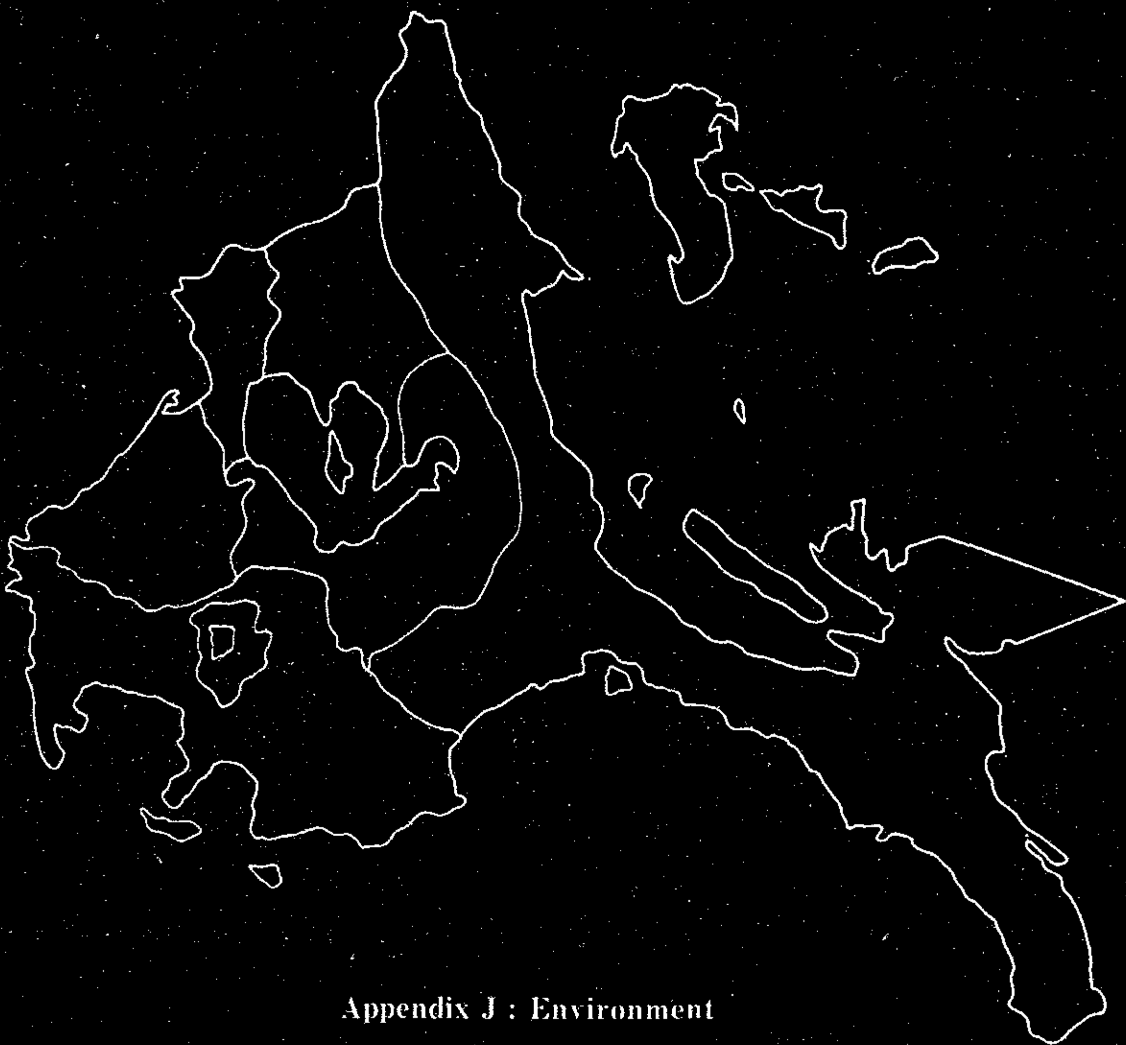
REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF TRADE AND INDUSTRY

THE MASTER PLAN STUDY ON THE PROJECT CALABARZON

FINAL REPORT



Appendix J : Environment

October, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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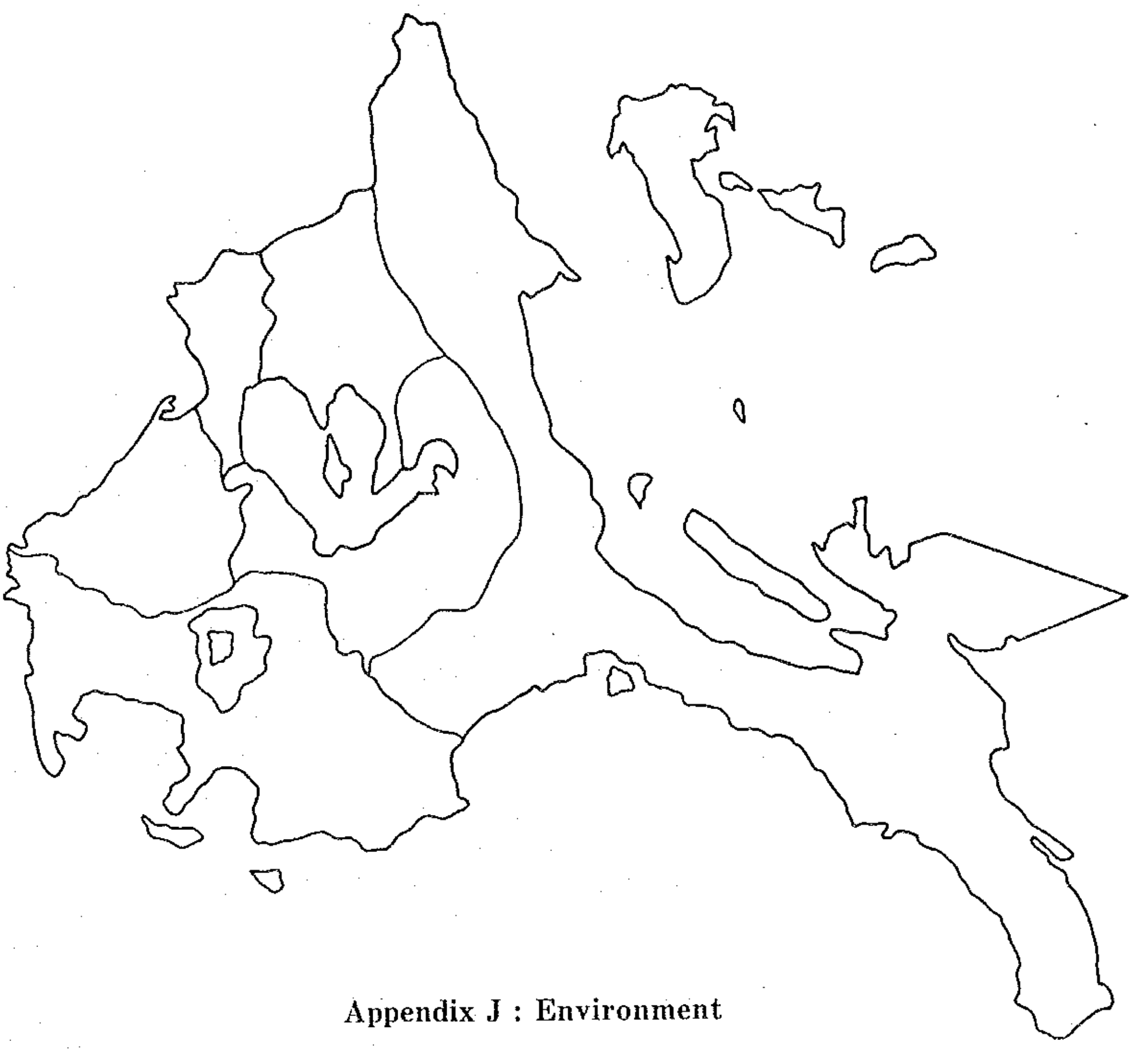

Appendix J : Environment

October, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF REPORTS

1. Executive Summary Report
2. Master Plan Report
3. Appendix A : Agriculture
4. Appendix B : Industry
5. Appendix C : Tourism
6. Appendix D : Water Resources
7. Appendix E : Transportation
8. Appendix F : Telecommunications
9. Appendix G : Energy
10. Appendix H : Urban and Spatial Development
11. Appendix I : Social Development
12. Appendix J : Environment
13. Appendix K : Project Profiles

Appendix J ENVIRONMENT

Table of Contents

Annex to Appendix J

I. Environmentally Critical Projects

II. Environmentally Critical Areas

List of Tables

List of Figures

Appendix J: ENVIRONMENT

J.1 Existing Natural and Physical Conditions

J.1.1 Overview

The CALABARZON region is a sub-region of Region IV, having a total area of approximately 16,000 km^2, covering five provinces located in the east and southeast of Metro Manila. The eastern-most part is the Sierra Madre mountains that constitute part of the backbone of Luzon island. In the southern part, several mountains of volcanic origin are found without any range of mountains.

Laguna Lake is found in the lowland to the southeast of Metro Manila, occupying part of Rizal and Laguna provinces. Taal Lake is in Batangas province. Rivers find their origins in these mountains and lakes, drain relatively small catchment areas and form small alluvial lowland along their main courses.

The Region is located in a tropical zone. The temperature is relatively high throughout the year with only small seasonal variance. The precipitation is governed mainly by tropical monsoon climate that usually exhibits distinct rainy and dry seasons. The annual precipitation varies within 1,800 - 4,000 mm. Some 70 - 80% of the total annual precipitation falls in five months from May to October. Floods occur often during rainy seasons. Damages by typhoons are also common phenomena. Another source of natural disasters is the Taal volcano which erupts once in a while.

Land use in the Region is dominantly agricultural, consisting of rice, sugarcane, pineapple, coconut and other crops cultivation. Vegetables are also common, especially in areas close to Metro Manila. Mountain areas are covered with coconut plantations and forests which are partly denuded.

Present land use in CALABARZON is summarized for Quezon and the four other provinces.

Land Use in CALABARZON

Land Use	Cavite, Laguna, Batangas and Rizal		Quezon	
	Area (ha.)	%	Area (ha.)	%
Agricultural crops	411,434	54.7	455,610	52.3
of which coconut	173,182	(23.0)	385,932	(44.3)
of which sugarcane	92,667	(12.3)	-	(0.0)
Grass and shrubland	192,065	25.5	68,858	7.9
Forest and woodland	72,157	9.6	310,463	35.7
Built-up area	41,104	5.5	33,289	3.8
Total	752,223	100.0	870,660	100.0

J.1.2 Physiography, geology and slopes

(1) Physiography

Physiographic characteristics of the CALABARZON region have been analyzed based on the maps of 1 to 50,000 prepared by the Bureau of Soils and Water Management (Subdivision of DA during 1970's and 80's).

The physiographic classification of land into 13 classes is summarized in Table J.1 for CALABARZON (Figure J.1 through J.5). Main characteristics by province are outlined below.

Cavite

The provincial land slopes generally from foot slopes in the south, through terraces, to alluvial plains in the north. The land in these classes occupies over 60% of the total land area. Hills (high relief) and mountains constitute some 20% and coastal plains 2%.

Laguna

Alluvial plains extend mainly in the lowlands along the southern to the eastern lakeshore of Laguna de Bay, accounting for 25% of the provincial land. Hills (high relief), mountains and volcanics combined occupy 34% of the total land area, located mainly along the southern to the eastern borders with the neighboring province of Quezon. Terraces and foot slopes are found between the mountainous areas and the alluvial plains.

Batangas

Plateaus formed by volcanic activities extend in large part of the province, while mountainous areas around the Taal volcano are relatively small. Terraces and foot slopes constitute 41% of the provincial land, and hills (high relief), mountains and volcanics account for 31%. Lowlands are confined to 1.5% on alluvial plains and 9% on coastal plains.

Rizal

The main part of the province is the middle to upper catchment areas of the Marikina river. Thus, hills (high relief) and mountains occupy 57% of the total land area. Another 14% is classified as hills (low relief). Alluvial plains concentrate along the northern lakeshore of Laguna de Bay, occupying 7% of the land area.

Quezon

The provincial land is dominantly hilly to mountainous covering two-thirds of the total land area. Hills of low profile extend from the central part to the Bondoc peninsula utilized for coconut trees and extensive grazing. Hills of high profile are found around the low profile hills and covered by forests or coconut trees. The northern part is the Sierra Madre mountains covered mostly by forests. Alluvial plains are limited to the lowland near Infanta, deltaic lowlands of small rivers and the areas around Lucena City, constituting 15% of the land.

(2) Geology

The Bureau of Mining of DENR has issued a geological map of CALABARZON in 1 to 50,000 scale, covering mainly the area to the west of central part of Laguna Lake. Other geological maps in 1 to 1,000,000 are available for the entire country. Based on these maps, main characteristics of typical geological formation in CALABARZON are outlined below (Figure J.6).

Mesozoic formation

This is the oldest formation in CALABARZON composed of sedimentary rocks of the Cretaceous period or later in the Mesozoic era. It distributes widely within the Sierra Madre mountains in the northeastern part of Rizal and the northern part of Quezon.

Cenozoic era, tertiary formation

Distributed in the formation corresponding to the tertiary period of the Cenozoic era are sedimentary and volcanic rocks. The sedimentary rocks are found mainly in the mountainous areas of Rizal and contain sandstone, shale and reef limestone. The volcanic rocks are the main constituent of the Sierra Madre mountains and consist of diorite and other rocks. Other formations are found in the Lobo mountains and part of the southwestern peninsular of Batangas.

Quaternary deposits and volcanics

Most widely distributed in the CALABARZON region , except in Quezon are the formations of volcanic rocks. They were formed by active volcanic activities mainly after the diluvial epoch of the tertiary period derived from the Taal, Banahaw and other volcanoes. Main constituent rocks are lava flow of andesite and basalt, breccia and tuff. They are deposited on foots of volcanoes and in shallow coastal areas to form plateaus or hills of low relief.

Alluvium

This is the newest formation derived through sedimentary processes of rivers, and contains sand, gravels and clay. Distribution in CALABARZON is in the lowland along the lakeshore of Laguna de Bay, the coastal areas in Cavite, along the southern coast of Batangas, and small deltaic plains in Quezon.

Faults

North-south faults are dominantly developed in the northern part of the Region and NW-SE faults are dominant in the Bondoc peninsula in Quezon. The N-S faults are dissected in some parts by NW-SE faults. Laguna de Bay was formed by major geological movements of these fault structures. Major faults are observed in the eastern and the western parts of the Lake. The one on the east runs in the north-south direction parallel to the Sierra Madre. In the west, the Marikina fault runs from the upper catchment area of the Marikina river, through Muntinlupa, all the way to the Taal lake. This fault is still active and considered to be strongly associated with the formation of the Taal lake as well.

(3) Slopes

Slopes represent an important factor affecting land development for various uses and need for land conservation. A slope map has been prepared in 1 to 250,000 scale based on existing data. The following summarize main features by province (Figure J.7 through J.11).

Cavite

The land is relatively flat with 79% of the total area having slopes less than 8%: 38,033 ha or 30% of the total area having 0 - 3%, and 63,654 ha or 49% having 3 - 8%. Slopes steeper than 30% are found only in the Palay-Palay mountains and the Tagaytay ridge, with the total area of 14,906 ha or 12% of the provincial land.

Laguna

Uplands in Laguna are relatively widespread with gentle slopes of 8 - 18%, totalling 64,552 ha or 37% of the total provincial area. Lands having smaller slopes occupy 86,732 ha or 49% of the total. Mountains with slopes over 30% have an area of 7,364 ha or 4% of the total found mostly around the Banahaw and Makiling mountains.

Batangas

The province has the largest area of relatively flat lands: 69,233 ha less than 3% and 43,882 ha in 3 - 8%, totalling 113,115 ha or 36% of the total area. Mountain areas with over 30% gradient also occupy a large area of 119,429 ha or 38% of the total.

Rizal

Lands with small slopes are limited in the province: 15,846 ha with less than 3% and 16,482 ha in 3 - 8%, totalling 32,328 ha or only 25% of the total area. Lands with 18 - 30% gradient total 32,056 ha or 25% of the land area, and slopes over 30% occupy 29,349 ha or 22% of the total.

Quezon

Flat lands with less than 3% gradient are found only in area around Lucena City, area in Infanta, and small lowland areas in the Bondoc peninsula and Polillo islands. Lands with 8 - 18% are found near mountains and hills and spread widely in the Bondoc peninsula. The northern part of the province and substantial part of the Bondoc peninsula are mountains of high profiles having slopes over 18%.

J.1.3 Vegetation and land use

Surveys were conducted by DA during the early 1980's for existing land use. Based on their results, land use patterns and vegetation in CALABARZON have been classified into

12 types. Land use statistics are summarized in Table J.2. Distribution of land use is illustrated by province in Figures J.12 through J.16. Main features are described below.

Coconut has the largest share of the agricultural land in CALABARZON and four of the five provinces except Rizal. It is particularly dominant in Quezon with 44% share. Multi-cropping is becoming a common practice in the coconut area. Main crops inter-cropped are coffee, banana and pineapple in Cavite, lanzones, coffee, rambutan and avocado in Laguna, coffee, blackpepper, lanzones and citrus in Batangas, and lanzones and banana in Quezon.

Irrigated paddy area is the second largest in Cavite and Laguna with 15,000 ha or 12% and 22,000 or 13% of the respective provincial land. In Batangas, the area of non-irrigated paddy is 16,000 ha or 5.2% of the total land, while the area of irrigated paddy is only 2,300 ha. In CALABARZON as a whole, both irrigated and non-irrigated paddy fields combined occupy 125,000 ha or 7.7% of the total land.

Forest and woodland cover 36% of the provincial land in Quezon, but in other provinces their coverage is only smaller than 10%. The built-up area occupies smaller than 5% of the total land area.

More details by province are summarized.

Cavite

1) Areas below the elevation 100 m are used mainly for irrigated paddy, occupying 15,169 ha or 12% of the provincial land area. Non-irrigated paddies occupy 7,146 ha or 6% of the total. Sugarcane fields extend in inlands close to 100 m contour, which are being gradually replaced by urban/industrial uses.

2) Coconut areas, often inter-cropped with coffee, bananas and pineapples, have a total area of 21,512 ha or 17% of the total.

3) Forest areas are found in the Palay-Palay mountains, having an area of 8,854 ha or 7% of the total provincial area.

Laguna

1) Irrigated paddies cover 22,300 ha, the largest among the CALABARZON provinces. They are mainly along the shares of Laguna Lake.

2) Sugarcane fields concentrate in the western shares of Laguna Lake. The total area is 11,860 ha or 6.7% of the total provincial area.

3) Coconut areas, widely distributed to the south of paddies, cover 69,300 ha or 39% of the total.

4) Shrubs and forests cover mountainous areas including Mt. Banahaw. Shrubs cover 16,900 ha or 9.6% and forests 26,000 ha or 15%.

<u>Batangas</u>

1) Irrigated paddy area is only 2,300 ha, while non-irrigated paddies occupy 16,400 ha or 5.2% representing the largest area in CALABARZON in this land use category.

2) Sugarcane is grown in extensive uplands with 70,300 ha or 22% of the total land area.

3) Coconut areas are found in Taal Lake - Tagaytay area, covering 80,200 ha or 25% of the total.

4) Grassland and shrubs cover 77,000 ha in total, dispersed along the western share of Taal Lake and on mountains in the southeastern part of the province.

5) Bamboo forests are distributed on valley slopes, totalling 10,100 ha. Other forests cover 19,500 ha or 6%.

<u>Rizal</u>

1) Irrigated paddies cover only 3,600 ha or 3% mostly along the Laguna lakeshores. Non-irrigated paddies covering 4,000 ha are found in valley floors.

2) Fruit trees and banana cover 7,800 ha and 1,200 ha, respectively.

3) Grasslands called Cagon are widely distributed in the province. Cagon is a result of shifting cultivation in the past. The total area of grasslands including Cagon is 69,900 ha or 53% of the provincial area.

4) Bamboo forests cover 4,700 ha or 3.6% of the total.

5) Forests are preserved mainly in the Sierra Madre mountains. The total area is 15,386 ha or 12% of the provincial land.

6) Residential areas are expanding in the areas adjacent to Metro Manila and along Laguna lakeshores. Built-up areas occupy 15,200 ha or 12% of the provincial land.

Quezon

1) Main irrigated paddies are found in areas around Lucena and on delta around Infanta. Non-irrigated paddies are found in alluvial lowlands distributed from Atimonan to the Bondoc peninsula.

2) Slash-and-burn farming, called kaigin, is practiced in Quezon in relatively large scale on mountains and hills such as along the southeast foot of Mt. Banakaw and northern part of Tagkawayan. The total area is approximately 30,000 ha.

3) Corn is cultivated mainly in the southern part of the Bondoc peninsula, with the total area of some 13,000 ha.

4) Coconut area is widespread covering 385,900 ha or 44% of the provincial area from the central part to the Bondoc peninsula. Coconut areas in lower elevation are inter-cropped mainly with bananas and lanzones. Shrubs grow in coconut forest floors that are not well cared for.

5) Grasslands are found mainly on the hills of the Bondoc peninsula as Cagon or Talahib, occupying 64,000 ha. Of this total area of grasslands, some 12,000 ha are pastures.

6) There are vast forests in the Sierra Madre mountains. Higher parts of Mt. Banahaw and central parts of the Bondoc peninsula are also covered by forests. Mangrove forests are found along coastal lowlands, covering in total 19,000 ha.

J.1.4 Soil and erosion

(1) Soil

A soil survey was conducted throughout the Country during 1970's and 80's. The survey was completed for CALABARZON except Cavite with soil maps in 1 to 50,000 scale.

Reports for Laguna and Rizal were published in 1987 and 89, respectively, and one for Batangas is in preparation.

The data were prepared based on aerophoto interpretation, soil profile surveys, physical and chemical analyses of sample specimen and others. Problems in developing soil maps arise from the lack of uniformity in soil type classification.

Soil conditions in CALABARZON are outlined below. Detailed descriptions by province are contained in Annex.

Most part of the CALABARZON land is covered by volcanic ash and tuff. In the Laguna de Bay basin, this constitutes 86% of the land area, while the remaining 14% is alluvial and fluvial plains. Alluvial plains along the Laguna lakeshore are subject to seasonal flooding due to their high clay content ranging from 40 to 70%. Fertility of the soil is generally high as it contains organic matters originating from the upland and carried by storm runoffs.

Soil in the foothills consists mostly of volcanic tuff with texture ranging from clay to clay loam. Fertility of this type of soil varies depending on topography and amount and/or intensity of rainfalls as well as soil property.

The remaining areas are mountainous, consisting of peaks, ridges, side slopes along crater rims and complex volcanic ranges. Land forms are composed mainly of lava flow of andesite and basalt, breccia and tuff.

(2) Erosion

The CALABARZON region has a tropical climate with high temperature throughout the year, and has distinct rainy and dry seasons. In addition, the large rainfall and rock weathering are typical of tropical climates. Thus, the Region is susceptible to soil erosion. Soil erosion problems will be directly related to degradation in agricultural productivity due to loss of top soil on cultivated lands, and in turn related to siltation problem at the lower parts of river systems due to soil lost and carried from the agricultural land.

In the CALABARZON region, about 40% of the entire area (most of Rizal and Laguna provinces) constitutes basins for rivers flowing into Laguna Lake. Soil erosions at the upper streams has a direct relationship with the siltation of Laguna Lake.

The erosion potential map for CALABARZON has been prepared based on slopes, land utilization/vegetation status, and soil type.

Erosion potentials are classified on the map in the following four types:

E0	:	None
E1	:	Slight
E2	:	Moderate
E3	:	Severe

Statistics by province have been compiled for different levels of erosion (Table J.3). Characteristics by province are presented below.

Cavite

E0 areas with least erosion potential are limited to coastal lowlands near Cavite City with an area of 2,840 ha. E1 (slight erosion) areas extend from areas with altitudes less than about 100 m to coastal lowlands with an area 21,560 ha. These areas occupy 17% of the provincial area. E2 (moderate erosion) areas with greater erosion potential extend widely from central parts to southern parts of the Cavite plateau, occupying 78,725 ha or 61% of the land. E3 (severe erosion) areas include steep slopes mainly from Tagaytay to the Taal Lake shores, and in the Palay-Palay mountains, having 25,650 ha or 20% of the total area of the province.

Laguna

E0 areas total 62,488 ha, 36% of the province. The area includes mainly alluvial lowlands along the Laguna Lake shore and lowlands around San Pablo. E1 areas total 35,816 ha, 20% of the province. E2 areas totalling 63,570 ha or 36% of the province include hills and the Caliraya plateau to the south of Laguna Lake. E3 areas have 14,096 ha, 8% of the province, covering volcanic areas such as Mt. Banahaw located to the south of Laguna Lake, and steep escarpments formed between the Caliraya plateau and Laguna Lake lowlands.

Batangas

E0 areas cover 65,665 ha, 21% of the province, including mainly seaside lowlands surrounding Batangas, Balayan and Nasugbu, and San Juan of the eastern part of the province, and some of the inland plateau. E1 areas total 106,998 ha, 34% of the province. E2 areas cover 85,907 ha, 27% of the province, while E3 areas have 58,011 ha, 18% of the province. These areas of greater erosion potential are found on the steep slopes around Taal Lake, volcanic lands to the west of Taal Lake, and mountains around Lobo.

Rizal

E0 areas occupy 16,523 ha or 13% of the province, including mainly lowlands along Laguna shores and along the Marikina river. E2 areas total 44,792 ha or 34% of the province while E3 areas total 56,867 ha or 44% of the province. These areas include the upper stream areas of the Marikina river and the Sierra Madre mountains. Thus, almost the entire Rizal province, except for some parts, is vulnerable to soil erosion.

Quezon

In Quezon Province, erosion degrees are classified into three types. Areas with "no apparent erosion" are limited primarily to alluvial lowlands. This rank includes areas stretching from Tiaong to Lucena, those around Infanta, and coastal lowlands of the Bondoc peninsula. Areas with "slight erosion" include almost all hills from the Sierra Madre mountains down to the Bondoc peninsula. Additionally, the entire area except the coastal lowlands of the Polillo islands is also included. There are few areas with "moderate erosion". They are found only in some parts of the Sierra Madre mountains and in the north-eastern part of the Bondoc peninsula.

J.1.5 Climate

(1) Climatic types

The climate of the Philippines is categorized into four types based primarily on rainfall characteristics:

- Type I : Two pronounced seasons, dry from November to April and wet during the rest of the year; rainfalls concentrating in June through September; effects of monsoons from the southwest;
- Type II : Dry season not pronounced; largest rainfalls in winter, usually in December through January;
- Type III : Wet month not pronounced; short dry season during winter to spring; characterized as between Type I and Type II but closer to Type I; and
- Type IV : Rainfalls more or less evenly distributed throughout the year; closer to Type II.

In the CALABARZON region, the Type I climate is predominantly observed except in Quezon, covering the entire province of Rizal, most part of Laguna except the eastern most area, the entire province of Cavite, and most part of Batangas except the eastern most areas. In Quezon, the Type I climate is observed only in small area conterminous with Laguna.

The Type II climate is observed in the coastal area of Quezon including islands. Type III is observed in the eastern most area of Batangas and its contiguous area in Quezon up to Lucena. Type IV is observed in the eastern most area of Laguna, mountainous areas in Quezon contiguous to Laguna, and the Bondoc peninsula in Quezon.

(2) Temperature

As the CALABARZON region lies in a tropical zone, it has high temperature and high humidity throughout the year with small seasonal variation. The annual temperature difference in Manila is only 3.7°C. Survey records for PAGASA are well maintained and indicate a difference of 4.5°C in Lucena.

The hottest month on an average is April or May. For the area surrounding Manila, May is the hottest month, with average temperature of 29.4°C (MIA), while temperatures are 29.5°C in the Port area. May is the hottest month in Lucena, with temperatures around 29.9°C. In the area of Manila, December is the coldest month with an average temperature being of 25.7°C (MIA). Lucena's coldest month is in January, with average temperature of about 25.4°C.

Within CALABARZON, temperatures vary mainly by altitude. The annual average temperatures at higher altitudes, particularly at places such as Tagaytay located at 500 - 600 m from sea level, are lower by 3 - 4°C.

(3) Precipitation

In Manila, the months of December to April are the dry season during which 99.3 mm of precipitation was observed on the average. This is only 5.4% of the annual total. The dry season in February has 3.6 mm of average precipitation. The months of May to November are the rainy season. The rains peak during July to September. These three months have 1,058 mm (58% of annual total) of precipitation, with 417 mm during the peak month of August.

At Science Garden (Quezon City) which is located inland and close to Manila, the months of December to April are considered the dry season, having 131.1 mm (5.6% of annual total) of precipitation. February is the driest month with 9.7 mm. May to November are the rainy months, with peaks during July to September. These three months have 1,334.7 mm (57% of annual total) of precipitation, 504.8 mm during the peak month of August.

The average annual precipitation in Infanta is 3,998.2 mm. During the peak month of October, a monthly rainfall of 608.8 mm is recorded. The lowest monthly precipitation is 179.7 mm in April. This area belongs to a typical Type IV climate.

In Lucena, the months from January to May constitute the dry season, with a total precipitation of 336.7 mm (17% of annual total) during those five months. The months from June until December constitute the rainy season, with October being the wettest month with 336.2 mm. The total during the three months from October until December is 876.7 mm (44% of annual total). The precipitation pattern is similar to that of Infanta. As there is a short dry season, the pattern is closer to Type III. The climate in the southeast parts of Batangas is considered to be close to this climatic type.

Tayabas located in Quezon lies at the southeastern foot of Mt. Banahaw. Its climate is similar to that of the southeastern part of Laguna province. The annual total precipitation is 3,083.9 mm. The months of February to April are relatively dry. During these three months, total precipitation is about 247.8 mm (8% of annual total). Peak rainfall is during the months of October to December, with total precipitation of about 1,446.3 mm (47% of annual total). November has the largest amount of precipitation with 519.9 mm.

For Rizal province, data from Navotas and Antipolo are obtained from existing monitoring stations. In Navotas, the annual precipitation is 2,440 mm, but during the months from December until April, there is little rain. The months from May to November constitute the rainy season. The largest precipitation is in August, with 594.8 mm of rainfall.

In Antipolo, the annual precipitation is 1,814 mm, and for the months from December until April, there is little rainfall. The total rainfall for these months is 121.4 mm (about 4% of the annual total). May to November is the rainy season, with most rainfalls recorded during July to September. August has the peak monthly rainfall with 431.7 mm. The precipitation patterns are of Type I climate.

In Santa Maria located in Laguna, the annual precipitation totals 2,122.5 mm. The dry season extends from January to March. The average precipitation is 91.4 mm during April. In subsequent months from May to December, the monthly precipitation peaks in May with 383.5 mm. This low peak indicates a difference from the Type I climate.

The western to southern parts of Laguna province are areas with heavy rains. Annual rainfall is 3,265 mm in Cavinti, and 2,857 mm in Liliw. In both Cavinti and Liliw, March has the least rain. In Cavinti, November has the largest rainfalls with 503.1 mm. The largest rainfalls in Liliw occur in October with 408.0 mm. This climate type may be partly caused by the surrounding mountains. In addition, annual precipitation is 1,905 mm in Santa Cruz, close to Laguna Lake.

In Bacoor, close to Cavite City, the annual precipitation is 1,982 mm, with the dry season from December to April, and the rainy season from May to November. In Amadeo located in inland of Cavite, the annual precipitation is lower at 1,648.9 mm, with the dry season from January to April. There is 91.4 mm of precipitation in December, and 99.5 mm in May. In these two months, precipitation is rather high, creating a little variance from a Type I climate. June to November are the rainy season, and the peak rainy month is August with 357.8 mm.

In San Pedro in the western part of Laguna province, the annual precipitation is 1,896.2 mm, with the dry season from January to April, and the rainy season from May to November. The precipitation pattern is similar to that of Amadeo.

In Tanauan in inland of Bantangas province, the annual precipitation is 1,840 mm, with the dry season from January to April, and the rainy season from May to November. The peak rainy month is August with 337.8 mm of rain. Precipitation pattern is of typical Type I climate having distinct dry and rainy seasons.

Since Mabini, Lobo, Laurel, etc. in Batangas province are either encompassed by mountains, or located on the Taal lake lowlands, they are shielded against the monsoon winds, resulting in relatively light precipitation: 1,687.8 mm in Mabini, 1,422.2 mm in Lobo, and 1,597 mm in Laurel. Nasugbu is located in the western part of Batangas province, facing South China Sea, and having mountains of 500 - 600 m in altitude in the back. Therefore, it is a heavy rainfall area with annual precipitation of 2,363.5 mm, being affected by geographical features.

As described above, the CALABARZON region in general has areas of heavy rainfalls in the east to the south of Laguna Lake, while areas of smaller precipitation are found in the western parts of Laguna Lake to Cavite, and the western part of Bantagas.

(4) Tropical cyclones

The sea to the southeast of the Philippines is a cradle of tropical cyclones. Cyclones start from the sea off the Philippines, and as they move along to the East China sea, China, and Japan, they grow stronger and turn into typhoons, and often cause disasters. Cyclones occur generally during July through October.

These tropical cyclones pass through the Philippine islands very often. In some cases, it is accompanied by strong winds which sometimes cause disasters. As they have not yet matured when they are near the Philippines, these disasters are relatively moderate.

Tropical cyclones play a significant role in the climate. In the Philippines, tropical cyclones are the "control factor" that determines the amount of precipitation in June through December. According to a recent study, 47% of total annual precipitation may be affected by tropical cyclones. Interaction between monsoons and cyclones affects a large amount of the precipitation in autumn to winter in the eastern parts of the Philippines.

According to PAGASA, there were 693 tropical cyclones in the Philippines during the 35-year period from 1951 to 1985. The average number of cyclones is 19.8 a year.

In the Philippines, the CALABARZON region has relatively fewer occasions for tropical cyclones to pass through. Data from 1948 through 1988 are as follows.

	Tropical Depression	Tropical Cyclone	Typhoon	Total
Cavite	2	5	5	12
Laguna	2	6	4	12
Batangas	3	8	11	22
Rizal	5	3	9	17

J.1.6 Natural disasters

(1) Floods

In CALABARZON region, one of the factors that prevent land development is flooding. Particularly, most floods occur during the rainy season from June through October. There are two types of floods: river overflowing and flooding caused by Laguna Lake.

River overflowing is temporary, and does not last over a long period of time. For rivers within the Region, no rivers have caused serious casualties, except for the Marikina river. Rivers flowing over plateaus in Cavite and Batangas provinces have cut deep valleys, limiting the flood areas within the river courses.

Flooding caused by Laguna Lake occur periodically. The water level of the Lake rises every year as the rainy season starts.

Laguna de Bay Flood Damage Survey
Land Use Area (Summary)

Land Level (meters above LLDA datum)	Residential	Agricultural	Industrial	Commercial	Marshes, Mud, etc.	Aggregate Area (Hectares)
10.5 - 11.0	602.7	3,287.3	224.8	45.7	549.3	4,709.8
11.0 - 11.5	333.8	981.4	49.8	10.1	573.9	1,949.0
11.5 - 12.0	281.9	1,124.0	5.8	-	567.5	1,979.2
12.0 - 12.5	193.5	1,635.1	11.0	3.4	775.3	2,618.3
12.5 - 13.0	210.6	2,965.5	18.1	23.6	2,419.4	5,637.2
13.0 - 13.5	63.9	1,870.9	-	1.9	2,667.5	4,604.2
13.5 - 14.0	126.7	1,242.4	5.2	-	1,341.7	2,716.0
14.0 - 14.5	125.9	1,355.8	7.8	16.5	787.4	2,293.0
14.5 - 14.6	52.9	15.6	-	0.3	31.0	99.8
Total	1,991.9	14,478.0	322.5	101.5	9,713.0	26,606.9

The lake water level varies to some extent depending on the precipitation in any year. In years with heavy precipitation, residential and agricultural areas are flooded for a long time, and there are often casualties. Although adequate data are not available for the precise extent of floods, the Laguna Lake flooding area is 10.5 ~ 14.6 m higher than the Laguna Lake standard level (LLDA Datum), according to a survey conducted by DPWTC (current DPWH) in 1975. It also reports that the total flooded area within this districts is estimated to 26,606.9 ha. Commercially utilized areas within the flood area include 1,991.9 ha of residential areas, 14,478 ha of agricultural areas, 322.5 ha of industrial areas, and 101.5 ha of commercial area totaling 16,893.9 ha (63% of the total flood area).

Main areas flooded include the northwestern shore of Laguna Lake where the Pasig river meets the Marikina river, the northern shore of Laguna Lake in Rizal province and coastal lowlands of Laguna province (Figure J.17).

Mangahan floodway and Napindan flood control structure were constructed in 1982 to 1988, in order to prevent Laguna Lake flooding. However, the agricultural lands between Pasig and Taytay (Rizal province) are now gradually being developed for housing, which requires the earliest possible solution for flood protection.

Housing developing is also being seen on the western shore of Laguna Lake and on Laguna shores along the South Super Highway.

(2) Volcanos

Taal volcano

There is an active volcano, Taal, within the Region. Since 1542, the Taal volcano had 33 recorded eruptions. Its more violent eruptions occurred in 1749, 1754, 1911 and 1965. The 1911 eruption damaged almost the whole area of volcano island and spewed ashes as far as to Manila. The 1965 eruption killed 150 people, injured more than 800, and displaced almost 65,000 people.

Mt. Banahaw

Violent eruption is recorded in 1730 and 1734, numerous fumaroles, hot springs and mudflows in 1730, 1843, and 1909. It is dormant at present.

J.2 Existing Environmental Conditions

J.2.1 Existing environmental problems and regulations

(1) Existing environmental problems

According to the 1989 Annual Report of DENR, Region IV, main sources of environmental pollution in the Southern Tagalog provinces are identified to be industries, automobiles, agricultural activities, power plants and domestic sewage. The most significant environmental problems in CALABARZON are found in Laguna de Bay and its vicinity. They include water quality in the lake, fluctuation of water levels due to temporary storage of flood water in the Marikina river as well as river inflows and rainfalls, resultant flooding of the lakeshore areas, and sea water intrusion through the Pasig river. These problems affect human activities on and around the lake in various ways such as lake fishery, lakeshore irrigation and livelihood of the people.

Other problems pointed out by DENR include the smoke emission and coal dust from the Calaca coal-fired thermal plant and its coal stock yard, the coal dust problem in the PNOC stock yard in Bauan, and the effluents from alcohol plants in the province of Batangas. Also pointed out by others are the air pollution and other problems associated with the geothermal development in Laguna, and the discharge of waste cooling water from the thermal power plants of Calaca and Malaya. The Philippine National Oil Company (PNOC) has initiated an environmental control program, including reinjection of the wastewater separated from the steam back to geothermal reserves and monitoring of surface water, groundwater, river sediments and soil around geothermal development sites. The red tides in Manila Bay pose serious threat to the fishery, although their main cause is presumably wastewater discharges from Metro Manila.

Water quality analysis has been conducted at this time for the Taal lake water as well as the Laguna de Bay water discussed in the next subsection. The Taal lake water has generally good quality for Class C standard (see below) by most indices. An exception was phosphase concentration, measured at 0.14 mg/l at Talisay and 0.104 mg/l at Agoncillo, respectively higher than the standard of 0.05 - 0.10 mg/l. Sulfide concentration was much higher than the standard of 0.05 mg/l for drinking water. These are due to volcanic activities. These elements can be relatively easily removed by conventional water treatment methods.

(2) Existing regulations

Land use regulations

Of the existing land use regulations, designation of National Parks and reforestation areas is important as it relates to the conservation of environment. According to DENR, five National Parks exist in CALABARZON as follows.

1) Taal Volcano Island N.P.

This park covers 2,465 ha of the volcano island within the Taal lake.

2) Rizal-Quezon-Laguna N.P.

This park encompasses the upper catchment area of the Marikina river and the Sierra Madre mountains, covering 46,310 ha in parts of the three provinces. The designation is for a wildlife sanctuary and a game reserve as well as a National Park.

3) Mt. Palay-Palay, Mataas na Gulod N.P.

This is a 5,220 ha park in the Palay-Palay mountains in Cavite.

4) Mt. Banahaw - San Cristobal N.P.

This park extends over the provinces of Laguna and Quezon, covering 11,124 ha, of which 2,745 ha are in Laguna and the rest in Quezon.

5) Quezon N.P.

This is a dipterocarp forest and a historical watershed with an area of 983 ha, established by virtue of Proclamations No. 740 dated October 25, 1934 and No. 594 dated August 5, 1940.

In addition, there are eight watershed forest reserves in Quezon with a total area of 2,683 ha: Buenavista, Lopez, Mulanay, Polillo, Mulawin Springs, Tibiang-Damagandong, Calauag and Alabat.

Reforestation areas in CALABARZON implemented by DENR are summarized below by province.

Cavite : 1) Mt. Palay-Palay, Mataas na Gulod reforestation project
2) Integrated social forestry; ISF (two locations, 192.6 ha)
3) Contractual reforestation (22.7 ha)

Laguna : 1) Mt. Banahaw - San Cristobal reforestation project (5,300 ha)
2) Caliraya - Lumot reforestation project (10,750 ha around the Caliraya - Lumot reservoir, including area in Quezon)
3) Pakil ISF CARP project (72 ha)

Batangas : 1) Lobo reforestation project (4.932 ha)
2) Laurel ISF CARP project (45.1 ha)
3) Nasugbu reforestation project (677 ha)

Rizal : 1) Antipolo integrated reforestation project (32,650 ha in the catchment areas of the Boso Boso and the Montalban rivers, the upper tributaries of the Marikina river), including contractual projects: San Isidro (156 ha), Green Phil. Foundation (70 ha), and Gregorio Araneta Foundation (120 ha).

Quezon : 1) Six completed reforestation projects with a total area of 13,310 ha: Real, Polillo-Burdeos, Quezon memorial, Alabat, Tagkawayan and Bondoc peninsula, and
2) 18 on-going reforestation projects with a total area of 887 ha.

Effluent regulations

The rules and regulations related to industrial and municipal wastewater effluents are contained in "the Effluent Regulations of 1982". These are based on the Presidential Decree No. 984, otherwise known as "the Pollution Control Decree of 1976" prepared by the National Pollution Control Commission. These regulations were revised in April 1990 by DENR Administrative Orders No.34 and No.35. In the CALABARZON region, they are enforced by DENR and LLDA.

Effluent standards are set according to receiving water bodies classified as follows:

Fresh surface water

AA : For source of public water supply. This class is intended primarily for water bodies having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the NSDW.

A : For source of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.

B : For primary contact recreation

C : For the propagation and growth of fish and other aquatic resources

D : For agriculture, irrigation, livestock watering and industrial cooling and processing.

Marine and estuarine water

NP : National Park or Reserve

SB : For the primary contact recreation

SC : For the propagation and growth of fish and other aquatic resources

Additional standards are set for effluents with high organic contents. They include effluents from manufacturing plants with BOD greater than 300 mg/l and effluents from desiccated coconut factories, tanneries, cassava and starch manufacturing plants, slaughterhouses, meat processing plants and petroleum refineries. In addition to metals and toxic substances, standards are set for color, pH, temperature, phenols, suspended solids, BOD and oil/grease for these effluents.

J.2.2 Present conditions of sanitation

(1) Wastewater

No piped domestic sewerage system exists in CALABARZON. Wastewater is mostly discharged directly into the ground, open drains, streams, rivers and occasionally the Laguna lake. Toilet wastewater is discharged into a cesspit or septic tank installed for each house or community. The wastewater from the cesspit or septic tank either infiltrates into the ground or overspilled and discharged as other wastewater.

To clarify the discharge of industrial wastewater in CALABARZON, data collected by LLDA through its monitoring system were compiled. Within the Laguna de Bay basin, 344 wet industries have been identified. They are classified into three types of industries as follows.

Wet industries in the Laguna de Bay basin

Province	Types of wet industries			Total
	Metal	Chemical	Food	
Metro Manila	44	58	44	146
Cavite	0	4	3	7
Laguna	16	30	64	110
Batangas	0	1	1	2
Rizal	26	17	36	79
Total	86	110	148	344

Of the total, 48 industries have acceptable effluent quality, 107 non-acceptable, and 189 unknown effluent quality. Location of the wet industries is illustrated in Figure J.18. They concentrate in the northwest and the west of the basin.

(2) Solid wastes

Some areas in CALABARZON are receiving areas for solid wastes generated in Metro Manila. According to the Metro Manila Authority (MMA), a total of 4,500 tons of solid wastes is generated by Metro Manila, but only 3,400 tons are collected. Of the 1,100 tons uncollected garbage, about 600 tons are dumped on streets, storm drains and empty lots.

Solid waste disposal in the Laguna basin was partially clarified by a questionnaire survey. Results summarized in Table 5.17 show that some solid waste disposal system is provided for 21 out of 25 municipalities in Laguna and Rizal, for which answers to the questionnaire were obtained. Average daily volume of solid wastes generated in Laguna and Rizal is 392 tons/day and 473 tons/day respectively, of which 191 tons/day and 98 tons/day are collected. Overall, about one-third of the solid wastes generated in the basin is collected.

J.2.3 Laguna de Bay environment

(1) Institutions for Laguna de Bay

LLDA

The Laguna Lake Development Authority (LLDA) was established in 1969 by the Republic Act No. 4850 for the purpose of promoting integrated development of the area around the lake. Initially, the role of LLDA was limited to the establishment of plans and authorization of development projects to be implemented by other government agencies.

The functions and authorities of LLDA were substantially changed by the Presidential Decree No. 813 in 1975. It was made directly responsible to the Office of the President and NEDA, with powers not only to plan and authorize but also to implement development projects in the whole basin of Laguna de Bay as well as the lake itself. Under the present administration, however, its functions have been effectively reduced to those related to lake fishery, water quality monitoring and other non-developmental activities.

LLDCC

The Laguna Lake Development Coordinating Council, established in 1975, was reactivated in 1989 for the purpose of coordinating the establishment of development policies around the lake and implementation of development projects. The Council, with LLDA as the chairman and NEDA as the vice chairman, has as its members the National Water Resources Board (NWRB), NIA, DPWH, DENR and the provinces of Rizal and Laguna. The Council is one of the special committees at RDC Region IV.

Monitoring activities

LLDA has been regularly monitoring the water quality of Laguna de Bay since more than 15 years ago through six stations in the West Bay, East Bay, Central Bay and South Bay. Water samples are taken every two weeks. LLDA monitors also the seven major rivers flowing into the lake by taking water samples once a month at nine points. The monitoring is done by most important chemical and biological parameters: ammonia, nitrate, dissolved oxygen, pH, inorganic phosphorus, temperature, turbidity, total dissolved solids and coliform. Monitoring on heavy metals and pesticides started recently but presently suffers from breakdown of equipment. LLDA also implements a monitoring program for point sources of pollution to determine their compliance to the prescribed effluent standards.

(2) Water quality analysis

Existing water quality data offered by LLDA have been compiled and additional water quality measurement was conducted at this time. These data cover four sampling points on the lake and nine sampling points on six tributaries (Figure J.19). Sediment samples were also taken at the four points on the lake and two points on tributaries. Results of the water quality analysis are summarized below.

Overall quality

The lake water quality is acceptable by the Philippine standards for various purposes, measured by most indices except total coliform (Figure J.20). High coliform concentration can be solved by chlorination for drinking water, but this involves high operating costs and unpleasant taste. Turbidity and total dissolved solids (TDS) are higher than international standards (Figures J.21 and J.22). High concentration of TDS and turbidity tends to increase the water treatment costs by coagulation and filtration for drinking water.

Seasonal variations of the lake water quality measured by several indices are significant. The water quality problems become serious during dry seasons, while during rainy seasons, pollutants are diluted and washed away (Figure J.23).

Concentration of inorganic phosphorus in the lake water exhibits a slightly increasing trend in recent years (Figure J.24). This is an indication of slowly progressing eutrophication. High concentration of ammonia, typically of human wastes, has been detected in West Bay (Figure J.25).

Heavy metals, such as lead, zinc, manganese and copper, have been detected in sediment in relatively high concentration. However, no reliable standards are available to judge the magnitude and significance of the problem. No serious pesticide problem has been identified.

Turbidity

Inorganic turbidity of the lake water, measured as SiO_2, is increasing rapidly in recent years (Figure J.21). This is clearly due to sediments transported from denuded catchment areas. Seasonal variations of turbidity is conspicuous, strongly correlated inversely with rainfall (Figure J.26). That is, when the rainfall is higher, the turbidity is lower, and vice versa. This indicate that the turbidity of the lake is caused not much by direct river inflow containing large amount of sediments but rather mainly by stirring up effects of water currents caused by river inflow and winds.

Chloride

Concentration of chloride, one of the most important water quality indices especially for sources of drinking water, decreased sharply after the completion of the Napindan hydraulic control structure in 1983 (Figure J.27). It has not shown any tendency to increase after the opening of the structure upon the demand by lake fishermen.

The maximum allowable concentration of chloride is set at 200 mg/l for sources of drinking water. The present concentration of chloride in the lake is below this threshold.

Implication to lake fishery

Although the chloride concentration decreased with the completion of the Napindan hydraulic control structure, no apparent relationship can be observed between the chloride concentration and fishery production in the lake (Figure J.27). The total fishery production from the lake reached its peak in 1984 and has been declining since then. This is due primarily to decrease in the area of fish pens as a result of dismantling of illegal fishpens. However, the yield per ha of fishpens has not shown any decline since 1985. This indicates that the fishery productivity does not have correlation with the chloride concentration.

Captive fishery reached high production levels in 1984 through 1986. This presumably reflects partly the dismantling of illegal fishpens. However, it started to decline sharply since then. In the meantime, the chloride concentration does not show any trend of increase nor decrease. This suggests that the reduced production is due to some other factors.

J.2.4 Existing institutions for environmental management

(1) Organizations for environmental management

In early 1970's, the National Environmental Protection Council (NEPC) was established under the Ministry of Human Settlement. On its initiative, various environmental impact assessment (EIA) techniques have been developed, and EIA manuals prepared. Environmental standards especially for water quality, have been set up, and EIA has become a mandatory for any development projects.

Under the present administration, different organizations administrating environmental issues were integrated into DENR. The Environmental Management Bureau (EMB) has been organized under DENR, and assigned responsibility for reviewing EIA's. In addition, environmental officers were appointed within regional offices of DENR, who are responsible for environmental issues for each region.

(2) System for Environmental Impact Assessment

It is now mandatory in the Philippines to conduct an EIA and submit them to EMB, before implementing any development project. Many EIA reports have been prepared so far.

Any EIA report describes the location, size, and features of each development area of the project, and assesses the impact on social and natural environmental which may be estimated in relation to the development, in order to establish appropriate countermeasures. EIA reports are examined by EMB following established procedures, and proper recommendations and advice on improvement are given. For projects requiring EIA's, specific manuals define environmentally critical types of development and areas to be looked into. The procedure and objects of EIA are given in Annex to this Appendix.

J.3 Land Capability

J.3.1 Land classification

Several key factors affecting land capability for various uses have been analyzed. They include physiography, soil, slope, geology, present land use, erosion potential and flood susceptibility. The land capability map in the scale 1 to 250,000, provided by DA, has also been referred to in determining the demarcation by land class.

Land capability classification has been adopted from DA, but only broad classification has been made for planning purposes. The classification is as follows:

- A : Very good land; can be cultivated safely; requires only simple but good farm management practices.
- B : Good land; can be cultivated safely; requires easily applied conservation practices.
- C : Moderately good land; must be cultivated with caution; requires careful management and intensive conservation practices.
- D : Fairly good land; must be cultivated with extra caution; requires very careful management and complex conservation practices for safe cultivation; best suited to pasture or forest.
- M : Steep, very severely to excessively eroded, or shallow for cultivation; suited to pasture or forest with careful management.

According to the classification presented above, the land capability map has been prepared (Figure J.28). Based on physiography, geology, soil and other factors, 54 units have been identified in CALABARZON. Land capability by each of these 54 units is summarized in Table J.4.

J.3.2 Land capability by unit

Environmental conditions of each of 54 units identified are described below.

(1) Sierra Madre Mountains (M)

This unit includes the northern part of Quezon province, the northeastern part of Rizal province and the Caliraya area. Its altitude is generally 400 - 500 m with a maximum height of 1,530 m. Its principal soil consists of alfisol and inceptisol. The unit is generally of a steep mountain range with general gradient of 30% or more. Its geographical features are made of Cretaceous sedimentary or igneous rocks and Tertiary volcanics. This unit is covered with trees of primary and secondary forests. At it is very steep, heavy rains can cause landslides. The erosion potential of the topsoil is high. Since the flood prone zone is limited to the bottom of escarpments, residential sites should be safe from of flooding. In terms of legal regulations, this unit is designated as a National Park and a reforestation area.

(2) Rizal Upland Area (D)

This upland area is around 300 - 500 m above sea level. It is located to the west of the Sierra Madre mountain range. Its principal soil types are inceptisol and alfisol. The area is rather steep with slopes of around 30%. Its geographical features are made up of Tertiary rocks and Quaternary volcanics. As almost all the forests are lost due to slash-and-burn farming, the land is widely covered with grass. The area has a rather high erosion potential so that much attention should be paid to the danger of topsoil loss when utilizing the land.

(3) Angono Hills (M)

This hill area protrudes into Laguna Lake like a peninsula. Its maximum altitude is 255 m. Its principal soil is inceptisol, which generally reaches 18 - 30% of the entire soil and more than 30% in certain places. Its geographical features are mainly Quaternary volcanics, including lava flow and tuff breccia. Its principal vegetation includes shrubs and grass. Since the area is steep, it has a high erosion potential.

(4) Talim Island (M)

This island is located to the south of Angono Hills. The entire island forms a hill and has almost no plains. The island rises to 410 m above sea level. Its geographical features are primarily Quaternary volcanics, including lava flow and tuff breccia such as andesite. The entire island is covered with shrubs and bamboo. Since the area is very steep, the erosion potential is high. Lowland along Laguna Lake is subject to flooding due to the rise in water level of Laguna Lake in the rainy season.

(5) Montalban Lowland (A)

This lowland includes cities like Montalban and San Mateo. The eastern and western parts of the lowland are separated by a fault. Both ends of this lowland end in mountains. As the San Mateo river runs in this lowland, this area is an alluvial lowland. Its geographical features are primarily made up of clayish vertisol and inceptisol, each of which has alluvial soils as its base. The land is generally flat with slopes of 8% or less. Its geographical features are mainly constituted by alluvium. While the land is principally used as rice paddies, it also has builtup areas such as the town of Motalban. The erosion potential is low. This area is subject to overflowing of rivers in the rainy season. However, this flooding of does not last long.

(6) Taytay Lowland (A)

This lowland, located at the northern shore of Laguna Lake, extends to the east of the Mangahan drainage canal. It is a fluvio-lacastrine lowland formed by the sedimentation of the Marikina river and Laguna Lake. Its principal soil types are fine clay Vertisol and Entisol. The land is almost flat with slopes of 3% or less. It is made up of sand and gravel of alluvium. The land is primarily used as residential land and rice paddies. Due to the expansion of the Metro Manila, however, the rice paddies are gradually being turned into new residential sites. Erosion potential is extremely low. This area is subject to both river overflowing and the flooding due to the rise in water level of Laguna Lake in the rainy season.

(7) Teresa-Tanay Lowland (A)

This lowland is located on the northern shore of Laguna Lake, extending between Teresa and Tanay. It is a fluvio-lacastrine lowland formed by sedimentation of rivers and Laguna Lake. Its principal soil types are Inceptisol and Entisol, each of which has alluvial soil as its base. The area is generally flat with slopes of 3% or less. The land is mainly used as rice paddies. The erosion potential is low. This area is subject to the flooding due to the rise in water level of Laguna Lake.

(8) Jalajala Lowland (A)

This lowland formed along the peninsula of Laguna Lake, including Jalajala in its center. Its soil is mainly inceptisol. The land is almost flat with slopes of 8% or less. Its geographical features are primarily made up of alluvial sediment. It is used mainly as rice paddies. The erosion potential is low. Lowland along the lakeside is subject to the flooding due to the rise in water level of Laguna Lake in the rainy season.

(9) Bagumbong Lowland (A)

This lowland is located on the eastern shore of the Jalajala peninsula, encompassing Rizal to and Laguna provinces. Its soil is mainly entisol. Its slopes are 8% or less, and almost the entire area is flat. Its geographical features are primarily made up of alluvium. The land is principally used as rice paddies. Since the area is a plain lowland, the erosion potential is low. The lowland, along the shore of Laguna Lake, may be subject to the flooding due to the rise in water level of Laguna Lake in the rainy season.

(10) Mabitac Lowland (A)

This lowland is located along the northern shore of Laguna Lake, including Mabitac in Laguna province in its center. It was formed by the alluvial effect of rivers and Laguna Lake. Its principal soil is vertisol, which is composed mainly of clay. The area is a plain lowland with slopes of 3% or less. Geographically the area is made up of alluvial sediment. While this area is mainly used as rice paddies, it includes large cities such as Mabitac. The lowland along the lake is subject to the flooding due to the rise in water level of Laguna Lake.

(11) Laguna Lake West Lowland (A)

This lowland, the western shore of Laguna Lake, extends from San Pedro to Los Banos. Topographically, it is made of alluvial fans or deltas along Laguna Lake formed by small rivers running from the Cavite plateau. Its principal soil types are inceptisol and vertisol. The area is generally flat with slopes of around 0 - 3%. While the land is mainly used as rice paddies, it also includes residential and industrial sites, which are growing. The erosion potential is low. Some parts of the lowland around Laguna Lake are subject to the flooding in the rainy season.

(12) Laguna Lake South Lowland (A)

This vast lowland is located at the south shore of Laguna Lake, extending from Los Banos to Santa Cruz. It is made of alluvial fans and deltas formed by rivers running from volcanoes such as Mt. Banahow into Laguna Lake. Principal soil types found in the area are inceptisol and vertisol. Its slopes are around 3% near the mountains, and 3% or less around the lakeside. Its geographical features are made up of clay, sand and gravel of alluvial deposits. While the land is mainly used as rice paddies, it includes many coconut trees. The erosion potential is low. The lowland, along the lakeside, is subject to the flooding due to the rise in water level of Lagune Lake in the rainy season.

(13) Maquiling - Atinbia Mountains (M)

These volcanic mountains extend from behind Los Banos to Calanan. Mt. Maquiling rises 1,110 m above sea level and Mt. Atinbia 654 m. The principal soil of the area is alfisol, which is found typically in mountains. The area is very steep with slopes of 30% or more. Its geographical features are mainly made up of Quaternary volcanic materials. As of now, this area is forested. Since it is very steep, the erosion potential is high. It is possible that heavy rain will cause landslides. The flood potential is low.

(14) Liliw Upland (C)

This upland is formed at the northern foot of Mt. Banahow. The origin of its principal soil is volcanic ash or volcanic sediment. Its slopes are around 8 - 18%. The land is used as terraced fields, where rice, coconut and other fruits are cultivated.

(15) Mt. Banahow (M)

This mountain area is located to the southeast of Laguna province along the Quezon province border. Mt. Banahow rises 2,157 m and Mt. San Cristobal 1,470 m. These mountains are the results of the volcanic activities through the Quaternary period. Its geographical features are principally made up of lava, tuff breccia and pyroclastics of andesite or basalt. The area is very steep with inclinations of 30% or more. The erosion potential is extremely high. There is an extensive river system around the conical volcano and a large slope is formed at the base of the mountain. Pagsanjan river, running from Mt. Banahow, has accumulated a large amount of sediment into Laguna Lake to form prominent deltas. As of now, this area is covered with trees and shrubs. Since the area is designated as a National Park and a reforestation area, preservative land use is desirable.

(16) Sariaya - Tayabas Upland (C)

This upland includes the slope of volcano formed at the southern base of Mt. Banahow. Its slopes are 8 - 18%. The slope of the volcano is eroded to form a deep escarpment. Its flat and less steep areas are planted mainly with coconut trees. In addition, part of the area is used as rice paddies.

(17) Santo Nino Mountain (M)

This mountain rises 963 m above sea. It is located to the east of Lipa City. Its geographical features are constituted by Quaternary volcanic rocks. The area is very steep with gradient of 30% or more. The land is used mainly as coconut plants at the foot of the mountain, while the apline regions are forested. The erosion potential is high.

(18) Cavite Lowland (A)

This lowland, extending from around Cavite City to Ternate, is the shore facing Manila Gulf. The area is an alluvial lowland formed by rivers running from the Cavite plateau. Its principal soil types are inceptisol and vertisol, most of which are loamy or clay. Seaside areas of this lowland are very flat with slopes of 3% or less. Although there are some places inland with slopes of more than 3%, the inland area is also flat in general. The land is mainly used as rice paddies. Industial area are expanding near Manila, especially around Cavite City. Both the erosion potential and flood potential are low. Water for industrial use around Cavite City is supplied by deep wells. Although there have been no serious problems up to now, this must be considered in urban development or industrialization in the future because overdependency on underground water would result in ground subsidence or intrusion of salt water.

(19) Cavite Plateau (C)

This plateau was formed by the sediment of lava from the Taal volcano during the Quaternary period. In general, it forms a slope ranging from around Tagaytay to Manila Gulf. The slope is steeper near Tagaytay. The entire plateau formed by the Taal volcano may be divided into two areas in terms of slopes and dissected level; one is the Cavite plateau, where slopes are less steep, and the other is Tagaytay upland, which is steeper and more dissected. Although the Cavite plateau has slopes of 3 - 8%, the area is generally flat. Its principal soil is made of loam, which includes tuff and pyrocladtics as its base. Currently the land is used mainly to cultivate tree crops such as sugarcane and mango. Both the erosion potential and the flood potential are low.

(20) Tagaytay Uplands (D)

This is an area of hills with a height of 250 to 600 m. Though it is a continuous part of the Cavite plateau, it is higher in altitude and steeper in slope. Rivers have deeper riverbeds, while the river width is rather narrow. Slopes are 8 to 18% on an average, with steeper slope of more than 30%. Geologically, pyroclastics and tuff breccia are the dominant components. Tree crops such as coconut, coffee, mango, etc are widely grown.

(21) Lipa Plateau (C)

This is a plateau formed by Taal Volcano activities, similar to the Cavite plateau. It encircles Canlubang and the southern shore of Taal Lake. Its altitude is from around 5 to 60 m to as high as 300 m, and is composed of loamy soil with volcanic ejecta. Generally the slope is approximately 3 - 8%, crating a broad, gentle sloped land. Rivers running over the plateau form narrow deep valleys. Currently the land is used for coconut, sugarcane, and other upland crops. Erosion potential is moderate. Potential for floods is low.

(22) San Juan Lowlands (B)

This is an area covering lands from alluvial lowlands up to the Lipa plateau, which have been formed at the joining point of rivers, such as the Bauan and Malaguing rivers. It is centered at Inceptisol and Vertisal. The slope is only 0 - 3%. The area is now used for rice paddies and coconut groves. Erosion potential is low. River overflow occurs from time to time.

(23) Sampiro Hills (D)

These are hills which lie between the coastal areas to the east of Lobo mountains.

(24) Lobo Mountains (M)

These are mountains along the eastern part of Batangas province. The altitude reaches 972 m. The rocks are primarily tertiary, and mostly igneosu rocks such as andesite, basalt and dyorite. The slope is more than 30%, which is covered by forests, shrubs, and grasslands. Erosion potential is high. In some parts, reforestation has been undertaken.

(25) Taal Lake Slopes (M)

These are steep slopes surrounding Taal Lake. The slopes are generally more than 30%. Slopes are made from ejecta or lava from Taal Volcano, tuff breccia etc, and are covered with coconut groves and shrubs. Erosion potential is high.

(26) Taal Lake Lowlands (B)

These are lowlands formed by rivers flowing into Taal Lake, around Laurel and continuously to the northern shore of Taal Lake. They are used for rice paddies and coconut groves.

(27) Batunlae - Palay-Palay Mountain (M)

It is located to the west of the Region, and along the boundaries between Batangas and Cavite provinces. The altitude reaches 810 m. This mountain was formed by Tertiary and Quaternary volcanic activities, and is made of lava or pyroclastics such as andesite, basalt, etc. The slope is more then 30%, and covered with forests, shrubs, grass lands, etc. Erosion potential is high. Mt. Palay-Palay is designated as a national park and reforestation area.

(28) Nasugbu Lowlands (A)

These are alluvial lowlands formed by rivers including the Lumindac river running from Mt. Batulao. Soil consists mainly of clayish vertisal. The land is rather flat, 0 - 3% which is used mainly for irrigated rice paddies. Erosion potential is low. There is the potential of temporary floods caused by river overflowing during the rainy season.

(29) Calantas Plateau (C)

This is a plateau similar to Lipa plateau, formed in the southern part of Mt. Batulao. It slopes 8 - 18% downwards to the south as a whole, and is composed of volcanic sedimentation with loamy soil. Rivers flow almost straight, making deep valleys. It is used mainly for coconut groves and sugarcane. Erosion potential is moderate. There is no potential for floods.

(30) Balibago Upland (M)

It is a peninsula located in the southwest part of Batangas province, and composed mainly of hills with average altitude of 249 m. The slopes are 18 - 30%. The upland is made of lime-stone, sand stone, etc. Currently, it is covered with shrubs and grass lands. Erosion potential is high.

(31) Balayan Coastal Lowland (A)

It is a coastal lowland formed along Balayan Bay, between Balayan and San Luis. The slope is less than 3%. The land consists of clayish vertisal, etc. At present, it is used for sugarcane cultivation. Erosion potential is low. There is no potential for floods.

(32) Calupan Hills (M)

This is a peninsula located between Balayan and Batangas Bays, and forms hills and mountains with an average attitude of 501 m. The slopes are more than 30%, creating lots of steep slopes. Soil consists mostly of Tertiary rocks, including lime-stone, sand stone, and andesite. Currently, it is covered with shrubs. Erosion potential is high.

(33) Batangas Coastal Lowland (A)

This is a coastal lowland around Batangas Bay, with soil made up mostly of clayish vertisal. The slope is less than 3%. Currently, the land is used for sugarcane cultivation. Erosion potential is low. There is no potential for floods.

(34) Narrow Coastal Lowlands (B)

These are small lowlands formed in the Calumpan peninsula and areas surrounding Lobo. Coconut groves and residential areas cover the land. The land is flat.

(35) San Pablo - Candelaria Lowlands (B)

These are lowlands that lie in San Pablo, Laguna province, continue to Candelaria in Quezon province, and are made of volcanic base slopes and alluvial fans. The slopes are approximately 3 - 8%. The lands are made up of volcanic deposits, alluvial deposites, etc. It is used mainly for agricultural purposes, such as coconut groves and rice paddies. Potentials for flood, etc. are low.

(36) Tiago - San Juan - Lucena Lowland (A)

This is an alluvial lowland formed between Mt. Banahaw and the Lobo mountain. It is covered mainly with alluvial soil. Coconut groves, rice paddies, and other fruit trees are cultivated. In the flat areas of the coastal lowlands, there is a potential for overflowing during heavy rainfalls in rainy seasons.

(37) Infanta Lowlands (A)

It is a delta area formed by the Agos river flowing from the Sierra Madre mountains. The area is approximately 15,000 ha, which is used for rice paddies and fish ponds. Drainage conditions are not favorable, which increases the potential for floods.

(38) Peninsula Hilly Upland (D)

It is a hilly upland forming the backbone between Luzon Isthmus and the Bondoc peninsula. The altitude ranges from 100 m to 300 m. It is made up mainly of Tertiary rocks, and covered mainly with coconut groves and grass lands.

(39) Peninsula Mountains (M)

There are mountians (more than 30% slope) that come out of the Sierra Madre mountains, with the isthmus continuing to the Bondoc peninsula. The altitude ranges from 100 m to 500 m. The mountians are composed mainly of Tertiary sedimentary rocks, and covered with coconut groves and grass lands.

(40) Cadig - Bayabas Mountain (M)

It is a mountain in parallel to the Bondoc peninsula, with an altitude of 728 m. It is of predominantly Tertiary sedimentary rocks. There remain extensive forests. Kaigin agriculture practice is conducted in some areas.

(41) Minor Coastal Lowlands in the Peninsula (A)

Many small alluvial lowlands exist between the isthmus and the east and west coasts of the Bondoc peninsula. They are used for coconut groves and rice paddies. In addition, there are many ponds. There are mangrove forests in the coastal areas.

(42) Lapez Lowland (A), (43) Pitgo Lowland (A), and (44) Macaleon Lowland (A)

These are relatively widespread coastal lowlands in the peninsula. They are covered mainly with rice paddies, coconut groves, etc. Coastal areas are covered with mangrove forests.

(45) Pagsajan River Lowland (A)

This is a lowland formed in the northern part of the Bondoc peninsula. It is used for coconut groves, corn cultivation, etc.

(46) Minor Inland Alluvial Lowlands (B)

These are valley lowlands located inland, and used mainly for rice paddies.

(47) Minor Alluvial Lowlands in Bondoc Peninsula (B)

These are valley lowlands formed inland in the Bondoc peninsula, and used for rice paddies and corn cultivation.

(48) Polillo Island - upland area (D/M), coastal lowland (A)

This is an island made mainly of Tertiary sedimentary rocks. The inland is covered with forests, coconut groves etc, and the coastal lowlands are used for rice paddies.

(49) Patnanogan Island, (50) Jomalig Island, (51) Alabat Island, (52) Cabalete Island - upland (D), lowland (A)

These islands are part of Quezon province. They are covered mainly by Tertiary sedimentary rocks, coral stones, etc.

(53) Maricaban Island, (54) Verde Island

These island are part of Batangas province.

J.4 Development Issues Related to Environment

J.4.1 Identification of development issues

(1) Possible problems

As the Project CALABARZON is a large scale project complex encompassing multiple sectors, it may cause a range of environmental problems, if implemented without paying proper attention to the environment. These problems may be broadly categorized into two classes: those that can be mitigated on a project-wise basis and others calling for a more integrated approach. Typical problems foreseen are listed below under each category.

(a) Environmental problems to be mitigated on a project-wise basis

- Industrial effluents
- Municipal wastewater discharges
- Solid waste disposal
- Air and water pollution related to mining/quarrying, industrial production and thermal power generation including geothermal
- Sedimentation in reservoirs
- Land slide around reservoirs
- Land use conflicts between agriculture and urbanization/industrialization

(b) Environmental problems calling for a more integrated approach

- Soil erosion
- Sedimentation in Laguna de Bay
- Land subsidence and salt water intrusion due to over-exploitation of groundwater
- Deterioration of forest resources due to illicit cutting for fuelwood and conversion to cultivation/grazing areas
- Non-point water pollution due to increased fertilizer and pesticide use
- Ecological changes in fauna and flora

Even the problems in category (a) call for coherent actions in line with comprehensive regulatory measures and careful planning.

(2) Main development issues

Of the possible problems as listed above, a few problems are already visible in CALABARZON and a few others seem to be more serious and calling for immediate attention. The visible problems are those related to Laguna de Bay and others associated with a few specific projects.

The problems related to Laguna de Bay include declining productivity of the lake, pollution due to urbanization/industrialization,and use of lake water for domestic and other purposes. The major problems associated with specific projects include air and water pollution related to the Calaca thermal power plant, relocation and resettlement problem related to the Batangas port development, and land conversion problem related to industrial estates.

Other main issues are erosion control of slope land, denuded forest areas and the land covered with volcanic ashes, and the watershed management of the Marikina river basin.

J.4.2 Problems related to Laguna de Bay

(1) Lake productivity

According to LLDA, fishery productivity in the lake decreased from 4 to 8 tons/ha in peak years to 1 to 2 tons/ha in recent years. The culture period has been prolonged from 4 to 6 months to 10 to 12 months. This decline in productivity is due to a number of factors including the following:

a) fluctuation in lake primary productivity,
b) the depth of lake water that affects the degree of disturbance on the lake bottom sediments due to wind and wave action,
c) the discharge of industrial and domestic effluents,
d) the erosion of upper catchment areas due to deforestation,
e) the illegal fishing practices which trap the eggs and juveniles of fish, and
f) turbidity.

(2) Pollution by urbanization

The urbanization/industrialization along the lakeshore is a main cause of pollution in the lake. Municipal sewage, currently discharged without treatment, is a potential threat to the lake water as well as industrial effluents. Another major problem is the solid waste disposal. At present, not only disposal but also collection of solid wastes is insufficient. Moreover, some municipalities are receiving solid wastes from Metro Manila in their hills.

This will eventually lead to the contamination of tributaries and the lake as well as groundwater.

According to a study by WHO-LLDA, the annual load to the lake of nitrogen increased from 3,492 tons in 1973 to 6,200 tons in 1978 and that of phosphorus from 942 tons to 1,600 tons in the same period. Over the period 1978-83, the average annual load of nitrogen and phosphorus increased by 11% and 24% respectively, much lower than predicted. The increase in load during 1978-83 is primarily due to the San Pedro river. Another heavily polluted river in terms of nitrogen and phosphorus was the Morong river.

The levels of wastewater treatment and necessary measures for solid waste management need to be worked out vis-a-vis the expected degree of urbanization and the required water quality in the lake.

(3) Use of lake water

The plan to tap lake water for domestic water supply was originally scheduled after the year 2000. However, the offer by NIA for the use of pumps at Putatan and Muntinlupa has made it possible for MWSS to advance the plan. The following plan was discussed in early 1990 by LLDA, NIA and MWSS:

1) Abstraction of water initially at the rate of 300,000 m^3/day starting in 1991 for the Manila South water supply project using the NIA Pumping System located in barangays, Putatan and Muntinlupa, Metro Manila, to benefit some 1.2 million population in four municipalities within the southeast sector of the MWSS Service Area;
2) Direct abstraction of water from the lake for the Rizal province water supply improvement project at the rate of 52,000 m^3/day to benefit particularly the municipalities of Angono and Binangonan with a total population of 107,551 (1980) starting at end of 1991. The system can be expanded to include Antipolo, Cainta, Taytay, and even Taguig; and
3) Expansion in 1994 of the water abstraction to 600,000 m^3/day using MWSS pumps to cover four additional towns as well as the increase in population in the municipalities already served.

As of July 1991, the proposed sharing by MWSS of the NIA pumping system has been suspended. Instead, the Angat project is considered as a more viable option as it will bring water to the same service area at lower cost. There has been a change of the MWSS service area in its Rizal province water supply improvement project, and Taytay is included instead of Binangonan.

The use of lake water for irrigation will be expanded by the implementation of the second Laguna de Bay Irrigation Project. This project will irrigate the Cavite friar lands and would require a maximum abstraction of 10.4 m^3/sec, which would reduce the lake water level by 21 cm during the period of November - May.

Should the lake water be used for domestic water supply, the quality would have to be upgraded from the present Class C to Class A. This implies that more stringent effluent standards would have to be imposed on industries and lake fishery would have to be regulated. Other activities along the lakeshore would also be affected such as agro-industry and reclamation. Barging of oil and other petroleum products across the lake may have to be phased out in favour of land-based transport.

J.4.3 Erosion control and watershed management

Of the Laguna basins, 25% is covered by forests, including most of the Marikina upper catchment reserve. From 1960 to 1977, 54,000 ha were deforested and mostly transformed into unproductive open grasslands, which now comprise 16% of the total basin area.

Areas of severe erosion extend generally on slope lands, which belong to Class M in the land capability map. They are the Sierra Madre mountain area, the Angono hill, the Talim island, Mt. Banahaw, Lobo mountain, Taal lake slopes, Batulao-Palay palay mountains, Balibago upland, and the Calumpan hill. Other erosion susceptible areas are the Tagaytay upland, the Sampiro hill, the Rizal upland area and most part of the Bondoc peninsula in Quezon. Erosion potential is illustrated by province in Figures J.29 through J.33. In the Laguna basins, 47% of the total land area is susceptible to erosion. The watershed management of the Marikina river basin is particularly important as the erodable area is quite large.

J.4.4 Institutional problems

(1) Inadequacy of current data

The preparation of geological, physiographic, vegetation and soil maps has been substantially delayed. The completion of topographic maps and aerophotography is also delayed. These are essential for planning and land development or conservation and environmental management. Also, most existing survey data are out of date. It is necessary to update them at the earliest possible time.

In addition to the data on water quality in Laguna Lake measured in terms of physico-chemical indices, hydrogeologic data on the Lake bed is also essential for planning, conservation and environmental management. A comprehensive data base should be established for the Laguna Lake environment by adequate monitoring.

(2) Lack of adquate monitoring

Continuous and systematic collection of data through monitoring is vital for environmental management. At present, both the number of experts and devices necessary for monitoring and evaluation are extremely inadequate. The number of officers and equipment in regional offices is especially inadequate.

Many people have pointed out that forest areas are decreasing rapidly. However, the exact extent of the problem is not known. It might be necessary to install an extensive and nationwide monitoring system using Land-Sat or SPOT to collect data including those for erosion or siltation in order to plan conservation of major river basins.

In order to effectively utilize the environmental data acquired and to predict future changes, computerization is necessary to construct a database to allow processing data as the necessity arises.

J.4.5 Project specific issues

(1) Calaca thermal power plant

The Calaca thermal power plant in Batangas is existing and as such not a part of the Project CALABARZON as planned. However, its environmental problems are highly visible and tend to undermine the image of CALABARZON. Besides, Calaca II, as the second stage of this thermal power plant, is at an advanced stage of implementation.

The environmental problems associated with the Calaca thermal power plant include the emission of sulfur containing smoke, coal dust from its stock yard, seepage and overflow from the ash pond, and discharge of waste cooling water. These problems would multiply, if the Calaca II is implemented without mitigation measures.

(2) Batangas port development

The Batangas port development is essential for the balanced development of the CALABARZON region as envisioned by the Master Plan. It will be implemented in stages and the first stage consists of the upgrading of existing port primarily for inter-regional transport needs. It will involve, however, relocation of people in the planned port expansion area. Some 700 families in barangay Sta. Clara are involved. Satisfactory solution to the relocation and resettlement will be a prerequisite not only for the successful implementation of the first stage but also for subsequent development to realize the full potential of the Batangas bay area and the Region as a whole.

(3) Land conversion

Land conversion from agricultural use to urban and industrial use is another major issue. In particular, land conversion for some industrial estates has been drawing serious attention of people. Future land conversion will be subject to the relevant administrative orders under CARP, although a few individual cases may remain to be an issue. A real issue in this connection is the lack of land use plans for most cities and municipalities which are official, detailed enough and providing effective tools for regulating future land use.

J.5 Strategy and Measures for Environmental Management

J.5.1 Strategy and general measures for environmental management

(1) Context of environmental management

It has been widely recognized that high economic growth in any region cannot be sustained without concomitant environmental management. With this respect, the real issue is not a trade-off between economic development and environmental conservation, but rather the environmental management for sustained economic growth.

The Laguna Lake, for instance, has been a source of livelihood in various ways for many people. The challenge is how to lend the lake environment to the livelihood of a wider range of people at present and in the future. This cannot be realized just by trying to preserve the physical conditions of the lake, as it undergoes natural process of transformation as well. The basic concept of the Master Plan is in fact environmental development as expressed in the objective.

The Project CALABARZON, being a large scale, multi-sectoral project complex, will have significant effects on the environment. This is particularly true as the CALABARZON region is characterized by relatively vulnerable water and related land environment. Laguna de Bay has been undergoing transformation accelerated by various human interventions. Lands in CALABARZON are extensively covered by volcanic ash and tuff to make them vulnerable to soil erosion. The Marikina river basin is also susceptible to erosion due to its topography and soil conditions.

If the Project CALABARZON is implemented without paying proper attention to the environment, a range of problems will arise. Effects of such problems will be as fundamental and long-lasting as the socio-economic impact of the Project CALABARZON. Therefore, *the environmental aspect should be taken as an integrated part of the* CALABARZON regional development, and a wholistic approach should be adopted consistently with other measures for socio-economic development.

(2) Strategy and general measures

Various environmental problems foreseen may be categorized into two classes: those that can be dealt with on a project-wise basis and others calling for a more integrated approach. For the latter, the watershed management approach should be taken (Appendix D: Water Resources), in view of the importance of water and related land issues. Of the former, wastewater treatment and solid waste disposal are two important issues, considering the future urbanization/industrialization of CALABARZON. Monitoring is essential for the both types of problems.

Watershed management

In view of generally vulnerable water and related land environment, concepts of watershed management should be applied widely to water resources development and management in CALABARZON. Objectives of watershed management are (1) to minimize the erosion of production top soil, (2) to minimize the discharge of organic and non-organic wastes into the ambient environment, and (3) to enhance the water retaining and productive capacities of the land.

General measures for watershed management include not only structural measures to store flood water for subsequent use or to arrest sand but also the following.

1) Improvement of farming practices such as deep ploughing, terracing on slopes, buffer strip cropping and mulching as well as controlled application of irrigation water, fertilizer and pesticides,
2) Allocation of sufficient cultivation area to perennial crops and other crops of better land surface coverage and soil enriching characteristics,
3) On-farm tree planting,
4) Pasture management,
5) Promotion of controlled grazing, and
6) Afforestation.

Applicability of these measures differs depending on particular areas such as the Marikina watershed, the Laguna basin, upland areas in Cavite and Batangas. Important factors affecting the applicability are rainfall patterns (both spatial and temporal), land use, vegetation cover, soil characteristics and topography (slope gradient and slope length). Appropriate measures should be selected for each area, taking account of these factors.

Wastewater and solid waste management

At present, serious water quality problems are observed in and around Laguna de Bay only during dry seasons, when the surface water discharge is minimal. During dry seasons, wastewater is in fact only significant source of discharge into the lake, being fed primarily by groundwater. Therefore, in principle, the discharge should not be reduced by interceptors or other diversion systems. Rather, quality of the discharge should be improved to increase self-purification capacity of the discharge itself. Thus, wastewater treatment at sources should be the basic principle to be pursued for the long-term solution of the lake water quality problems.

For domestic wastewater, a small scale treatment system should be the basic unit to be established. This may be called a community treatment system and serve the population of some 30,000.

For planning the domestic wastewater treatment system, the whole basin may be divided into several planning zones. One community treatment system will be provided to each zone. For unit processes, either stabilization pond or lagoon system may be preferred initially for economic reasons. This system can be easily converted to a mechanically aerated lagoon system.

In defining the planning zones and planning the treatment system by zone, solid waste disposal should also be taken into account. This would call for an extensive survey to identify sites suitable for receiving solid wastes not only from CALABARZON municipalities but also from Metro Manila. Hydrological relationships with the Laguna lake as well as capacity of each site should be taken into account.

For industrial effluents, individual treatment systems are recommended in principle as the short-to mid-term measures. For each planning zone, wet industries should be identified by type of industry, and treatment standards should be established for each type. For industrial estates, a community treatment system is more recommendable.

Priority for implementing the comprehensive treatment system by zone including the domestic sewerage and solid waste disposal should be established by LLDA on the basis of existing wet industries, planned industrialization, and expected population growth. The first priority may be given to the area west and northwest of Laguna de Bay.

Monitoring

Monitoring is essential for identifying environmental problems at an early stage of development and taking corrective measures to minimize possible adverse effects. On-going monitoring activities by LLDA, DENR and other agencies need to be much expanded and integrated. Monitoring should cover not only physico-chemical indices as presently done by LLDA, but also biological and socio-economic indices.

As a first step, a survey should be conducted to assess the data available from various agencies to determine indices to be used for monitoring and to identify needs for further data collection. An environmental data base should be established, consisting of data related to both natural and socio-economic conditions. The data base will allow processing these data and providing output in the form necessary for planning and control functions. Also, it will provide a common basic for carrying out the environmental impact assessment (EIA) of individual projects consistently.

J.5.2 Measures for Laguna Lake

In view of the importance of the Laguna Lake environment within the overall CALABARZON regional development and the imminence and complexity of the environmental problems facing the lake, the Master Plan proposes measures to be taken or principles to be observed specifically for the Laguna Lake.

1) There should in principle be no full scale extraction of Lake water for domestic and industrial water supply at least up to the mid-term future except minor extraction to satisfy urgent needs. Exceptions may be made of a few towns in Rizal where available data prove that no viable alternative exists.

2) In the meantime, consensus should be worked out among those concerned over the use of Lake water for various purposes including fisherfolks, farmers and lakeshore inhabitants as well as MWSS, NIA, LLDA and others government agencies. A comprehensive development plan should be prepared based on the consensus.

3) Groundwater should continue to be the prime source of industrial water; a groundwater potential study should be carried out in view of rapidly increasing demand for industrial water, covering an extensive area within CALABARZON.

4) Status quo water quality in the Lake should be taken as the basis for planning future development of the Laguna catchment area; i.e. the status quo quality should be maintained.

5) Further location of industries should be regulated (discouraged) first by strict land use control based on land use plans to be prepared by municipality, and second by stepwise enforcement of wastewater discharge and solid waste disposal regulations; priority should be established for land use planning and implementation of sewerage and solid waste treatment systems.

6) Vigorous reforestation should be conducted in the denuded forest areas to enhance water retaining capacity and reduce soil erosion as a necessary condition for watershed management; as a sufficient condition, projects should be initiated to provide means of livelihood for people already living in the upper catchment area.

7) An environmental monitoring and evaluation system should be established for the Laguna basins with the participation of NGO's, research institutes and international experts as well as local people and government agencies.

Immediate actions recommended

Public fora should be created for the Laguna Lake environment to discuss the strategy and measures described above and any related matters with the participation of local groups of people, research institutes, government agencies, NGO's and other relevant entities. It should prepare recommendation on those strategy and measures with modifications as necessary for adaption, as matter of principle, by the relevant government authority.

An information and communication system appropriate for continuous monitoring of activities and phenomena within the Laguna Lake catchment area, discussion thereon and coordination thereof should be worked out also in the fora and recommended to the relevant government authority. As the first component of the system, the Laguna Lake environmental monitoring and evaluation system should be designed, possibly with the assistance of international aid organization, clarifying roles to be played by NGO's, research institutes and government agencies and their relationships with international community.

Tables

Table J.1 Physiography of CALABARZON

Land Form	Cavite		Laguna		Batangas		Rizal		Quezon		CALABARZON		NOTE
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	
Alluvial Plain	17,197.5	13.35	44,158	25.09	4,630	1.46	9,182.0	7.01	126,813	14.57	201,981	12.62	
Coastal Plain	2,624.2	2.04			29,159	9.21			35,419	4.07	67,202	4.20	
Terrace 1	17,983.4	13.96	12,170	6.92	79,044	24.97					109,197	6.82	
Terrace 2	7,303.0	5.67	5,660	3.22	32,255	10.19					45,218	2.82	Dissected
Foot Slopes	36,292.8	28.18	14,340	8.15	18,586	5.87	3,857.5	2.95	39,468	4.53	112,544	7.03	
Scarpments					18,983	6					18,983	1.19	
Plains			13,220	7.51	799	0.25	613.0	0.47	3,424	0.39	18,056	1.13	Flat Land
Plateaus			4,880	2.77			6,791.5	5.19	6,144	0.71	17,816	1.11	
Hills (Low Relief)	22,098.1	17.16	20,086	11.41	34,305	10.84	19,089.4	14.58	290,344	33.35	385,923	24.11	
Hills (High Relief)	6,916.7	5.37	42,683	24.26	52,291	16.52	53,045.0	40.53	208,314	23.93	363,250	22.69	
Mountain	18,359.3	14.26	7,522	4.27	29,567	9.34	21,120.6	16.14	141,218	16.22	217,787	13.60	
Volcanics			8,915	5.07	16,962	5.36			19,516	2.24	64,922	4.00	Volcanic Slope, Volcanic Cone
Miscellaneous			2,336	1.33			17,193.0	13.14					Built-up, Wet land
TOTAL	128,775 *	100	175,970	100	316,581	100	130,892	100	870,660	100	1,600,879	100	

Note:
* Estimates vary among different sources; official estimate by the provincial government of Cavite is 142.706 Ha.

Table J.2 Existing General Land Use

(ha)

Land Use	Cavite		Laguna		Batangas		Rizal		Quezon		CALABARZON	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Total Provincial	128,775 *	100.0	175,974	100.0	316,581	100.0	130,894	100.0	870,660	100.0	1,622,883	100.0
Agricultural Crops :	88,707	68.9	107,117	60.9	196,847	62.2	18,764	14.3	455,610	52.3	867,044	53.4
Paddy: Irrigation	15,169	11.8	22,296	12.7	2,301	0.7	3,564	2.7	40,098	4.6	83,428	5.1
Paddy: Non-Irrig.	7,146	5.5	1,320	0.8	16,433	5.2	3,982	3.0	13,175	1.5	42,057	2.6
Other Seasonals	7,544	5.9	1,232	0.7	25,979	8.2	44	0.0	16,312	1.9	51,112	3.1
Fruit Trees	6,528	5.1	1,092	0.6	607	0.2	7,839	6.0			16,065	1.0
Banana	12,371	9.6			990	0.3	1,215	0.9			14,575	0.9
Coconut	21,513	16.7	69,317	39.4	80,234	25.3	2,119	1.6	385,932	44.3	559,114	34.5
Sugarcane	10,503	8.2	11,860	6.7	70,304	22.2					92,667	5.7
Other Perennials	7,933	6.2							93	0.0	8,026	0.5
Forest and Woodland	8,854	6.9	26,079	14.8	19,453	6.1	17,771	13.6	310,463	35.7	382,620	23.6
Bamboo	1,612	1.3			10,149	3.2	4,733	3.6			16,495	1.0
Grassland and Shrubland	15,259	11.8	29,968	17.0	76,984	24.3	69,855	53.4	68,858	7.9	260,924	16.1
Wetland & Special Use Area	921	0.7	2,147	1.2	3,884	1.2	442	0.3	33,289	3.8	40,683	2.5
Built-up Area	8,251	6.4	10,576	6.0	7,040	2.2	15,237	11.6	2,424	0.3	43,528	2.7
Mining and Quarrying	17	0.0	70	0.0	276	0.1	1,520	1.2	16	0.0	1,899	0.1
Other Built-up Area			17	0.0							17	0.0
Unclassified Areas	5,155	4.0			1,948	0.6	2,572	2.0			9,674	0.6

Source: Bureau of Soils

Note:
* Estimates vary among different sources, official estimate by the provincial government of Cavite is 142,706 Ha.

Table J.3 Erosion Potential in Four Provinces

Erosion Rank	Cavite		Laguna		Batangas		Rizal		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
1. None (E0)	2,840	2	62,488	36	65,665	21	16,533	13	147,576	19
2. Slight (E1)	21,560	17	35,816	20	106,998	34	12,700	9	177,074	24
3. Moderate (E2)	78,775	61	63,570	36	85,907	27	44,792	34	272,784	36
4. Severe (E3)	25,650	20	14,096	8	58,011	18	56,867	44	154,604	21
Total	128,775	100	175,970	100	316,581	100	180,892	100	752,218	100

Table J.4 Land Capability in CALABARZON (1/4)

Characteristics Name of Area (Tentative)	Topography	Major Soil	Slope	Geology	Major Land Use	Erosion Potential	Flood Prone Area	Legal Restriction	Land Capability Class
1. Siera Madre Mountain Area	4-500m-up to 1,469m Mountaineous area	Mountain Soils	More than 30% steep slope area	Cretaceous-tertiary rocks/ diorite, andesite/basalt	Forest	Severe erosion	None	National park reforestration area	M
2. Rizal Upland Area	300-500m hilly upland area	Inceptisols/ Alfisols	30% + relatively steep	Tertiary/quartenary volcanics	Grass land/partly secondary forest	Severe	None		D
3. Angono Hill	Hilly upland up to 255m	Inceptisols	18-30% partly over 30%	Quartenary volcanics/lava	Shrub	Severe	None		M
4. Talim Island	Hilly upland up to 410m	Entisols	18-30%	Quartenary volcanics	Shrub	Severe	Coastal lowlands is affected by Laguna lake		M
5. Montalban Lowland	Fluvial lowland	Vertisols/ Inceptisols	Less than 8% relatively flat area	Alluvial deposits	Residential, paddy	Slight	Overflow from the river (temporarily)		A
6. Taytay Lowland	Fluvial to lacustrine lowland	Vertisols/ Entisols	0-3% very flat land	Alluvial deposits	Residential area/paddy	None	Flood by Laguna lake		A
7. Tercas-Tanay Lowland	Fluvial to lacustrine lowland	Inceptisols/ Entisols	0-3% very flat land	Alluvial deposits	Paddy	None	Flood by Laguna lake		A
8. Jalajala Lowland	Narrow lacustrine lowland partly fluvial	Inceptisols	Less than 8%	Alluvial and lacustrine deposits	Paddy	None to slight	Flood by Laguna lake		A
9. Bagumbong Lowland	Lacustrine lowland	Entisols	Less than 8%	Alluvial and lacustrine deposits	Paddy	None	Flood by Laguna lake		A
10. Mabitac Lowland	Fluvial lowland/partly lacustrine lowland	Vertisols	0-3%	Alluvial/lacustrine deposits	Paddy/built-up area	None	Partly flooded by Laguna lake		A
11. Laguna Lake West Lowland	Fluvial lowland	Inceptisols/ Vertisols	0-3%	Alluvial deposits	Paddy/built-up area	Slight	Partly flooded by Laguna lake		A
12. Laguna Lake South Lowland	Fluvial lowland	Inceptisols/ Vertisols	0-3% almost flat land	Alluvial deposits	Paddy coconut forest	None to slight	Partly flooded by Laguna lake		A
13. Maguiling-Aumbia Mountain	Mt. Makiling, 1,110m Mt. Atimbia, 654m	Alfisols	More than 30%	Quartenary volcanic deposits	Forest	Severe	None		M
14. Liliw Upland	Foot slope	Volcanic Loamy Soils	8-18% Partly more than 18%	Volcanic Pyroclastics Alluvial deposits	Coconut Rice paddy	Moderate	None	None	C
15. Mt. Banahow	Mountain ranging from 1,410-2,151m	Alfisols	More than 30%	Quartenary volcanic deposits	Forest shrub grass land	Severe	None	National park reforestation	M

Table J.4 Land Capability in CALABARZON (2/4)

Characteristics Name of Area (Tentative)	Topography	Major Soil	Slope	Geology	Major Land Use	Erosion Potential	Flood Prone Area	Legal Restriction	Land Capability Class
16. Sariya-Tayabas	Foot slope	Volcanic Loamy Soils	8-18%	Volcanic pyroclastics	Coconut Rice paddy	Moderate	None	None	C
17. Sto. Nino Mountain	Mountain up to 963m	Alfisols	More than 30%	Quartenary volcanic deposits	Forest foot slope area/coconut	Severe	None		M
18. Cavite Lowland	Alluvial to coastal lowland	Inceptisols/ Vertisols	0-3% partly 3-8%	Alluvial deposits/partly tuff	Paddy/built-up area	None to slight	Coastal area has slight flood potential		A
19. Cavite Plateau	Undulating taffaceous plateau partly dissected	Inceptisols	3-8%	Tuffaceous rock/pyroclastics	Sugarcane free crops/grass land	Slight	None		C
20. Tagaytay Upland	Upland/partly dissected deeply	Inceptisols	8-18% partly over 18-30%	Pyroclastics/tuff breccia	Tree crops/coconut	Moderate to severe	None		C
21. Lipa Plateau	Upland are but gently sloping/partly dissected	Inceptisols	3-8% partly flat	Quartenary pyroclastics	Coconut/sugarcane upland crops	Moderate/ partly severe	None		C
22. San Juan Lowland	Mainly alluvial lowland	Inceptisols/ Vertisols	0-3% flat land	Quartenary pyroclastics alluvial deposits	Paddy coconut upland crops	Slight	River over flow		B
23. Sampiro Hill	Lowlying hill	Inceptisols	8-18%	Tertiary volcanics/meta-andesite/basalt	Shrub	Moderate to severe	None		D
24. Lobo Mountain	Mountain area up to 972m	Alfisols	More than 30%	Tertiary volcanics/ andesite/basalt/pyorite	Forest/shrub grass land	Severe	None	Reforestation area	M
25. Taal Lake Slopes	Slope area around Taal lake basin	Alfisols/ Inceptisols	Mainly over 30%	Quartenary volcanic/ pyroclastics/breccis	Coconut/shrub/ grass land	Severe/partly moderate	None	Partly national park/reforestation	M
26. Taal Lake Lowland	Alluvial lowland along Taal lake	Inceptisols	0-3%	Alluvial deposits	Paddy	None	None		B
27. Batulao-Palaypalay Mountain	Volcanic mountains up to 810m	Alfisols	More than 30%	Tertiary volcanic lava/ pyroclastics/andesite/basalt	Forest/shrub/ grass land	Severe	None	National park reforestation	M
28. Nasugbu Lowland	Coastal lowland	Vertisols/ Entisols	0-3%	Alluvial deposits	Paddy	None	River overflow temporarily		A
29. Calantas Plateau	Gently sloping plateau partly dissected deeply	Inceptisols	8-18% mainly	Quartenary volcanics/ pyroclastics/tuff	Sugarcane/coconut	Moderate	None		C
30. Balibago Upland	Hilly upland up to 249m	Alfisols/ Inceptisols	18-30% partly over 39%	Tertiary rocks/ limestone/sandstone	Shrub/grass land	Severe	None		M

Table J.4 Land Capability in CALABARZON (3/4)

Characteristics Name of Area (Tentative)	Topography	Major Soil	Slope	Geology	Major Land Use	Erosion Potential	Flood Prone Area	Legal Restriction	Land Capability Class
31. Balayan Coastal Lowland	Coastal lowland	Entisols/ Vertisols	0-3%	Alluvial/coastal deposits	Sugarcane	None			A
32. Calumpan Hill	Hilly upland up to 501m	Alfisols	More than 30%	Tertiary rocks/limestone/ andesite/sandstone	Shrub	Severe			M
33. Batangas Coastal Lowland	Coastal lowland	Entisols/ Vertisols	0-3%	Alluvial coastal deposits	Paddy/sugarcane	None			A
34. Narrow Coastal Lowland	Narrow coastal lowland	Entisols	0-3%	Alluvial coastal deposits	Coconut	None			B
35. San Pablo-Candelaria Lowland	Lowlying Foot slope-alluvial fan	Volcanic, Loam Alluvial Sand and Gravel	3-8%	Volcanic deposits Alluvial deposits	Coconut Rice paddy	Slight	None	None	B
36. Tiaong-San Jaan-Lucena Lowland	Alluvial lowland-coastal	Alluivial Soils	0-3%	Alluvial clay, sand/gravel	Coconut Rice paddy	None	River overflow in coastal lowland	None	A
37. Inlanta Lowland	Alluvial delta	Alluivial Soils	0-3%	Alluvial Deposits	Rice paddy Coconut mangrove	None	River overflow due to bad drainage	None	A
38. Peninsula Hilly Upland	Hilly upland from 100m-300m +	Sandy-Loamy Soils	18-30%	Tertiary sedimentary rocks	Coconut Grass land	Moderate-severe	None		D
39. Peninsula Mountains	Mountain from 100m-500m +	Mountain Soils	More than 30%	Tertiary sedimentary rocks	Forest, coconut Grass land	Severe	None	Reforestation	M
40. Cadig-Bayabas Mountain	Mountain up to 728m	Mountain Soils	More than 30%	Tertiary sedimentary rocks	Forest Grass land	Severe	None		M
41. Minor Coastal Lowland in Peninsula	Alluvial clay, loam and sandy	Alluvial Clay, Loam and Sandy	0-3%	Alluvium	Coconut, paddy Mangrove	None	River overflow	Preservation of mangrove forest	A
42. Lopez Lowland	Alluvial-coastal lowland	Alluvial Clay, Loam and Sandy	0-3%	Alluvium	Coconut, paddy Mangrove	None	River overflow	Preservation of mangrove forest	A
43. Pitogo Lowland	Alluvial-coastal lowland	Alluvial Clay, Loam and Sandy	0-3%	Alluvium	Coconut, paddy Mangrove	None	River overflow	Preservation of mangrove forest	A
44. Macalcon Lowland	Alluvial-coastal lowland	Alluvial Clay, Loam and Sandy	0-3%	Alluvium	Coconut Paddy	None	River overflow		A

Table J.4 Land Capability in CALABARZON (4/4)

Characteristics Name of Area (Tentative)	Topography	Major Soil	Slope	Geology	Major Land Use	Erosion Potential	Flood Prone Area	Legal Restriction	Land Capability Class
45. Pagsanjan River Lowland	Alluvial lowland	Alluvial Clay, Loam and Sandy	0-3%	Alluvium	Coconut corm	None to slight	River overflow		A
46. Minor inland Alluvial Lowland	Alluvial lowland	Alluvial Clay, Loam and Sandy	3-8%	Alluvium	Paddy	Slight	River overflow		B
47. Minor Alluvial Lowland in Bondac Peninusla	Alluvial lowland	Alluvial Clay, Loam and Sandy	3-8%	Alluvium	Paddy Corn	Slight	River overflow		B
48. Polillo Island	Island	-	Hilly upland 18-30% Lowland 3-8%	Tertiary sedimentary rocks	Forest, coconut Paddy	None to slight	Flooding in coastal lowland	Preservation of mangrove forest	• Up land area : D-M • Coastal lowland : A
49. Patnanongan Island	Island	-	0-3% partly 3-8%	Tertiary sedimentary coral limestone	Coconut forest	None to slight	None	Preservation of mangrove forest	• Up land area: D • Coastal lowland : A
50. Jomalig Island	Caral island	-	3-8%	Coral limestone	Coconut	None	None		• Up land area: D • Coastal lowland : A
51. Alabat Island	Island	-	Hilly area: 30% + Coastal area: 0-3%	Tertiary sedimentary rocks	Coconut forest	None to slight	None		• Hilly area: D • Lowland area : A
52. Cabalete Island	Island	-	3-18%	Tertiary sedimentary rocks	Coconut	None	None		• Hilly area: D • Lowland area : A
53. Maricaban Island	Island	-							D-M?
54. Verde Island	Island	-							D-M?