1.0 INTRODUCTION

1.1 Overview of the Protected Area Management Manual and Related Documents

The **Management Manual for the Subic Bay Protected Area (SBPA)** consists of seven volumes. The volumes are:

- Volume 1: Introduction and Area Ecological Profile
- Volume 2: Management Plan
- Volume 3: Zoning Guidelines
- Volume 4: Programs and Projects
- Volume 5: Budget and Financing Plan
- Volume 6: Monitoring and Enforcement Plan
- Volume 7: Alternative Livelihood Strategies Plan

Consistent with the National Integrated Protected Areas System (NIPAS) Act (RA 7586), these volumes serve as the long-term framework for planning and managing the SBPA and as a guide in the preparation of the annual operations plan and budget.

The Management Manual is supported by additional documents, which provide the bases for designation and planning the SBPA and adjacent buffer zones. A **15-volume set of Resource Inventory documents** contain the detailed results of investigations that were conducted as part of the Subic Bay Protected Areas Management Plan Project (SBPAMPP). These inventories, conducted in 2000, were designed to develop and summarize information relevant to the identification of protected areas within the Subic Bay Freeport Zone (SBFZ). Inventories focused on the acquisition of data for the establishment of boundaries and categories of protection for the existing Subic Watershed Forest Reserve (SWFR), and also identified other potential protected areas within the SBFZ. These areas are being addressed by the development of **Protected Area Suitability Assessments (PASAs) for the Redondo Peninsula and Mount Balakibok areas**, which have been submitted independent of SBPA planning documents.

Recognizing that the protection of biological diversity requires protection of biological resources outside of protected areas, a volume of **Guidelines for the Protection of Flora and Fauna Outside of Protected Areas** was developed. This document:

- provides general guidelines for the protection of flora and fauna and guidelines specific to different habitats and land uses,
- summarizes applicable laws and regulations for the protection of flora and fauna,
- presents an organizational and administrative framework, and
- provides recommendations for implementation.

Taken together, these documents provide a comprehensive set of tools that can be used for establishing and managing the SBPA and surrounding ecological resources to ensure the conservation of biological diversity and sustainable development within the SBFZ.

1.2 Scope and Elements

This volume contains a comprehensive and structured summary of the physical, biological, and socio-economic environment of the proposed SBPA. This ecological profile summarizes the baseline information that served as the bases for defining and planning for the protected area and for identifying issues and concerns that need to be addressed in the Subic Bay Protected Area Management Plan (SBPAMP).

Section 2.0 presents the historical context and rationale for establishing the Subic Bay Protected Area. Section 3.0 provides the national, regional, and local perspectives, including the policy framework, economic development context, and assessment of development opportunities and constraints.

The current conditions within the SBFZ and its adjoining land and water are described in sections 4.0 through 6.0. Information on the following components of the Subic Bay Area is included:

- Physical Environment
- Biological Resources
  - Forest resources including plants and animals
  - Marine resources including seagrass beds, coral reefs, and fish
- Socio-Economic and Cultural Environment
  - Land Use and Infrastructure
  - Institutional structures and stakeholders

The data and information contained in this profile were drawn primarily from the Resource Inventory Reports conducted as part of the SBPAMP project. These Resource Inventory Reports covered the following topics:

- Physical environment (geology, hydrology, airshed, physical oceanography and water quality),
- Terrestrial ecosystems (flora, fauna, and forest economics),
- Marine ecosystems (marine biology, fisheries, plankton, and mangroves),
- Land use, socio-economics, and population and demography.

Secondary sources available at different offices of SBMA and offices of national agencies at the provincial, regional and national level were also used.

Emerging issues relevant to the establishment of the SBPA are addressed in section 10 of this volume.

1.3 Methodology

1.3.1 Conceptual Approach and Overall Methodology

The overall conceptual approach used in the development of the PAMP incorporates the Ecosystem Management Approach (EMA) and Integrated Catchment Management Approach (ICMA) for:

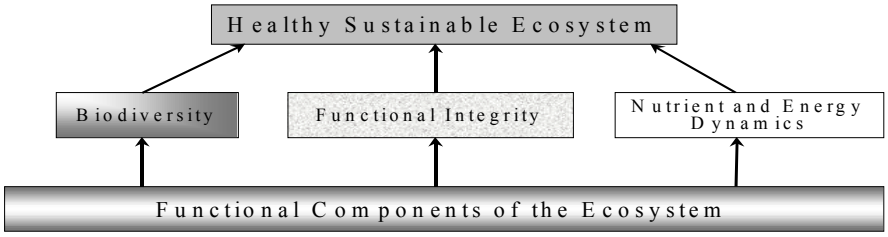
a) delineating the PA boundaries and its management zones; and
b) identifying strategies for managing the PA

Ecosystem Management Approach

The concept of ecosystem management recognizes ecosystems as the central management focus and incorporates the concept of ecosystem sustainability. Ecological and societal values are identified as the bases for setting protected area management goals. Social values are an important dimension: society not only stands to derive significant economic gain from protecting biodiverse ecosystems; it is beginning to understand that retention of natural flora and fauna and their gene pools is a global imperative.

Ecological values are determined using a comprehensive and hierarchical approach. The ultimate values to be protected are healthy sustainable ecosystems. Values common to all ecosystems (i.e., biological diversity, functional integrity, and nutrient and energy dynamics) comprise the next tier in the hierarchy (See Figure 1). Once the ecosystem types for SBFZ have been identified, functional food webs are developed that embrace all species within the ecosystem and focus on their role in maintaining higher ecosystem values. Other attributes of these functional components are then identified, and any specific values (e.g., keystone species) are then determined to complete the identification of ecological values.

Figure 1. Hierarchy of Ecosystem Values



Societal values are addressed using standard approaches that consider regulatory requirements (e.g., threatened and endangered species) and values developed in consultation with local, regional, and global stakeholders. The ecological and societal values then provide a basis for determining potential services provided by different categories of protected areas. This list of values was initially developed in the Inception Workshop in October 1999. It was revised and augmented as a result of the resource inventories and outcomes of the Resource Inventory Workshop (see section 9). It was

then further continuously reviewed and revised throughout the planning process of the PAMPP.

Compatibility of protected areas with potential types of human uses and development (e.g., Eco-tourism, theme parks, and research stations) was also considered as part of the planning process. Consultations with stakeholders were initiated through direct contacts and during the Inception Workshop. Stakeholder workshops were subsequently held during the PAMPP in order to provide information and obtain stakeholder inputs at appropriate points throughout the planning process.

Integrated Catchment Management Approach

Integrated catchment management (ICM) or "whole catchment" management is an approach to natural resource management that seeks to understand and address the interrelated issues pertaining to land, water, vegetation, wildlife, and other resources on a catchment or basin-wide scale. The rationale for the ICM approach derives from a number of considerations. It permits a comprehensive understanding of the natural phenomena as well as human activities both on land and on the water that contribute to determining the water quality of the receiving water body. Understanding the relationship between land-based and water-borne activities in a particular catchment system will lead to the appreciation of area-specific issues and challenges and to the formulation of focused policies.

Another rationale for the ICM approach is that different segments of society and various sectors of the economy have their own agenda to pursue and targets to achieve each without any coherent idea of how their resource utilization affects, and is affected by all other components of the ecosystem. As a result the ability of the natural resources to provide for human needs across generations is threatened by conflicting demands on, and unsustainable use of, these resources. Through the ICM approach such disparate interests could be brought together toward the pursuit of common objectives that are mutually beneficial to them and to the environment.

Yet another rationale for the ICM approach owes to the peculiar geography of the project area. The possibility of extending the protected area up to the fringes of marine environment makes it imperative to extend analysis to the total system comprising the receiving water body and its upper terrestrial catchment in order to evolve water-sensitive land use policies in the catchment areas including the terrestrial portion of the protected area and in the terrestrial buffer subzones.

The ICM strategy is a variant of the older generic concept of coastal resource management. It delineates the inland portion of the coastal zone to embrace all lands the use of which could affect the resources and waters of the coastal zone. This means that the entire watershed (hence, "catchment") is included within the management zone because much of what happens in the watershed eventually affects the ocean through runoff into streams, rivers, and estuaries that finally flow into the sea (Cicin-Sain and Knecht, 1998). Similarly, the seaward portion of the management zone or receiving

waters can extend to the legal maximum limit of 200 nautical miles from the shoreline as allowed under the U.N. Convention on the Law of the Sea. For practical purposes, a more manageable portion of the country's oceanic domain may be adopted, say, the 12 nautical miles of territorial sea or the 15 kilometers of municipal waters as defined by Republic Acts (RAs) 7160 and 8550, respectively. Due to the peculiar configuration and relatively small size of Subic Bay (and of the smaller bays of Olongapo, Triboa, and Ilanin), the seaward part of particular ICMs to be identified cannot extend beyond the limits of the municipal waters of Olongapo City and the municipalities of Subic and Morong.

1.3.2 Information Gathering and Analysis

a) General Approach

The conceptual approach to collecting information follows the basic approach described in section 2.1; it recognizes that decisions regarding protected areas will be based on the values provided by natural resources. Where they exist, healthy sustainable ecosystems are the ultimate value to be protected because of the variety of services they provide. In this context, field inventory methodology began by systematically identifying ecological and human use values, conducting investigations focused on obtaining the data necessary to make decisions, and integrating efforts with related ongoing investigations to maximize efficiency and minimize duplication of effort.

The overall methodological approach recognized that, for a given area, management of some of the resource values might be in conflict. For example, protection of endangered species may conflict with materials extraction. As a result, these values need to be addressed during protected area planning and management so that different values can be protected in different areas. The comprehensive and systematic identification of values needs to be performed prior to designing the data collection program.

While many decisions needed to be made, they fell into two primary categories:

- selection of boundaries of the protected area proper, of management zones within the PA, and of buffer zones; and
- development of the structure and processes for long- and short-term management of the protected area.

With these in mind, field surveys were designed to focus on obtaining data relevant to these decisions. Initial tasks were to review existing literature and reports, perform reconnaissance surveys of the SBFZ by air and sea, and examine recent satellite and aerial photography. Based on these informations, inventory methods were refined prior to initiating fieldwork.

Inventory surveys were conducted on the resources of areas of the SBFZ that were candidates for PA designation according to:

<u>Physical Environment</u>

- Terrestrial Geology
- Marine Geology
- Physical Oceanography
- Hydrology
- Water Quality
- Air

Biological Environment

- Terrestrial Flora
- Terrestrial Fauna
- Coral Reefs
- Seagrasses and Seaweeds
- Plankton, Dinoflagellates, Benthos
- Mangroves

Socio-economic Environment

- Land Use and Settlement Patterns
- Socio-economics
- Census

Results of these surveys were summarized in 15 reports, plus an overall Resources Inventory Integration Report that provided a comprehensive and current summary of information on which to base environmental planning decisions.

b) Field Methodology

Sampling intensity, location, and degree of quantification were tailored to the data needs of each of the 15 field tasks. Actual field methods included direct observations of land uses, habitats, and species occurrence, qualitative data and quantitative measurements of water quality, ocean currents, coral reef location and condition, and vegetation structure. Socio-economic methods included extensive review of existing information on land use, jurisdictional boundaries, and demographic data. Inventory methods are summarized in the Resource Inventory Report, Volume 1; detailed methods for each of the respective inventory tasks are provided in Volumes 2-16 of the Resource Inventory Report (Woodward-Clyde 2001). Importantly, fieldwork for various disciplines was planned and undertaken with due regard to the basic geographic units of the surface catchments.

In the project area six integrated catchments were identified. These were delineated to include two components: the watershed and the receiving water body or bodies as described below.

IC #1

This covers the watershed of Binictican River and other small rivers that have their headwaters in Mt. Silanguin on the southern tip of Redondo Peninsula. The receiving water body is the mouth of Subic Bay.

IC #2

This embraces the Agusuhin river basin with headwaters in Mt. Maybe in the middle part of Redondo Peninsula and drains into the inner part of Subic Bay.

IC #3

This covers watersheds of all rivers flowing into the Subic bayhead from the western and eastern parts of the municipality of Subic. The western Subic catchments include those of Basilio River, Cawag River, Redondo Creek, and other intermittent streams collecting run-off from Mt. Cawag, Mt. Basilio, and Mt. Redondo. These watersheds are collectively called Cawag River Basin.

The eastern catchments include those of the Marelalec, Nibangon, Calapandayan, and Matain rivers that drain into the bayhead.

IC #4

This includes watersheds of the Kalaklan and Sta. Rita rivers that originate from Mt. Balakibok and drain into the inner bay, mainly Olongapo Bay. This catchment embraces in its lower reaches the heavily built up area of Olongapo City as well as the urbanized area and the beachfront.

IC #5

This combines the watersheds of rivers draining into Olongapo Bay. The catchments are those of Malawaan, Binictican, and Boton rivers. The direct receiver of run-off from these rivers is the Boton cove east of Cubi Point.

IC #6

This embraces the catchments of rivers originating from Hill 394 including Triboa, Ilanin, and Binanga and the receiving waters are Triboa Bay, Ilanin Bay, and Port Binanga, respectively, as well as the whole mouth of Subic Bay.

All the catchments are situated within the Subic Bay Freeport Zone.

1.3.3 Planning Methodology

Certain aspects of the methodology were modified in the Inception Report in view of insights gained in the intervening period between the submission of the original proposal and project commencement.

a) Spatial Framework

This Protected Area Management Plan obviously focuses on the protected area but the policies and actions necessary to effectively manage the protected area cannot be confined within the PA boundaries alone. The analytical and policy development phases of the planning process therefore must consider as wide a spatial context as possible encompassing the areas intended to be placed under protected area status. This is to allow comprehensive understanding of the physical, biological, social, cultural and other processes and the interrelationships between identified ecosystems comprising the spatial

system. Upon this comprehensive understanding will be built the infrastructure of management strategies, policies and actions of the PAMP.

The delineation of the spatial framework is in two levels of resolution: macro and micro levels. The macro level adopts the concept of integrated catchment management (ICM). The micro level delineation of protected area boundaries, on the other hand, adheres to the criteria and definitions prescribed in the NIPAS Act with some modifications made according to the peculiarities of the area and the location and extent of intact ecosystems. The micro level delineation is further discussed in Section 5.

The integrated catchment system was used to organize the findings of the resource inventories. Each IC is briefly described by highlighting its resource values and area-specific issues as culled from the Resource Inventory Reports. This characterization provides a quick impression of the broad regional context of the protected area to be identified.

(1) IC System #1

Part of the military reservation lies in the terrestrial catchment in southeastern Redondo Peninsula; hence, no intense activity has yet been observed. The abolition of the military use of the area however is expected to encourage more people to settle in the area. An intact forest cover remains on the upper reaches of Mt. Silanguin suggesting its possible consideration as a potential protected area in the future. Existing mining claims, however, cover the entire catchment. Erosion is a potential threat due to the very steep slopes. This will be compounded should the mining claims be approved.

The receiving water lies at the mouth of Subic Bay to the west of Grande and Chiquita islands. Vessels of all kinds enter and exit Subic Bay through this portion of the bay's mouth. Biological resources of the area, especially at Sueste Pt., indicate the "highest abundance and number of species" (RIR Vol. V) of fish due to the high percentage of coral cover and abundance of seagrass and seaweeds. This area could easily become the marine component of another protected area system.

Actual and potential threats to this area are over-fishing, siltation from natural and man-made erosion from the upper catchment, and pollution (oil and grease) once vessel traffic becomes heavy.

(2) IC System #2 and IC System #4

The marine portion of these systems comprises the inner portion of Subic Bay near and around Mayanga Island. The results of transect survey indicate that this part of Subic Bay is seriously overfished. Fish species and biomass are low and there is very little coral cover. The reported presence of marine debris such as sunken vessels on the eastern part of the bay, however, can provide fish sanctuaries as artificial reefs. Also, the abundant seagrass meadows around Agusuhin Pt. on the western shore serve as nurseries for fry and other juveniles.

Even the relatively clean western side of the bay may be in danger of domestic waste pollution when the proposal by Subic municipality to redevelop the Malampaya yard around Agusuhin Pt. as another urban center pushes through. The Malampaya yard was the site where offshore drilling platforms used in the gas fields of Malampaya, Palawan were fabricated.

(3) IC System #3

The marine component of this system is the bayhead of Subic Bay. It receives all the sediment load of all the rivers on the western and eastern part of Subic municipality. The materials deposited into this water body include silt from quarrying and earth moving associated with construction works, agricultural chemical residues from the still extensive farmlands of Subic, industrial effluent, and domestic waste from the concentrated coastal settlements, urban areas, and hotels and beach resorts. . The threat of siltation comes from possible mining development on both sides of the bay. Data from the MGSB of Region III indicate that the mining claims on the watersheds of Marelalec, Nibangon and Calapacuan rivers have been approved. If mining development goes in full blast this will aggravate the already silted state of the bayhead. The low flushing potential of the bayhead compounds the problem; if unregulated, pollution will get worse over time. The inner bay receives the sediment load of the Sta. Rita river basin on the east and the Agusuhin river basin on the west. At the moment water pollution from the domestic and industrial waste from Olongapo City and the industrial and port zones of SBMA poses the gravest concern.

The threat of agricultural residues finding their way into water bodies is at present relatively low due to low level of inorganic chemical use and high level of soil conservation practice among the farmers (RIR Vol. XV). The potential threat of soil erosion and siltation can be inferred from the staggering rate of population increase in the uplands which has reached an average of 11.1% per annum, particularly in barangays Cawag, Aningway, Sacatihan, Batiawan, and Naugsol (RIR Vol. XIV). The sedimentation of sand and silt is highest on the north and northeast bayhead and on the western shoreface (RIR Vol. X), and can be further aggravated by intensified cultivation, quarrying, deforestation, and settlement encroachment into the uplands.

The pressure on this IC system can be deduced from the behavior of the population of the two LGUs abutting the bay: Olongapo City and the municipality of Subic. Census years 1990 and 1995 indicated a net population loss in Olongapo City at the rate of –1.45% yearly while that of Subic has risen to 4.0%. The trend in Olongapo may be attributed to the closure of the naval base but the high population growth rate of Subic deserves a closer look. Former base employees and their dependents who had nowhere else to go chose to settle in Subic and have found temporary livelihood in the open access fisheries as confirmed by the Fisheries Assessment Report (RIR Vol. VI) or in upland cultivation.

Collecting bangus fry, catching aquarium fishes, and collecting turtle eggs are also observed in addition to fishing. As a result, the artisanal fisheries is an over-

crowded activity because fishermen density in Subic Bay is higher than in any other fishing grounds in the country. Over-fishing and dwindling catch invite unsustainable fishing methods resulting in rapid degradation of existing resources and habitats.

(4) IC System #5

IC #5 lies on the eastern portion of the former baseland and accommodates a greater variety and higher intensity of land use, i.e., built up, recreational, infrastructure, and many facilities of the former US naval base. Its forest cover is fairly extensive but mainly is of the open canopy type. The closed canopy forest lies at the upper reaches of the catchments of Malawaan, Binictican and Boton rivers. Mangrove forests occur on the estuaries of Binictican and Boton rivers. The Binictican mangrove forest has the highest total mean reproduction rate. But both mangrove forests are threatened by conversion to non-forest uses. Already, an estimated 74% of Binictican mangrove and 43% of Boton mangrove forests have given way to industrial, commercial, and recreational uses (RIR Vol. V).

Other major SBMA development projects will further affect the environment of IC #5 such as the widening and extension of the Rizal-Argonaut highway, the expansion and development of the industrial zone, and the development of the seaport at Cubi Point. The impact of these developments especially during their operational stage on the water quality of the receiving waters can only be anticipated. At its full development, the industrial zone can be expected to create problems in the handling of effluents. Similarly, the container seaport will discharge oil and grease and other pollutants on the water. When the berthing capacity of the port is full, any number of vessels will lie at anchor around the port waiting to be berthed.

(5) IC System #6

IC #6 covers the western portion of the former baseland. Compared to IC #5, this integrated catchment has higher conservation value. It has a more extensive coverage of closed canopy forest and mangrove forests in Triboa and Ilanin bays which, though not as biodiverse, attract considerable wildlife due to minimal human impact. The primary receiving water body is the area near the bay mouth. The band of marine water about 1.5 km wide extending from Camayan Pt. and Binanga Pt. to Grande and Chiquita islands could serve as fish sanctuary due to the presence of significant coral and seagrass cover. The receiving water also includes the immediate drainage outfalls of Triboa and Ilanin rivers.

The activities that will affect IC #6 will be related to fisheries, recreation and eco-tourism. Properly protected, the fish sanctuary is expected to improve the catch of fisherfolk. Without effective regulation, however, this could encourage overfishing and worse, poaching in the sanctuary itself. Tourism facilities and recreational activities are also likely to run in conflict with protection objectives.

Hotels and beach resorts are being eyed to rise on Grande Island itself and in Ilanin Bay. A marine exploratory center to be established in Ilanin Bay is in the works. A dolphinarium has started operation of late in the same bay.

The other receiving body of water is Port Binanga. Port Binanga receives the drainage from Binanga River, which originates near Hill 394. No major issue is expected to arise from this catchment. The run-off from Laplap River on the Morong boundary that collects from existing settlements and agricultural areas might contribute to siltation and damage the corals and seagrass beds in Port Binanga.

b) Focused Strategies and Policies

The ICM approach allows the formulation of strategies and policies that address area-specific issues. Such strategies and policies pertain more to the buffer zones and outer regions of the protected area. They do not form an official part of the PAMP but are nonetheless essential to its effective implementation. Hence, the institutional arrangements and linkages that are necessary to address the issues are taken up in Section 8.

c) Iterative and Consultative Process

The planning methodology involved an iterative and highly consultative process that includes the following elements:

- Literature research and 'desk top' review
- Consultation with government agencies and departments
- Base-line survey of natural resources and ecological inventory
- Field work to establish land use context and issues
- Air-photo interpretation and mapping of PA natural resource, terrain, and land use features
- Series of major stakeholder workshops concerning the key stages of the PA planning process:
  - Workshop 1- project definition
  - Workshop 2 – resource inventory: ecological profile and identification of key issues and assumptions
  - Workshop 3 – confirmation of PA boundary selection criteria and designation of protected areas
  - Workshop 4 – development of guidelines for the protection of flora and fauna
- Series of internal workshops concerning each of the above major project/workshop topics
- Synthesis of resource inventories, air photo interpretation, field work reconnaissance, consultation findings, workshop outcomes to formulate both Flora and Fauna Guidelines, and PAMP documents format, content and strategies.

d) Planning

The initial task involved a comprehensive literature review, including all pertinent government policies, legislation, strategies and other relevant documents.

Concurrently, the resource inventories were undertaken for the specified areas as outlined above. The information gained from extensive baseline research and field investigations were presented to stakeholders at the second workshop, documented, and then made a vital input to the identification of the Protected Area and the various management zones.

The first planning task was to develop a set of guiding principles as a basis for determining suitable uses and management objectives of the Protected Area and to validate the criteria through the stakeholder workshops. In addition, the project team developed a PAMP vision, goals and objectives. The vision outlines the principal aims of the PAMP and what it seeks to achieve. This then allowed a range of goals addressing environmental, social and economic issue to be determined, for which more detailed objectives were developed. This was achieved with the inclusion of a stakeholder workshop to examine, add to and validate vision, goals and objectives.

The next step was to identify the Protected Area itself together with the internal boundaries of the various management zones, and the Buffer Zone. For this the team developed boundary definition criteria, examined all background data and air photography, and undertook substantial field reconnaissance. This process also involved the workshop sessions where all aspects of this work were presented, openly discussed, commented on, contributed to, and validated.

The development of appropriate management strategies for the Protected Area followed. This involved the designation of permitted and restricted uses/activities of the various management zones and buffer zones/sub-zones. These were also presented, discussed and validated through the workshop sessions.

Additional tasks included the identification of coastal management options and the formulation of a coastal management plan.

A separate set of guidelines for the protection of flora and fauna outside the Protected Area was developed. This resulted in the formulation of protection techniques for application in the buffer zone and advice on region-wide environmental protection, institutional arrangements, and best practices.

Finally, the PAMPP also included the specific development of alternative livelihood practice strategies for the Protected Area, Buffer Zone and beyond. The alternative livelihood projects developed subsequently took into account consideration of allowable resources for extraction, skills, culture, technology utilization and current economic activities.

PAMPP Workflow

The final study program incorporating the various tasks outlined above was divided into five stages of work as follows:

- Baseline profiling
- Areal conceptualization and policy framework
- Plan formulation
- Implementation framework and strategies
- Integration

The break down of individual tasks and activities within each of these stages is as shown in Figure 2.

Figure 2. Study Workflow Diagram

2.0 HISTORICAL CONTEXT AND RATIONALE FOR PROTECTED AREA ESTABLISHMENT

2.1 History of the Subic Bay Region

The military establishment at Subic Bay pre-dates the Spanish-American war. A royal decree of Spain in 1884 selected the area as a naval base in the Far East. By 1898, the Spaniards had completed dredging the harbor and several permanent buildings had been built, including an arsenal.

The history of the US Naval Reservation at Subic started on November 9,1907 when President Theodore Roosevelt reserved certain parcels of land in Zambales and Bataan for US Navy purposes. The Philippines was then a colony of the United States. Even after US recognition of the declaration of independence and sovereignty of the Republic of the Philippines, the Americans continued to maintain a military establishment under the 1947 RP-US Military Bases Agreement, which granted the US basing rights for 99 years. As a result of the struggle for nationalism and to reduce American control over the country's lands and waters, President Carlos P. Garcia issued Proclamation No. 731 declaring certain portions of lands already classified as alienable and disposable, open for disposition under Republic Act No. 274 in relation to Commonwealth Acts No. 141 and 3038.

Subsequently, the 1966 Ramos-Rusk Exchange Notes amended the 1947 Agreement and shortened the term of the agreement from the original 99 years to 25 years from the date of the amendment. The agreement was to continue only until September 16, 1991, after which it became subject to actual and full termination upon one year's notice by either party. In 1991, the Philippine Senate rejected the proposed new Treaty, which would have extended the presence of the US military forces in the country. A notice of termination was given and the US military forces were withdrawn in December 1992. The Bases and Conversion Act (RA 7227) on February 5, 1992 turned over to the Subic Bay Metropolitan Authority (SBMA) the lands and facilities within the naval base to manage, develop and supervise the Subic Special Economic Zone and Freeport.

The strict security provided by the United States Navy at Subic Bay until 1992 preserved significant natural resources. Adjacent marine areas and mangrove swamps provide additional natural habitats for a variety of species that are becoming rare in the Philippines. These ecosystems form a continuum from forested mountains through mangrove swamps to coral reefs and seagrass beds. These contiguous ecosystems constitute a unique biological area of national and international significance.
The SBMA Ecology Center, therefore, recognized protection and planning of these areas as a pivotal mandate, in order to ensure their sustainability. These natural resources provide opportunities for unique development that are commercially attractive and ensure their protection and sustainability.

In October 1999 Woodward-Clyde Philippines began work on the Subic Bay Protected Area Management Plan (SBPAMP) project under contract to the Ecology Center with funding provided by the Japanese Bank for International Cooperation (JBIC). This management manual and related documents are the results of this project.

2.2 The Subic Bay Freeport Zone

As provided in RA 7227, the Subic Special Economic Zone and Freeport, later referred to as the Subic Bay Freeport Zone (SBFZ), "shall be developed into a self-sustaining industrial, commercial, financial and investment center to generate employment opportunities in and around the zone and to attract and promote productive foreign investments". RA 7227 vested upon the SBMA the responsibility and authority of administering, managing and developing the Freeport Zone. This law also mandated the SBMA to maintain and preserve the forested areas as a national park (Section 13(7)) and "to protect, maintain, and develop the virgin forests within the baselands which will be proclaimed as a national park and subject to a permanent total log ban. For this purpose, the rules and regulations of the Department of Environment and Natural Resources and other government agencies directly involved in such functions shall be implemented by the Subic Authority".

Section 12 of RA 7227 likewise specified that the metes and bounds of the Subic Special Economic Zone and Freeport "shall be delineated in a proclamation to be issued by the President of the Philippines". Thus, in February 1995, President Fidel V. Ramos issued Proclamation 532 delineating the metes and bounds of the Subic Bay Special Economic and Freeport Zone. The total approximate area of the Freeport Zone is 67,452 hectares consisting of the City of Olongapo and the municipality of Subic, province of Zambales. The Freeport Zone would also encompass the "baselands" occupied by the Subic Naval Base and its contiguous extensions as embraced, covered and defined by the 1947 Military Bases Agreement as amended. These baselands are within the territorial jurisdiction of the Municipalities of Morong and Hermosa, Province of Bataan and the Municipality of San Antonio, Province of Zambales. Said proclamation also vested upon the SBMA the maintenance and protection of the proclaimed watershed reservations and natural resources within the Subic Bay Freeport Zone. Figure 3 shows the metes and bounds of the SBFZ.

2.3 The Subic Watershed Forest Reserve

The Subic Watershed Forest Reserve (SWFR), known for its high level of wildlife biodiversity and endemism, was proclaimed as a critical watershed under Presidential Proclamation No. 962 on June 25, 1992. It lies in the west central part of Luzon, and is specifically at the southern portion of the Zambales Biogeographic Zone described by 14°45.0' and 14° 51.0' N latitudes and 120° 15.5' and 120° 15.0' E longitudes. This secondary growth forest has a total area of 9,856 hectares and is classified as semi-ever-green lowland forest with a yearly period of moisture stress due to rainfall seasonality (Fernando, et al., 1998).

Figure 3 Map Showing the Metes and Bounds of Subic Bay Special Economic and Freeport Zone

The SWFR is considered the home of the last remaining old growth forests in western Luzon. The reserve is believed to be highly biologically diverse and has a wide variety of flora and fauna that should be protected from extinction. It contains 3,000 varieties of trees, 10,000 species of flowering plants and ferns, 760 species of birds and some small animals. The rivers and surrounding bodies of water is reported to carry more than 750 species of edible fishes and shellfish (Fernando, et. al., 1998).

The reserve has since been part of the Subic Bay Freeport Zone by virtue of Presidential Proclamation No. 532 and is under the administrative jurisdiction of the Subic Bay Metropolitan Authority by virtue of RA 7227 of 1992 and Presidential Proclamation No. 962.

2.4 The Proposed Subic-Bataan Natural Park

The watershed reserve is also considered part of the contiguous forest area that encompasses the SWFR and Bataan Natural Park. This forest area is one of the top ten-priority protected areas in the Philippines of the Department of Environment and Natural Resources (DENR). A resolution of the NPPSC (Resolution No. 03, entitled "Resolution Governing the Management and Administration of the Proposed Subic-Bataan National Park") specifically "… recognized that the Subic Watershed Reserve and Bataan National Park are two separate and distinct protected areas within one biogeographic zone. The Conservation of Priority Protected Areas Project (CPPAP) together with the World Bank-Global Environment Facility (GEF) and the DENR has recently completed the Protected Area Management Plan for the Bataan side of the said natural park.

2.5 The Subic Bay Protected Areas Management Plan Project

The conversion of the former US Naval Reservation and the surrounding areas into the Subic Bay Freeport Zone (SBFZ) and the consequent emphasis on commercial development poses a potential threat to the area's ecosystem and its diverse resources. Within this framework and given its mandate, SBMA is to identify natural resources within its jurisdiction that would require protection and planning to ensure survival of these resources.

The SBMA with the funding from the Japan Bank for International Cooperation (JBIC) initiated the Subic Bay Protected Areas Management Plan (SBPAMP) Project for Subic Bay in October 1999. The PAMP is one of the components of the Subic Bay Environment Management Project under Loan Agreement No. PH-P182.

A comprehensive and systematic approach was developed to systematically address ecological and human use issues for the planning of the protected areas and surrounding land and water resources. The basic elements of the approach are:

- setting goals based on values;
- scoping studies based on decisions to be made, and
- considering planning needs in designing technical data collection.

3.0 NATIONAL, REGIONAL AND LOCAL DEVELOPMENT PERSPECTIVE

3.1 Introduction

This Section provides a synopsis of the international agreements and national policies that have implications, either directly or indirectly, on the protection and management of the natural resources, particularly, the preservation of Philippine biodiversity. Subsequent discussions focus on relevant laws, rules and regulations, and plans currently in place in the study area. A more extensive discussion of these policies is provided in Volume XIV of the Resource Inventory Reports - Land Use and Settlements Pattern Report (Regunay 2001).

3.2 National Policy Framework

The Philippine Constitution provides the most basic policy framework for the conservation and protection of the environment and natural resources. This basic law provides for the delineation of forestlands and national parks. The Constitution likewise tasks Congress to determine measures to prohibit logging in endangered forests and watershed areas. It is also very specific as regards to rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and cultural well being.

3.2.1 International Agreements

The Government of the Philippines (GOP) is a signatory to a number of international agreements on biodiversity conservation. These agreements, while recognizing the respective laws of each country, nonetheless are significant in two aspects. Such agreements not only manifest the global importance of biodiversity conservation but also commit the signatory countries to undertake conservation activities at the local level. Detailed discussions on the international agreements are furnished in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001). Some of the international commitments associated with biodiversity conservation as outlined in the DENR-UNDP report entitled "Philippine Biodiversity: As Assessment and Action" are enumerated below:

1. Convention on Biological Biodiversity
2. Convention on Wetlands of International Importance
3. Bonn Convention
4. Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)
5. International Union for the Conservation of Nature and Natural Resources (IUCN)
6. Palau Rambut Declaration
7. Agreement on the Conservation of Nature and Natural Resources
8. General Agreement on Tariffs and Trade (GATT)

3.2.2 Relevant Laws and Legislation on Environment and Natural Resources

Drawing from the policy statements and provisions of the Constitution, a number of legislation and laws were enacted to promote and strengthen environmental and natural resources management and development. These are:

- Republic Act 6969 – An Act to Control Toxic Substances and Hazardous and Nuclear Wastes, Providing Penalties for Violations Thereof, and for Other Purposes
- Republic Act 7586 – An Act Providing for the Establishment and Management of National Integrated Protected Areas System, Defining Its Scope and Coverage and for Other Purposes
- Republic Act 7942 – An Act Instituting a New System of Mineral Resource Exploitation, Development, Utilization, and Conservation
- Republic Act 8371 – An Act to Recognize, Protect, and Promote the Rights of Indigenous Cultural Communities/Indigenous Peoples, Creating a National Commission on Indigenous Peoples, Establishing Implementing Mechanisms, Appropriating Funds Therefore and for Other Purposes
- Republic Act 8749 – An Act Providing for a Comprehensive Air Pollution Control Policy and for Other Purposes.
- Presidential Decree 705 – Revising Presidential Decree No. 389, Otherwise Known As the Forestry Reform Code of the Philippines
- Presidential Proclamation No. 24 – Establishing and Designating a Parcel of the Public Domain Situated in the Municipalities of Hermosa, Orani, Samal, Abucay, Balanga, Pilar, Bagac, and Morong, Province of Bataan and the Municipality of Subic, Province of Zambales, as Bataan National Park
- Presidential Proclamation No. 926 – Establishing Subic Watershed Forest Reserve for Purposes of Protecting, Maintaining, or Improving Its Water Yield and Providing Restraining Mechanism for Inappropriate Forest Exploitation and Disruptive Land Use, a Certain Parcel of Land of the Public Domain Situated in the Province of Bataan, Island of Luzon, Philippines
- Executive Order 192 Series of 1987 – Reorganizing the Department of Environment and Natural Resources
- Executive Order 247 Series of 1995 – Prescribing Guidelines and Establishing a Regulatory Framework for Prospecting of Biological and Genetic Resources, their By-Products and Derivatives for Scientific and Commercial Purposes and for Other Purposes

In addition to the above legislation, the Department of Environment and Natural Resources issued numerous administrative orders, memorandum circulars and orders to support resource protection and biodiversity conservation. Two of these have important implications for the protected area at Subic Bay. One defines all large tracts of mangrove areas as wilderness areas, thus limiting access to and extraction of mangrove forest resources. AO 24 series of 1991 prohibits logging in old growth or virgin forests and declares these areas as part of the integrated protected areas system. Other issuances relevant to biodiversity conservation and protected area management are presented below:

- Administrative Order (AO) 72-90 – Amending DENR AO 72 Series of 1990 to Include National Parks and Other Protected Areas in the Survey Standard Instrumentation and Procedures in the Verification and Approval of Maps in the Department of Environment and Natural Resources

- AO 13-92 – Regulations Governing the Establishment of Buffer Zones Within Forest Lands

- AO 25-92 – National Integrated Protected Areas System (NIPAS) Implementing Rules and Regulations

- AO 27-92 – Management of Mossy Forest

- MC 22-92 – Guidelines on the Preparation and Submission of Maps of Areas covered by NIPAS

- AO 16-93 – Guidelines on the Establishment and Management of Buffer Zones for Protected Areas

- AO 39-94 – Amending Section 50 Chapter VIII of AO 25-92

- AO 15-95 – Revised General Guidelines in the Implementation of the Sub-classification of Forestlands and Other Inalienable Lands of the Public Domain

- AO 37-96 – Revising AO 21-92 to Further Strengthen the Implementation of the Environmental Impact Statement (EIS) System

- AO 05-97 – Procedures in the Retention of Areas within Certain Distances Along the Banks of Rivers, Streams, and Shores of Seas, Lakes and Oceans for Environmental Protection

- Memorandum Order (MO) 08-95 – Clarification on the Provision of the NIPAS Law regarding the Modification of Boundary of Protected Area and Buffer Zone

- AO 34-96 – Guidelines on the Management of Certified Ancestral Domain Claims

3.2.3 Relevant Legislation on Agriculture

There are laws and statutes on agriculture that should be considered in the study of protected areas and biodiversity conservation. These are RA 6657 or the Comprehensive Agrarian Reform Law (CARL) and RA 8435 or the Agriculture and Fisheries Modernization Act (AFMA). The CARL provides for the implementation of the Comprehensive Agrarian Reform Program (CARP) and defines the limits to the conversion of agricultural lands to non-agricultural uses.

The AFMA, on the other hand, declares as a national policy the promotion of "industrialization and full employment based on sound agricultural development and agrarian reform, through industries that make full and efficient use of human and natural resources, and which are competitive in both domestic and foreign markets…. Private enterprises, including corporations, cooperatives, and similar collective organizations, shall be encouraged to broaden the base of their ownership". In addition to this provision, the law also mandates the delineation of Strategic Agriculture and Fisheries Development Zones (SAFDZ) as centers for development in the agriculture and fisheries sectors.

Other legal issuances designed to regulate agro-biodiversity include the guidelines on the introduction of certain species of animals such as horses, pigs, cattle, game fowls, etc., (various Department of Agriculture Administrative Orders) and plants (PD 1433). Orders were also issued to control the export of indigenous crops and animal species to maintain the comparative advantage of the country in these species (e.g. Administrative Order 14 Series of 1987 on ramie).

3.2.4 Relevant Laws on Coastal and Marine Ecosystems

PD 704 governs the utilization of fishery resources in the country. Supportive of the policy directions of said law, several orders were issued that pertain to the following:

- prohibiting or regulating the capture of endangered marine species, e.g., marine turtles or *pawikan, dugong*; (FAO No. 76 Section 2)

- prohibiting the use of destructive gears like *muro-ami and kayakas*; (FAO No. 163 Series of 1986 Section 2)

- prohibiting the use of commercial trawl and purse seine in municipal waters, regulating the use of fine mesh nets; (PD704 Section 35; FAO No. 155 Series 1096 Section 2)

- declaring marine sanctuaries; (PD704 Section 32; FAO No. 118 Series of 1981; FAO No. 128 Series 1980; FAO No. 151 Series 1986; FAO No.176 to 182 Series 1991) and

- regulating the farming of seaweeds and coral reefs. (FAO No. 146 Series 1983 Section 2, Section 4; RA 8550 Section 91)

3.2.5 Laws of Significance to the SBPAMP

Significant laws relevant to the study of the Protected Areas include the following:

1. Republic Act 7227 – Bases Conversion and Development Act

2. SBMA Implementing Rules and Regulations (IRR)

3. Presidential Proclamation No. 532 – Delineating the metes and bounds of the Subic Special Economic Zone and Freeport Established Pursuant to Republic Act No. 7227, Otherwise Known as the Bases Conversion and Development Act of 1992, approved March 13 1992

4. Republic Act 7160 – Local Government Code

5. Republic Act 7279 – Urban Development and Housing Act

3.2.6 The National Physical Framework Plan

In 1992, the National Land Use Committee (NLUC) completed the 1993-2023 National Physical Framework Plan (NPFP) that outlined the multi-sectoral policy agenda that will guide land use activities, settlement patterns, environmental management, and development of the country's other physical resources. The Plan has four main components and these are: a) Protection Land Use; b) Production Land Use; c) Settlements Development and d) Infrastructure Development.

Protection land use refers to the rehabilitation, conservation, sustainable development and management of the following areas:

- Areas belonging to the NIPAS system;

- Areas outside the NIPAS but requiring equivalent amount of protection such as residual forests above 50% in slope, 1000 m in elevation, and reserve for other purposes, mangroves, buffer strips and easements, and freshwater swamps and marshes; and

- Areas prone to natural hazards termed as environmentally constrained areas.

Production land use refers to the direct or indirect utilization of land resources for crop production, agro-forestry, grazing and pasture, mining, fishing, industry and tourism. The plan adopts a policy that discourages further settlements and growth in areas that need to be protected. It also recommends that all infrastructure projects in environmentally critical areas be subject to the Environmental Impact Assessment (EIA)

process. The NPFP likewise proposes the passage of a National Land Use Act that will integrate into a comprehensive framework the policies and laws concerning land and water use planning and management. To date, however, Congress has yet to pass this proposed legislation.

3.3 Regional and Local Economic and Development Context

3.3.1 The Regional Physical Framework Plan

The regional implications of the NPFP are detailed in the Regional Physical Framework Plans (RPFPs). RPFPs embody the general as well as place-specific policies to guide land use planning at lower levels and define the extent of protection and production lands in each of the administrative regions. The major components of the RPFP include the Production Land Use (existing and available areas for future use), the Protection Land Use/Environmental Rehabilitation and Conservation, Settlement Plan, and Infrastructure Plan/Long Term Infrastructure Projects (LDAP, 1994). It must be emphasized that the RPFP becomes effective only when local government units adopt such policies and issue the corresponding statutes. Details of the Central Luzon RPFP are provided in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001).

3.3.2 The Provincial Physical Framework Plan

The Provincial Physical Framework Plan or PPFP provides a more detailed representation of the relevant portion of the RPFP. It is an integration of the land use plans of municipalities and cities comprising the province. The PPFP designates the roles and functions of major urban centers and the areas for protection and production purposes of the province.

The Zambales PPFP

Referred to as the "Zambales Comprehensive Approach for Resource Development", the spatial development strategy as contained in the PPFP for Zambales covering the period 1993-2002, proposes the establishment of eco-tourism areas along the entire stretch of the western section of the province. The plan also provides for the conversion of the large tracks of "opportunity (underutilized) lands" for production purposes. Of import to the protected area management study is the proposal to develop the Nagsaza and Silanguin areas in the municipality of San Antonio for industrial parks and tourism purposes, respectively.

Among the relevant policies outlined in the PPFP are as follows:

- Location of mining and quarrying activities outside a 10-km radius from urban centers, eco-tourism sites, watersheds and other protected areas;

- Strict enforcement of the 1-km buffer zone around protected areas to avoid human intrusions and further damage to protected lands;

- Intensification of campaign against illegal logging and conversion of mangroves and the promotion of reforestation;

- Identification and provision of sanitary landfills; and

- Formulation of systems and plans to improve soil productivity.

The Bataan PPFP

As indicated in the 1993-2002 PPFP, the development of Bataan province hinges on the promotion of eco-tourism, establishment of small and medium enterprises, and agro-industrialization. The policy proposals contained in the PPFP are:

- Promotion of appropriate land management and system and soil conservation strategies for the uplands;

- Disapproval of new applications for conversion of swamp areas to fishponds;

- Protection and conservation of forest and NIPAS areas through the strict implementation of anti-logging laws and conduct of reforestation activities;

- Construction of access roads leading to opportunity lands to encourage the development and the establishment of settlements in these areas; and

- Development and promotion of the Hermosa Agro-industrial Estate, the Bataan Technology Park and the Mariveles Regional Industrial Center.

3.4 Local Development Context

3.4.1 The Municipal Comprehensive Land Use Plans

Section 20 of the LGC and Article 41 of its implementing rules and regulations mandate the preparation of comprehensive land use plans (CLUPs) by each city and municipality. The CLUP localizes the higher level physical framework plans, i.e., NPFP, RPFP, PPFP, and outlines the policies and strategies pertaining to the use of all parcels of lands in the city or municipality. It also provides the basis for the preparation of medium term development plans, investment programs, and development ordinances. The main implementing tool for the CLUP is Zoning Ordinance.

Pursuant to the requirements of the LGC, Executive Order No. 72 was issued in March 1993 instructing all local government units to prepare their respective CLUPs. Based on the documents and information gathered from the municipal governments that comprise the study area, only the municipalities of Subic and San Antonio in Zambales and

Morong, Hermosa and Dinalupihan in Bataan have initiated the preparation of their respective CLUPs. The towns of San Marcelino and Castillejos including the City of Olongapo in Zambales have not prepared their CLUPs. The status and key land use proposals of these CLUPs are briefly discussed in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001).

3.4.2 SBMA Development Plans

In assessing the potential of a protected area within the study area it is important to have a clear understanding of the range of development projects that are on-going or have been approved, or committed even if actual ground work has not yet commenced. Of significance are the development proposals that have been submitted to the SBMA Board for consideration. Approved and planned projects have been carefully considered in the establishment of the SBPA and adjacent buffer zones. The known developments are discussed below. Figure 4 shows the location of the specific projects and proposals of the SBMA.

The SBMA formed four main strategies for the human, economic and environmental development of the Freeport Zone. The four strategies and specific projects under each are as follows:

- Expanded Horizon (Subic Bay Area Municipal Development Projects, Bataan Technology Park, Subic-Clark-Tarlac Toll Road);
- Port Development (Subic Bay Seaport Master Plan, Subic Bay Airport Master Plan);
- Nature Theme Parks (Grande Island, Pamulaklakin Forest Trails); and
- Cyber Subic.

Other proposed and approved SBMA projects identified are outlined below:

Transportation

Roads

- Rizal Argonaut Widening and SBF-Expressway
- Morong Road Improvement
- All Weather Service Road and Perimeter Fence
- Subic-Clark-Tarlac Expressway Project
- Proposed Two-lane port access road
- Security fencing and construction (Approved)

Bridges

- New Kalaklan Bridge and Security Plaza
- Magsaysay Bridge

Seaport

- Construction of New Terminal (Cubi Point)
- Rehabilitation of Rivera Wharf
- Rehabilitation of Bravo Wharf
- Rehabilitation of Boton Wharf (Bulk Cargo)
- Rehabilitation of Nabasan Wharf
- Rehabilitation of Leyte Wharf
- Rehabilitation of NSD Marine Terminal
- Rehabilitation of Sattler Pier
- Rehabilitation of AFDM-5 Approach Pier

Airport Improvement Project

- SBIA Approach Lighting System
- SBIA Runway Rehabilitation Works
- SBIA Road-Alignment at Argonaut Highway
- SBIA Apron Extension
- Improvement of Argonaut-Palawan Junction Extension (Maritan Highway)

Utilities

Power Improvement Projects

- Extension of Power Supply Line to Tipo Plaza
- Proposed Power Generating Plant
- Emergency Rehabilitation of Sub-stations and Distribution System

Water System

- Installation of Water Supply at Tipo System

Waste Disposal Management Projects

- Construction of New Sanitary Landfill
- Existing Landfill Closure and Reclamation Project

Sewerage System

- Sewerage Treatment Plan (Proposed)

Telecommunications

- New Communication Tower Construction
- Rehabilitation of Oracle Cubi Communication Tower and B-8329

- Rehabilitation of Mount Sta. Rita (B-400)
- Rehabilitation of Communication Tower at Ilanin Forest

Facilities

- PWTSG Facility
- Subic Bay Sports Center (Magsaysay Blvd)
- Development of Tipo Plaza
- New Building for Law Enforcement Academy
- Subic Chapel Construction
- Subic Bay Museum and Subic Bay Science Center
- SBFZ Gate Enhancement Project
- Subic Bay Arts Center Improvement
- Subic Gateway Convention Center

Other Projects

- Marine Exploratorium (Ocean Adventure) (Approved and established)
- Two Hotels/Resorts Development (Proposed)
- Eco-Tourism Hill 394 (Approved)
- Industrial Zone (Proposed)
- Grande Island (Proposed)
- Malampaya Site (Proposed)
- Industrial Zone Master Plan (Bataan Technology Park) (Proposed)

Details of some of these projects and their potential effect on the SBPA are provided in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001).

3.4.3 The Subic-Bataan Natural Park

The Draft Proclamation of the Subic-Bataan Natural Park (SBNP) contains the declaration of certain parcels of land of public domain covering the SWFR and Bataan Natural Park (BNP) as protected areas. The two (2) parcels, namely SWFR (Parcel 1) and BNP (Parcel 2) are included under the category of Natural Park subject to further ground verification. This further amends Presidential Proclamation No. 24 dated December 1, 1945, as amended by Proclamation NO. 16 of 1966, Proclamation No. 1564 dated August 3, 1976, Proclamation No. 1956 dated March 25, 1980, Proclamation 192 dated November 27, 1987, Proclamation No. 926 dated June 25, 1992 and Proclamation No. 532.

Figure 4. Approved and Proposed Future Developments within the SBFZ

The Draft Proclamation further states that the management and administration of the SWFR and BNP will be under SBMA and DENR, respectively. However, as provided in the draft, management and administration of the protected area by the SBMA shall be in accordance with the appropriate provisions of the NIPAS Law and still subject to existing DENR Policies on protected areas in a manner provided for in the DENR-SBMA MOA. It also includes the provision on the establishment of additional and separate trust fund for SWFR.

The purpose for establishing the Natural Park is to protect and conserve its ecological, biological, scientific and educational features. The DENR and SBMA shall prioritize the boundary delineation of the SBNP, institutionalize the offices (Protected Area Supervisor [PASu] and PA Staff) that shall administer and manage the respective parcels covered by this proclamation, and draft and finalize the respective management plans in accordance with the General Management Planning Strategy (GMPS) guidelines for protected areas.

The BNP hosts the remaining vestiges of old growth forests in the Zambales Biogeographic Zone. Species that can be found only in the park such as the mountain rose, fire orchid, oak, etc., and is one of the main reasons for its importance as a protected area. The majority of the area of the natural park is being threatened by rapid urbanization and industrialization of Bataan, aggravated by small-scale logging, kaingin farming (i.e., swidden agriculture) and insufficient funding support for the management of the park.

3.5 Other Development Plans

In addition to the physical framework and development plans of SBMA, there are other plans that have been prepared by the different government agencies in Central Luzon. These include:

- Central Luzon Regional Development Plan (RDP) 1999-2004,
- Central Luzon Tourism Master Plan,
- Zambales Development Plan, and
- Strategic Agriculture and Fishery Development Zone.

These are discussed in detail in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001).

3.6 An Assessment of Development Opportunities and Constraints

This section assesses the socio-economic setting - development opportunities and constraints in the study area - including a review of existing livelihood strategies and programs. The assessment is made from both a macro-regional and community level perspective. It made use of the following surveys and studies earlier prepared for the SBPAMP. They include:

- Upland and Coastal Livelihood Strategies;
- Census of Protected Area and Buffer Zone;
- An Assessment of the Fisheries of Subic Bay, Zambales, Philippines;
- Financial and Economic Analysis of Forest Resources Development and Utilization in Subic Bay Protected Area; and
- Forest Resource Economics

Macro-Regional Perspective

3.6.1 The Regional Demographic and Economic Setting

Region III's population on the average grew as fast as that of the whole country and during the past three decades maintained its share in the total national population at about 10%.

The region remains very much ***oriented towards Metro Manila***. Population growth lies consistently along a line that approximates the direction of the North Expressway Corridor towards Metro Manila. The ***attraction potentials*** of Subic Bay Metropolitan Authority (SBMA) and the Clark Special Economic Zone (SEZ) are, however, starting to draw surrounding towns to its economic sphere of influence in spite of the strong overall pull of Metro Manila.

3.6.2 The Economic Potential Of Nature-Based Tourism

Visitor Attraction Potential of the Subic Bay Freeport Zone

SBMA has been attracting a large number of visitors, mostly local, who come to enjoy the available ***natural attractions***, ***sports/recreational facilities***, and ***shopping*** opportunities.

A 1997 survey conducted by the UP Asian Institute of Tourism (AIT) for the Department of Tourism (DOT) showed that nearly ***one–fifth*** (19.5%) of ***foreign*** visitors in Region III visited the region because of natural attractions (12.2%), sports/recreation/adventure (4.9%), and shopping opportunities (2.4%). More than ***one-fourth*** (25.9%) of ***local*** visitors to the region did so for the same reasons (UP-AIT, June 1998).

Table 1 shows, visitor arrivals in SBMA have been growing at about 30% per annum during the past 5 years.

Table 1. Visitor Arrivals in SBMA: 1995-2000

Year	Foreign	Local	Total
1995	17,472	2,457,669	2,475,141
1996	49,764	1,786,388	1,836,152
1997	95,554	2,604,082	2,699,636
1998	91,280	2,261,655	2,352,935
1999	61,844	3,406,018	3,467,862
2000			6,739,889

While foreign visitors constitute less than 3% (2.96%) of total foreign visitor arrivals in the Philippines, it has a ***good growth potential*** as can be seen from the growth rates of 2,475,000 in 1995 to 6,739,000 in 1997.

Potential Economic Contribution of Visitor Arrivals at the Subic Bay Freeport Zone

The economic impact of visitor arrivals result from the so-called "economic multiplier effect" or the process by which tourist spending stimulates further spending and increases economic activity.

The Tourism Income Multiplier (TIM) is the factor by which tourism expenditures should be multiplied to determine the generated tourist income. The TIM represents the ***gross impact*** of tourist expenditures on the economy. It, however, only measures the ***economic value*** of the ***direct use*** by tourists of the Subic Bay Freeport Zone. It does not describe the broader economic benefits of conservation that are often substantial but are very difficult and costly to quantify.

While very limited, the TIM can be considered ***critical for conservation efforts*** in developing country settings like the Philippines since they could, if ***properly*** and ***responsibly*** tapped, yield substantial ***financial resources*** for both local and national conservation efforts. A complete explanation of the TIM is presented in Volume XIV of the Resource Inventory Reports– Land Use and Settlements Pattern Report (Regunay 2001).

Community-Level Perspective

Priorities for conserving the protected areas of Subic Bay should be derived from location of the diverse environmental resources and the nature of threats to it. Threats to the areas are habitat change, introduction of exotic species, pollution, unsustainable harvesting of wild species, and direct competition between people and wild species for living space and other resources.

There is therefore a need for policies and plans that encourage the cross-*sectoral analysis and management* (i.e. avoidance, mitigation or compensation) of environmental and social impacts and *just and sustainable solutions* to fundamental conflicts among the

people living or making their living within the protected areas, its buffer zones, and the areas greatly affecting the protected zones.

3.6.3 Socio-economic Characteristics

It is important to consider the socio-economic *characteristics*, the *way of life*, and the strategies as well as *coping mechanisms* of the residents of the Subic Bay Freeport Zone. These serve as key inputs in the preparation of strategies for livelihood development and financing the PAMP by bringing in investments and businesses into the area.

Household, age, and sex characteristics; health and sanitation conditions; tenurial status; sources of income; and perception of the natural environment are important socio-economic characteristics that were evaluated during Resource Inventories and used as a basis for development of the PAMP.

3.6.4 Sources of Livelihood

Agriculture

Agricultural activities consist of crop production (sweet potato, *gabi, ubi*, corn, vegetables), tiger grass processing for broom making, fruit tree production (mango, cashew, jackfruit, citrus, star apple, banana), forest tree production (gmelina, narra, mahogany, eucalyptus), livestock production (cattle, carabao, goat, hog, chicken, and duck), cut flower production, and fish culture. Agricultural crops are grown for both home consumption and commercial purposes. Markets for the agricultural products include the public markets and neighborhood. The proceeds are used to purchase basic food items such as rice, sugar, coffee, and cooking oil, as well as spent on education and medical expenses.

The Aetas, for example, are gradually shifting from swidden to sedentary farming. As such, there is an increase in their agricultural crop production aside from their traditional forest resource gathering activities.

Forest Products Gathering and Processing

The Aetas are mostly engaged in the gathering of forest resources such as honey, cogon, leaves, roots, barks, and stems of trees and plants for food, medicinal, and commercial purposes. The majority of these are for family consumption.

They extract forest products for food, house construction, medicinal purposes, home and personal adornments, furniture, tools, and fuel. The three most common forest products harvested are buho, fuelwood, and medicinal herbs. Buho is the most frequently harvested among the bamboo species as this is used for construction of houses.

The Aetas also hunt and trap forest animals such as wild deer, pigs, birds, monkeys, and fruitbats. The most commonly hunted animals are wild pig and fowl. The excess meat of

deer and wild pig is sold within the community and in local markets. Birds (*kilyawan, kulasisisi,* and *bato-bato*) are sold as pets. Wild fowl is sold to cockfighters for breeding fighting cocks.

Areas with relatively good forest resources have higher rates of extraction. These areas are Batiawan, Naugsol, Cawag Upland, Pundakit, Sta. Rita, Old and New Cabalan, Tipo, and Mabayo.

Fishing

Mudfish, catfish, *biya*, *tilapia*, small crabs (*talangka*) and freshwater shells and bivalves are the river resources frequently harvested by communities located along the rivers, especially in Batiawan, Old Cabalan, Binaritan, Kalakhan, and Naugsol. These products are marketed.

Marine/coastal products on the other hand include fish, squid, shellfish, bivalves, crustaceans, mollusks, seaweeds, and turtle eggs. Municipal fishing is done by most of the households surveyed characterized by the use of limited fishing equipment and gear and non-motorized bancas. Average weekly catch is 10 kilos of small fish, oftentimes insufficient to recover the fishermen's expenses. Popular municipal fishing grounds include Silanguin and Nagsaza Bay, Grande Island, and Cawag Bay in San Antonio and Subic as well as areas around Sabang and Morong in Bataan. Deep-sea fishing entails bigger investments and is usually undertaken by fishermen's associations.

Households in Cawag, Matain, Barretto, Calapacuan, Pundakit, and Nagsaza earn relatively higher incomes from aquarium fishing, their main source of livelihood. A fishing boat with a crew of up to five persons can gather Php 20,000 worth of aquarium fish in two days. This is year-round except during inclement weather. Aquarium fish are sold to aquarium fish shops and dealers in Metro Manila.

Sea turtle eggs are prized marine resources sold to Chinese residents in Subic who value them for their aphrodisiac and healing properties. Turtles have been reported in Sampalok, Agusuhin, Nagbayucan, Kinabuksan, Nagsaza and Silanguin.

The volume of catch per fisherman has declined over the years. Factors cited include overfishing due to increased number of fishermen and the use of more fishing gears as well as environmentally destructive fishing practices. Illegal fishing practices such as dynamite fishing and the use of sodium cyanide in aquarium fish gathering have been observed in Pundakit, Cawag, and Silanguin Bay.

Other Sources of Income

Other sources of income include:

- Trading of food and consumer items
- Employment
- Operation of tourism-oriented businesses

It may be noted that coastal residents have more opportunities to earn from odd jobs and vending mainly due to their proximity to poblacion centers.

3.6.5 Review of Livelihood Programs

There is a dearth of livelihood programs in the Subic Bay Freeport Zone.

Most of the livelihood activities are self-financed and as such, limit the households' ability to expand. Some cooperatives, however, such as the Calapandayan Multi-Purpose Cooperative, have grown on its own with only technical assistance coming from government agencies. The residents of the Cawag and Iram resettlements have been the only ones who have received substantive livelihood assistance ranging from technical and training to credit and loan funds.

Livelihood Programs for Upland Communities

1. Livelihood Program for Resettlement Areas

The Department of Environment and Natural Resources - Mt. Pinatubo Commission (DENR-MPC) Livelihood Program has provided assistance to families displaced by the Mt. Pinatubo eruption and who have resettled in Iram and Cawag.

As of 1995, the Integrated Communal Agro-Industrial Program for Upland Settlers (ICAIPUS) distributed 232 has. of farm lot, most of which were developed as agri-livestock and agro-forestry areas. As of the same period, the DENR has awarded a total of 607.95 has. of farm lot under the Certificate of Community Forest Stewardship (CCFS) Contract.

The programs organized the residents into association and cooperatives that served as conduits for technical and financial assistance. Loans have been provided for the following livelihood projects:

- Crop production;
- Cutflower production;
- Tiger grass farming and broom making;
- Duck raising;
- Agro-forestry production;
- Agri-livestock production; and
- Fish culture.

2. Livelihood Programs for Other Upland Areas

Most of the livelihood activities of upland communities are self-financed. However, some have received assistance from funding and government agencies and non-governmental organizations.

Livelihood Programs for Coastal Communities

None among the coastal communities has received financial assistance for livelihood activities. The Calapandayan Multi Purpose Cooperative serves as an inspiration to other fishermen cooperatives, proving that a cooperative can grow with mere technical assistance. It has received technical assistance from the Bureau of Fisheries and Aquatic Resources (BFAR) and DTI, in the form of observation tours of successful aquatic/fish culture.

3.6.6 Assessment of Economic Development Opportunities and Constraints

The foregoing have shown that the forest, river and marine ecosystems are rich sources of materials that may be tapped to enhance the socio-economic status of the residents in the protected area and buffer zone. This section will discuss the opportunities in, and constraints to, the economic development of these areas.

Opportunities

1. Large Potentials for Nature Tourism

The Subic Bay Freeport Zone has enormous potentials for nature tourism: forests with diverse ***flora*** and ***fauna*** (e.g. sea turtles, monkeys, hornbills, large fruit bats and manta rays; and interesting ***Aeta folk culture*** wherein the forest and marine resources play a large role in their lives. Properly and responsibly managed nature tourism combined with other tourism-related attractions and activities can bring in large revenues to the local economies.

2. Indigenous Knowledge and Forest Management Practices

The Aetas have for generations used their indigenous knowledge to conserve the forest resources. Their knowledge of the medicinal and ecological values of flora and the interaction between the various species are valuable in the formulation of protected area management strategies.

3. Presence of Organized Groups

The existence of organized groups presents an opportunity that may be tapped in the implementation of the livelihood programs and the protected area management plan. For instance, the cooperatives that hold Community Certificates of Forest Stewardship (CCFS) under the Community Based Forest Management (CBFM) program of the DENR can manage the area on a communal basis. This provides some form of tenurial security to the members and motivation for their environmental protection activities. The groups

can also be effective channels of information, education and communication (IEC) in the implementation of the protected area management plan.

4. Perception of the Forest and Marine Ecosystems as Source of Food, Materials and Livelihood

The respondents in the survey place a high value on the economic and material significance of the forest and coastal/marine environments. As they are dependent on these ecosystems for their livelihood, the concept and practice of environmental protection and its associated regulation of economic activities would not be difficult for them to understand.

5. Demonstrated Ability of Settlers to Utilize Land For Productive Use

The upland residents, particularly in Cawag, recall that when they were resettled, the area was arid, cogonal, and lacked vegetation. Within three years, fruit trees were already abundant in the area. In a few more years, fruit trees such as mango, jackfruit, cashew, citrus, and other cash crops will bear a large volume of fruits. This experience has made several settlers confident that they can improve their lives through hard work and perseverance. Most of the upland communities are engaged in planting of forest and fruit trees, particularly mango, cashew, banana, and jackfruit. Most residents prefer to plant fruit trees because these provide income over a shorter period.

Constraints

1. High Incidence of Poverty

The high incidence of poverty among the communities within and around the protected area is a major constraint as this compels the community members to engage in the wanton extraction of already diminishing forest and marine resources.

Although the Aetas have for generations depended on the forests for their food and material needs, their indigenous knowledge on forest management coupled with their beliefs associated with nature have prevented the depletion of natural resources. However, this picture is changing due to the high incidence of poverty among them resulting from their displacement from their Mt. Pinatubo ancestral land and their resettlement to unfamiliar areas.

Already, some traditional practices on conservation are being dropped. The Aetas have abandoned the fallowing of the soil over a long period of time because they have lost their ancestral lands to lowlanders and government projects. Formal recognition of the Ancestral Lands claim of the Pastolan Aetas however, may return them to their practices.

2. Lack of Alternative Livelihood Opportunities

Most residents are engaged in traditional livelihood activities and have limited options for livelihood generation due to the following:

- Low level of formal education that cannot match skilled labor requirements of industrial, business and service establishments.
- Little knowledge on product and market trends.

3. Lack of Training and Skills Development

The low earning capability is due to the low level of education and lack of easily accessed alternative livelihood and skills training. Livelihood training provided by the government and non-government sector is limited. The coastal communities generally have not received any training on livelihood skills and sustainable fishery management and coastal resources conservation practices. Only a few groups have received training, notable of which are the associations in the Iram and Cawag resettlement areas on agricultural, agro-forestry, agri-livestock and fishery production.

Training on enterprise development should be given priority. The entrepreneurial skills of the residents should be developed including management, bookkeeping, and organizational development.

4. Lack of Access to Credit

Among the communities, the Iram and Cawag resettlements have received substantial financing support for their livelihood activities. Most of the enterprises are self-financed. The *lack of access to financing* seriously hampers the ability of the enterprises to move onto value adding activities, develop new products, and tap larger markets. Fishermen have greater difficulty in availing of credit due to the inherent risks involved in fishing. Most fishermen meet their financing requirements through one or a combination of the cooperatives, organized groups, and private lenders.

5. Small Volume of Products with Substantial Value Added Content

Most of the enterprises dealing with agri-forestry products are of cottage and micro-enterprise types. Only brooms, baskets, and hammocks have value added and are sold in small volumes. The incomes derived from these enterprises are insufficient to meet the basic and social expenses of the households.

6. Declining Fish Catch

Municipal fishermen have noticed a *decline in fish catch* as well as the *longer hours* it takes to catch fish. This may be attributed to the damage to coral reefs from dynamite fishing and other illegal fishing methods. As a consequence, fishermen have to fish

farther away, requiring more days (four to five days) at sea. This translates to increased production costs and *less profit* to be shared among the crew and boat owner.

7. Lack of Infrastructure and Basic Services

The lack of *basic services* such as health and infrastructure affects the overall well being of human resources. Most of the basic social services do not reach the remote barangays.

The lack of physical infrastructure also affects the livelihood activities of some communities. During the rainy season, the sourcing of raw materials and marketing of products are adversely affected because of *limited access* to and from the communities.

8. Low Awareness on Environmental Laws/Applications

Only a few respondents know of the NIPAs Act. Those who are do not understand its provisions. As such, the community members do not know which uses are allowed in certain areas and are expected to continue with their resource extractive activities.

4.0 PHYSICAL ENVIRONMENT

This section is based primarily on information collected during inventories of physical resources that were conducted as part of the SBPAMP project. The studies examined the environmental components of the watershed as well as their relationship to the ecological and environmental quality of Subic Bay. This synthesis provides the scientific basis for developing the SBPAMP and related documents. It focuses on those aspects that are especially important in planning the protection of the natural ecosystems of Subic Bay. The main features to be protected include the terrestrial and marine flora and fauna that comprise the rain forest, mangrove, and marine ecosystems of the bay.

Information on the physical aspects of the environment is presented in an integrated manner so that the links between the different environmental processes are clear. There is particular emphasis on the relationship between the condition of the living marine resources and the environmental loading of the bay because protecting the marine environment requires broad planning for the entire catchment of Subic Bay.

4.1 Physical Geography

Subic Bay is on the southwestern shore of Luzon with a small and isolated watershed. The nearest adjacent potential source of loading is Manila Bay located 50 km away. The watershed relief ranges from flat to steep. Peak elevations on the eastern side do not exceed 900m MSL (mean sea level). Mount Santa Rosa, in the southeast has an elevation of 880m MSL. Mount Balakibok to the north is 843m above MSL. Pointed Peak on the Redondo Peninsula to the west rises to 1,071m MSL. Broad, somewhat eroded alluvial fans coalesce on the lower slopes of these volcanic complexes, and there are relatively flat coastal areas generally below 20 m MSL.

Within the SWFR area, Binictican/Malawaan, Boton and Minanga Rivers originate from the western and northwestern slopes of Mt. Sta. Rosa and flow down to Subic Bay. The Binictican-Malawaan River basin is 23 km^2 in area, extending in a northwesterly direction from Mt. Santa Rosa to Olongapo Bay. The basin incorporates the two rivers, which merge before discharging into the Bay. Elevations within the basin range from about 350 m MSL in the upper headwater areas to less than 10 m MSL at the rivers' confluence. The Binictican River enters the Olongapo Bay about 630 m below the confluence. (Rabajante, 2001).

Figure 5 shows the watersheds and major point sources of environmental loads to the bay. Figures 6 and 7 show the locations of the coral reefs, seagrass and seaweed beds, respectively. These features are important outright because they provide the major habitats for many of the fish populations. Taken together these three figures summarize the entire environmental framework of the marine portion of the Protected Areas Management Plan study. Implicit in their protection is the concept that the marine system does not exceed the carrying capacity of the bay

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Figure 5. Subic Bay Watersheds

Figure 6. Location of Coral Reefs

Figure 7. Location of Seagrass and Seaweeds within SBFZ

The shape, size and depth of Subic Bay provide fundamental controls on how environmental loads are assimilated and dispersed. The bay is roughly rectangular, with a maximum length of 16.5 km, an average width of 7 km and a surface area of 142 km^2. The long axis extends inland to the north. It averages 28 m in depth with a maximum at the mouth near 50 m. A series of four islands are arranged roughly along the centerline of the bay. The largest is Grande Island, near the mouth, which serves to isolate the bay from the adjoining South China Sea. The west shore of the bay is relatively straight and the eastern shore is irregular with four embayments.

4.2 Climate

The climate is dominated by three major weather systems: 1) the Northeast Monsoon (October-March), 2) the North Pacific Trades (April and May), and 3) the Southwest Monsoon (June – September). The climate of Subic belongs to Type I of the modified Coronas classification of Philippine climates. It is characterized by the existence of two distinct seasons, dry from November to April and wet from June to September. The wet season coincides with the prevalence of the southwest monsoon. The bulk of the mean annual rainfall (83.4%) in SBFZ occurs during the months of June to September during the prevalence of the southwest monsoon. The sky over the Freeport zone is generally cloudy. On the average, more than half of the sky is cloud covered from June to October. The remaining 8 months of the year account for 16.6% of the annual rainfall. The maximum rain coincides with the Southwest Monsoon. Typically, 3 to 4 tropical cyclones (storms or typhoons) impact the area each year between May and November. These bring the most intense rains. The average annual minimum, maximum and normal temperatures are approximately 24^{o}C, 32^{o}C, and 28^{o}C, respectively.

Surface winds in the area are predominantly from the NNE during the year with a frequency of almost 22%. The next frequent wind direction is NE at19%, SW at about 9%, followed by ENE at almost 10%. The annual average wind speeds are generally light.

4.3 On-shore Geology

This part of Luzon has both volcanic and tectonic activity. There have been numerous examples where this activity has caused major economic setbacks to the development of the region (e.g. 1990 Luzon Earthquake and the post-1991 Mt. Pinatubo lahar crisis). The geological framework and processes actively interact with the environmental processes and ecology of the system. The Mt Pinatubo eruption, 35 km to the north, blanketed the area with more than 15 cm of ash (tephra deposits). This ash has a sandy character that makes it easy to identify where it is draped over the soil or deposited in the bay. The bay deposits represent the combination of direct air-fall and subsequent wash-off from the land.

The major lahar from the 1991 Mt. Pinatubo eruption did not flow into the Subic Bay watershed. Another volcano located south of the SWFR is Mt. Natib, last documented

eruption of which was about 27,000 years ago. However, the sparse geochronological and stratigraphic data suggest that it could erupt again and when is entirely unpredictable.

Seismic activity in the area is moderate. Earthquake sources include the subsea Manila Trench and four faults in the area (Zambales, Iba, Subic Bay, and San Antonio) and the more distant Philippine, Casigun, Marikina and Lubang faults contribute to the overall seismic hazards of the watershed. In this area earthquakes of magnitudes of 5.2 to 5.8 have a recurrence interval of 3 years that increases to 60 years at magnitudes 7.0 to 7.3. Earthquake activity, combined with steep slopes, high rainfall and relatively rapid soil formation make soil failures and landslides active hazards. Some of the alluvial and coastal deposits are subject to liquefaction. The area is also prone to floods and tsunamis.

Finally, there are many beaches along the shoreline of the bay. In some places these help shelter important ecosystems such as mangroves. Elsewhere they provide a fundamental barrier against direct incursion of coastal erosion on upland systems. These beaches are active and change with episodes of storms and high river discharges. Beaches are also places frequently impacted by resorts and commercial developments. They are, perhaps, the only geological systems that are candidates for planned protection, both for their beneficial environmental role and their inherent value.

All of these factors combine to make the Subic Bay area a place where geological processes are active and often readily observed. The planning of environmental protections and restricted areas needs to incorporate how the impacts of geohazards can be reduced. For example, it is far better to allow flood plains and mangrove areas to provide overflow storage for floodwaters than it is to dike the riverbank, or interfere with natural flow regimes by constructing flood mitigation works in river channels. It is also necessary to recognize that, in many cases, the living resources of the ecosystems are unavoidably subject to major episodic stresses from geohazards. The eruption of Mt. Pinatubo is an excellent example. The forest systems need to be given the opportunity to continue to adjust to these changing geological conditions. In turn, these forest systems serve to stabilize steep slopes and control the soil erosion. Results of the on-shore geologic studies are presented in Volume XI Onshore Geology Report (Sonido and Umbal 2001) of the Resource Inventory Reports for the SBPAMP project.

4.4 Soils

The Freeport Zone contains seven (7) types of soil according to the Bureau of Soils and Water Management (BWSM). These include: Angeles fine sand, Antipolo clay, Antipolo soils undifferentiated, Hydrosol, Mountain soils undifferentiated, Pilar silt loam and Quingua silt loam.

Angeles fine sand is suitable for cultivation. Its dominant features are level to nearly level, somewhat excessively drained, coarse textured, moderately deep soil, slightly dry and has low fertility. It is suited for upland field crops.

Antipolo clay, Mountain soils undifferentiated and Antipolo soils undifferentiated are limited to pasture or forest areas, which if cultivated, could cause severe erosion. These soil types are characterized by steep, well-drained and shallow soils. Recommended land use for these types include pasture lands (grazing) or tree farm or forest.

Quingua silt loam soil type, on the other hand, is suitable for cultivation and is defined to be level to nearly level, well-drained, medium textured and deep to very deep soils. This type is recommended for diversified upland crops. Hydrosol type is limited to wildlife and is suitable for fishpond, salt bed site or recreation uses. It is poorly drained, marshy or swampy.

Pilar silt loam is suitable for cultivation. It is characterized as well drained; medium textured, and deep to very deep soils. It occurs in areas level to nearly level. The BSWM recommends upland crops for such type.

Table 2 provides the matrix indicating land capability, dominant features, limitations & hazards and recommended land use for each soil type.

Table 2. Soil Type-Land Capability Matrix

Subic Bay Freeport Zone (Proclamation 532)

Soil Type	Land Capability	Dominant Features	Limitations and Hazards	Recommended Land Use
Angeles fine sand	Good land (lands suitable for cultivation)	Level to nearly level; somewhat excessively drained; coarse textured moderately deep soils	Slight droughtness; low fertility	Upland field crops especially sugar cane with sufficient irrigation water
Antipolo clay; Antipolo soils undifferentiated; Mountain soils undifferentiated	Lands limited to pasture or forest	Steep; well drained, shallow soils	Very severe erosion if cultivated	Pasture land (grazing) or tree farm or forest
Hydrosol	Lands limited to wildlife	Very poorly drained; marshy or swampy	Very severe wetness	Fishpond, salt bed site or recreation
Pilar silt loam	Very good land (lands suitable for cultivation)	Level to nearly level well drained; medium texture, deep to very deep soils	None to very slight	Diversified upland field crops
Quingua silt loam	Very good land (lands suitable for cultivation)	Level to nearly level; well drained medium texture, deep to very deep soils	None to very slight	Diversified upland field crops

Source: BSWM

Figure 8 Soil Map of SBFZ

4.5 Hydrology

The characteristics of the individual basin and the regional hydrology control the seasonal and episodic discharges of the rivers within the project area. Flood levels and discharges along key locations along Sta. Rita, Binictican, Cawag, and Wild Horse Rivers have the 25-, and 50-yr rainfall events in the hydrologic assessment report, Volume VIII of the Resource Inventory Reports (Rabajante 2001).

The results of the hydrology study emphasize the seasonal and episodic nature of the discharge of freshwater to the bay. The watersheds are relatively small and the soils are generally permeable. This means that discharges are very small during the dry season. Loads derived at nearly constant rates, such as the discharge of the municipal wasteloads, have little dilution as they make their way down to the bay. On the other hand, there are episodic torrential rains during the wet season. These rapidly flush loads into the bay. These flows are erosive and introduce high turbidity into the bay. This is a particularly important consideration where catchments are degraded by excess removal of vegetation, intensive land use, etc.

4.6 Airshed Characteristics

The Philippine Clean Air Act of 1999 (R.A.8749) defines an airshed as "areas with similar climate, meteorology and topography which affect the interchange and diffusion of pollutants in the atmosphere, or areas which share common interests or face similar development programs, prospects or problems". The airshed of Subic Bay approximately conforms to the watershed because steep ridges of about 1000m elevation outline the basin.

The only significant stationary source of air pollutants is the Subic Power Corporation that operates a diesel generating plant with a net capacity of 116 MW. Other stationary sources contribute less than 1% of the particulate and NO_2 loads and less than 2% of the SO_2 loads.

The 1998 motor vehicle statistics for Olongapo show that there are 2,397 cars, 5,249 utility vehicles (jeepneys and pickups), 953 trucks and trailers, 801 buses and 1,867 tricycles and motorcycles. Overall these mobile sources of air pollution account for about 61% of the total particulate emissions. The power plant, which is the main stationary source, contributes more than 92 % of the total SO_2 and 80% of the total NO_2 emissions in the airshed.

The predicted maximum long-term concentration of particulates, whose main source is Olongapo traffic, is much less than the ambient long-term guideline of 90 μg/Ncm. Similarly, the predicted long term maximum concentration of SO_2 is well below the DENR guideline value of 80 μg/Ncm. There is no long-term DENR guideline for NO_2 but the predicted long-term maximum is well below the USEPA annual primary standard of 100 μg/Ncm.

A carrying capacity analysis indicated that the airshed is still very much within its estimated allowable carrying capacity. It would take at least 10 years with an air emissions growth rate of 11% per year for the air carrying capacity for SO_2 and NO_2 to be exceeded. The airshed can tolerate a much larger annual growth rate for particulate matter loading. These results show that air pollution loads in the airshed are modest and that, at the present levels, air pollution is not a significant factor in planning for protected areas of Subic Bay. Results of air circulation studies are presented in Volume XII of the Resource Inventory Reports (Delas Alas 2001).

4.7 Marine Geology

The large local relief, steep river profiles and high rainfall mean that large masses of sediment is brought to the bay by rivers and redistributed by marine processes each year. Thus, there is a clear link between actions taken to protect or extend vegetated areas and the supply of sediment. Less obvious relationships are also important. The eruption of Mt. Pinatubo in 1991 had a dramatic impact on the bay and its watershed. Something on the order of 15 cm of ash covered both the bay and the watershed. Coral reefs and sea grass beds were directly impacted by this airfall. The availability of the ash deposits across the watershed increased the sediment loads in the rivers. Thus the whole marine sediment supply regime was perturbed by this recent event.

The sources of the marine sediments include: a) rivers, b) volcanic ash airfall, and biogenetic material produced in the bay (e.g., plankton remains, reefs, and corals). The Sta. Rita River (formerly the Kalaklan River) is the longest and it also has the largest watershed (see Figure 5). It drains the southern slopes of Mt. Balakibok, flows through the city of Olongapo, and enters the bay at Kalaklan Pt., just west of the former U.S. Navy base. The short and steep Agusuhin, Quinabucsan, and Cayuao rivers drain the high relief of the Redondo Peninsula. There is also a relatively large amount of direct drainage to the bay along this steep western margin. The Marelalec and Nibangon rivers enter the northern end of the bay near the town of Subic. About 2 km further to the southeast the Matain River flows into the bay behind small sand spit. The Malawaan-Binictican, Boton, Triboa, Ilanin, Binanga and Laplap rivers all drain into the eastern shores of the bay from the Bataan Peninsula highlands. The total annual sediment load delivered to the bay by these rivers is not known at this time. Large muddy plumes are often seen in the entire northern portion of the bay following even moderate rains.

The principal airfall of volcanic ash occurred in the June 1991 eruption of Mt. Pinatubo that is 33 km to the north. There was considerable ash that has a sandy texture and a tan to gray color. The deposition and reworking of this material has given the beaches and nearshore areas a lighter color than they would have without the ash. This pyroclastic material, now residing on the hill slopes, is still being reworked by rainfall and streams. Consequently, the rivers still have an elevated sediment yield, although this effect is diminishing over time. Mt. Pinatubo is not within the Subic Bay watershed so no lahar flows entered the bay.

Figure 9 shows the present distribution of alluvial sediment within Subic Bay. Mud, silt, and muddy sands are common in the whole portion of the bay north of Cubi Point. An especially interesting area is the portion of the bay floor that is now receiving a large amount of muddy sediment from the erosion of unprotected slopes of Saddle Mountain where subdivision construction and road widening is now underway. The bottom sediments are also muddy in the eastern portions of Olongapo and Triboa Bays and Port Binanga. Of special interest is the patch of sediment with more than 40% mud located north and east of Grande Island. Episodic resuspension of this mud serves to limit the nearby live coral areas that have been impacted by the combined impacts of the Mt. Pinatubo airfall event and harmful fishing practices.

Coarse sediments including gravel and larger blocks occur around Grande and Chiquita Islands. These also occur near Camayan Point and along the western shore of the bay. The area off Mt. Redondo where the 2% gravel contour bulges away from the shoreline probably represents the effect of deforestation of the steep hillside. This would increase the speed and erosiveness of runoff flows during intense rainfalls. This applies similarly to the whole western shoreline of the bay.

The relatively oligotrophic (nutrient poor) status of the bay waters combined with the big volume of sediments from the land mean that plankton remains are an insignificant portion of the bay sediments in most places. The location of coral reefs (see Figure 6) is clearly influenced by the relative turbidity of the waters. The reefs are distributed in the southern portion of the bay with most being near the mouth. Just east of Grande Island a shallow layer 2 to 4 cm thick of carbonated grains was located during the sediment sampling. Although this mostly consisted of shell and coral fragments the planktonic foramanifera remains were a noticeable constituent.

Once muddy sediment is deposited on the floor of the bay it is very unlikely to be re-entrained by wind waves. The size of the bay limits the size of the waves that even under strong wind conditions can produce. The comparatively large depths of most of the bay put the cohesive bottom sediment below the depth where sufficient wave action stir the sediment off the bottom. The reefs around Grande Island and the nearby shores of the bay are well protected from high turbidity except during violent storms.

The beach sediments have been profoundly affected by the Mt. Pinatubo eruption. Prior to this sandy ashfall the beaches were derived from local sediment which is darker in color. The sudden introduction of ash provided much more sand than is normally available in this natural system. Progradation (beach expansion) of a few meters is observed along most of the coastal segments of Subic Bay and other nearby embayments.

Figure 9. Distribution of Alluvial Sediments within Subic Bay

Beach erosion is a more immediate and observable shoreline geohazard, especially in the beach pockets along the western coast of Subic Bay. This is evident from the beach face escarpments observed along the western shoreline. Such is part of the natural shore re-stabilization process following rapid progradation.

Seismicity data for southwestern Luzon shows that there have been numerous earthquakes in the vicinity of Subic Bay. Many are generated from the Manila Deep-Sea Trench offshore to the west, from subsea faults in the Verde Passage Zone to the South, or from the many branches of the Zambales fault zone to the north and east. There are at least three sets of faults within Subic Bay itself. The faults within the bay cut sediments that were probably deposited as recently as 5000 years ago, and there is some evidence for fault displacements of recent sediments.

All of this seismic exposure points to a potential for tsunami inundation of the coasts. There are no historic records of such occurrences. The shoreline should be included as a risk area but a more refined study is needed before this risk can be quantified.

Clearly the project area is active geologically and this activity needs to be considered in the protection of areas for environmental reasons. The most dramatic example can be seen from the large changes in the bottom sediments over the past decade. The sudden deposition of up to 15 cm of Mt. Pinatubo ash in 1991 changed all areas of the bay. The reefs and sea grasses would have been engulfed. The benthic communities that depend on muddy sediments must have been stressed or eliminated. Since then, the bay bottom has been reverting to its normal condition. This means that the substrate that supports the benthic communities and grass beds is now becoming available to these communities. The living marine resources have been re-establishing themselves and this should be taken into account in deciding which areas to protect. With proper protection, they may flourish.

Although only a preliminary screening analysis has been conducted it appears that the coral reef locations around Grande and Chiquita Islands are clear of turbidity from most sediment plumes and entrained bottom sediments. This suggests that they are not marginal locations and that these reefs too can be expected to recover given appropriate protection. The reefs located around the margins of the bay are more vulnerable to water column turbidity. This means that protecting the forests surrounding the bay, and reforesting areas of steep relief near the shore can promote the recovery of these reefs.

Consideration should also be given to beach protection. It appears that the beaches of Subic Bay are now in an anomalous built-out condition. If planning and construction proceeds on the basis that these beaches are normal there will be never-ending consequences as they erode back to their previous state. Results of marine geologic studies are provided in Volume X of the Resource Inventory Reports (Siringan 2001).

4.8 Physical Oceanography

The distribution of water masses (hydrography) and current patterns (circulation) in Subic Bay are not well known. These are important in dispersing and mixing pollutant and nutrient loads. Given the size and depth of Subic Bay compared to its watershed size and the rainfall distribution, preliminary studies show that the hydrography of the bay has seasonal characteristics. The very low freshwater input during the dry season means that most of the time the bay water can be expected to be closed to ocean water salinity over its whole depth (unstratified). The exceptions occur during brief periods of heavy local rain showers when streams suddenly discharge vigorously into the bay heads. This freshwater tends to override the denser salt water to form a lens of lower salinity that dissipates as the water masses mix. The mixing processes are inhibited by the density interface between these two water layers so plumes of muddy river discharge can be seen extending several kilometers into the bay from the river mouths. During the dry season these plumes eventually disperse and disappear within a day. Results of the physical oceanographic surveys are provided in Volume IX of the Resource Inventory Report (Rivera 2001).

The greatly increased river discharges to the bay during the wet season probably increases the extent and duration of stratified conditions in the bay. Stratification can alter the overall circulation patterns in the bay.

The primary forcing of the circulation results from the action of winds, tides and density differences. The water mass density differences that result from the stratification patterns are not well known. Tide level measurements or predictions are also not available for the bay.

The tide measurements showed a dominant diurnal (one high- and one low tide per day) pattern during the spring tides (fortnightly greatest range). Only during the days approaching neap tides (least difference in elevation between high and low tide) did a semi-diurnal pattern (twice daily) appear, The maximum tide range during the measurement interval was 1.3 m. Given the size and depth of Subic Bay this data suggests that it is subject to only modest tidal currents and relatively restricted tidal mixing.

The measurement of water density vertical profiles showed only slight differences in the characteristics of the surface and bottom water. Temperature profiles near the mouth of the bay showed a difference of about 2 ^{o}C with a maximum gradient near a depth of 35 m. This temperature stratification occurred in all places where the depths were greater than approximately 35 m indicating a continuous layer of bottom water beneath a relatively well mixed surface layer of 20 – 25 m thick. It is likely that this pattern reflects a continuation of similar temperature stratification in the adjoining South China Sea. This vertical stratification is weakly reflected in the salinity profiles which increase 1 to 1.5 ppt from the surface to the bottom where the water is deeper than 35 m. Several of the salinity profiles show sharp vertical gradients in the upper 2 to 4 meters with significantly lower (1 – 1.5 ppt) values above. This shows that the small rains during the

dry season have an observable effect over much of the bay. However, when the density profiles, computed from these temperature and salinity profiles, are compared to other coastal areas it is found that this stratification is relatively minor.

The strength of the tidal currents vary with the phase of the tide and the relative time between neap and spring tide ranges. The flows are strongest when the tide range is greatest. Figures 10 and 11 are model results for maximum flood and ebb tides. The currents are strongest near the mouth of the bay and along its western shore.

Tide currents are a constantly changing component of the total circulation of the bay. During the dry season the other significant component is force by the wind. During this season the wind is variable but tends to settle into an airflow of 3 – 5 m/s during the afternoon. Thus the wind-driven currents are also variable. The numerical model was used to represent three common northeast winds. The results are shown on Figures 12, 13 and 14. These represent surface currents and the overall patterns are similar for the different wind speeds. The most general feature is that the currents are strongest and aligned with the airflow direction in many shallow areas along the shore. This is a well known pattern called down-wind streaming. Eddy-like current patterns are seen at the bay head and in the tributary bays along the eastern shore. This suggests that dispersion of pollutants that are introduced to these locations is somewhat inhibited due to this tendency toward wind-driven recirculation.

Figure 10. Predicted and Observed Surface Currents in Subic Bay during the Northern Monsoon Season

Figure 11. Modeled Surface Currents for a m/s N/E Wind

Figure 12. Predicted Surface Currents in Subic Bay during the Wet Season

Figure 13. Predicted Storm Surge during Typhoon Passage with Surface Winds of 150 kph

Figure 14. Predicted Storm Surge during Typhoon Passage with Surface Winds of 200 kph

Water circulation in Subic Bay during the dry season is hard to portray because it is constantly changing. For example, the actual flows are a combination of wind-forced and tidal components. Both are constantly changing and so are the circulation patterns. Overall, there is a tendency for the current near the mouth of the bay and around Grande Island to be strongest during the dry season.

The study of dry season oceanographic processes shows that the waters of the bay have near oceanic salinities except when its upper reaches and eastern bays receive river discharge pulses from occasional brief rain showers. The tidal circulation is least in the shallow upper region of the main bay and its eastern tributaries. The same is true of wind-driven currents. This means that the dispersion of pollutant and nutrient loads is somewhat limited to these locations.

The best circulation is near the mouth of the bay, along its western shore and around Chiquita Island. Such conditions favor the recovery and development of the coral reefs, which should be attainable given adequate protection. On the other hand, the coral reefs are sensitive to nutrient and pollution loads and without further quantification of present and future loading expectations and the dispersal processes it is not possible to tell whether the exposure limits for coral impacts is being reached.

4.9 Water Quality

The land restrictions in the Subic Bay Freeport Zone (and those of the former U.S. Navy base) have kept the Subic Bay surroundings relatively undeveloped. There is no heavy industry. There is an active international port, light industry and a major airport. The northwestern portion of the bay has small urban areas (e.g. the town of Subic) and many resorts which are popular with Filipinos. The northeastern portion has the port, and airport adjacent to Olongapo City. The western and southern portions of Subic Bay and all of the bays along the West Coast of the Redondo Peninsula are remote from most settlements and more exposed to the ocean.

Samples from the lower river stations show that the salinities are relatively high, indicating that these lower river reaches are estuarine during the dry season. In considering the dissolved oxygen concentrations (DO) it is well to bear in mind that a value of 4 mg/l is normally taken as the cut-off value for healthy fish populations. In the United States the salt water dissolved oxygen criteria are set by the individual states, but commonly require no reading below 4 mg/l and no 24-hr average below 5 mg/l. In comparison, the values in the river stations are low, especially in the Kalaklan, which takes the load from Olongapo. The Marelalec has a high total suspended solids (TSS) value. The Water Quality Assessment Report, Volume VIII of the Resource Inventory Report provides additional detail on water quality for the SBFZ (Pagdanganan 2001).

The physical characteristic data shows generally normal and healthy values for the rest of the stations. The TSS values are somewhat elevated in Olongapo Bay as the load from Kalaklan River is only partially diluted. Somewhat depressed DO values in the bottom waters of Port Silanguin and lower Subic Bay suggest that vertical exchange of oxygen

from the water surface is limited by the depth, vertical density gradients, and relatively weak currents.

Relatively high values for the nutrients (N and P) and fecal coliform bacteria were measured in the river stations. The rapid changes in these values in adjacent stations within the bay reflect nutrient uptake into the phytoplankton and die-off of the bacteria in the salt water. The nitrogen values are elevated at stations near the source rivers and in mid-bay. Phosphorus values also show that the nutrient loads dilute slowly after they are first introduced into the bay. None of the metal concentration values are above their detection limits. A picture of Subic Bay as a system that is neither clean nor highly polluted emerges from this dry season data. Its nutrient loads are a factor as they are relatively high in the restricted Olongapo Bay and bayhead areas. It is not known whether the present loads are approaching, or have exceeded, the carrying capacity of Olongapo Bay.

It is evident from the marine biological studies that Olongapo Bay and the bayhead portions of Subic Bay do not support coral reefs and other organisms that require ocean waters with high water quality characteristics. The concentrations of nutrients in the middle and lower bay are reduced but it is not clear that they are low enough to prevent algae from developing on the reefs.

4.10 Summary and Conclusions

Studies of the physical environment at Subic Bay produced a number of relevant findings regarding the establishment and management of protected areas. Major conclusions of these investigations are listed below:

- Geohazards exist in the region that could adversely affect the ecological resources of the proposed protected areas.
- Beach erosion on the east side of Subic Bay is a significant geohazard. Beaches are important geologic features to be protected.
- The airshed is similar in configuration to the watershed of Subic Bay. Airshed loads are currently modest and air pollution is not currently a significant factor in environmental planning.
- Clear links exist between the amount of vegetation cover and the amount of sedimentation in the river, mangrove, and bay environment. Materials released during the eruption of Mount Pinatubo had a dramatic impact on sedimentation in the bay.
- Reefs in the vicinity of Grande Island are well protected from wave-generated turbidity.
- Tsunamis have been reported in the region but none have affected Subic Bay.
- Strong tides occur seasonally in Subic Bay. Maximum tides in March 2000 reached 1.3m.
- Currents in shallow areas of the bay are influenced by surface winds.
- Kalaklan, Matagan, and Marelalec Rivers are major sources of nutrient and pollutant loads to Subic Bay. At present, water quality in the bay is neither clean nor highly polluted.

5.0 TERRESTRIAL ECOSYSTEMS

Terrestrial ecosystems in the SBFZ, particularly the forested area of the SWFR, show high degrees of biological diversity. Many of the species found in these ecosystems are endemic to the Philippines, and a few occur only on Luzon. Many of the plant and animal species found in the forest are considered threatened with extinction. Moreover, the forest area, which comprises most of the SWFR, is particularly noteworthy in that it is a unique remnant stand of lowland dipterocarp forest in the Philippines.

While the intact forest is less than 10,000 hectares in area, the forest still harbors a full complement of functional groups of plants and animals that are necessary for sustaining a healthy ecosystem. These functional groups and representative species are shown in Figure 15. The area of forest within the SWFR is too small to sustain populations of some species that require large areas (e.g., hawks and eagles). Therefore, it is important that this patch of forest is contiguous with the Bataan Natural Park, thus providing an area large enough to support populations of these species.

During 2000 a series of natural resource inventories was conducted within the Subic Bay Freeport Zone to determine the location and quality of resources in need of protection. The results of these inventories and other studies are summarized in this section. Additional detail on the results of these inventories is reported in Volume II Flora Resource Inventory Report (Dalmacio 2001), Volume III Fauna Resource Inventory Report (Caleda 2001), and Volume IV Financial and Economic Analyses of Forest Resources Development and Utilization Report (Carandang 2001) of the Resource Inventory Reports prepared as part of the SBPAMP project. These reports were the main sources of information on forest resources summarized in this section.

5.1 Flora

The SBFZ is rich in plant species. The flora resource inventory report (Dalmacio 2001) recorded 283 plant species in 80 plant families within the SWFR. In a more intensive study, Fernando et al. (1998) recorded a total of 745 plant species belonging to 122 families from an area of approximately 17.5 hectares within the NavMag portion of the SWFR. The distribution of forest and other terrestrial habitats are presented in Figure 16.

In the natural forest in SWFR, White lauan (*Shorea contorta*) is the most dominant tree species. Other important species include Bolong-eta (*Diospyros pilosanthera*), Anyatan (*Cliestanthus blancoi*), Pandakaki (*Ervatamia pandacaqui*), Alupag (*Litchi chinensis* subspecies *philippinensis*), Apitong (*Dipterocarpus grandiflorus*), Tamayuan (*Strombosia philippinensis*), Fire tree (*Delonix regia*), Tibig (*Ficus nota*), Mali-mali (*Leae guineensis*), Kupang (*Parkia roxburgii*), and Tangisang Bayawak (*Ficus variegata*). Among non-tree species, Bikal (*Dinochloa acutiflora*), Buho (*Schizostachyum lumampao*), Pamulaklakin (*Symphorema luzonica*), and Ooko (*Mikamia cordata*) predominate.

Figure 15. Functional Groups of the Ecosystem

Figure 16. Forest and Terrestrial Habitats

In the SWFR stocking density for trees ≥15 cm in diameter ranged from 75 to 375 trees per hectare. In terms of basal area, stocking density ranged from 2.25 m^2 per hectare to more than 68 m^2 per hectare. Forty-two percent of the sample plots contained mature trees with diameters of more than 75 centimeters. On the other hand, a number of stands were under-stocked, composed mostly of less than 100 stems of young growth.

The dominant tree species in brushlands in the SWFR are Banaba (*Lagerstroemia speciosa*), Pandakaki, and Ipil-ipil (*Leucaena leucocephala*). They are growing in association with *Chromolaena odorata*, *Centrocema pubescens*, Ooko, Nito (*Lygodium circinatum*) and Buho. In grasslands, the grass Cogon (*Imperata cylindrica*) is most dominant. Also common are Chromolaena and Talahib (*Saccharum spontaneum*). Binayuyu (*Antidesma ghaesambilla*) is the common tree species.

5.2 Fauna

The fauna in the SBFZ is relatively diverse for an island ecosystem and there is a high degree of endemism. Species diversity is high, except for arthropods (Fernando et al. 1998). Of 118 wildlife species recorded during surveys in the lower portion of the SWFR, 69 are endemic to the Philippines. These consisted of 55 bird, 11 mammal, 1 reptile, and 2 amphibian species. These results are consistent with the recognized importance of the Philippines in global biodiversity and of the forest at Subic Bay as a repository of Philippine biodiversity.

The most abundant mammal species in the SBFZ are Lesser Bamboo Bat (*Tylonycteris pachypus*), Common Short-nosed Fruit Bat (*Cynopterus brachyotis*), and Musky Fruit Bat (*Ptenochirus jagori*). Among birds the following are the most abundant: Philippine Bulbul (*Hypsipetes philippinus*), Pygmy Swiftlet (*Collocalia troglodytes*), Glossy Swiftlet (*Collocalia esculenta*), Brown-backed Needle Tail Swift (*Hirundapus gigantea*), Amethyst Fruit Dove (*Phapitreron amethystina*), White-eared Fruit Dove (*Phapitreron leucotis*), and Lesser Coucal (*Centropus bengalensis*). Among reptiles and amphibians the following are the most abundant: Philippine Gecko (*Gekko gecko*), Variable Malay Monitor Lizard (*Varanus salvator*), Puddle Frog (*Occidozyga laevis*), Common Forest Frog (*Platymantis dorsalis*), Variable-backed Frog (*Rana signata*), and Everett's Frog (*Rana everetti luzonensis*) .

The SWFR harbors the highest number of animal species (mammals, birds, reptiles and amphibians combined) as compared to other areas of natural habitat within the SBFZ, Mt. Silanguin and Mt. Balakibok. The overall higher species richness in SWFR may be related to there being a greater variety of habitats, including more complex three-dimensional forest structures, and less disturbance than in the other two study areas. An important result of the fauna survey was the documentation of many endemic animal species in the SBFZ. Additional rare and endemic species will most likely be recorded in these study areas in the future.

Another important discovery was the presence in the SBFZ of many species that are endangered or threatened with extinction. All four endemic species of mammal recorded in the SBFZ are classified as threatened and endangered in the PAWB-DENR list. Among the 36 endemic species of birds, 19 are listed as endangered and vulnerable, or near threatened to critically endangered. Two species of near threatened status reptiles were recorded. Five endemic amphibian species belong to the endangered and vulnerable category, and two amphibian species are in the near threatened category.

5.3 Economically Important Species

Among economically important species in the SWFR, the most prominent are: Bikal (*Dinichloa acutiflora*), a climbing bamboo; White Lauan (*Shorea contorta*), a timber species; Buho, a bamboo with many uses; Pamulaklakin or Molawin baging, a woody vine with decorative and some medicinal uses; and Bolong-eta, an endemic species used for construction and other woodworks. Rattan is a common non-timber species used in furniture manufacture and for tying.

Based on the socio-economic survey, a variety of forest products are being extracted from SBFZ forests by local communities. These include bamboo (Buho, Kawayan tinik, Bayog, and Bikal) of which Buho is the most economically important. It is used for housing by the locals and sells for 4 to 5 pesos apiece. Kawayan tinik stands are also inside the fringes of the forests. This bamboo is perhaps the most important bamboo species in terms of economic use. However, it is uncommon in the area. There are also few stands of Bayog. Bikal (a climbing bamboo) abounds. Although supply is practically unlimited, there are only few known uses for this species. The local community depends much on rattan but less on other vines. Nito vine is probably one of the few being commercialized by the local people.

Wood is the most abundant resource in the area. These are used for house construction and furniture. The survey showed that gathering of timber products is mostly for home use, but there is illegal cutting in some areas. Most local community members use fuel wood and charcoal for cooking. A few of them also sell fuel wood and charcoal in nearby town markets. Orchids and other rare plants are also gathered by the communities for home gardens and decorations. There are also recorded sales of these products. Buho and other non-timber species may be considered for limited sustainable harvesting and utilization by the local people.

The native Aetas depend on several forest trees bearing edible fruits, tubers, wild bananas and young plant shoots for food. A variety of animals in the forest are eaten by the Aeta and members of other nearby communities. These include giant fruit bats, monitor lizards, and wild pigs. Sale of these items was not observed.

Assuming conservative estimates of yield, indicators show that there is promise in establishing tree plantations in the SBFZ. Plantation establishment cost is high, estimated as much as P38,500 pesos or more per hectare especially in the first three years. However, at an average harvest rotation of 10 years, gmelina posts a 24.6 percent

internal rate of return (IRR) with a benefit cost ratio (BCR) of 6.7. The net present value (NPV) of gmelina investment at 12% interest rate is P41,950. Gmelina, bagras, and mangium showed generally declining indicators as rotation is lengthened. Mahogany (*Swietenia macrophylla*), however, showed increasing BCR as the rotation length is increased.

5.4 Summary and Conclusions

Flora and fauna inventories in the SWFR, at Mount Silanguin and in the vicinity of Mount Balakibok indicated that substantial patches of natural ecosystems remain in these areas. An economic evaluation of these resources documented the dependence of local communities on resources provided by these ecosystems. Major conclusions from the studies are provided below:

- Areas of forest habitat within the SWFR support the full complement of plant and animal functional groups necessary for sustaining a healthy forest ecosystem.
- The SBFZ is rich in plant species; the inventory recorded 738 plant species belonging to 126 plant families in the area. Of the plant species known, about 34% are endemic to the Philippines, and 6.5% occur only on Luzon.
- White lauan is the dominant tree species in most forest areas. Alupag and Apitong are the dominant tree species in the forests on Mount Silanguin and Mount Balakibok, respectively.
- The most abundant mammals in the SBFZ are the bamboo bat, Common short-nosed fruit bat, and musky fruit bat. The SWFR contains a roost of the largest bats in the world, attaining a wingspan of 1.5m. Other mammals include the Philippine macaque, pigs, and cloud rat.
- Swifts, swiftlets, doves, and coucal are abundant bird species in the zone. Parrots, hornbills, kingfishers, and bee eaters are also common. Raptors include the white-breasted sea eagle, serpent eagle, and Philippine falconet.
- Monitor lizards, skinks, geckos, and flying lizards (*Draco volans*) are common reptiles. Snakes in forested areas include pythons, cobras, and pit vipers.
- Amphibian fauna consisted of several frog species.
- Of the three areas surveyed, the SWFR harbored the greatest diversity of species, probably because it is the largest and least disturbed.
- Inventories documented the presence of many endemic animal species.
- Faunal surveys documented the presence of many species classified as endangered or threatened with extinction. All four endemic mammal species and 19 of the 36 endemic bird species are considered threatened, endangered, or otherwise in need of protection. Several species of reptiles and amphibians were also classified as threatened, endangered, or vulnerable to extinction.
- Several economically important plants occur in forested areas. These include climbing bamboo, buho, rattan palms, and timber species. Most households in the region rely on fuel wood and charcoal. Buho is an important non-timber species used for construction.
- The Aeta depend on many plant species for food. These include fruits, tubers, and shoots. They also consume a variety of mammal, reptile, and bird species.

- There is promise in establishing tree plantations in buffer zone and non-protected areas of the SBFZ. Tree species suitable for plantations include gmelina, bagras, mangium, and mahogany.

6.0 MARINE ECOSYSTEMS

The living marine resources of Subic Bay represent a rich diversity of habitats and species exposed to various types of disturbances and under various levels of protection. Major marine habitats include coral reefs, mangrove forests, seagrass beds, seaweed beds that support fish populations, plankton, and bottom dwelling organisms. In general, the diverse habitats and species show that it is a viable ecosystem comprised of all essential components. Building on previous studies, inventory surveys during 2000 evaluated their present conditions and the prospects for affording meaningful protection.

Detailed results of these investigations are provided in Volume V Marine Biology Report (Vergara 2001), Volume VI Fisheries Assessment Report (Ingles 2001), and Volume VII Plankton, Dinoflagellates, Benthos Study Report (Estudillo 2001) of the Resource Inventory Reports. These reports provided the summary of marine resource information in this section.

6.1 Coral Reefs

The locations and relative condition of the coral reefs in the project area are summarized on Figure 7. The only reefs developed to the point that they are characterized by classical spur and groove formations in the tidally-exposed sections is the Grande Island reef adjacent to Camayan Point. The reefs along the western shore of Subic Bay have poorly developed structure and show the effects of excessive mechanical damage. Observations made in March 2000 when compared with earlier studies indicate an ongoing decline in the condition of many of the reefs. The reef fringing the western shore of Grande Island, formerly reported to be in good to excellent condition, is now mostly bare rock with the few corals coated with encrusting algae.

The noted downward trend in the condition of the reef postdates the eruption of Mount Pinatubo in 1991. The eruption stressed the reefs with air fall of sediment. However, the effects of this burial appear to have been overcome before the 1994 surveys. The damage now is mechanical or from blanketing by algae. The high biomass represents the brown algae Padina. It is not known whether this outbreak is seasonal. If it is not, then it is a clear indication that the reefs are endangered by some combination of a nutrient overload and reduction of the fish that normally graze on algae on the reefs. Given the overall decline in the condition of the reef it is likely that these processes are at work.

Principal threats to reefs within the SBFZ include siltation, increased nutrient loads, overfishing, and destructive harvesting practices (e.g., dynamite fishing). At this time the degree to which the carrying capacity of the system is being affected is not known. There are ample reports in the literature of significant improvements in the growth and development of coral reefs within a few years of the establishment of adequate protection.

6.2 Mangroves

The coastal mangrove systems are important to the stability of coastal ecosystems. These stabilize the shore against erosion and provide an area into which floodwater can expand. These serve as a breeding ground and key habitat for marine fishes, crustaceans and fauna. These provide refuge to a variety of reptiles, amphibians and small mammals. These systems also trap some of the sediment that would otherwise be delivered to the bay. Mangrove systems at Binictican, Boton, Triboa, and Kamayan were surveyed in the spring of 2000. In general these systems were found to have a viable assemblage of species and most are in sustainable condition. However, they are threatened by the development of adjacent lands. They are vulnerable to clearing, filling and diking. Approximately 74% of the former Binictican area and 43% of the former Boton area have been converted to industrial and commercial sites in the recent past.

6.3 Seagrasses and Seaweeds

Seaweeds and seagrasses comprise the attached plants of the marine ecosystems of Subic Bay. These provide important food sources for many invertebrate and fish species and additionally provide structural habitat for the young (fry, juveniles) of many fish species consumed by communities in and around the bay.

Seagrasses

Seagrasses have been found to provide support to the coastal environment in terms of reducing wave energy, filtering suspended sediments, and providing a habitat for fish and benthic organisms. These are nursery areas for the fry of some economically important fish. There is a good diversity and relatively widespread coverage of seagrasses in Subic Bay. Figure 7 shows their locations. Nine species occur within the bay and these represent more than half of the total species known to occur in the Philippines. The seagrasses appear to be colonizing and expanding their coverage on areas of bay bottom where the natural, somewhat muddier, sediments are burying the Mt. Pinatubo ash layer. This is especially apparent in an area near Cubi Point.

Within the entire inner bounds of the bay nine species of seagrasses were observed, representing more than half of the total number of species found in the Philippines. In all of the sites surveyed, the density of *Halophila minor* exceeded those of all other species. This does not come as a surprise as characteristically, *H. minor* prefers sheltered areas on sandy and muddy substrates, of down to 2 m depth in the lower littoral and upper subtidal zones. These conditions occur commonly in Subic Bay.

These studies demonstrate a characterization of the bay into three distinct but unisolated conditions. The eastern coastal perimeter has a moderate exposure to anthropogenic

circumstances, although located in the vicinity of large and small-scale operations, e.g. the airport, the Subic Bay Freeport and associated hotels and small beach resort establishments. The western or innermost zone was observed to be more in contact with the local population, particularly so during weekends when the resorts are filled to capacity. This zone was also observed to have the most turbid water, with the most volume of solid refuse associated with the benthos and with the highest observed incidence of banca traffic. The immediate outer seaward zone in comparison to the other two found within the Bay had generally better water transparency and less human exposure at the time of the study.

The relatively high seagrass diversity indicates that the Subic Bay area has a high resilience potential to natural and anthropogenic stresses. As seagrasses are frequently found to be in close association with invertebrate and fish fry and fingerlings, this high diversity may indicate its potential to support economically important fish that spawn in the area. For example, the frontage of Miami Beach, an area along the western perimeter and south of the more densely populated area of the Subic Freeport, has a nearshore seagrass area that was observed to be densely populated (approximately 80-90 fry per school, more than 7 schools observed) with rabbitfish fry. Just south of Miami Beach is Agusuhin that has *several E. acoroides* clumps found 3 to 4 meters from shore and quantifiable populations of *H. minor*.

The presence of large seagrass beds is an indication of relatively good ecological conditions. Nutrients need to be plentiful enough to support these grass communities while not being so excessive as to stimulate phytoplankton blooms. Such blooms, or even high, but sub-bloom densities of phytoplankton block the light and limit the seagrasses. There will be a need to balance between the needs and tolerances of these grass beds for nutrients and the lower tolerances of the coral reefs further down the bay.

Seaweeds

Seaweeds are an important living marine resource in Subic Bay. These exist for the greater part of their lives as attached organisms. Some of these species are a local food resource. Unlike seagrasses, seaweeds are not deeply rooted and the stability of the bottom sediment is an important factor in their development and viability. They do not tolerate turbid conditions.

Twenty-eight species of seaweeds were found in sites studied in Subic Bay. The most common species was *Padina australis,* found at 11 sites. It is disturbing to note that the *Padina* has overgrown quite a large area of corals. Of the seaweed species found in the area, 11 have been documented to be economically important either as human food, animal feed or source of gelling substances. These species are: *Caulerpa racemosa*, *Hydroclathrus clathratus, Hydroclathrus tenuis, Sargassum crassifolium, Sargassum sp., Turbinaria ornata, Eucheuma sp., Gracilaria coronopifolia, Gracilaria salicornia, Gracilaria sp.* and *Hypnea sp.*

The seaweed communities on the eastern side of the bay are quite diverse with 25 species. The sandy-coralline intertidal area along Chiquita Island was observed to host the most diverse seaweed community with 16 species. The seaweed species on the western side of the bay were found loosely attached or free-floating mats on the bottom (*Padina australis*) or attached to coral rubble, rope, wood and other solid objects on the bottom (*Acetabularia sp., Halicoryne wrightii*). *P. australis* dominated the very patchy seaweed communities on the western side of the bay.

6.4 Phytoplankton and Benthos

Several areas in Subic Bay and along the coast of the Redondo Peninsula were sampled for phytoplankton (small floating plants) and benthos (bottom-dwelling organisms) in March 2000. These corresponded to the locations of the water quality stations within the bay. In the bottom samples a total of 1,256 organisms were recovered representing 44 animal taxa. The highest species diversity indices were in Nagzasa Bay and Port Silanguin, outside of Subic Bay. The lowest diversities were found in the upper portions of Subic Bay at stations near the town of Subic and near the mouth of the Kalaklan River outside Olongapo City. However, this station also showed the highest biomass due to the large size of polychaete worms.

The density and diversity of the phytoplankton appears to be within the range normally expected for a bay. A special effort was conducted to process bottom sediment samples seeking cysts of dinoflagellates and other potentially harmful algae. There is growing worldwide concern about these organisms, especially in ports where the discharge of ballast water can transfer seed populations. The sampling showed that cysts from several species are present in the bottom sediments of the bay. This means that the bay is somewhat preconditioned and sensitized to outbreaks of blooms. The dynamics of these outbreaks are not well known but excess nutrient loads are suspected to be a prime cause. There were no documented occurrences of such blooms in Subic Bay but there were in other locations in the Philippines.

6.5 Fish

Underwater visual surveys of fish were conducted along selected transects within the bay in March 2000. The fish fauna of the bay was generally depauperate. Both the number of species and the number of individuals were low. The fauna was strongly dominated by small (<10 cm) species and consisted mostly of the juveniles or early adults (see biomass estimates). Biomass estimates range from 5.45 to 30.25 kg / 1,000 m2 while density range from 410 to 1448 individuals per 1000m2. These characteristics are typical of a reef under heavy fishing pressure.

Cluster analysis shows that 3 groupings or clusters are faunistically similar and likely to be influenced by similar conditions and factors that shape their specific fish community structures. These are: NW Chiquita Is., Sueste Pt. and NE Port Silanguin, Camayan Pt. and NE Mayanga Is., and NW Nazasa Bay. These areas are likely to be seeded with propagules from a single source; the propagules spawned by one of the reefs are carried

by currents and recruit in the other reef. The Chiquita I. - Sueste Point - NE Port Silanguin group is likely of the former case (seeded by a single source). Propagules recruiting in these sites are probably brought by currents flowing northeast along the coast of the Redondo Peninsula. The Camayan Point - Mayanga I. group is likely of the latter case (Camayan Point providing the propagules that recruit in Mayanga I.). These findings should be considered in making management and zoning plans for the Bay.

A marked decrease in abundance from 1997 to the present was observed at Camayan Pt. and Chiquita Is. No comparable historical data is available for the other sites, but their present abundance is at the same levels as that of Camayan Pt. and Chiquita Is. The decline in abundances was significant to be a mere artifact of the survey method (the underwater visual census). This should be looked into more closely to identify possible causes and design a course of action.

The fish fauna at NE Mayanga Is. is badly in need of management. Fishing appears to be so heavy that the target species at the site were mostly small individuals. The recovery of this site will depend on the reduction of fishing pressure and the availability of spawning populations to replenish or re-seed the site with larvae. Camayan Point, which is about 9 km to the south, had a similar fish fauna assemblage. It is likely that currents carry propagules (not only of fish) and recruit in Mayanga I. Camayan Point therefore could potentially reseed Mayanga I.

Chiquita Is., aside from Sueste Pt., appears to have the only remaining good coral cover within the bay. In fact, this site is one of the favorite dive destinations of local dive operators. The fish fauna at this site was dominated by small, gregarious species (e.g. damselfishes, angelfishes, and butterflyfishes) - the kinds that attract recreational divers.

The fish populations encountered in the area were mostly small species and juveniles of commercially valuable species. Sueste Point had the highest abundance and number of fish species among the six sites surveyed, which puts a high recovery and tourism value to this area.

Fish resources of the bay support many fishers. The problems confronting them are similar to problems elsewhere in the Philippines. Decreasing catch rates are the result of habitat destruction caused by ecologically harmful fishing techniques such as cyanide fishing and singapong. Cyanide fishing is still practiced in the bay destroying coral and other organisms, as well as being dangerous to fish. Singapong gear exploits the early life stage of commercial fish, thus affecting the fishery. Another major problem is the high fisher density that leads to over-fishing. As the human population of the bay increases, increased sediment loads, nutrients, and chemical pollution threaten the fishery.

Approximately 30% of Subic Bay have been protected from fishing for several decades. Because of this protection, there is still a healthy artisanal fishery in the bay; without this protection, the fishery would have collapsed long ago.

6.6 Discussion and Conclusions

The rich diversity of habitats and species of marine life in Subic Bay show that it is a viable ecosystem with all essential components present.

Major conclusions from the study are:

- The coral reefs are deteriorating, the cause of which are mostly mechanical.
- The coastal mangrove systems are in good condition. However, these are threatened by the development of adjacent lands.
- The high seagrass diversity of Subic Bay has a high resilience potential to natural and anthropogenic stresses.
- The predominance of Padina australis among the seaweeds threatens the coral reefs.
- The phytoplankton and benthos of the Bay appear to be within the range normally accepted for a bay.
- The fish showed a marked decrease due to over-fishing and destructive fishing practices. Protection of 30% of Subic Bay from fishing has so far managed to sustain a healthy artisanal fishery.

7.0 SOCIO ECONOMIC AND CULTURAL PROFILE

This section focuses on the general features of the local population and its major activities. This component of the environment is important for it provides a general view of the use of the physical and natural resources of the areas by the local inhabitants. It can relate man's activities to the quality of his environment; and it can be used to manage the future state of the environment based on present pattern and intensity of human activities.

Most of the recent information on which this profile is based comes from recent studies conducted as part of the SBPAMP project. Additional details on the topics are addressed in Volume XIV Land Use and Settlement Pattern Report (Regunay 2001), Volume XV Census of Protected Area and Buffer Zone Occupants Report (Toribio 2001), and Volume XVI Upland and Coastal Livelihood Assessment of Protected Area and Buffer Zone Occupants Report (Rollolazo 2001) of the Resource Inventory Reports.

7.1 Demography

7.1.1 Population and Settlements Structure

Settlements in the SBFZ can be classified as either urban or rural. Urban settlements are primarily those that serve as the administrative, market, economic, and educational centers and act as the central places to their respective constituent settlement areas. This category includes the city center of Olongapo City and the town center or poblacion of Subic. In terms of hierarchy, Olongapo functions as the primary urban center in the SBFZ while the Subic poblacion (barangays Asinan Poblacion and Proper) serves as the market center for most of the barangays in Subic.

The rural settlements, on the other hand, are composed of the lowland agricultural, coastal and upland barangays in the Freeport Zone. The initial listing of the coastal and upland barangays have been provided earlier in the World Bank census study. Except for the two barangays in Subic, the other communities have been classified as either coastal or upland settlements.

Table 3 presents the population levels and corresponding growth rates of the barangays situated within the political boundaries of the Freeport Zone, for the census period of 1990 and 1995. As can be gleaned from this table, upland barangays of Olongapo City exhibited high population levels. The negative population growth rates of the barangays in the City indicate that the area is nearing its threshold capacity. In the Municipality of Subic, the coastal barangay of Calapacuan had the highest population with 9,944 while the upland barangay of Naugsol had the highest population growth rate with 8.60.

Table 3. Population Level and Growth Rate

Municipality/City	Population Level		Growth Rate
Barangay	1990	1995	
Olongapo City	**193,327**	**179,754**	**-1.45**
- Asinan	3,073	3,204	0.84
- Banicain	8,038	6,273	-4.84
- Barretto	12,213	12,095	-0.19
- East Bajac-Bajac	19,071	19,098	0.03
- East Tapinac	12,252	11,134	-1.90
- Gordon Heights	19,677	19,068	-0.63
- Kalaklan	11,789	9,245	-4.75
- New Kalalake	10,081	9,062	-2.11
- Mabayuan	9,760	9,987	0.46
- New Cabalan	13,009	14,352	1.98
- New Ilalim	1,493	1,656	2.09
- New Kababae	2,185	2,147	-0.35
- Old Cabalan	10,167	9,354	-1.65
- Pag-asa	7,045	5,698	-4.16
- Santa Rita	34,856	30,580	-2.58
- West Bajac-Bajac	10,214	9,155	-2.17
- West Tapinac	8,404	7,646	-.187
Subic	**46,929**	**57,099**	**4.00**
- Aningway Sacatihan	1,728	2,964	11.40
- Asinan Poblacion	700	702	0.06
- Asinan Proper	1,539	2,760	12.39
- Baraca-Camachile (Pob.)	3,082	2,774	-2.08
- Batiawan	430	685	9.76
- Calapacuan	8,403	9,944	3.42
- Calapandayan (Pob.)	5,293	6,448	4.03
- Cawag	2,750	5,110	13.19
- Ilwas (Pob.)	3,300	3,089	-1.31
- Mangan-Vaca	3,051	3,598	3.35
- Matain	5,876	5,910	0.12
- Naugsol	783	1,183	8.60
- Pamatawan	2,295	2,282	-0.11
- San Isidro	2,420	3,229	5.94
- Santo Tomas	3,258	4,050	4.45
- Wawandue (Pob.)	2,021	2,371	3.25
San Antonio	**26,944**	**25,765**	**-0.89**
- Pundakit	1,821	1,538	-3.32
Morong	**17,155**	**18,731**	**1.77**
- Mabayo	2,042	2,271	2.15
Dinalupihan	**58,172**	**65,159**	**2.29**
- Bangal	2,198	2,393	1.71
Hermosa	**34,633**	**38,764**	**2.28**
- Tipo	2,220	1,912	-2.94
- Sacrifice Valley	453	931	15.50

7.1.2 Census of SBFZ Occupants

A census undertaken in early 2000 obtained a wide range of socio-economic, resource utilization and community perception data for the preparation of the PAMP. Surveys were coordinated with the economic and livelihood activities engaged by upland and coastal/ lowland communities in the vicinity of the project area.

Toribio (2001) provides a comprehensive summary of the population census results.

7.1.3 Age Structure

The ages of 0 to 15 and more than 65 years old belong to the economically dependent members of the society. Those who are 16 to 65 years old comprise the potential income earners or the economically independent. In general, the survey showed that there are more potential income earners compared to the economically dependent.

The upland barangays have a higher number of economically dependent members at a ratio of 97:100 as compared to the coastal barangays at 57:100. This indicates that the potential earners in the coastal areas have fewer dependents to support.

7.2 Livelihood and Income Sources

Major income sources seem to be dictated by the kind of environment a person is in. Major economic activities in the upland barangays usually involve farming and forest product gathering while in the coastal communities, fishing and other related activities. Inhabitants of barangays near the town centers such as Calapacuan, Barretto, Gordon Heights, Bangal and Sta. Rita have job employment as a major source of income. These areas are less dependent on natural resources extraction.

The average household monthly income in all areas surveyed is P4,261, way below the 1997 per capita poverty threshold of P12, 836 (P13,063 for urban areas and P10,742 for rural areas) as set by the NEDA. This connotes that majority of the households are living below the poverty line. The areas with very low incomes (less than P3,000 per month) include Naugsol, Cawag, (both coastal and upland), Sta. Rita and Binaritan. Except for Sta. Rita, these are mainly fishing and farming communities (Toribio, 2001).

7.2.1 Upland Communities

As mentioned above, the usual primary source of income of the upland inhabitants are farming and forest product gathering. The average monthly income of the surveyed upland communities is P4,272, which is lower than that of their coastal counterparts. However, the upland communities have better food security. Food obtained from the farms and forests can be bartered for their other needs such as salt, rice, oil and clothing. Therefore, stated cash incomes may not reflect their true household incomes.

7.2.2 Coastal Communities

The main livelihood for coastal communities is fishing and other related activities. Their average monthly income is P4,486. The coastal communities surveyed include Matain, Wawandue, Baraca-Camachile, Calapacuan, Calapandayan, Pundaquit and portions of Cawag located in Redondo Peninsula.

7.3 Economic Production

For the upland communities in the vicinity of the SBPA, economic and livelihood activities include agro-forestry, buho-gathering, banana blossoms gathering (amukao variety), cottage industries and family-based enterprises, hunting and honey collection. The coastal/lowland communities engage in municipal fishing, deep sea fishing, bangus/fry gathering, aquarium fish gathering, buy and sell activities, employment and tourism/beach resort management.

7.3.1 Agriculture

Agro-forestry activities comprise fruit tree plantation, cash crop production, livestock and swine raising. The most significant tree planting activity is mango production followed by bananas (*latondan*), cashew, jackfruit, citrus, coconut and star apple (Rollolazo, 2001).

In the Batiawan, Naugsol, Pastolan, Iram and Cawag resettlement areas, households plant mangoes (*kalabaw, piko*, Indian) in every available space (5 hectares under the CBFM and other agreements with DENR, ancestral rights). A big volume of fruit production is anticipated within the next 5 to 10 years.

Varied cash crops planted in both home and farm lots *include kamoteng kahoy/baging, gabi, ube*, corn and vegetables such as *sitao, patola*, tomatoes and eggplants. These are grown for both home consumption and commercial purposes.

7.3.2 Forestry

Wild pig/deer hunting and honey collection is periodically undertaken as there are laws prescribing seasons for hunting. These are predominantly Aeta household activities. Buho-gathering is one of the primary economic activities of residents of Batiawan, Naugsol and other resettlement sites and an important source of cash income. Cottage industries and family-based enterprises involve processing of rattan, buho and bamboo into finished products such as lamps, key chains, novelty items, baskets, trays, hammocks, loofah from medicinal plants, etc..

7.3.3 Fisheries

Municipal fishing is one of the livelihood activities of coastal communities; however, it is no longer viable to the majority of the fishermen due to decreasing fish supply and increasing production costs. Deep-sea fishing (such as the *payao* method) is by necessity engaged in by large groups or organizations because of the high investment costs involved compared to municipal fishing. Other economic activities include bangus/fry gathering, aquarium fish gathering, and buy and sell activities (Rollolazo, 2001).

7.3.4 Commerce and Industry

Most employment in the lowland and coastal communities is clerical or seasonal jobs (construction, services). Mostly contractual, they are paid daily wages of P 175 to P 185. Some residents engage in management of beach resorts including other facilities in partnership with others. The Barangay Council of Barretto for instance is currently operating a public beach resort.

8.0 LAND USE AND INFRASTRUCTURE PROFILE

This section presents an analysis of the prevailing land use configuration in the SBFZ including the changes in the local landscape that have taken place in the last 10 years or so.

8.1 General Land Uses

8.1.1 1987 Land Use Configuration

Based on 1987 data from the Bureau of Soils and Water Management (BSWM), shrubland/grassland areas comprised 60 percent of the SBFZ. These shrubland/grassland areas were mostly situated in the municipalities of Subic, San Antonio and Olongapo City. On the other hand, forest areas accounted for 30 percent of the total Freeport Zone or around 16,690.40 hectares. Large portions of the forested areas were in SWFR and Subic. Built-up areas were located primarily in the former naval base, Olongapo City and Subic. Small parcels of wetland/mangrove areas were found to occur in Subic and SWFR.

8.1.2 Existing General Land Uses

The extent of the general land uses in the SBFZ based on the Aerial Photographs by FF Cruz and GSMI is shown in Figure 17 and tabulated in Table 4.

As of year 2000, the open canopy forest covers the highest percentage with 21,954.43 hectares, approximately 39.6 percent. This type of land use is generally found in the municipality of Subic, within the SWFR and Olongapo City. On the other hand, open/grassland accounted for 27.5 percent of the total Freeport Zone or around 15,264.14 hectares. Brushland and closed canopy forests are located primarily in portions of SWFR, southern part of San Antonio, Subic and Olongapo City.

Table 4. Land Use Distribution in the SBFZ, 2000

Land Use Type	Area (in hectares)	Percentage
Open canopy forest	21,954.43	39.64
Open/grassland	15,264.14	27.56
Brushland	5,040.65	9.10
Closed canopy forest	4,703.94	8.49
Built-up	2,835.09	5.12
Agricultural (rice field)	1,344.69	2.43
Agricultural (mixed crop)	731.33	1.32
Corals	481.03	0.87
Infrastructure and utilities/facilities	476.35	0.86
Mangrove	451.32	0.81
Vacant land/open space	406.65	0.73
Crop land	230.09	0.42
Residential	185.30	0.33
Sub-marginal forest	126.29	0.23
Industrial park	120.10	0.22
Parks/playground and other recreational spaces	114.07	0.21
Special use	107.15	0.19
Grassland	103.55	0.19
Industrial	96.96	0.18
Plantation	81.85	0.15
Commercial	75.21	0.14
Agricultural	68.13	0.12
Land under development	67.19	0.12
Mossy forest	64.25	0.12
Vacant structure	59.23	0.11
Waterbody	57.50	0.10
Institutional	43.43	0.08
Agricultural (crop)	31.97	0.06
Port	24.40	0.04
Bore land	20.71	0.04
Lahar	9.22	0.02
Agricultural (orchard)	8.47	0.02
Piggery	2.79	0.01
Utilities	1.55	0.00
Total	**55,388.99**	**100.00**

Figure 17. Land Use Map of Subic Bay Freeport Zone, 2000

8.2 Existing Land Use of the Subic Watershed Forest Reserve (SWFR)

Table 5 shows the land use distribution of the SWFR. Of the total area of 9,716.88 hectares, 4,342.22 hectares or 44.69 percent are closed canopy forests while 3,363.17 hectares or 34.61 percent are considered open canopy forests. The mangrove areas cover 91.19 hectares while 98.73 hectares are devoted to agriculture. The built up areas (residential, commercial, institutional and industrial) account for 4.48 percent of the total SWFR area. Figure 18 presents the existing land use and vegetation map of the SWFR.

Table 5. Land Use Distribution in SWFR, 2000

Land Use	Area (in hectares)	Percent Distribution
Closed Canopy Forest	4,342.22	44.69
Open Canopy Forest	3,363.17	34.61
Mangrove	91.19	0.94
Corals	10.41	0.11
Brushland	307.20	3.16
Open/Grassland	215.16	2.21
Boreland	20.71	0.21
Agriculture	98.73	1.02
Built-up (residential, commercial, industrial and institutional)	435.38	4.48
Infrastructure and Utilities/Facilities	193.44	1.99
Parks/Playground and /Other Recreational Spaces	92.30	0.95
Special Use	66.52	0.69
Land Under Development	64.94	0.67
Vacant Land/Open Space	354.03	3.64
Vacant Structure	33.01	0.34
Water Body	28.47	0.29
Total	**9,716.88**	**100.00**

Figure 18. Land Use Map of SWFR, 2000

9.0 INSTITUTIONAL AND STAKEHOLDERS PROFILE

This section discusses the existing institutional and administrative arrangements currently in place to provide coordination and directions relevant to the management of the SBPA. It also describes the different institutions and existing community organizations within the Freeport Zone.

The descriptions of existing institutional structures and organization provided below make it apparent that an extensive framework of planning structures exists for the coordinated protection of the environment. These descriptions and the referenced supporting materials provide an important basis for proceeding with implementation of the SBPAMP.

9.1 Planning Structure and Organization

Table 6 provides a snapshot of the existing planning structure and organization in the Philippines. As a rule, committees and councils are created to:

- ensure coordination across sectors (e.g., social, trade and industry, environment and natural resources, transportation, tourism, agriculture, etc.)
- provide linkages among plans, (e.g., land use plans, socio-economic development plans, medium term investment plans) at various levels of the bureaucracy (i.e., national, regional, provincial/city, and municipal).

Table 6. Planning Structure and Organization in the Philippines

Committee/Council		Agency/Office
National Economic Development Authority (NEDA) Board	Chairman	Office of the President (OP)
	Vice Chairman	NEDA
	Members	OP Departments of: Finance (DOF) Trade and Industry (DTI) Agriculture (DA) Interior and Local Govt. (DILG) Public Works and Highways (DPWH) Transportation and Communications (DOTC) Science and Technology (DOST)

Committee/Council		Agency/Office
		Labor and Employment (DOLE) Budget and Mgt. (DBM) Health (DOH) Foreign Affairs (DFA) Agrarian Reform (DAR) Energy (DOE) Bangko Sentral ng Pilipinas (BSP)
	Secretariat	NEDA
National Land Use Committee (NLUC)	Chairman	NEDA
	Members	DA DAR DILG DENR DPWH DTI DOTC DOST Housing and Land Use Regulatory Board (HLURB)
	Secretariat	Regional Development Coordinating Staff (RDCS), NEDA
Regional Land Use Committee (RLUC)	Chairman	NEDA Regional Office (NRO)
	Members	Regional offices of: DA DAR DILG DENR DPWH DTI DOTC DOST HLURB Non-government Organization (NGO)
	Secretariat	NEDA Regional Office
	Members	Municipal League of Mayors

Committee/Council		Agency/Office
		Provincial League of Governors Regional offices of: DOF DTI DA DILG DENR DPWH DOTC DOST DOLE DBM DOH DAR BSP Lower House of Congress
Regional Development Council	Chairman	Local Government Unit or NGO
	Vice Chairman	NRO
	Secretary	NRO RO
	Members	Municipal League of Mayors Provincial League of Governors Regional offices of: DOF DTI DA DILG DENR DPWH DOTC DOST DOLE DBM DOH DAR BSP Lower House of Congress
Provincial Land Use Committee (PLUC)	Chairman	Provincial Planning and Development Office (PPDO), LGU
	Members	Provincial offices of: DA

Committee/Council		Agency/Office
		DAR DILG DENR DPWH DTI HLURB NGO
	Secretariat	PPDO
Provincial Devt. Council	Chairman	Provincial government
	Members	All municipal governments Committee on Appropriations of the Provincial Legislative Council Representative of the Lower House of Congress Private Sector/NGO PPDO
City/Municipal Devt. Council	Chairman	City/municipal govt.
	Members	Committee on Appropriations of City/Municipal Legislative Council Lower House of Congress NGO/private sector Barangay governments Local offices of: DENR DILG DTI DAR

Such intended coordination and linkages are "more ideal than real. In reality, lower level plans and investment programs are often developed with little or no regard for plans and programs at the higher levels". Worse, it was observed that the linkage between sectoral master plans and land use plans for specific areas is even weaker with proposals contained in the former not evident in the latter (DENR-UNDP, 1997).

9.2 Institutions within the SBFZ

The existing institutions within the SBFZ are composed of the different departments of the SBMA, government agencies such as local government units (LGUs), Community Environment and Natural Resources Offices (CENRO), non-governmental agencies, people's organizations, private groups and civil society within the political jurisdiction of

the Freeport Zone. Until recently, close coordination with other agencies and institutions outside the SBMA was non-existent for some reasons. Proper linking and coordination are necessary not only to facilitate the flow of information on current issues and concerns pertaining to sustainable development and environmental protection and preservation but also to promote, obtain and sustain support for these undertakings.

The list below summarizes the following institutions and their corresponding mandates relevant to the SBPA.

9.2.1 Subic Bay Metropolitan Authority (SBMA)

The environmental mandates of SBMA are derived from Republic Act (RA) 7227 otherwise known as the Bases Conversion and Development Act. This law vests upon the SBMA the management, development, and supervision of the Subic Special Economic Zone and Freeport. Section 13 of RA 7227 mandates SBMA:

a. To protect, maintain, and develop the virgin forests within the baselands which will be proclaimed as a national park and subject to a permanent total log ban, and for this purpose, the rules and regulations of the Department of the Environment and Natural Resources and other government agencies directly involved in the above function shall be implemented…. to maintain and preserve the forested areas as a national park.

b. To adopt and implement measures and standards for environmental pollution control of all areas within its territory, including, but not limited to all bodies of water and enforce the same.

Further, Section 96 of the SBMA Implementing Rules and Regulations (IRR) for RA 7227 empowers the Ecology Center (EC) to protect the environment and natural resources within the Subic Bay Freeport and/or jurisdiction of the SBMA. For this purpose, IRR gives the EC the following responsibilities:

a. Have responsibility for the implementation of all environmental and natural resources conservation and protection programs adopted or assumed by the SBMA as a natural corporation and as a government entity.

b. Undertake normal functions associated with environmental management, including but not limited to enforcement, monitoring, permitting, training, and education, and contingency and emergency planning.

c. Privatize services and infrastructure related to environmental management to the extent that it shall deem appropriate. This shall include environmental services as water supply, wastewater treatment facilities, waste management facilities, waste transportation services, and

environmental monitoring services as can be contracted to the private sector.

Meanwhile, Section 100 of the IRR states that:

a. The SBMA shall, in cooperation with DENR, cause to be protected the forested area defined by the DENR and shall manage the area in accordance with the practices acceptable to DENR. This shall include the provision of forest guards, as defined by DENR, to ensure that the natural resources of the area are provided sufficient protection to ensure longevity.

b. The Natural Resource Protection Area agreed upon between SBMA and DENR shall include such area as necessary to provide for the protection of the watershed upon which SBMA is dependent for its water supply. This area shall include both the virgin forests as agreed upon with DENR.

The other authorities and responsibilities of the SBMA relevant to environmental management as stipulated in the IRR include the following:

a. Issuance of all permits and clearances related to environmental protection and conservation within the SBFZ to include but not limited to Environmental Compliance Certificates, Authorities to Construct, Permit to Operate, and Water Use Permits (Section 99).

b. Implement a regional air quality program within its jurisdiction. The SBMA shall formulate an air quality management strategy for limiting emissions from both mobile and stationary sources (Section 101).

c. Implement a water quality-monitoring program within its jurisdiction. All sources of water pollution within the SBFZ and/or the jurisdiction of the SBMA shall be subject to regulation and shall be required to obtain a Permit to Operate as a condition of their occupancy in the regulatory area of the SBMA (Section 103).

d. Define solid and hazardous and toxic wastes in a manner consistent with the definitions developed by the DENR under Republic Act 6969 and shall define the requirements for waste generators, transporters, and owners/ operators of waste management facilities (Section 103).

e. Issue policies and objectives on water resources that will seek to ensure that sources of water supply within the SBFZ and/or jurisdiction of the SBMA shall be protected and conserved, including marine waters, surface waters, and groundwater. The SBMA shall formulate a groundwater protection program to ensure the continued viability of groundwater

resources. The SBMA shall also require new water resource developments to obtain a water use permit prior to the development of a groundwater well or surface water abstraction (Section 104).

f. Designate such areas that SBMA deems appropriate as Conservation Areas. These areas may include those areas necessary for the protection of water supplies (such as groundwater aquifer recharge zones) or are important to the protection and preservation of biodiversity (such as marine conservation and sanctuary areas and natural forest areas). Those areas designated as Conservation Areas shall be included in any land use plan or zoning ordinances adopted by the SBMA (Section 105).

The main office of SBMA responsible for environmental and protected area management is the Ecology Center (EC). A detailed discussion of the existing organizational mandate, functions, and structure of the EC are provided by Woodward-Clyde Institutional Strengthening Study. The proposed organizational structure for managing the SBPA is provided in section 8 of Volume 2 of this plan.

The multiple implementation functions of the EC are addressed by three existing and one new division. The EC presently maintains 20 personnel fifteen (15) of whom are professional/technical level including department head and division chiefs.

1) Environmental Quality and Permitting Division

This Division has six technical personnel, including the division chief and one administrative staff. It is concerned with environmental quality maintenance and monitoring, standards enforcement and implementation of environment-related permitting system including the issuance of Environmental Compliance Certificate (ECC).

2) Waste Management Division

This Division which has the most number of personnel consists of three sections: repair and maintenance, collection and disposal. It formulates policies and guidelines on the management of wastes including prevention and remediation programs for oil spills. It monitors and provides technical assistance on the management of solid and hazardous wastes and implement projects related to waste minimization, waste recycling and solid waste management.

3) Protected Area Management Division

The primary responsibility for protected area management within the EC is lodged with the Protected Areas Division. This division is composed at present of seven technical personnel (two are working for Conservation of Priority Protected Areas Project), one administrative staff and several workers and laborers. It spearheads the protection,

management, conservation, rehabilitation, and enforcement of rules concerning the protected areas within the SBFZ.

4) Social Development Division

In addition to the basic functions described above, a fourth operating function referred to as "social development" was introduced by the World Bank (WB) in 1996. The WB Team proposed the creation of a social development division whose functions include:

- assessment of socio-economic impacts within the Freeport and adjacent localities;
- implementation of a property acquisition and compensation plan (PACP);
- role as community relations and grievance office for communities/localities affected by SBMA development projects;
- implementation of a resettlement action plan (RAP) for those to be displaced by SBMA development projects;
- social impact assessment (SIA);
- implementation of an indigenous people's development plan (IPDP);
- implementation of an environmental education program for locators/investors, workers and communities surrounding the Freeport;
- conduct of community consultations with barangay councils;
- implementation/supervision of community-based forestry projects;
- development and implementation of a gender sensitivity program;
- development of links with NGOs and POs to ensure constant dialogue; and
- response to all other emerging social issues (e.g., squatting and encroachment).

This social development function has now been incorporated and operationalized in the EC through the creation of a Social Development Division.

a) Proposed Organizational Structure of the EC

In 1998, the SBMA-EC through the assistance of Woodward Clyde Philippines initiated a study to strengthen the institutional development capability of EC on environment and protected area management. A key recommendation from that study is the proposal for an expanded and re-structured organization of the EC. The recommendations of this study regarding the Protected Area Division were preliminary pending the completion of the SBPAMP.

9.2.2 Local Government Units (LGUs)

The authorities of local government units (LGUs) emanate from the provisions of Republic Act 7160 otherwise known as the Local Government Code (LGC) and its Implementing Rules and Regulations. Among the authorities and responsibilities of the LGUs as contained in the LGC and its IRR are the following:

For Cities/Municipalities

a. Implementation of community-based forestry projects through:

- Integrated social forestry programs and similar projects;
- Management and control of communal forests with an area not exceeding fifty square kilometers; and
- Establishment of tree parks, greenbelts, and similar forest development projects.

b. Provision of solid waste disposal or environmental management systems and services or facilities related to general hygiene and sanitation.

c. Reclassification of agricultural lands through an ordinance enacted by the sanggunian after conducting public hearings for the purpose provided that there exists an approved zoning ordinance implementing its comprehensive land use plan.

d. Preparation of comprehensive land use plans enacted through zoning ordinances. The requirements for food production, human settlements, ecological balance, and industrial expansion shall be considered in the preparation of such plans.

e. Approval of ordinances and passage of resolutions necessary for an efficient and effective municipal government by the Sangguniang Bayan that shall:

- Adopt measures to protect inhabitants of municipality from the harmful effects of man-made or natural disasters and calamities.
- Protect the environment and impose appropriate penalties for acts that endanger the environment such as dynamite fishing and other forms of destructive fishing, illegal logging and smuggling of logs, smuggling of natural resources products and endangered species of flora and fauna, slash and burn farming and other such activities which result in pollution, acceleration of eutrophication of rivers and lakes, or of ecological imbalance.

f. Regulation of activities relative to the use of land, buildings, and structures within the municipality in order to promote the general welfare.

g. Approval of ordinances in the efficient and effective delivery of basic services and facilities.

h. Provision for the establishment, maintenance, protection, and conservation of natural forests and watersheds, tree parks, greenbelts, mangroves and other similar forest development projects.

i. Provision for the establishment, operation, maintenance and repair of an efficient waterworks system to supply water for the inhabitants, protect the purity and quantity of water supply of the municipality and for this purpose, extend the coverage of appropriate ordinances over all territory within the drainage area of said water supply and within 100 meters of reservoir, conduit, canal, aqueduct, pumping station, or watershed used in connection with the water service.

j. Provision for an efficient and effective system of solid waste and garbage collection and disposal and prohibit littering and the placing or throwing of garbage refuse and other filth and wastes.

For Provinces

k. Enforcement of forestry laws limited to community-based forestry projects, pollution control law, small-scale mining law, and other laws on the protection of the environment, and mini-hydroelectric projects for local purposes.

l. Enactment by the Sangguniang Panlalawigan of ordinances and passage of resolutions to protect the environment and imposition of appropriate penalties for acts which endanger the environment such as dynamite fishing and other forms of destructive fishing, illegal logging and smuggling of logs, smuggling of natural resources products and endangered species of flora and fauna, slash and burn farming and other such activities which result in pollution, acceleration of eutrophication of rivers and lakes, or of ecological imbalance.

m. Adoption of measures and safeguards against pollution and for the preservation and maintenance of the natural ecosystem in the province, in consonance with the approved standards on human settlements and environmental sanitation.

n. Facilitation of or provision for the establishment and maintenance of a waterworks system or district waterworks for supplying water to inhabitants of component cities and municipalities.

Further to the above authorities and responsibilities, the governor and city and municipal mayors may appoint a city/municipal Environment and Natural Resources Officer whose functions shall be as follows:

a. Formulate measures for the consideration of the Sanggunian and provide technical assistance and support to the governor or mayor, as the case maybe, in carrying out measures to ensure the delivery of basic services and provision of basic facilities relative to environmental and natural

resources services.

b. Develop plans and strategies on natural resources programs and projects and implement them upon approval thereof by the governor or mayor, as the case maybe.

c. Establish, maintain, protect and preserve communal forests, watersheds, tree parks, mangroves, greenbelts, and similar forest projects and commercial forests like industrial tree farms and agro-forestry projects.

d. Provide extension services to beneficiaries of forest development projects and technical, financial and infrastructure assistance.

e. Manage and maintain seedbanks and produce seedlings for forest tree parks.

f. Provide extension services to beneficiaries of forest development projects and render assistance to natural resources related conservation and utilization activities.

g. Coordinate with government agencies and NGOs in the implementation of measures to prevent and control land, air, and water pollution with assistance from the DENR.

The LGUs covered in the SBFZ are:

- City of Olongapo
- Municipality of Subic
- Municipality of San Antonio
- Municipality of Morong
- Municipality of Dinalupihan
- Municipality of Hermosa

9.2.3 Department of Environment and Natural Resources (DENR)

As mandated by Section 4 of Executive Order No. 192, the DENR shall be responsible for the "conservation, management, development and proper use of the country's natural resources, specifically forest and grazing lands, mineral resources, including those in reservation and watershed areas, and lands of the public domain".

Along with this mandate, the DENR is cloaked with powers to formulate, implement, and supervise policies, plans, programs and rules and regulations relevant to the management, conservation, development, use and replenishment of the country's natural resources. The agency is also tasked to impose and collect payments, fees, charges, rentals, and levies for the exploration, development, utilization or gathering of such resources.

Further, DENR shall regulate the development, disposition, extraction, exploration and use of the country's forest, land and mineral resources. In addition, the agency shall:

a. Exercise exclusive jurisdiction on the management and disposition of all lands of the public domain and shall continue to be the sole agency responsible for classification, sub-classification, surveying and titling of lands in consultation with appropriate agencies.

b. Promulgate rules and regulations for the control of water, air, and land pollution.

c. Promulgate ambient and effluent standards for water and air quality including the allowable levels of other pollutants and radiations.

Promulgate policies, rules and regulations for the conservation of the country's genetic resources and biological diversity, and endangered habitats.

At the local level, the Provincial Environment and Natural Resources Office (PENRO) and the Community Environment and Natural Resources Office (CENRO) serve as the field operating units of the DENR. The concerned DENR offices in the SBFZ are:

- CENRO Olongapo
- CENRO Bagac
- CENRO Pilar
- PENRO Zambales
- PENRO Bataan

Other governmental agencies with jurisdictions that could be involved in SBPA management or in the management of buffer zones include the following:

- Department of Agriculture,
- Bureau of Fisheries and Aquatic Resources,
- Philippine Coast Guard,
- Philippine National Police, and
- Non-governmental Organizations (NGOs) and Private Groups (PGs).

These groups play an important role in the development process and in the protection of natural resources.

9.2.4 Community Organizations

Community organizations play a pivotal role in development, specifically in livelihood project implementation. They facilitate the provision of crucial services to its members, from conceptualization to production and marketing. Their role in implementing the alternative livelihood strategies portion of the SBPAMP is, therefore, critical to the successful implementation.

There are more organized groups and cooperatives in the uplands than in the coastal communities. The Federation of Municipal Fisheries and Aquatic Resource Management Council (FARM-Cs), initially organized by the Bureau of Fisheries (BFAR), is only active in some barangays of the Municipality of Subic. These include Matain, Kalapandayan, Baraca-Camachile and Kalaklan. The FARM-C in other coastal barangays is not as active and organized as attested by a fisherman from Baretto in an interview. Initiatives of some groups have been observed to exist in the area, an example of which is the GRAMEEN Banking Group, organized in Kinabukasan, Barangay Cawag. This group is reported to provide loans for fishing activities (Rollolazo, 2001).

The Kalapandayan Fishermen Multipurpose Cooperative is an example of a successful cooperative. The group presents a strong membership and various services (consumer store, loan assistance, mortuary fund, marketing as consignee, etc.).

Volume XVI of the Resource Inventory Reports entitled " Upland and Coastal Livelihood Assessment of Protected Area and Buffer Zone Occupants Report", provides a more detailed discussion on this matter.

10.0 EMERGING ISSUES AND CONCERNS

This section provides the summary of issues and concerns that need to be considered in the establishment and management of protected areas. These considerations were identified and drawn from the results of the Resource Inventory Study (Woodward-Clyde 2001) and from stakeholder inputs obtained during workshops and consultations throughout the Subic Bay PAMP project. Physical resources, such as air, that were not found to be PA management issues in the foreseeable future are not addressed in this section.

10.1 Physical Environment

10.1.1 Geology and Soils

Available geologic and geohazards information indicate that like most areas in the Philippines, the Subic Bay area is vulnerable to geologic hazards (e.g. earthquakes, volcanic activity, mass movements, etc.). The coastal bay area, which is underlain by water-saturated recent alluvial deposits, is prone to earthquake-induced ground failure (e.g. liquefaction).

As available space within the flat areas is used up, development may be directed towards the hill slopes and highland areas which are increasingly more prone to mass movement failures (e.g. landslides, slumps, creeps, etc.).

Uncertainties on future occurrence of explosive eruptions from Natib Volcano, earthquakes from the Subic Bay Fault, or tsunamis make it difficult to adequately gauge future impacts to the protected area. Historical analogues (e.g. Pinatubo Volcano) have shown that geohazard events with long repose periods are oftentimes the most destructive. SBPA resources most likely to be affected include beaches, low-lying mangrove areas, and shallow reefs. Volcanic eruptions would adversely affect all ecological resources.

10.1.2 Water Resources

There are multiple water issues identified as known or potential concerns to the protection of resources within the SBPA. Inventory surveys indicated modest but increasing nutrient loads and chemical pollution, particularly in the upper bay.

Increasing population and lack of adequate sewage treatment from communities in upper Subic Bay has affected portions of the upper bay. Continued development and population increases will adversely affect coral reefs, seagrass beds, and other important habitats in the lower bay in the near future.

Sedimentation from the eruption of Mount Pinatubo damaged many of the coral reefs but provided additional substrate for seagrass beds. Sedimentation from increased land

clearing in the upper bay is producing additional sediment loads and adversely affecting the biological resources of the bay.

Earthquakes, volcanic eruptions, typhoons, and tsunamis are potential threats. Kalaklan, Matagan, and Marelalec Rivers are major sources of nutrients, sediment, and pollutants that can affect protected marine areas. Increasing industrialization along the upper bay increases the potential for discharge of hazardous materials into the bay. These substances can poison the environment, reduce productivity and make organisms such as fish and shellfish unfit for human consumption. Without adequate controls, the multiple effects of these physical stressors can reduce biological diversity and productivity and make the marine ecosystems and the services they provide unsustainable.

At present, freshwater bodies within the SBPA are subject to human disturbance and pollution primarily in lower areas near the coast. Construction activities, increased industrialization, and increased use of these areas for other purposes can lead to soil erosion, sedimentation in areas influenced by runoff and flooding in lowland areas.

10.2 Biological Environment

Several major issues emerged from the development of the SBPAMP. Adequate size to sustain ecological and human use values was a major concern. The area of existing habitat for the terrestrial portion of the SBPA, less than 10,000 hectares, is marginally small for supporting the diverse populations of various species, particularly the larger ones. Forest fragmentation that limits connections among similar areas is another major issue affecting the survival and sustainability of plants and animal populations that constitute the biodiversity.

In view of the above issues and ones addressed in more detail below, the following general recommendations were developed:

- core areas and important habitats receive special protection,
- areas of forest be expanded and rehabilitated, as appropriate,
- fire and other destructive practices be controlled, and
- the boundaries of the SBPA be contiguous with those of the Bataan Natural Park to increase the overall size of terrestrial forest area under coordinated protection.

There are other threats to the SBPA:

- Introduction of exotic plant and animal species can disrupt ecosystem organization and endanger species.
- Illegal or unmanaged extraction of plant and animal products can deplete forest resources.
- Continued development of transportation corridors could result in fragmenting the vital continuum of forest-mangrove-marine ecosystems.
- Failure to provide communities affected by SBPA development can result in negative attitudes towards protection and increase illegal activities in and near the protected area.

- Inadequate enforcement of the existing laws and regulations.
- Inadequate information on the levels of productivity and extraction of plant and animal products necessary for their sustainable management.

Sustainability of ecological resources and their human values ultimately depends on effective management and the support of local communities and individuals. The connection between declining fish populations and destruction of breeding habitat is not generally apparent. Most communities recognize the value of vegetation cover in reducing the effects of flooding but secondary effects of sedimentation and freshwater input on reefs and other nearshore marine habitats is seldom recognized or appreciated by most citizens. Confirmation of the interconnectedness of the resource values among physical resources, biological resources, and socio-economic resources is one of the major findings to emerge from inventory studies. To be of management value, this concept must be incorporated into protected area and buffer zone management plans and programs and must be communicated to all stakeholders.

Additional issues of concern are addressed in Volume II of this plan in section 3: Summary of Issues, Threats, and Opportunities.

10.2.1 Terrestrial Flora

Fire is the single most destructive agent and must be effectively controlled and managed if these areas will again be forested and the existing natural forest protected. Fire prone areas are those near human communities. In SWFR, these are in the Pastolan area and in Morong side. Grassland fires encroach on adjacent forest and prevent the regeneration of tree seedlings thus reducing overall forest cover.

Illegal cutting of forest stands and encroachment into the forest areas pose a significant threat to the existing forest vegetation in the SBFZ. Also the pressure of on-going urban development and resource access on land reserves are key concerns cited.

Extraction of plant materials such as timber, tiger grass, buho, climbing bamboo, rattan, and orchids can occur but needs to be managed so that the resources are sustainable for future generations. It has also been reported that climbing bamboo and other plants are harvested in a manner that may not be sustainable near the Pamulaklakin and Jungle Environmental Survival Training (JEST) facilities as part of their tourism programs. At present, management is limited by an understanding of what levels can be sustained.

Protection of the vegetation has many economic benefits that would be threatened if the SBPA were not established. These include:

- sustainability of economic resources used by indigenous people,
- attraction of tourists and development of ecotourism,
- protection of water resources for local communities,
- reduction of flooding potential,
- reduction of sedimentation and degradation of marine resources, and
- potential for bio-prospecting for medicines and other important plant chemicals.

10.2.2 Terrestrial Fauna

The Philippines is rich in native animal species, many of which occur nowhere else in the world. Most of these species that inhabit forests are endangered due to extensive deforestation and overexploitation. The environs of Subic Bay are among the last areas in Luzon with substantial areas of natural forest remaining.

Many of the issues and concerns for fauna are the same as previously described for flora. Overexploitation of resources with human uses includes over-hunting of species such as pigs and bats. For example, the small bamboo bat is eaten by Aeta and is also consumed as part of survival training at the JEST facility. The long-term management of this and other species will depend on acquisition of data that permits sustainable management of these resources.

Habitat rehabilitation and protection is an important consideration in establishing the SBPA. Areas such as the bat roost for the giant fruit bat; nursery areas for fish invertebrate species in mangrove, seagrass bed, and reef areas; and beach protection for endangered sea turtles are in need of immediate and effective protection.

10.2.3 Marine

Several issues and concerns emerged from marine investigations that provide a basis for development of this protected area management plan. Perhaps the most significant was the discovery and delineation of many important marine habitats in direct association with the forest and wildlife resources of the SWFR.

Boundaries in Marine Areas

On the basis of information developed during marine inventories, modification of the boundaries of the proposed SBPA to encompass these resources is a major concern. Although most of the zones of the protected areas have been defined and validated, the boundaries in the marine areas must be formally adopted and marked. This would permit the efficient monitoring of resource use and compliance to regulations. The opportunity that this limitation presents is the participatory manner by which these markers are designed, installed and maintained. Local stakeholders may be made to work together and to realize that the bay could actually be managed through collaborative efforts.

Sedimentation and Pollution

As indicated in the marine biophysical inventory of SBMA, the marine waters found in the innermost portion of the bay is recipient to most of the garbage, sewage, and sediment from populated areas. This type of threat to the bay will continue unless some remedial measures are implemented. If and when this situation is presented as a real threat to the health, livelihood and recreation of residents in the locality, they may take on some initiative towards remedial measures.

Conflicting Resource Uses

The area of the bay, including its marine and terrestrial components, presents a limited resource in reference to the constantly increasing local and foreign visitor population. Land use covers the range of domestic, industrial, forest, recreation uses while the marine components are used for fishing and recreation. Increasing populations contribute to sewage and garbage volumes that conflict with recreation, particularly swimming which requires relatively pristine waters. This is true with pollution versus fishing, industrial uses versus recreation, forest habitat versus recreation, etc. Conflicting uses will present the need for zoning, the drafting of management guidelines and a collaborative effort among all stakeholders.

Water skiing, jet skiing, diving, resorts and boat trips are non-extractive recreational activities observed in the area. Motorized vehicles, particularly those that are driven repetitively at high speed above the reef may cause some disturbance to the corals beneath due to the intensity of vibrations and sounds. Thus there may be some minor conflict with these uses both within and outside the protected area. There is a need to generate inputs from stakeholders, particularly resort owners, into the management plan.

Compliance with Wastewater Discharge Limits

Increased nutrient loads are detrimental to marine ecosystem's health. Based on recent surveys, it appears that at the moment not all industries established nearshore comply with nationally imposed environmental conditions. With inevitable increases in growth, conditions are likely to worsen, threatening the sustainability of marine resources throughout the bay. Collective effort among leaders of municipalities in the form of issuing relevant ordinances must be encouraged in support of national efforts/policies in this area.

Conflicting goals for resource management

Resort owners may have different interests from fishers thus have different points of view on coastal management. So have the business sector and those pushing for conservation, golfers, forest managers, and so on. Once self-interest is relegated behind the common interest, the need to create a unified concept of coastal management may be easier recognized and training or orientation on coastal management better accepted. Design and implementation of an effective protected area management plan must consider the needs of all stakeholders and a common vision must be supported by them for the SBPA to be truly sustainable.

10.3 Socio-Economic and Cultural Environment

10.3.1 Fisheries

The issues and problems confronting the fisheries of Subic Bay are common to many parts of the country. Decreasing catch is the effect of the destruction of the habitats with the use of ecologically harmful fishing gears and practices. Similarly, the "*free access*" nature of the fishery resulted in the high density of fishers now based in Subic Bay. Note that the availability of only 1.83 hectares of fishing ground per fisher is dismally very

small and not sustainable. Philippine average for fishers density in traditional fishing grounds is between 75-500 hectares per fisher.

As there are no laws regulating fishing (number of fishers, number of fishing units), the number of fishers is expected to increase. This will put more pressure on the existing but already declining stocks. Together with the local disappearance of certain fish stocks and the reduced mean sizes of fishes, all three indices whenever present at the same time, are ominous signs of overharvesting of resources. The sustainability of the fisheries resources inside the bay will be jeopardized.

If this situation is not addressed directly there will be mounting pressure to open the protected area to fishing. Fishers looked for alternative grounds when they experienced the decrease in availability of fish inside Subic Bay some five years ago. It was fortunate that fishing on the fish aggregating devices (FADs) located in South China Sea was highly profitable. The discovery came at the most opportune time when the fishers still had the capital to undertake these changes. About 400 boats based in Subic Bay comprise the distant water fleets.

The shift of many fishers to other areas practically extended the profitable timetable of fishing inside the bay. The distant fleet reduced the fishing effort inside the Bay by as much as 30%. It presumably also allowed recovery of certain stocks. Note that boats that ventured outside were larger craft using larger fishing gears.

The resources of Subic Bay were then left for the artisanal fleet that cannot afford to fish outside. This situation will not last for long. Fishing pressure is increasing, especially from those who lost jobs when the Naval Base was vacated. What is worrisome is that the remaining fishers of Subic Bay are the poorest ones.

It is therefore strongly recommended that the protection of the existing area to fishing be continued in order to buffer the intensive fishing activity in the non-protected part of the bay. Management must look into reducing the very high number of fishers and fishing units operating inside the Bay and at the same time prevent new entrants to the fishing sector. This is the key if sustainability, protection and conservation of the fisheries resources and their habitats are main objectives of the protected area management project.

Subic Bay is in a comfortable position to immediately act on this issue since a viable fishing alternative exists. The establishment of a credit facility for the poor fishers is what it takes to reduce fishing effort and to shift fishing activities to other areas.

It is interesting to note that despite all these developments, fisheries productivity remained high and the fisheries resources somehow appear to be able to withstand these pressures. The reason is presumably the upside effects of the protected zone where the fishes could reproduce and grow. What the fishery gets from the non-protected area are the “spill over” population from the protected area. Such has been observed in other two key protected areas (Alcala 1986, 1992). But unless some concrete action is undertaken

to regulate the fishery, Subic Bay may simply follow the fate of Manila and many other bays of the country - a fishing ground with no fish.

10.3.2 Upland Communities

Upland communities are quite aware of the implications of logging and other destructive forest activities. As Roger Liwanag of Batiawan puts it "the mountain is our resource and life (*ang bundok ang aming kayamanan at buhay*), there is where we get our food and cash for our day-to-day needs. The mountains are just like our big shopping centers where we get our subsistence". Whenever he goes hunting, he would ask his kids what food they want to eat – *hito, dalag*, shrimp, *bayawak*, etc., and searches for the desired food.

Several concerns related to loss of forest cover have been identified, including diminished fish/river resources such as shrimp and fish and decreased water supply.

Other socio-economic issues related to the establishment of protected areas were identified during planning studies. Several of these issues involved concerns of moving away from direct dependence on forest products as a result of forest protection to alternative livelihoods.

1. Limited market outlets and low price for their produce

Some key informants expressed their limited options in marketing their produce. They have no recource but to sell their produce to local traders and nearby public markets at low prices.

2. Limited Processing and Product Development Alternatives

There is no value added to raw materials marketed directly to local traders and nearby markets. It is also observed that there is low level of processing technology or innovations on product development due to limited exposure, market demands, and product design.

There are many Aeta and non-Aeta families who are engaged in cottage industries (handicraft). However, production systems are not defined, slow and are not well inclined to define production targets. These have implications on the type of capability building and training activities that will be designed for individuals and organizations.

3. Lack of Livelihood Support

Earlier mentioned is the limited access to financing, market facilities, technology, and infrastructure support for the improvement of production output or productivity in the uplands. It should be emphasized that these supports are crucial to the success of livelihood projects.

4. Lack of Access Instruments

This is an issue brought about by key informants in many upland communities. Some agreements, i.e., CBFM, CCFS, have been entered into with some communities (Naugsol, Batiawan, some areas in Cawag and Iram resettlement) that provided a sense of tenure. The insecurity of tenure though did not hamper the effort of many upland communities at engaging in agro-forestry activities, the result of which are quite impressive. In fact, some key informants felt that to a certain extent these investments helped the upland families to put claims on occupied lands for sustainable use. These areas should be carefully studied in the planning of protected areas including definition of land use and management zones.

10.3.3 Coastal Communities

The overall situation of the coastal and marine resources is not encouraging. Fishermen are quite pessimistic of their plight, as they perceived continuing decline in fishery and other marine resources. For instance, one key informant traced fish production over a twenty-year period starting in the 80s. He noted 50% decrease in fish catch during the 90s and perceived further decreases in the future. This in contrast to a more optimistic view of the upland farmers because of continuing fruit tree planting which they expect to harvest within the next five to ten years.

The fishermen went on to relate a decreasing income from their fish catch.

	1980s	1990s	1999
Individual share	P1,000/trip	P500/trip	P150-P200/trip

Although, there are other livelihood options for fishermen, the condition of fishery and marine resources need serious thought and concern.

Some of the issues that have to be addressed and that have crucial implication on the drawing of livelihood strategies and planning include:

1. Decreasing fish/marine resource supply

The decrease in fish supply is notably caused by the increase in the number of fishermen after the Mt. Pinatubo eruption and damage of coral reefs due to dynamite use and continuing illegal fishing methods. The end result is marine habitat destruction and increased poverty among fishermen. Planning has to consider strategies that will bring about more awareness on marine and fishery conservation and management including IEC and advocacy activities.

2. Violation of Marine Regulations and Laws

Although there are existing fishery and marine regulations and laws, resource inventory surveys revealed that citizens know that these are sometimes violated or not enforced.

Others expressed concern for what they considered the lack of political will on the part of the authorities. Some fishermen indicated that the violators are not from their ranks or barangays but from other provinces as the Visayas or Cavite.

Other issues identified during planning surveys were inadequate fishing gears, lack of safety mechanism/navigational equipment, piracy, and financing constraints. While not directly related to the management of the protected area, they are considerations in planning for alternative livelihood strategies. Although there are other livelihood options for the coastal communities due to their proximity to the commercial and trading centers, continuing inaction will further deplete the already low supply of fishing and marine resources, further increasing poverty conditions of coastal communities. Overall, drawing strategies for alternative livelihood has to take into consideration the holistic needs of fishermen including financing, production and marketing concerns.

Alternative modes of fish/marine production should be explored such as fish cage methods, seaweeds production, etc.

Owing to the rapid industrialization of the area, livelihood skills should cater to the needs of industries so more residents could be employed formally. Some organizations such as some cooperatives have shown successful initiatives. Knowledge and insights could be drawn in the conceptualization of livelihood activities as well as design of organizational and institutional development strategies.

10.4 Land Use

There were two approaches used in the identification of planning and land use issues, constraints and opportunities. The first one involved the overlaying of the various thematic maps to generate inconsistencies in the actual use and legal intentions of the land or incompatibility of the use with the existing environmental condition and status of the area. The second approach entailed an assessment of the policy and institutional conflicts drawn from the review of the planning environment and from dialogues with representatives of the various stakeholders in the area.

The following land use issues below were derived from map overlay analysis.

1. Land Classification and Regulatory Status Map and SBFZ Administrative Map

- Presence of the military
- Portions of the Bataan Natural Park is within the legal boundaries of the SBFZ
- DENR projects (reforestation, CBFM, usufruct) within SBFZ

2. Land Classification and Regulatory Status Map and Land Use Map 2000 (FF Cruz and satellite imagery)

- Large tract of grassland areas over classified forest lands

- Presence of pasture leases/permits and Industrial Forest Management Agreement (IFMA) over forested areas in Mt. Silanguin
- Agricultural uses and settlement areas within the military reservations in Mt. Silanguin and Mt. Nagzasa
- Settlements within the declared Olongapo Watershed Reserve

3. Land Classification Map and Slope Map

- There are steeply sloping areas situated in classified A & D lands particularly in Subic and Olongapo areas
- The two military reservations in Mt. Silanguin and Mt. Nagzasa are dominated by steeply sloping areas
- There are very steep areas (50% and more in slope) in the Mt. Balakibok area which by law should be declared as protected areas

4. Land Use Map 2000 (supported by FF Cruz and satellite imagery) and Slope Map

- Presence of settlements in steeply sloping areas of Olongapo City and Subic
- Large tracts of grassland along the steep and very steep slopes of Barangays Cawag, Pundaquit and Batiawan
- Existence of agricultural areas in steeply sloping lands of Subic

5. Land Use Map, Slope Map and Erosion Map

- Susceptibility to moderate to severe erosion of steep to very steep grassland areas in Barangays Cawag, Pundaquit and Batiawan

6. Land Classification Map and SAFDZ Map

- Proposed built-up areas within the forest zone of Barangay Cawag, Subic and Olongapo City
- Proposed livestock sub-development zone overlaps with existing IFMA in Barangay Pundaquit
- Proposed strategic crop sub-development zone and strategic livestock sub-development zone overlap with existing IFMA and ISF/CBFM projects of DENR
- Proposed forestry/watershed zone within A & D lands in Barangay Batiawan, Subic and Olongapo City near the boundary with Dinalupihan, Bataan
- Proposed strategic crop sub-development zone adjacent to the proposed boundary of the SWFR in Hermosa, Bataan

The other planning and land use issues and constraints below were derived from discussions with representatives of the various stakeholders within the area.

1. Forestlands

- Mineral claims and permits inside NIPAS areas, declared watersheds and classified forestlands
- Military Reservation overlapping with NIPAS areas, declared watersheds and classified forestlands
- Permits, licenses, leases, stewardship contracts (e.g. pasture lease permits, tree farm leases, integrated social forestry) inside protected and forest areas
- Land claims (with tax declarations) inside protected areas and forest lands
- Existence of ancestral land/domain claims
- Illegal occupation of forest lands and NIPAS areas
- Titles inside classified forest lands and NIPAS areas
- Absence of tenurial instruments over resource access and use within protected areas
- Illegal harvest and utilization of minor forest products and non-timber resources
- Presence of settlements and other uses (e.g. industrial, grazing, agriculture, infrastructure and utilities) inside protected areas and forest lands
- Tourism development

2. Coastal areas

- Tenurial arrangements and instruments for access and use of coastal and fishery resources
- Conflicting uses of coastal areas, e.g. for fishponds, resort development, settlements, agriculture and quarrying purposes
- Titling of foreshore areas
- Conflicting water uses

3. Agriculture areas

- Conversion of prime agricultural lands and agrarian reform areas to other uses
- Conversion of pasture/livestock areas to other uses
- Unclear policies on idle grassland areas, degraded grazing areas and areas covered by cancelled grazing permits/leases
- Agricultural development on legal river easements

4. Built-up areas

- Urban development in sloping and other hazard prone areas
- Encroachment in forest zones and easements of water bodies
- Presence of squatter settlements
- Conflicting land uses

5. Infrastructure

- Acquisition of right-of-way in forest zones and private/titled properties

6. Rivers/lakes/streams

- Pollution of rivers and other tributaries by indiscriminate dumping of liquid and solid wastes
- Conflicting uses of water resources

10.5 Institutional Issues

The institutional issues to be addressed relevant to protected area management can be grouped into two major concerns. The first pertains to the conflicts and overlaps as regards jurisdiction and authorities of agencies within the SBFZ. The other deals with the inadequate capacities of existing organizations for environment and natural resources (ENR) protection, conservation, management, and development.

Specific issues concerning jurisdictional conflicts and overlaps include the following:

- Unclear delineation of jurisdictions of the DENR, local government units, and SBMA for forest lands outside the "fenced/secured" area

- Overlapping jurisdictions over coastal areas of DENR, Department of Agriculture/BFAR, Department of Tourism, local government units, and SBMA

- Overlapping responsibilities of local government units, DA and DAR on agricultural development

- Absence of a mechanism for a coordinated urban planning and development

- Unclear institutional structure for protecting freshwater bodies

Issues on institutional capacities for ENR management relate to the ability of the concerned agencies to manage, direct, and participate in a comprehensive program for resource and biodiversity conservation and development. The agencies and offices within the SBFZ that have either direct or indirect responsibilities and authorities over land and resource management and biodiversity conservation, i.e., SBMA-Ecology Center, DENR, and LGUs neither have the logistics and staffing resources to solely address the problems and issues cited above. Besides, these agencies have also other social and economic development mandates that need to be given adequate attention and support. These responsibilities surely will compete with the requirements for ENR management especially in terms of financial resources and allocation of the limited financial, personnel, and physical assets of these agencies.

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