0.25
0.47	29.52	0.37	11.1	2.30	0.23	0.11	0.25
0.74	29.41	0.44	15.6	1.63	0.23	0.09	0.25
1.11	29.27	0.53	22.1	1.15	0.24	0.08	0.25
1.61	29.11	0.63	31.2	0.81	0.24	0.08	0.25
2.28	28.91	0.74	44.1	0.57	0.24	0.07	0.25
3.15	28.68	0.88	62.4	0.41	0.25	0.06	0.25
4.29	28.41	1.05	88.2	0.29	0.25	0.06	0.25
5.78	28.08	1.25	124.8	0.20	0.25	0.05	0.25
7.72	27.70	1.49	176.5	0.14	0.25	0.05	0.25
10.24	27.25	1.77	249.5	0.10	0.25	0.04	0.25
13.53	26.71	2.11	352.9	0.07	0.25	0.04	0.25
17.84	26.07	2.51	499.0	0.04	0.25	0.04	0.25
23.52	25.31	2.99	705.8	0.03	0.25	0.03	0.25
31.09	24.42	3.56	998.1	0.02	0.25	0.03	0.25
41.35	23.35	4.23	1411.5	0.01	0.25	0.02	0.25
55.65	22.10	5.03	1996.1	0.00	0.25	0.02	0.25
*****NORMAL TRAPPING LEVEL REACHED							
77.05	20.62	5.99	2822.9	0.00	0.25	0.01	0.25
121.52	19.09	7.06	3910.1	-0.01	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 20.59 M BELOW WATER SURFACE, DILUTION = 2606.67

318

CASE I.D. Case #10 - 10 m discharge, current 25 cm/sec, 0.03 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	10.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	10.00	0.08	1.0	25.78	0.00	1.70	1.70
0.00	10.00	0.08	1.0	25.60	0.00	1.69	1.69
0.00	9.85	0.10	1.4	18.24	0.07	1.22	1.22
0.03	9.63	0.14	2.0	12.92	0.12	0.89	0.90
0.08	9.38	0.20	2.8	9.15	0.16	0.66	0.68
0.15	9.13	0.27	3.9	6.48	0.19	0.49	0.53
0.26	8.91	0.35	5.5	4.58	0.21	0.37	0.42
0.39	8.70	0.46	7.8	3.24	0.22	0.28	0.36
0.58	8.50	0.58	11.1	2.29	0.23	0.22	0.32
0.83	8.28	0.72	15.6	1.62	0.23	0.17	0.29
1.21	8.04	0.87	22.1	1.15	0.24	0.14	0.28
1.77	7.75	1.05	31.2	0.81	0.24	0.12	0.27
2.55	7.41	1.26	44.1	0.57	0.24	0.10	0.26
3.63	7.00	1.51	62.4	0.40	0.25	0.09	0.26
5.08	6.51	1.80	88.2	0.28	0.25	0.08	0.26
7.01	5.94	2.15	124.8	0.20	0.25	0.07	0.26
9.54	5.26	2.56	176.5	0.14	0.25	0.06	0.26
12.85	4.46	3.05	249.6	0.10	0.25	0.06	0.26
17.20	3.52	3.64	352.9	0.06	0.25	0.05	0.25
22.95	2.41	4.33	499.1	0.04	0.25	0.05	0.25
30.71	1.10	5.16	705.8	0.02	0.25	0.04	0.25

PLUME HITS WATER SURFACE; PLUMES DID NOT TRAP OR MERGE
PLUME SURFACES, DILUTION = 908.99

319

CASE I.D. Case #11 - 20 m discharge, current 25 cm/sec, 0.03 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	20.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	20.00	0.08	1.0	25.84	0.00	1.70	1.70
0.00	20.00	0.08	1.0	25.66	0.00	1.69	1.69
0.00	19.85	0.10	1.4	18.29	0.07	1.22	1.22
0.03	19.63	0.14	2.0	12.95	0.12	0.89	0.90
0.08	19.38	0.20	2.8	9.17	0.16	0.66	0.68
0.15	19.13	0.27	3.9	6.49	0.19	0.49	0.53
0.26	18.91	0.35	5.5	4.59	0.21	0.37	0.42
0.39	18.70	0.46	7.8	3.25	0.22	0.28	0.36
0.58	18.50	0.58	11.1	2.30	0.23	0.22	0.32
0.83	18.28	0.72	15.6	1.62	0.23	0.17	0.29
1.21	18.04	0.87	22.1	1.15	0.24	0.14	0.28
1.76	17.75	1.05	31.2	0.81	0.24	0.12	0.27
2.55	17.41	1.26	44.1	0.57	0.24	0.10	0.26
3.63	17.00	1.51	62.4	0.40	0.25	0.09	0.26
5.09	16.51	1.80	88.2	0.28	0.25	0.08	0.26
7.02	15.94	2.15	124.8	0.19	0.25	0.07	0.26
9.57	15.27	2.56	176.5	0.13	0.25	0.06	0.26
12.94	14.47	3.06	249.6	0.09	0.25	0.06	0.26
17.39	13.53	3.64	352.9	0.06	0.25	0.05	0.25
23.27	12.42	4.34	499.1	0.04	0.25	0.04	0.25
31.08	11.10	5.16	705.8	0.02	0.25	0.04	0.25
41.61	9.55	6.15	998.1	0.01	0.25	0.03	0.25
56.24	7.72	7.32	1411.6	0.01	0.25	0.03	0.25
*****NORMAL TRAPPING LEVEL REACHED							
78.20	5.56	8.72	1996.3	0.00	0.25	0.02	0.25
129.18	3.35	10.31	2784.3	-0.01	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 6.25 M BELOW WATER SURFACE, DILUTION = 1799.14

043091/1529

320'

CASE I.D. Case #12 - 30 m discharge, current 25 cm/sec, 0.03 mc/sec flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	8.7	
TOTAL EFFLUENT FLOW	=	0.0300	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	1.70	1.70
0.00	30.00	0.08	1.0	25.70	0.00	1.69	1.69
0.00	29.85	0.10	1.4	18.31	0.07	1.22	1.22
0.03	29.63	0.14	2.0	12.97	0.12	0.89	0.90
0.08	29.38	0.20	2.8	9.18	0.16	0.66	0.68
0.15	29.13	0.27	3.9	6.50	0.19	0.49	0.53
0.26	28.91	0.35	5.5	4.60	0.21	0.37	0.43
0.39	28.79	0.46	7.8	3.26	0.22	0.28	0.36
0.58	28.50	0.58	11.1	2.30	0.23	0.22	0.32
0.83	28.28	0.72	15.6	1.63	0.23	0.17	0.29
1.21	28.04	0.87	22.1	1.15	0.24	0.14	0.28
1.76	27.75	1.05	31.2	0.81	0.24	0.12	0.27
2.55	27.41	1.26	44.1	0.57	0.24	0.10	0.26
3.63	27.00	1.51	62.4	0.40	0.25	0.09	0.26
5.08	26.51	1.80	88.2	0.28	0.25	0.08	0.26
7.00	25.94	2.15	124.8	0.20	0.25	0.07	0.26
9.53	25.26	2.56	176.5	0.14	0.25	0.06	0.26
12.85	24.46	3.05	249.5	0.10	0.25	0.06	0.26
17.21	23.52	3.64	352.9	0.06	0.25	0.05	0.25
22.94	22.40	4.33	499.1	0.04	0.25	0.05	0.25
30.52	21.09	5.16	705.8	0.03	0.25	0.04	0.25
40.69	19.53	6.15	998.1	0.01	0.25	0.04	0.25
*****NORMAL TRAPPING LEVEL REACHED							
55.31	17.72	7.32	1411.5	-0.01	0.25	0.03	0.25
90.14	15.88	8.67	1968.7	-0.02	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 18.32 M BELOW WATER SURFACE, DILUTION = 1264.79

321

CASE I.D. Case #13 - 30 m discharge, current 10 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	0.00	PPT
INITIAL DENSITY OF THE PLUME	=	-4.2907	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	26.62	0.00	0.57	0.57
0.00	30.00	0.08	1.0	26.44	0.00	0.56	0.56
0.01	29.85	0.10	1.4	18.84	0.03	0.45	0.46
0.02	29.66	0.13	2.0	13.34	0.05	0.38	0.39
0.07	29.40	0.16	2.8	9.45	0.06	0.34	0.34
0.13	29.11	0.20	3.9	6.69	0.07	0.30	0.31
0.22	28.78	0.25	5.5	4.73	0.08	0.26	0.28
0.35	28.43	0.32	7.8	3.35	0.09	0.23	0.25
0.51	28.03	0.39	11.0	2.37	0.09	0.21	0.23
0.71	27.60	0.49	15.6	1.67	0.09	0.18	0.20
0.98	27.13	0.61	22.1	1.18	0.10	0.16	0.19
1.30	26.63	0.76	31.2	0.83	0.10	0.14	0.17
1.71	26.08	0.94	44.1	0.59	0.10	0.12	0.16
2.22	25.48	1.17	62.4	0.41	0.10	0.11	0.15
2.86	24.83	1.43	88.2	0.29	0.10	0.09	0.14
3.67	24.11	1.75	124.7	0.20	0.10	0.08	0.13
4.70	23.32	2.13	176.3	0.14	0.10	0.07	0.12
6.01	22.42	2.59	249.4	0.10	0.10	0.06	0.12
7.70	21.41	3.13	352.6	0.07	0.10	0.06	0.11
9.89	20.26	3.77	498.7	0.04	0.10	0.05	0.11
12.72	18.96	4.55	705.2	0.02	0.10	0.04	0.11
16.48	17.54	5.49	997.3	0.00	0.10	0.03	0.11
*****NORMAL TRAPPING LEVEL REACHED							
22.06	15.99	6.62	1410.5	-0.01	0.10	0.02	0.10
34.67	14.64	7.81	1913.4	-0.02	0.10	0.00	0.10

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 17.06 M BELOW WATER SURFACE, DILUTION = 1112.78

CASE I.D. Case #14 - 30 m discharge, current 25 cm/sec, 0.01 cms flow

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	0.00	PPT
INITIAL DENSITY OF THE PLUME	=	-4.2907	SIGMAT UNITS
FROUDE NUMBER	=	2.9	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	1	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	1000.0	M(DEFAULT)
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	26.62	0.00	0.57	0.57
0.00	30.00	0.08	1.0	26.44	0.00	0.56	0.56
0.01	29.92	0.10	1.4	18.84	0.07	0.43	0.44
0.02	29.86	0.13	2.0	13.34	0.12	0.33	0.35
0.05	29.80	0.17	2.8	9.45	0.16	0.25	0.30
0.09	29.75	0.22	3.9	6.69	0.19	0.19	0.27
0.16	29.69	0.26	5.5	4.73	0.21	0.15	0.26
0.28	29.62	0.31	7.8	3.35	0.22	0.12	0.25
0.47	29.52	0.37	11.0	2.37	0.23	0.11	0.25
0.73	29.41	0.44	15.6	1.68	0.23	0.09	0.25
1.10	29.27	0.53	22.1	1.19	0.24	0.08	0.25
1.60	29.10	0.63	31.2	0.84	0.24	0.08	0.25
2.25	28.91	0.74	44.1	0.59	0.24	0.07	0.25
3.12	28.68	0.88	62.4	0.42	0.25	0.06	0.25
4.24	28.40	1.05	88.2	0.29	0.25	0.06	0.25
5.71	28.08	1.25	124.7	0.21	0.25	0.05	0.25
7.62	27.70	1.49	176.3	0.14	0.25	0.05	0.25
10.10	27.24	1.77	249.4	0.10	0.25	0.04	0.25
13.35	26.70	2.11	352.6	0.07	0.25	0.04	0.25
17.59	26.06	2.51	498.7	0.05	0.25	0.04	0.25
23.18	25.31	2.99	705.2	0.03	0.25	0.03	0.25
30.63	24.41	3.55	997.3	0.02	0.25	0.03	0.25
40.71	23.35	4.23	1410.4	0.01	0.25	0.02	0.25
54.71	22.09	5.03	1994.6	0.00	0.25	0.02	0.25
*****NORMAL TRAPPING LEVEL REACHED							
75.52	20.61	5.99	2820.8	0.00	0.25	0.02	0.25
121.10	19.02	7.10	3961.7	-0.01	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 20.90 M BELOW WATER SURFACE, DILUTION = 2650.23

323

CASE I.D. Case #15 - 30 m discharge, current 10 cm/sec, 0.01 cms flow, 2 ports

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	1.5	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	2	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	10.00	M
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	10.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	10.00	0.08	1.0	25.78	0.00	0.28	0.28
0.00	10.00	0.08	1.0	25.60	0.00	0.28	0.28
0.01	9.89	0.09	1.4	18.24	0.03	0.27	0.28
0.03	9.75	0.11	2.0	12.92	0.05	0.26	0.26
0.06	9.60	0.13	2.8	9.15	0.06	0.24	0.24
0.12	9.44	0.17	3.9	6.48	0.07	0.21	0.23
0.19	9.25	0.21	5.5	4.58	0.08	0.19	0.21
0.28	9.05	0.25	7.8	3.24	0.09	0.17	0.19
0.41	8.82	0.32	11.1	2.29	0.09	0.15	0.18
0.57	8.58	0.39	15.6	1.62	0.09	0.13	0.16
0.77	8.31	0.48	22.1	1.15	0.10	0.12	0.15
1.02	8.02	0.59	31.2	0.81	0.10	0.10	0.14
1.34	7.70	0.72	44.1	0.57	0.10	0.09	0.13
1.75	7.34	0.88	62.4	0.40	0.10	0.08	0.13
2.26	6.95	1.07	88.2	0.28	0.10	0.07	0.12
2.93	6.50	1.30	124.8	0.20	0.10	0.06	0.12
3.78	5.99	1.57	176.5	0.14	0.10	0.06	0.11
4.87	5.41	1.89	249.6	0.10	0.10	0.05	0.11
6.29	4.73	2.27	352.9	0.07	0.10	0.04	0.11
8.14	3.95	2.72	499.1	0.04	0.10	0.04	0.11
10.55	3.06	3.26	705.8	0.03	0.10	0.03	0.11
13.78	2.03	3.91	998.2	0.01	0.10	0.03	0.10
18.28	0.84	4.68	1411.6	0.00	0.10	0.02	0.10

*****PLUMES MERGE AT 0.36 M BELOW THE SURFACE WITH AN AVE. DILUTION OF1604.5

*****NORMAL TRAPPING LEVEL REACHED

PLUME HITS WATER SURFACE; PLUMES MERGED BEFORE TRAPPING LEVEL REACHED
TRAPPING LEVEL= 0.33 M BELOW WATER SURFACE, DILUTION = 1617.79

CASE I.D. Case #16 - 30 m discharge, current 25 cm/sec, 0.01 cms flow, 2 ports

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	1.4	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	2	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	10.00	M
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	0.28	0.28
0.00	30.00	0.08	1.0	25.70	0.00	0.28	0.28
0.00	29.98	0.10	1.4	18.32	0.07	0.21	0.23
0.01	29.98	0.13	2.0	12.97	0.12	0.15	0.20
0.02	29.97	0.15	2.8	9.19	0.16	0.12	0.20
0.07	29.93	0.17	3.9	6.50	0.19	0.10	0.21
0.16	29.89	0.20	5.5	4.60	0.21	0.09	0.23
0.30	29.83	0.23	7.8	3.26	0.22	0.09	0.23
0.48	29.76	0.27	11.1	2.30	0.23	0.08	0.24
0.73	29.68	0.32	15.6	1.63	0.23	0.07	0.25
1.06	29.59	0.38	22.1	1.15	0.24	0.07	0.25
1.50	29.47	0.45	31.2	0.81	0.24	0.06	0.25
2.06	29.34	0.53	44.1	0.58	0.24	0.06	0.25
2.80	29.18	0.63	62.4	0.41	0.25	0.05	0.25
3.76	28.98	0.75	88.2	0.29	0.25	0.05	0.25
5.01	28.76	0.89	124.8	0.20	0.25	0.04	0.25
6.64	28.49	1.06	176.5	0.14	0.25	0.04	0.25
8.75	28.17	1.26	249.5	0.10	0.25	0.04	0.25
11.51	27.79	1.49	352.9	0.07	0.25	0.03	0.25
15.11	27.34	1.78	499.0	0.05	0.25	0.03	0.25
19.82	26.81	2.11	705.7	0.03	0.25	0.03	0.25
26.06	26.17	2.52	998.1	0.02	0.25	0.02	0.25
34.44	25.42	2.99	1411.5	0.01	0.25	0.02	0.25
46.03	24.53	3.56	1996.1	0.01	0.25	0.02	0.25
62.87	23.48	4.24	2822.9	0.00	0.25	0.01	0.25
*****NORMAL TRAPPING LEVEL REACHED; PLUMES MERGE							
90.57	22.24	5.04	3992.2	0.00	0.25	0.01	0.25
138.90	21.40	5.65	5018.2	0.00	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO; PLUMES MERGED ABOVE TRAPPING LEVEL
TRAPPING LEVEL= 23.23 M BELOW WATER SURFACE, DILUTION = 3046.57

325

CASE I.D. Case #17 - 30 m discharge, current 10 cm/sec, 0.01 cms flow, 4 ports

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.10	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	0.7	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	4	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	10.00	M
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	0.14	0.14
0.00	30.00	0.08	1.0	25.70	0.00	0.14	0.14
0.01	29.95	0.08	1.4	18.32	0.03	0.16	0.16
0.02	29.88	0.10	2.0	12.97	0.05	0.17	0.17
0.05	29.80	0.11	2.8	9.18	0.06	0.16	0.17
0.09	29.70	0.14	3.9	6.50	0.07	0.15	0.17
0.15	29.60	0.16	5.5	4.60	0.08	0.14	0.16
0.23	29.48	0.20	7.8	3.26	0.09	0.13	0.15
0.32	29.35	0.25	11.1	2.30	0.09	0.11	0.15
0.45	29.21	0.30	15.6	1.63	0.09	0.10	0.14
0.60	29.06	0.37	22.1	1.15	0.10	0.09	0.13
0.80	28.88	0.44	31.2	0.81	0.10	0.08	0.13
1.06	28.68	0.54	44.1	0.57	0.10	0.07	0.12
1.39	28.46	0.65	62.4	0.41	0.10	0.06	0.12
1.81	28.21	0.79	88.2	0.29	0.10	0.06	0.11
2.36	27.91	0.94	124.8	0.20	0.10	0.05	0.11
3.06	27.57	1.13	176.5	0.14	0.10	0.05	0.11
3.98	27.18	1.36	249.5	0.10	0.10	0.04	0.11
5.16	26.72	1.63	352.9	0.07	0.10	0.04	0.11
6.70	26.19	1.94	499.0	0.05	0.10	0.03	0.11
8.72	25.56	2.32	705.8	0.03	0.10	0.03	0.10
11.39	24.83	2.77	998.1	0.02	0.10	0.03	0.10
14.97	23.97	3.31	1411.5	0.01	0.10	0.02	0.10
19.86	22.96	3.95	1996.1	0.01	0.10	0.02	0.10
26.86	21.79	4.71	2822.9	0.00	0.10	0.01	0.10
*****NORMAL TRAPPING LEVEL REACHED; PLUMES MERGE							
38.32	20.43	5.63	3992.2	0.00	0.10	0.01	0.10
53.52	19.66	6.21	4847.3	-0.01	0.10	0.00	0.10

VERTICAL PLUME VELOCITY WENT THRU ZERO; PLUMES MERGED ABOVE TRAPPING LEVEL
TRAPPING LEVEL= 21.56 M BELOW WATER SURFACE, DILUTION = 3004.64

CASE I.D. Case #18 - 30 m discharge, current 25 cm/sec, 0.01 cms flow, 4 ports

INITIAL THICKNESS OF PLUME ELEMENT	=	PORT RADIUS	(DEFAULT)
IMPINGEMENT ENTRAINMENT COEFFICIENT	=	1.00	(DEFAULT)
AMBIENT CURRENT SPEED	=	0.25	M/S
INITIAL TEMPERATURE OF THE PLUME	=	30.00	DEGREES CENTIGRADE
INITIAL SALINITY OF THE PLUME	=	1.00	PPT
INITIAL DENSITY OF THE PLUME	=	-3.5450	SIGMAT UNITS
FROUDE NUMBER	=	0.7	
TOTAL EFFLUENT FLOW	=	0.0100	CMS
NUMBER OF PORTS	=	4	
PORT DIAMETER	=	0.1500	M
PORT SPACING	=	10.00	M
VERTICAL PORT ANGLE FROM HORIZONTAL	=	90.0	DEGREES
PORT DEPTH	=	30.00	M

X (M)	Z (M)	PLUME RADIUS (M)	DILU-TION	DENDIFF (SIGMA)	HORIZ VEL (M/S)	VERT VEL (M/S)	TOTAL VEL (M/S)
0.00	30.00	0.08	1.0	25.88	0.00	0.14	0.14
0.00	30.00	0.08	1.0	25.70	0.00	0.14	0.14
0.00	30.00	0.09	1.4	18.32	0.07	0.10	0.12
0.00	30.00	0.10	2.0	12.97	0.12	0.07	0.14
0.00	30.00	0.11	2.8	9.19	0.16	0.05	0.17
0.06	29.98	0.13	3.9	6.50	0.19	0.06	0.20
0.18	29.95	0.14	5.5	4.60	0.21	0.07	0.22
0.31	29.90	0.17	7.8	3.26	0.22	0.07	0.23
0.47	29.86	0.19	11.1	2.30	0.23	0.06	0.24
0.69	29.80	0.23	15.6	1.63	0.23	0.06	0.24
0.97	29.73	0.27	22.1	1.15	0.24	0.05	0.25
1.33	29.65	0.32	31.2	0.81	0.24	0.05	0.25
1.81	29.56	0.38	44.1	0.58	0.24	0.05	0.25
2.43	29.45	0.45	62.4	0.41	0.25	0.04	0.25
3.24	29.31	0.53	88.2	0.29	0.25	0.04	0.25
4.29	29.15	0.63	124.8	0.20	0.25	0.04	0.25
5.65	28.96	0.75	176.5	0.14	0.25	0.03	0.25
7.43	28.74	0.89	249.5	0.10	0.25	0.03	0.25
9.74	28.47	1.06	352.9	0.07	0.25	0.03	0.25
12.74	28.15	1.26	499.0	0.05	0.25	0.03	0.25
16.68	27.78	1.50	705.7	0.03	0.25	0.02	0.25
21.85	27.33	1.78	998.1	0.02	0.25	0.02	0.25
28.71	26.80	2.12	1411.5	0.01	0.25	0.02	0.25
38.00	26.17	2.52	1996.1	0.01	0.25	0.02	0.25
51.09	25.42	3.00	2822.9	0.00	0.25	0.01	0.25
*****NORMAL TRAPPING LEVEL REACHED							
71.42	24.54	3.56	3992.2	0.00	0.25	0.01	0.25
119.00	23.55	4.24	5645.8	0.00	0.25	0.00	0.25
128.75	23.51	4.28	5764.4	0.00	0.25	0.00	0.25

VERTICAL PLUME VELOCITY WENT THRU ZERO
TRAPPING LEVEL= 25.01 M BELOW WATER SURFACE, DILUTION = 3345.42

327

1/4 T UNCLASSIFIED MANILA 09426/01

OCP

ORIGIN: AID-3 INFO: AMB DCM AA RA ECON/6 (OCP -3 C&R)

VZCZC
RR RUEHC
DE RUEHML #9426/01 099 **
ZNR UUUUU ZZH
R 280642Z APR 92
FM AMEMBASSY MANILA
TO SECSTATE WASHDC 4893
BT
UNCLAS SECTION 01 OF 04 MANILA 09426

CLASS: UNCLASSIFIED
CHRGE: AID 04/26/92
APPRV: OCP:DZVINAKIS
DRFTD: OCP:KLUEPHANG:EBI
CLEAR: 1.OCP:JSTARNES
2.OCP:ANAANEP
DISTR: AID (OCP-3 C&R)
ORGIN: OCR

AIDAC

FOR MOLLY KUX, ENVIRONMENTAL COORDINATOR, ASIA/DR/TR;
INFO DON CLARK, ASIA/EA/P

E.O. 12356: N/A
SUBJECT: APPROVAL OF ENVIRONMENTAL DOCUMENTS FOR THREE
- USAID/MANILA PROJECTS

REF: REF (A) STATE 091671, (B) 92 MANILA 04033
- (C) 91 MANILA 2790

1. THANK YOU FOR REF CABLE (A). FOR THE FIVE PCIS SUBPROJECT, BEC GAVE PARTIAL CONDITIONAL APPROVAL TO THREE AND RESERVED APPROVAL FOR TWO OTHERS. OUR RESPONSE TO THE ADDITIONAL INFORMATION REQUESTED IN REF(A) IS CONTAINED BELOW. WE AND THE GOP ARE ANXIOUS TO MOVE FORWARD WITH IMPLEMENTATION ON THESE PROJECTS AND HOPE THE INFORMATION REQUESTED WILL BE SATISFACTORY TO SECURE BEC APPROVAL.

2. GSC AGRO-PROCESSING CENTER

A. MISSION APPRECIATES THAT BUREAU ENVIRONMENTAL COORDINATOR (BEC) APPROVES ENVIRONMENTAL ASSESSMENT (EA) FOR GSC AGRO-PROCESSING CENTER (APC). TO CLARIFY, SPECIFIC PRIVATE FUNDING FOR THE AGRO-PROCESSING CENTER IS NOT YET DETERMINED AS THE GOVERNMENT IS STILL SOLICITING INTEREST FROM VARIOUS PRIVATE SECTOR FIRMS. IT IS POSSIBLE THAT WE MIGHT IN THE FUTURE BE ASKED TO FUND LIMITED ASSISTANCE TO THIS PRIVATE SECTOR COMPONENT IN THE FORM OF SITE DEVELOPMENT.

B. MISSION CONFIRMS THAT THE MENTIONED MASTER PLAN IN REF(B) IS THE GROWTH PLAN.
UNCLASSIFIED

C. BEC ASKED MISSION TO EXPLAIN "THE FISHERIES FOR SMALL, HOOK-AND-LINE AND PURSE SEINE FISHERMAN IN THIS REGION ARE ALL EXCELLENT AND THAT DAMES AND MOORE (DM) AGREES WITH THIS CONCLUSION"; AND THE SEEMINGLY CONTRADICTORY STATEMENT IN DM'S EA.

I. AS FAR AS THE SMALL, HOOK AND LINE FISHERIES IS CONCERNED, MISSION BELIEVES THE BEC WILL AGREE WITH BOTH REF(B) AND DAMES AND MOORE CONSULTANTS (DM) THAT THIS

TYPE OF FISHING INDUSTRY DOES NOT POSE A THREAT FOR DEPLETING THE FISHERIES INDUSTRY. AS REPORTED BY DM ON PAGE XV IN THE EA, "CONSTRUCTION OF THE FISH PORT WILL IMPROVE SANITARY CONDITIONS FOR FISH LANDINGS, AND THEREFORE SHOULD RESULT IN A BETTER QUALITY AND BETTER PRICE FOR SASHIMI. ALTHOUGH THIS MIGHT ENCOURAGE ADDITIONAL FISHING PRESSURE, THE FISHERY IS PRIMARILY HOOK-AND-LINE AND IS PROBABLY SUSTAINABLE, WITH NO SIGNIFICANT ADVERSE IMPACT ON TUNA STOCKS."

IN REF(B), THE MISSION REPORTED THAT THE DEPARTMENT OF AGRICULTURE (DOA) AND USAID HAVE AGREED TO A NEED FOR LONG-TERM COMMITMENTS TO CARRY OUT NECESSARY MEASURES TO RESTORE FISHERY RESOURCES. THERE IS, HOWEVER, ALSO AN IMMEDIATE NEED AS THE EA RECOMMENDED, TO IMPROVE SANITARY CONDITIONS AT THE FISH LANDING SITES WHICH WOULD IMPROVE MARKET VALUE OF THE PRODUCT AND THEREFORE FISHERMEN'S INCOMES. THE SMALL-SCALE FISHERMEN'S ASSOCIATION AND DOA, SINCE THE DRAFT EA WAS SUBMITTED A YEAR AGO, HAVE BEEN TAKING MEASURES TO RESTORE THE FISHERY INSIDE SARANGANI BAY. THE HOOK-AND-LINE FISHERY FOR TUNA, IN ITSELF, WOULD BE A SUSTAINABLE FISHERY

THE EA RECOMMENDATION TO PROVIDE A NEW LANDING AREA WITH SANITARY FACILITIES AND ADEQUATE SUPPORT SERVICES IS NOT EXPECTED TO ACCELERATE THE DECLINE OF THE HOOK-AND-LINE FISHERY.

II. HOWEVER, WHAT WE INTERPRET THE BEC'S CONCERNS AS REFLECTED IN REF(A) INQUIRY IS THAT THE PURSE SEINERS, IF ALLOWED TO CONTINUE THEIR PRACTICE OF FISHING JUVENILE FISHES WILL SOON DEPLETE THE FISHING STOCKS; AND THE CONSTRUCTION OF A FISH PORT COMPLEX WILL ENCOURAGE THIS DEPLETION TO AN EVEN LARGER EXTENT, THUS, THREATENING THE FISHERY INDUSTRY.

THE DM REPORTED ON PAGE XV THAT "MOST OF THE TUNA NOW LANDED AT THE EXISTING CANNERIES IN SARANGANI BAY ARE VERY SMALL JUVENILES CAUGHT BY PURSE SEINERS. THIS
UNCLASSIFIED

HARVEST IS NOT SUSTAINABLE, AND REPRESENTS A SIGNIFICANT ADVERSE IMPACT ON TUNA STOCKS. THE FISH PORT PROPOSED BY DPWH DOES NOT PROVIDE FOR PURSE SEINER DOCKING OR
RT
#9426

NNNN

319-

LANDING FACILITIES, THEREFORE, THE PROPOSED PROJECT WILL NOT ENCOURAGE THIS UNSUSTAINABLE EXPLOITATION OF THE TUNA RESOURCE."

III. THE CHANGED POSITION AFTER THE DM REPORT, IS THAT THE PROJECT BOARD DECIDED TO BUILD PORT FACILITIES, AS REPORTED IN REF(B) THAT WOULD PROVIDE A BASE FOR TUNA PURSE SEINE VESSELS SHIPPING WITHIN A 1,520 NAUTICAL MILE ARC IN THE WESTERN PACIFIC OCEAN, WHERE THE TUNA AND SKIPJACK RESOURCE IS REPUTED TO BE VERY ABUNDANT AND NOT THREATENED BY OVEREXPLOITATION. THE MODERN FISHING PORT COULD PROVIDE THE ADEQUATE MEANS OF EXTENDING THE FISHING DISTANCES OF THE PURSE SEINERS, THUS, PROVIDING THEM AN ALTERNATE FISHING SOURCE. WE AGREE THAT WHATEVER THE SOURCE AREA, PRUDENT RESOURCE MANAGEMENT SHOULD BE PART OF THE ECONOMIC DEVELOPMENT OF THE AREA.

IV. THE ENVIRONMENTAL ASSESSMENT FLESHED THESE ISSUES OUT TO THE DECISION MAKERS AND ALONG WITH THE GROWTH PLAN PROVIDES BACKGROUND TO ALLOW SUBSEQUENT SOLID BUSINESS, LEGISLATIVE, OR ENVIRONMENTAL STEPS TO BE TAKEN. LIMITS ON SIZE, TONNAGE OF CATCH, SEASON FOR FISHING OR OTHER REMEDIAL OR MITIGATIVE ACTIONS COULD THEN BE FOLLOWED BY THE PROJECT BOARD AND LOCAL AUTHORITIES. THE MISSION'S POSITION AS WELL AS THE BEC'S CONCERNS FOR SUPPORTING THE FISH PORT IS BASED ON THIS LINE OF REASONING AND WHAT IS STATED IN REF(B) STILL STANDS. THE MISSION BELIEVES THAT THESE ISSUES OVER TIME BE PLACED BEFORE THE PROJECT BOARD. IF THE PROSPECTIVE IS PURELY ECONOMIC, AND THE FISHERY DEPLETION OCCURS WITHOUT CORRECTIVE MEASURES, THE PURSE SEINE FLEET FISHERMAN WILL FEEL THE FISHERY DEPLETION ECONOMIC PINCH BEFORE ANYONE ELSE. THE SECRETARY OF AGRICULTURE IS IN CLOSE CONTACT WITH FISHING GROUPS AND WE ARE PLANNING TO CONTINUE WORKING CLOSELY WITH THE JAPANESE, THE COMPONENT SPONSOR.

V. FINALLY, WE BELIEVE THAT IT WOULD BE BEST TO GIVE THE PROJECT BOARD THE OPPORTUNITIES TO DEVELOP ENVIRONMENTAL PLANS AND INTERVENTIONS AS THE FOUR-YEAR CONSTRUCTION PERIOD PROCEEDS. THE BEC CONCERNS ARE APPRECIATED AND WILL BE BROUGHT TO THEIR ATTENTION.
UNCLASSIFIED

3. ENVIRONMENTAL PROCEDURES FOR PHILIPPINE CAPITAL
- INFRASTRUCTURE SUPPORT (PCIS) PROJECTS

A. ON BEC COMMENTARY ABOUT USAID ENVIRONMENTAL PROCEDURES, NO ONE IS ADVOCATING A SUBSTITUTE FOR AID'S EA PROCEDURES. THE ISSUE HERE IS THAT IF ANYONE PRODUCES AN EA WHICH SATISFIES USAID 22 CFR 216, THEN THAT EA SHOULD SUFFICE FOR USAID. OUR UNDERSTANDING IS THAT BEC IS NOT REQUIRED TO CERTIFY ANYONE TO PRODUCE AN EA. IF A DOCUMENT IS PRODUCED BY A HOST COUNTRY THAT SATISFIES BOTH THE HOST COUNTRY'S AND USAID'S EA REGULATORY REQUIREMENTS, IT IS DUPLICATIVE FOR THE COUNTRY GO THROUGH THE EXPENSE AND TIME DELAYS TO PRODUCE ANOTHER EA. RECENT TRACK RECORD SHOWS THAT

DENR/EMB HARDLY LACKS POLITICAL AUTONOMY, PARTICULARLY ON ENERGY PROJECTS. LACK OF TRAINED DENR/EMB PERSONNEL TO ADDRESS CERTAIN ISSUES? CERTAINLY. THEREIN LIES THE NEED OF THE MEO TO REVIEW SPECIFIC PROJECT BY PROJECT, BEFORE ENDORSING THE PROJECT TO THE BEC BEFORE APPROVAL. WE BELIEVE WE HAVE DONE THIS IN THIS INSTANCE.

4. FIVE PCIS INITIAL ENVIRONMENTAL EXAMINATIONS (IEES)

- (I) CAMARINES SUR TELECOMMUNICATIONS ($1,445,000) DEFERRED.
- (II) MT. PINATUBO VOLCANO EMERGENCY EQUIPMENT ($3,380,000) CONDITIONAL APPROVAL
- (III) NATIONAL ADMINISTRATIVE TRUNKED MOBILE RADIO COMMUNICATIONS SYSTEM ($23,000,000) CONDITIONAL APPROVAL
- (IV) VERY SMALL APERTURE TERMINAL (VSAT) ($3,661,500) CONDITIONAL APPROVAL
- (V) MAK-BAN GEOTHERMAL POWER PROJECT ($28,466,716) DEFERRED

A. WITH RESPECT TO THE FIVE IEES SUBMITTED TO THE BEC, MISSION PREPARED THE IEES ACCORDING TO USAID IEE PREPARATION GUIDELINES OF AUGUST 1976. WE DID NOT RELY ONLY UPON GOP WORK BUT CONDUCTED OUR OWN SEPARATE
BT
#9426

NNNN

-331-

STUDIES IN DEVELOPING THE IEES. WE DID SPEND SUBSTANTIAL ORIGINAL TIME ON IEE PREPARATION BUT DID NOT PROVIDE THE SUFFICIENT INFORMATION DEVELOPED FOR THE FOUR TELECOMMUNICATIONS SUBPROJECTS TO THE BEC FOR CONCURRENCE WITH THE MISSION THRESHOLD DECISIONS. THE FOUR TELECOMMUNICATIONS SUBPROJECTS DO NOT INVOLVE MAJOR ACTION SIGNIFICANTLY AFFECTING THE ENVIRONMENT AND BELOW
UNCLASSIFIED

IS ADDITIONAL INFORMATION FOR THESE PROJECTS TO SUPPORT THIS.

B. PROPOSAL NUMBER (I), THE CAMARINES SUR TELECOMMUNICATIONS PROJECT WHEREIN BEC DEFERRED THE IEE APPROVAL, IS FOR A TELECOMMUNICATION SYSTEM FOR AN ENTIRE PROVINCE INVOLVING THE USE OF TRUNKING RADIO. YOU ARE RIGHT THE PROJECT WILL NOT INVOLVE ANY CONSTRUCTION ACTIVITY, AND WE SHOULD HAVE SO STATED. OTHERWISE, WE WOULD HAVE DESCRIBED SUCH CONSTRUCTION ACTIVITY. THE PROJECT INVOLVES THE DISTRIBUTION OF RADIO HAND SETS TO PRIVATE INDIVIDUALS, INSTALLATION OF MOBILE PHONES AND CAR PHONES ON VEHICLES AND PUBLIC CALLING STATIONS IN EXISTING PUBLIC BUILDINGS OF CITIES AND MUNICIPALITIES IN THE PROVINCE. THE CENTRAL CONTROL PANEL OF ELECTRONIC EQUIPMENT WILL ALSO BE INSTALLED IN AN AVAILABLE BUILDING. THESE ACTIVITIES SHOULD NOT CAUSE ANY HARM TO THE ENVIRONMENT.

ACTION REQUESTED. BEC TO APPROVE THE IEE FOR (I) THE CAMARINES SUR TELECOMMUNICATIONS PROJECT.

C. PROPOSAL NUMBER (II), THE MT. PINATUBO VOLCANO EMERGENCY TELECOMMUNICATIONS PROJECT INVOLVES THE INSTALLATION OF AN EARTH SATELLITE STATION IN THE AREA AFFECTED BY MT. PINATUBO ERUPTION. AS PREVIOUSLY STATED IN OUR ORIGINAL REQUEST, THE ONLY ACTIVITY WHICH INVOLVED THE ENVIRONMENT IS THE CONSTRUCTION OF FOUNDATION WORKS FOR THE STATIONS SIMILAR TO THOSE FOR BUNGALOW-TYPE HOUSING STRUCTURE FOUNDATIONS TO SUPPORT THE DISH-SHAPED EQUIPMENT. THE EARTH STATION IS CO-LOCATED WITH OTHER EXISTING TELECOMMUNICATIONS EQUIPMENT. THIS EQUIPMENT WAS INSTALLED WITHIN 3 DAYS DURING THE VOLCANO ERUPTION AND ARE NOW OPERATIONAL. ACCESS ROADS WERE ALREADY IN EXISTENCE. MISSION BELIEVES THIS PROJECT HAS NO SIGNIFICANT IMPACT TO THE ENVIRONMENT. EVENTS HAVE NOW OVERTAKEN TO COMPLY WITH BEC'S REQUEST FOR CONTRACT OR LOAN SPECIFICATIONS FOR STANDARDS, DESIGNS, CHOICE OF SITE, ETC. AND MISSION WOULD REQUIRE JUSTIFICATION TO SPEND THE TIME AND EFFORT TO SUPPLY THESE. CERTAINLY A COMMUNICATION NETWORK SHOULD HAVE A POSITIVE ENVIRONMENTAL IMPACT.

ACTION REQUESTED: BEC TO CHANGE (II) THE MT. PINATUBO VOLCANO EMERGENCY TELECOMMUNICATIONS PROJECT FROM CONDITIONAL APPROVAL TO APPROVAL OF IEE.
UNCLASSIFIED

D. PROPOSAL NUMBER (III), THE NATIONAL ADMINISTRATIVE

332

TRUNKED MOBILE RADIO COMMUNICATIONS SYSTEM AND PROPOSAL NUMBER (IV) THE VERY SMALL APERTURE TERMINAL (VSAT) ARE PROJECTS OF THE SAME NATURE AS THE CAMARINES SUR TELECOMMUNICATIONS PROJECT PROPOSAL NUMBER (I). VSAT EQUIPMENT IS A SMALL DISH, ABOUT 1.8 TO 2.4 METERS IN DIAMETER AND CAN BE MOUNTED ANYWHERE, MORE PARTICULARLY ON TOP OF THE USER'S FACILITIES, SUCH AS A BANK OR BUSINESS BUILDING USING THE VSAT EQUIPMENT. NO CONSTRUCTION TYPE OR SAFETY RELATED ISSUES ARE ANTICIPATED. VSAT WILL PROVIDE NOT ONLY VOICE TRANSMISSION BUT ALSO RECORD DATA, AND TV SERVICES TRANSMISSIONS.

ACTION REQUESTED: BEC TO CHANGE (III) THE NATIONAL TRUNK RADIO AND (IV) VSAT FROM CONDITIONAL APPROVALS TO APPROVALS OF IEES.

E. IN REF(A), PARA 3C YOU REFERRED TO THE NEED OF AN ENVIRONMENTAL ACTION PLAN. WE DO NOT SEE THE RELEVANCES OF AN ACTION PLAN FOR A PROJECT HAVING NO ADVERSE ENVIRONMENTAL IMPACT, SUCH AS, INSTALLATION OF TELEPHONE INSTRUMENTS IN HOMES AND EXISTING BUILDINGS.

F. PROPOSAL (V), MAR-BAN GEOTHERMAL POWER PROJECT

BT
#9426

NNNN

333

I. THIS IS NOT A NEW POWER PLANT BUT REPRESENTS THE INTRODUCTION OF TECHNOLOGY TO AN EXISTING PLANT. IN A REAL SENSE THE PROJECT IS ONE OF ENERGY EFFICIENCY AND ENVIRONMENTAL MITIGATION. WE HAVE REQUESTED ORMAT TO PROVIDE YOU WITH SPECIFIC ADDITIONAL INFORMATION YOU REQUESTED IN REF(A) SINCE SOME OF THE INFORMATION MIGHT BE PROPRIETARY. WE HOPE THIS INFORMATION IS SUFFICIENT FOR YOU TO APPROVE THE IEE.

II. INSTEAD OF A FULL EA, ENVIRONMENTAL MANAGEMENT BUREAU (EMB) INSTRUCTED GOP'S NATIONAL POWER CORPORATION (NPC) TO ENDORSE THE PROJECT'S PROFILE (SENT PREVIOUSLY IN JUNE TO AID/W) TO EMB FOR THE ISSUANCE OF AN ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC) TO AUTHORIZE THE PROJECT'S FULL CONSTRUCTION IMPLEMENTATION. ACCORDING TO EMB, THE PROJECT PROFILE IS SUFFICIENT FOR TEEM TO ISSUE THE ECC SINCE THE PROJECT WILL JUST MAKE USE OF AN EXCESS STEAM FROM AN EXISTING PLANT. THE PLANT WOULD BE MORE EFFICIENT, AND EQUIPMENT FOR MODIFICATIONS ARE ADD-ON. THIS IS NOT A NEW POWER PLANT, SO HOW MUCH DIRT THAT WILL BE TURNED-OVER WILL BE MINIMAL.
UNCLASSIFIED

III. REQUEST YOUR APPROVAL OF THE IEE SINCE THIS IS THE ONLY REMAINING APPROVAL REQUIRED FOR THE GOP TO ISSUE THEIR PROJECT FINANCING APPROVAL. SINCE THIS ADD-ON TO AN EXISTING PLANT WILL PROVIDE CRITICALLY NEEDED ELECTRIC POWER INTO THE NATION'S GRID, THERE IS AN URGENT NEED FOR RECEIVING YOUR APPROVAL IN ORDER FOR THE PROJECT TO START. WHATEVER YOU CAN DO TO EXPEDITE APPROVAL WILL BE VERY MUCH APPRECIATED, EVEN PROVIDING A CONDITIONAL APPROVAL, SINCE THIS PROJECT IS NOT A NEW START AS EXPLAINED IN THE IEE AS REPEATED IN P.II. ABOVE.

IV. FYI, WE HAVE SENT YOU A COPY OF THE PHILIPPINES' EMB ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC) ON THIS PROJECT. THE ECC PROVIDES A MONITORING AND REPORTING PROCESS AND PROCEDURES FOR EMB TO ASSURE ORMAT IS PRACTICING ADEQUATE ENVIRONMENTAL SAFEGUARDS. YOUR REQUEST FOR A MISSION ACTION PLAN SEEMS DUPLICATIVE.

ACTION REQUESTED: BEC TO APPROVE IEE FOR PROPOSAL (V), THE MAK-BAN GEOTHERMAL POWER PLANT.

5. LOCAL GOVERNMENT INFRASTRUCTURE FUND (LGIF)

A. THE MISSION HAS INCORPORATED JIM TARRANT'S PROPOSAL IN HIS APRIL, 1991 MEMORANDUM INTO THE SCOPE OF WORK (SOW) FOR DEVELOPING A SCREENING PROCESS OF THE LGIF PROJECT. MISSION RECEIVED THE BEC FAX MESSAGE CONTAINING SUMMARY OF THE PROGRAMMATIC EA PROCEDURES. SINCE THEY ARE THE SAME AS THE SOW DEVELOPED FROM TARRANT'S APRIL, 1991 MEMORANDUM AND REPEATED IN REF(A), MISSION HAVE, THEREFORE, SENT OUT THE SOW FOR BIDDING, AS BEC WAS INFORMED BY FAX ON MARCH 17, 1992.

6. OUR SUMMARY REQUEST IS AS FOLLOWS:

A. APPROVE IEE FOR TELECOMMUNICATIONS PROJECTS

(I) CAMARINES SUR TELECOMMUNICATIONS
(II) MT. PINATUBO VOLCANO EMERGENCY EQUIPMENT
(III) NATIONAL ADMINISTRATIVE TRUNKED MOBILE RADIO
- COMMUNICATIONS SYSTEM
(IV) VERY SMALL APERTURE TERMINAL (VSAT)

B. IEE APPROVAL FOR

(V) MAR-BAN GEOTHERMAL POWER PROJECT. HUBBARD

BT
#9426

NNNN

335

B

To: Kenneth P. Luephang MANILA-RMC 18F
From: James Tarrant
Subject: Five IEEs and an EA Appro Date: 04/14/92
Forwarded By: James Tarrant

Distribution:

Not Requested

TO: MANILA01-LUE010BB Kenneth P. Luephang
- SSWGATE@BANS00017@SERVERS[LUE010BB:MANIL

Full Subject: Five IEEs and an EA Approval

Comments by: Jim Tarrant@NE.DR@AIDW
Forwarded to: SSWGATE@BANS00017@SERVERS[LUE010BB:MANILA01]
Comments:

Want to make sure you got the E-mail

---------- [Original Message] ----------

Greetings, Ken. Thank you for your extensive response to our cable on the five PCIS IEEs and the approval of the GSC Agro-processing Center and Fish Port. Your response and the information I received from Bill Delphos who also works for Ormat satisfies the Bureau's remaining concerns.

I am very sorry for the delays in approving these activities. Our problems, in this regard, have been several. First, despite our numerous requests, OCP has been unable, until know, to provide the Bureau with any kind of schedule of projects and sub-projects requiring environmental review (EAs and IEEs). In the case of the Cagayan de Oro Airport, e.g., we had no idea the project even exisited until the scoping report landed thump on our desk. This planning problem is exacerbated by an exteremely stretched staff back here, particularly since the USAEP started. Nevertheless, I have to say that communication has vastly improved since you took over the post of MEO for OCP. So, if we can get into synch. better with clear and realistic deadlines set ahead of time and adequate information provided, particularly at the IEE stage, and finally, initial review and environmental comments from the Mission then the process will proceed much more efficiently.

Specific Comments. Your responses to the agro-processing/fish port concerns are clear and sufficient to us. Since we approved the EA in the last cable, I don't think we have any further action at this end. Our main concern, by the way was with the purse seine fisheries. I agree that now that there is a project management board, they are the ones best left to deal with that issue (which may require fishery agreements with Indonesia).

As for the five PCIS IEEs, I am recommending to Molly complete approval of all

336

of them. I will draft a cable to that effect immediately. Your explanations, in this cable, were much fuller than were the IEEs' very brief descriptions. As mentioned above, Bill Delphos's response were sufficient to respond to our concerns (and you will have to admit that geothermal projects are pretty touchy in the Philippines).

Again, thanks for your prompt response and all my best. Cable to follow.

KLP
C

A/S L

UNCLASSIFIED STATE 091671/01

RECEIVED

ACTION: AID-3 INFO: DCM/4

VZCZCMLO113
OO RUEHML
DE RUEHC #1671/01 0842123
ZNR UUUUU ZZH
O 2421192 MAR 92
FM SECSTATE WASHDC
TO AMEMBASSY MANILA IMMEDIATE 8029
BT

MAR 25 9 26 AM '92

24-MAR-92 TOR: 23:11
CHRG: AID
DIST: AIDA

USAID/C&R

UNCLAS SECTION 01 OF 03 STATE 091671

IMMEDIATE TELEGRAM
ACTION TAKEN
3/25/92 8:30AM
DATE | HOURS | MIN.

ADM AID PLEASE PASS TO DZVINAKIS

E.O. 12356: N/A
TAGS:
SUBJECT: APPROVAL OF ENVIRONMENTAL DOCUMENTS FOR THREE USAID/MANILA PROJECTS

REF: (A) 92 MANILA 04033 (B) 91 MANILA 2790

1. SUMMARY. THIS CABLE PROVIDES BUREAU ENVIRONMENTAL COORDINATOR (BEC) REVIEW, COMMENT AND/OR APPROVAL FOR THREE USAID/MANILA PROJECTS: (1) THE MDP'S GSC AGRO-PROCESSING CENTER (492-0456) WHICH IS APPROVED; (2) THE IEE FOR FIVE PHILIPPINES CAPITAL INFRASTRUCTURE SUPPORT (492-0458) SUB-PROJECTS, OF WHICH THREE OF THE FIVE ARE CONDITIONALLY APPROVED, ONE DEFERRED PENDING MORE INFORMATION AND ONE NOT APPROVED IN ITS PRESENT FORM, AND (3) THE LOCAL GOVERNMENT INFRASTRUCTURE FUND PROJECT (492-0463) FOR WHICH GUIDANCE IS PROVIDED IN THIS CABLE AND IN AN ACCOMPANYING FAX MESSAGE WILL REQUIRE A PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (PEA), WHICH WILL ESTABLISH CRITERIA FOR CLASSES OF SUB-ACTIVITIES THAT WILL OR WILL NOT REQUIRE EAS. END SUMMARY.

DIV	ACT	INF
OD		✓
OPE		
OLA		
PESO		
CSO		
ORM		✓
EXO		
D/EXO		
A/EXO		
PROC		
HRD		
C&R		
DMD		
CMD		
GSO		
TRV		
SHFG		
OSD		
CFM		
OCP	✓	
ONRAD		✓
OPHN		
OFFPVC		
RAO/M		
DUE DATE		
3-26-92		

2. GSC AGRO-PROCESSING CENTER EA. EA APPROVAL FOR THE GSC AGRO-PROCESSING CENTER. BEC UNDERSTANDS FROM REF (A) THAT USAID/MANILA WILL NOT BE FINANCING ANYTHING AT ALL

REGARDING THE AGRO-PROCESSING CENTER, INCLUDING WATER SUPPLY, WASTE DISPOSAL, ACCESS ROADS AND OTHER INFRASTRUCTURE. BASED ON THAT FACT, THE EA IS APPROVED BY THE BEC. IF USAID/MANILA IS NOT GOING TO FUND THE APC WHO WILL, THE JAPANESE?

BEC APPRECIATES MISSION RESPONSE TO CONCERNS RAISED IN THE EA. WE MAY NOTE THAT THERE ARE STILL SOME PUZZLING ISSUES. IN REF.(A), PARA. 2 OF THE SECTION QUOTE CONCLUSION UNQUOTE, MAKES REFERENCE TO THE MISSION'S EFFORTS TO MEET AGENCY ENVIRONMENTAL PROCEDURES IN THIS PROJECT THROUGH, AMONGST OTHER THINGS, QUOTE THE ONGOING GLOBAL ENVIRONMENTAL CONCERNS BUILT INTO THE DEVELOPMENT OF THE MASTER PLAN UNQUOTE FOR THE MDP. THIS IS THE FIRST REFERENCE THE BEC HAS HEARD OF A MASTER PLAN. IS THIS RELATED TO THE GROWTH PLAN OR IS IT SOMETHING SEPARATE? THE BEC STILL FINDS SOME OF THE STATEMENTS IN REF (A) CONFUSING AND CONTRADICTORY, PARTICULARLY REGARDING THE

338

STATE OF THE FISHERIES IN THIS REGION. WE NOTE, FOR EXAMPLE, THAT THE CABLE ASSERTS THAT THE FISHERIES FOR SMALL, HOOK AND LINE AND PURSE SEINE FISHERMAN IN THIS REGION ARE ALL EXCELLENT AND THAT DAMES & MOORE AGREES WITH THIS CONCLUSION. AS THAT STATEMENT FLATLY CONTRADICTS WHAT THEY SAID IN THEIR EA, EITHER THE EA OR THE CABLE SHOULD BE CORRECTED FOR THE RECORD.

ON THE ISSUE OF THE MISSION'S LEADERSHIP ROLE IN ENVIRONMENTAL MANAGEMENT, THE BEC IS PLEASED THAT A DA HEADED MANAGEMENT BOARD HAS FINALLY BEEN APPOINTED TO DEAL WITH THE DEVELOPMENT OF THE APC AND OTHER GSC PROJECTS. WE ARE ALSO PLEASED THAT USAID/MANILA WILL CONTINUE TO TAKE AN ACTIVE PART IN THE DELIBERATIONS OF THIS BOARD.

3. IEES FOR FIVE PHILIPPINES CAPITAL INFRASTRUCTURE SUPPORT (492-0458) SUB-PROJECTS.
(A) THIS REVIEW OF THE FIVE PCIS IEES PROVIDES A GOOD OPPORTUNITY FOR CLARIFYING ENVIRONMENTAL PROCEDURES FOR THESE SUB-PROJECTS. DURING DISCUSSIONS WITH THE PCIS PROJECT OFFICERS, IN APRIL, 1991, JIM TARRANT WAS INFORMED THAT THE PCIS PROJECT PAPER HAD PROPOSED THE USE OF GOP ENVIRONMENTAL PROCEDURES FOR REVIEW OF PROPOSALS. THE GOP EA PROCEDURES (CALLED EIS) ARE, IN FACT, MORE DETAILED THAN A.I.D.'S, MAINLY BECAUSE THE STUDIES ARE MEANT TO BE CARRIED OUT DURING THE PROJECT'S DETAILED DESIGN STAGE. THE PROJECT OFFICER WAS REMINDED THAT THIS DECISION DID NOT MEAN THAT DENR'S PROCEDURES COULD REPLACE THOSE OF A.I.D., GIVEN DENR/EMB'S SERIOUS LACK OF TRAINED PERSONNEL AND INADEQUATE POLITICAL AUTONOMY. IN ADDITION, THERE IS NO EXPLICIT PROVISION IN 22 CFR 216 FOR ACCEPTING HOST

COUNTRY EIAS AS A SUBSTITUTE FOR AID'S EA AND NO PROCESS WITHIN A.I.D. FOR CERTIFYING HOST COUNTRY PROCEDURES. HOWEVER, THE MISSION ENVIRONMENTAL OFFICER (MEO) SHOULD SEND A SUMMARY OF THE ENVIRONMENTAL COMPLIANCE CERTIFICATE (ECC) AND ITS RECOMMENDATIONS FOR MONITORING AND MITIGATION (IF ANY) TO THE BEC FOR BUREAU REFERENCE AND RECORDS, IF POSSIBLE, AT THE SAME TIME AS THE IEES OR EAS ARE SUBMITTED, DEPENDING UPON THE SUB-PROJECT IN QUESTION.

(B) IN A MEMO FROM JIM TARRANT TO THE PCIS PROJECT OFFICER, ALSO APRIL, 1991, HE SUGGESTED A SIMPLE SCREENING PROCESS FOR THE PCIS AND LGIF PROJECTS. THE DESIRABILITY OF THIS APPROACH IS APPARENT IN THIS GROUP OF SUB-PROJECTS. FOUR OF THE FIVE ARE FOR APPARENTLY INNOCUOUS RADIO TELECOMMUNICATIONS EQUIPMENT (ALTHOUGH WE CANNOT BE CERTAIN FROM THE LITTLE INFORMATION PROVIDED) WHILE THE FIFTH IS A MAJOR GEOTHERMAL INSTALLATION. IT WOULD APPEAR
BT
#1671

NNNN

THAT THE PROJECT HAS ADOPTED DENR'S SCREENING PROCESS. HOWEVER, AS NOTED ABOVE, THIS IS NOT ADEQUATE.

(C) THE PROJECT OFFICER AND MEO ARE REMINDED THAT ALL FINAL ENVIRONMENTAL STUDIES, WHETHER EA/EISS OR IEES (FOR THOSE INSTANCES WHEN THESE ARE THE LAST ENVIRONMENTAL REVIEWS BEFORE PROJECT IMPLEMENTATION, I.E., A CATEGORICAL EXCLUSION, NEGATIVE DETERMINATION OR POLITICAL EXEMPTION), MUST SPECIFY ALL ENVIRONMENTAL MITIGATION AND MONITORING MEASURES TO BE CARRIED OUT DURING THE PROJECT ALONG WITH MISSION APPROVAL OF THESE IN THE FORM OF AN ENVIRONMENTAL ACTION PLAN FOR THE ACTIVITY, OTHERWISE THE IEE IS INCOMPLETE. IN OTHER WORDS, JUST SUBMITTING THE IEE WITHOUT A PLAN OF ACTION IS NOT SUFFICIENT TO MEET AGENCY PROCEDURES AND ASIA BUREAU POLICY.

(D) WITH RESPECT TO THE FIVE PCIS IEES SUBMITTED TO THE BUREAU, THE INFORMATION PROVIDED ON THE INDIVIDUAL SUB-PROJECTS IS AS MINIMAL AS IT COULD POSSIBLY BE. THIS HAS THE RESULT OF MAKING THE BUREAU REVIEW PROCESS THAT MUCH MORE DIFFICULT. PROPOSAL NUMBER 1 IS FOR A TELECOMMUNICATIONS SYSTEM FOR AN ENTIRE PROVINCE. IT IS SUMMARIZED IN THREE SENTENCES WITHOUT ANY DISCUSSION WHATSOEVER ABOUT HOW THIS SYSTEM WILL BE SET UP. WILL THE PROJECT REALLY INVOLVE NO CONSTRUCTION, NO INSTALLATION, JUST DISTRIBUTION OF EQUIPMENT (E.G. REPLACEMENT OF OLD PHONE SETS WITH NEW PHONE SETS)? IF IT IS INDEED MERELY THE LATTER, THEN THERE SHOULD BE NO PROBLEM WITH CLEARANCE. UNFORTUNATELY, THERE IS NO WAY TO KNOW FROM THE EXTREMELY MINIMALIST PROJECT DESCRIPTIONS PROVIDED. AS A RESULT, IEE APPROVAL FOR THIS SUB-PROJECT MUST BE

DEFERRED UNTIL MORE COMPLETE INFORMATION ABOUT THE PROJECT IS RECEIVED.

(E) THE SECOND PROJECT, THE MT. PINATUBO SUB-PROJECT, IS AN EMERGENCY PROJECT. THE BUREAU IS LEFT TO INFER THAT, BECAUSE OF THE USE OF THE WORD MOBILE, THERE MAY NOT BE ANY CONSTRUCTION INVOLVED. THE SAME APPEARS TO BE TRUE OF THE THIRD PROJECT, THE NATIONAL ADMINISTRATIVE TRUNKED RADIO SYSTEM, ANOTHER MULTIMILLION DOLLAR PROJECT SUMMARIZED IN FOUR SENTENCES. CONDITIONAL BEC APPROVAL OF THESE TWO SUB-PROJECTS IS GIVEN, PROVIDED NO CONSTRUCTION ACTIVITIES ARE INVOLVED. IF CONSTRUCTION IS INVOLVED, THE MISSION MUST PROVIDE THE BUREAU A REVISED IEE. THIS IEE SHOULD INCLUDE A DESCRIPTION OF THE TYPES/SCALE, ETC. OF CONSTRUCTION ACTIVITIES AND THE CONTRACT OR LOAN SPECIFICATIONS FOR STANDARDS, DESIGNS, CHOICE OF SITE, ETC. WHICH WILL BE REQUIRED.

(F) SUB-PROJECT FOUR ON THE VSAT SYSTEM AGAIN APPEARS TO CONCERN PORTABLE TELECOMMUNICATION SYSTEMS. AS WITH SUB-PROJECTS (2) AND (3), THE IEE RELEVANT INFORMATION PROVIDED IS INCOMPLETE, SO CONDITIONAL APPROVAL FOR THIS SUB-PROJECT PROVIDED FURTHER INFORMATION ON CONSTRUCTION, SAFETY AND OTHER SIMILAR CONCERNS IS GIVEN.

(G) THE FIFTH SUB-PROJECT, THE MAK-BAN GEOTHERMAL POWER

PLANT IEE CANNOT BE APPROVED AT THIS TIME. A 15.73MW INSTALLATION, THIS PROJECT IS A MAJOR ACTIVITY. EMB'S APPROVAL WAS PROVIDED ON THE BASIS OF A QUOTE PROJECT PROFILE UNQUOTE WHICH PRESUMABLY IS THE DOCUMENT WHICH WAS SENT TO THE BUREAU. THIS DOCUMENT IS A VAST IMPROVEMENT ON THE CURSORY INFORMATION IN THE MISSION IEE BUT DOES NOT ADDRESS ALL THE ENVIRONMENTAL CONCERNS OF THE SUB-PROJECT. HENCE, THE MISSION WILL NEED TO SUBMIT A REVISED IEE FOR THIS PROJECT ALONG WITH A MISSION ACTION PLAN. THE FOLLOWING CONCERNS SHOULD BE ADDRESSED IN THE REVISED IEE:
A) THE SITTING AND CONSTRUCTION REQUIREMENTS OF THE ACCESS ROADS TO THE THREE SITES;
B) THE REMOVAL OF OVERBURDEN, CLEARING AND GRADING OF THE SITES AND BURNING OR OTHER DISPOSAL OF DEBRIS;
C) PLAN FOR THE RELOCATION OF THE SIX HOUSEHOLDS TO BE DISPLACED IN TWO OF THE SITES;
D) PLAN FOR THE SAFE TRANSPORT AND USE OF THE NORMAL PENTANE MOTIVE FLUID;
E) MONITORING PLAN FOR VOLATILE AND TOXIC GASES ASSOCIATED WITH GEOTHERMAL STEAM EXTRACTION AND MONITORING OF THE STEAM REINJECTION PROCESS (STEAM REINJECTION IS CLEARLY A POSITIVE ASPECT OF THE PROJECT WHICH SHOULD AVOID MANY OTHER ENVIRONMENTAL PROBLEMS).

F) POTENTIAL ENVIRONMENTAL DEMANDS FROM SUPPORT SERVICES WHICH WILL BE ATTRACTED OR NEEDED FOR THE THREE NEW PLANTS.
G) POTENTIAL STRESS ON EXISTING GROUNDWATER AQUIFERS FROM WELL WATER TO BE DRAWN FOR USE IN THE OPERATION OF THE THREE PLANTS.
H) KINDS OF CONTRACT SPECIFICATIONS, MONITORING AND OTHER MECHANISMS THE MISSION WILL USE TO ENSURE COMPLIANCE WITH SAFETY AND OTHER ENVIRONMENTAL RECOMMENDATIONS IN THE IEE.
IF THE INVESTIGATION OF ANY OF THESE ISSUES LEADS TO A FINDING OF POTENTIALLY SIGNIFICANT IMPACTS, AN EA FOR THAT
BT
#1671

NNNN

(OR THOSE) ISSUE(S) MUST BE UNDERTAKEN.

4(A). THE LOCAL GOVERNMENT INFRASTRUCTURE FUND (LGIF) PROJECT WILL CONSIST OF APPROXIMATELY 250 SMALL-SCALE INFRASTRUCTURE SUB-PROJECTS CARRIED OUT IN ABOUT 70 PROVINCES AND CHARTERED CITIES. SUB-PROJECTS INCLUDE SCHOOLS, SECONDARY OR BARANGAY ROADS, SIMPLE MARKETS, WATER EXTENSIONS, HEALTH CLINICS AND POSSIBLY HOSPITAL EXTENSIONS. SOME BASIC ENVIRONMENTAL INFRASTRUCTURE IS ALSO ANTICIPATED. THE PROJECT IS FOR FIVE YEARS AND BUDGETED AT $100 MILLION. STRUCTURAL DESIGNS WILL BE STANDARDIZED WITH SITE ADAPTATION, WHERE NECESSARY, IN ORDER TO CONTROL COSTS AND EFFICIENCY

(B) SINCE THE PROPOSED PROJECT DEALS WITH THE CONSTRUCTION OF INFRASTRUCTURE, ANY INDIVIDUAL SUB-PROJECT COULD HAVE POTENTIALLY SIGNIFICANT ENVIRONMENTAL IMPACTS. HOWEVER, SINCE MOST OF THE PROJECTS ARE RELATIVELY SMALL AND ON EXISTING SITES AND ALIGNMENTS, THERE IS A HIGH PROBABILITY THAT CAREFUL DESIGN, INCLUDING SITE ADAPTATION AND MANAGEMENT GUIDELINES AND SPECIFIC MITIGATION MEASURES CAN BE BUILT INTO THE PROJECT DESIGN PROCESS TO ADDRESS ENVIRONMENTAL CONCERNS FOR MOST IF NOT ALL SUB-PROJECTS. GIVEN THIS BACKGROUND, WE ARE PROPOSING THE FOLLOWING ENVIRONMENTAL PROCEDURES FOR THE PROJECT.
THE ENVIRONMENTAL REVIEW PROCESS IS INTENDED TO IMPROVE AND FACILITATE PROJECT AND SUB-PROJECT DESIGN AND IMPLEMENTATION, NOT TO DELAY UNNECESSARILY PROJECTS FROM BEING IMPLEMENTED. THIS OBJECTIVE CAN BE ACCOMPLISHED BY UNDERTAKING WHAT IS ESSENTIALLY A PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE LGIF. SUCH ASSESSMENTS ARE DESCRIBED IN 22 CFR 216.6 (D) QUOTE, OTHER PROGRAMMATIC EVALUATIONS OF CLASSES OF ACTIONS MAY BE CONDUCTED IN AN EFFORT TO ESTABLISH ADDITIONAL CATEGORICAL EXCLUSIONS OR DESIGN STANDARDS OR CRITERIA FOR SUCH CLASSES THAT WILL ELIMINATE OR MINIMIZE ADVERSE EFFECTS OF SUCH ACTIONS, ENHANCE THE ENVIRONMENTAL EFFECT OF SUCH ACTION OR REDUCE THE AMOUNT OF PAPERWORK OR TIME INVOLVED

IN THESE PROCEDURES UNQUOTE. THESE RECOMMENDED ENVIRONMENTAL PROCEDURES ARE AIMED AT REDUCING THE LEVEL OF ENVIRONMENTAL RISK AND UNCERTAINTY OF A SUB-PROJECT TO ACCEPTABLE LEVELS AND DOING SO WITH THE LEAST AMOUNT OF PAPERWORK.(B) AS THE PROJECT DESCRIPTION INDICATES, THE LGIF PROJECT CONTAINS A WIDE VARIATION IN THE RELATIVE ENVIRONMENTAL RISK OF ANY GIVEN SUB-PROJECT. HENCE, A REPLACEMENT OR NEW SCHOOL-BUILDING ON AN EXISTING CAMPUS, DESIGNED WITH THE APPROPRIATE UTILITIES, MAY POSE CONSIDERABLY FEWER ENVIRONMENTAL RISKS THAN BUILDING A LARGE, URBAN MARKET, LOCATED ON A NEW AND BUSY SITE, FOR EXAMPLE. HOWEVER, THERE ARE SEVERAL CHARACTERISTICS TO THE LGIF PROJECT DESIGN WHICH REDUCE ITS OVERALL RELATIVE ENVIRONMENTAL RISK. PROPOSED SUB-PROJECT TYPES USUALLY ARE:

1) ADDITIONS TO EXISTING STRUCTURES OR UPGRADES OF EXISTING ALIGNMENTS;
2) SMALL-SCALE STRUCTURES, ON SITES SPECIFICALLY

DESIGNATED FOR SUCH FACILITIES;
3) STRUCTURES DESIGNED ON THE BASIS OF STANDARDIZED, EASY TO MAINTAIN/REPAIR MODELS WHICH ARE SITE-ADAPTED AND BUILT TO GOOD CONSTRUCTION STANDARDS.

STILL, THERE ARE LIKELY TO BE SOME SIGNIFICANT ENVIRONMENTAL IMPACTS FOR SOME SUB-PROJECTS. IN ORDER TO FOCUS ON THOSE SUB-PROJECTS WHICH POSE GREATER RISKS THAN OTHERS, THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (EA) REQUIRED FOR THIS PROJECT SHOULD FIRST SCREEN AND CATEGORIZE PROJECTS BY TYPE, SCALE AND ABILITY TO BUILD IN MITIGATION IN SUB-PROJECT DESIGN (AS OPPOSED TO SITE IDENTIFICATION OR OPERATIONAL CONCERNS). A SECOND SCREENING AND CATEGORY STAGE WILL CLASSIFY SITES AND OPERATION/MAINTENANCE NEEDS BY THE LIKELIHOOD OF SIGNIFICANT ENVIRONMENTAL IMPACT POTENTIAL. DESIGN, CONSTRUCTION AND ADMINISTRATIVE MITIGATION MEASURES WILL BE PROPOSED FOR THOSE PROJECTS WHICH MIGHT HAVE ENVIRONMENTAL PROBLEMS THAT CAN BE ADDRESSED WITHOUT A FULL EA, FOLLOWED BY PERIODIC MONITORING AND INSPECTION. THIS WILL REDUCE THE NUMBER AND TYPES OF SUB-PROJECTS REQUIRING EAS TO A MORE MANAGEABLE NUMBER, IN SO DOING, IMPROVING THE LIKELIHOOD THAT THOSE ASSESSMENTS WILL BE COMPLETED WELL AND IN A TIMELY FASHION. A COMPLETE SUMMARY OF THE PROGRAMMATIC EA PROCEDURES WILL BE SENT IN A FAX MESSAGE, DUE TO THE LIMITATIONS OF THE CABLE FORMAT.

DRAFTER:JTARRANT APPROVED:MKUX BAKER
BT
#1671

NNNN

"D

ORIGIN: AID-3 INFO: AMB DCM AA ECON RA/B (OCP -3 OD C&R- 3)

VZCZC
OO RUERC
DE RUEHML #6295 066 **
ZNR UUUUU ZZH
O 062905Z MAR 92
FM AMEMBASSY MANILA
TO SECSTATE WASHDC IMMEDIATE 2790
BT
UNCLAS MANILA 06295

CLASS: UNCLASSIFIED
CHRGE: AID 3/5/92
APPRV: OCP:DZVINAKIS
DRFTD: OCP:KLUEPHANG: E
CLEAR: OCP:ANAANEP
DISTR: AID (OCP-3 OD C&R-3)
ORGIN: OCR

AIDAC

FOR MOLLY KUX, ENVIRONMENTAL COORDINATOR, ASIA/DR/TR; INFO THOMAS NICASTRO, ASIA/DR/TR; AND DON CLARK, ASIA/ EA/P

E.O. 12356: N.A.
SUBJECT: A) ENVIRONMENTAL ASSESSMENTS (EA) OF AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX, GENERAL SANTOS CITY, SOUTH COTABATO; (B) INITIAL ENVIRONMENTAL EXAMINATION OF FIVE PHILIPPINE CAPITAL INFRASTRUCTURE SUPPORT (PCIS) SUBPROJECTS; (C) SCOPE OF WORK FOR THE ENVIRONMENTAL ASSESSMENT (EA) OF LOCAL GOVERNMENT INFRASTRUCTURE FUND PROJECT (PROJECT NO. 492-0463)

REF: (A) CABLE MANILA 004033 OF FEBRUARY 10, 1992
- (B) ACTION MEMORANDUM FOR THE ASIA ENVIRONMENTAL
- COORDINATOR OF JANUARY 16, 1992
- (C) ACTION MEMORANDUM FOR THE ASIA BUREAU
- ENVIRONMENTAL COORDINATOR OF FEBRUARY 6, 1992

1. THIS IS TO FOLLOW-UP OUR EARLIER REQUESTS FOR YOUR ENVIRONMENTAL CLEARANCE/APPROVAL ON THE FOLLOWING PROJECTS:

- (A) CLEARANCE FOR THE FINALIZATION OF EA OF THE AGRO-PROCESSING FACILITIES AND FISH PORT COMPLEX, GENERAL SANTOS CITY, SOUTH COTABATO SENT TO YOUR OFFICE THROUGH CABLE NO. 004033 ON FEBRUARY 10, 1992. THE MISSION PROVIDED ANSWERS TO RELEVANT QUESTIONS RAISED BY THE BUREAU ENVIRONMENTAL COORDINATOR (BEC) WHICH SHOULD PROVIDE THE BASIS FOR CLEARING THE EA REPORT FOR FINALIZATION.
UNCLASSIFIED

- (B) APPROVAL OF THE INITIAL ENVIRONMENTAL EXAMINATION (IEE) OF FIVE PCIS SUBPROJECTS, NAMELY, I) CAMARINES SUR TELECOMMUNICATIONS PROJECT: II) MT. PINATUBO VOLCANO EMERGENCY TELECOMMUNICATIONS EQUIPMENT PROJECT: III) NATIONAL ADMINISTRATIVE TRUNKED MOBILE RADIO COMMUNICATIONS SYSTEM: IV) VERY SMALL APPERTURE TERMINAL (VSAT) TELECOMMUNICATIONS PROJECT: AND V) MAYBAN GEOTHERMAL POWER PLANT PROJECT. THE IEES WERE FORWARDED TO BEC OFFICE THROUGH EXPRESS MAIL ON JANUARY 16, 1992. THE IEE APPROVALS ARE NOW THE REMAINING

344

BOTTLENECK FOR PROJ ECT IMPLEMENTATION. PLEASE PROVIDE YOUR CLEARANCE SOONEST.

- (C) APPROVAL OF THE SCOPE OF WORK (SOW) OF TH E EA OF THE LOCAL GOVERNMENT INFRASTRUCTURE FUND PROJ ECT SENT TO YOUR OFFICE VIA EXPRESS MAIL ON FEBRUARY 6, 1992. THE SOW AND THE RATIONALE FOR ITS PROCEDURE WAS DEVELOPED IN COLLABORATION WITH AID/WASHINGTON BUREAU ENVIRONMENTAL STAFF, MR. JIM TARRANT, DURING HIS TDY TO THE MISSION.

2. WE WOULD APPRECIATE THE BEC ENVIRONMENTAL CLEARANCE/APPROVAL OF THESE PROJECTS AS SOON AS POSSIBLE IN ORDER FOR US TO PROCEED WITH IMPLEMENTATION OF THE PROJ ECTS. WISNER

BT
#6295

NNNN

343