

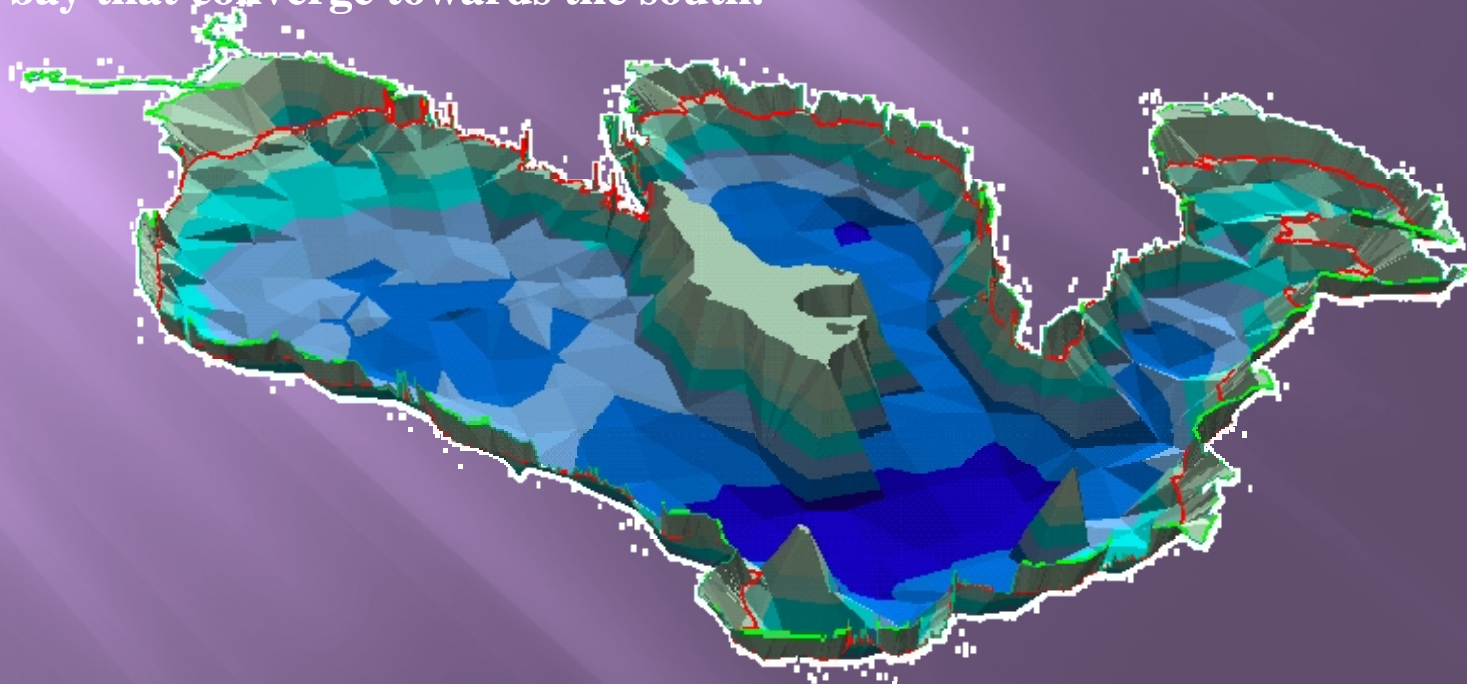
OVERVIEW OF LAGUNA DE BAY' S WATER QUALITY MONITORING PROGRAM

Emiterio C. Hernandez
Officer-in-Charge, IWRMD
Laguna Lake Development Authority

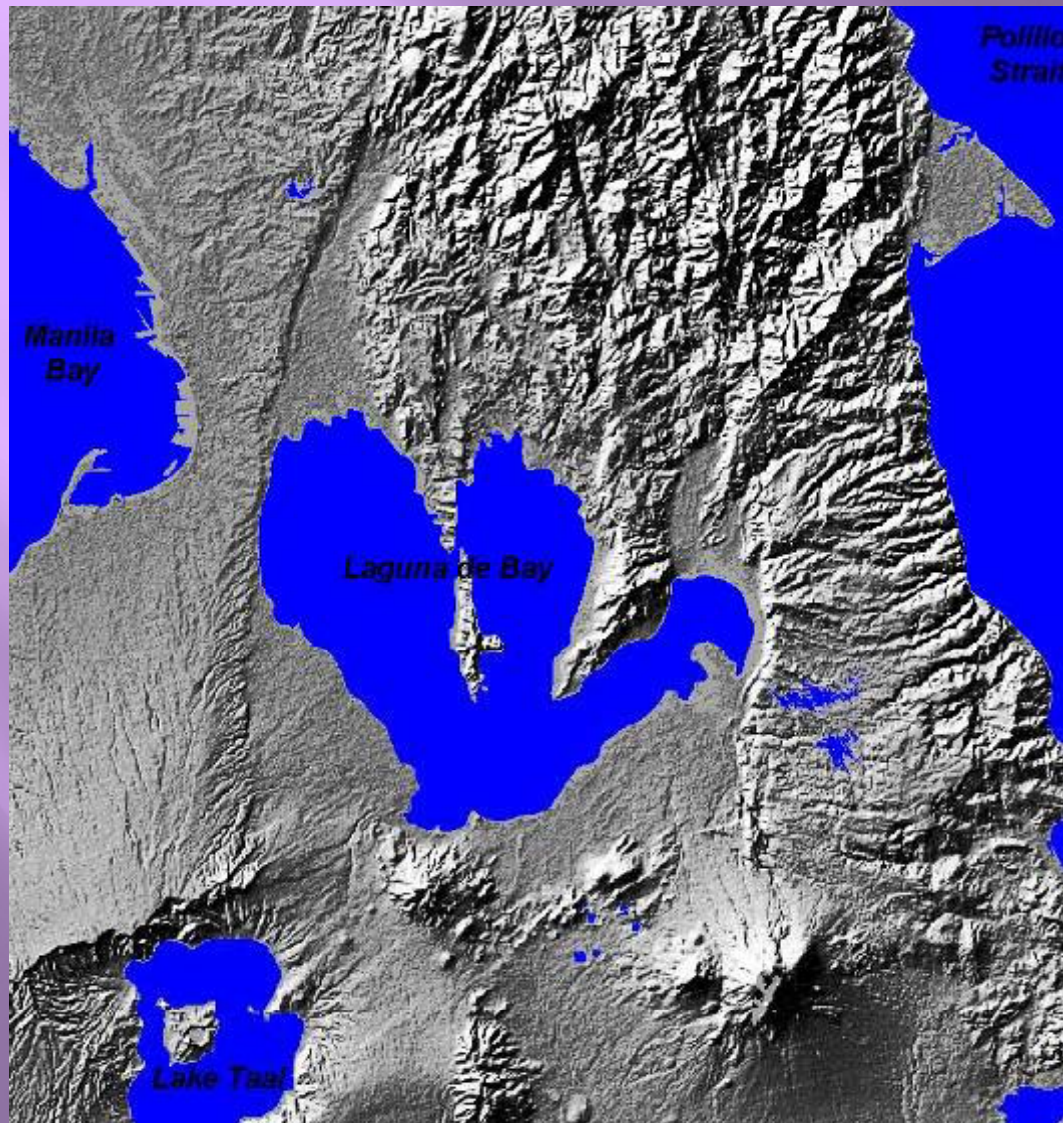


Laguna de Bay

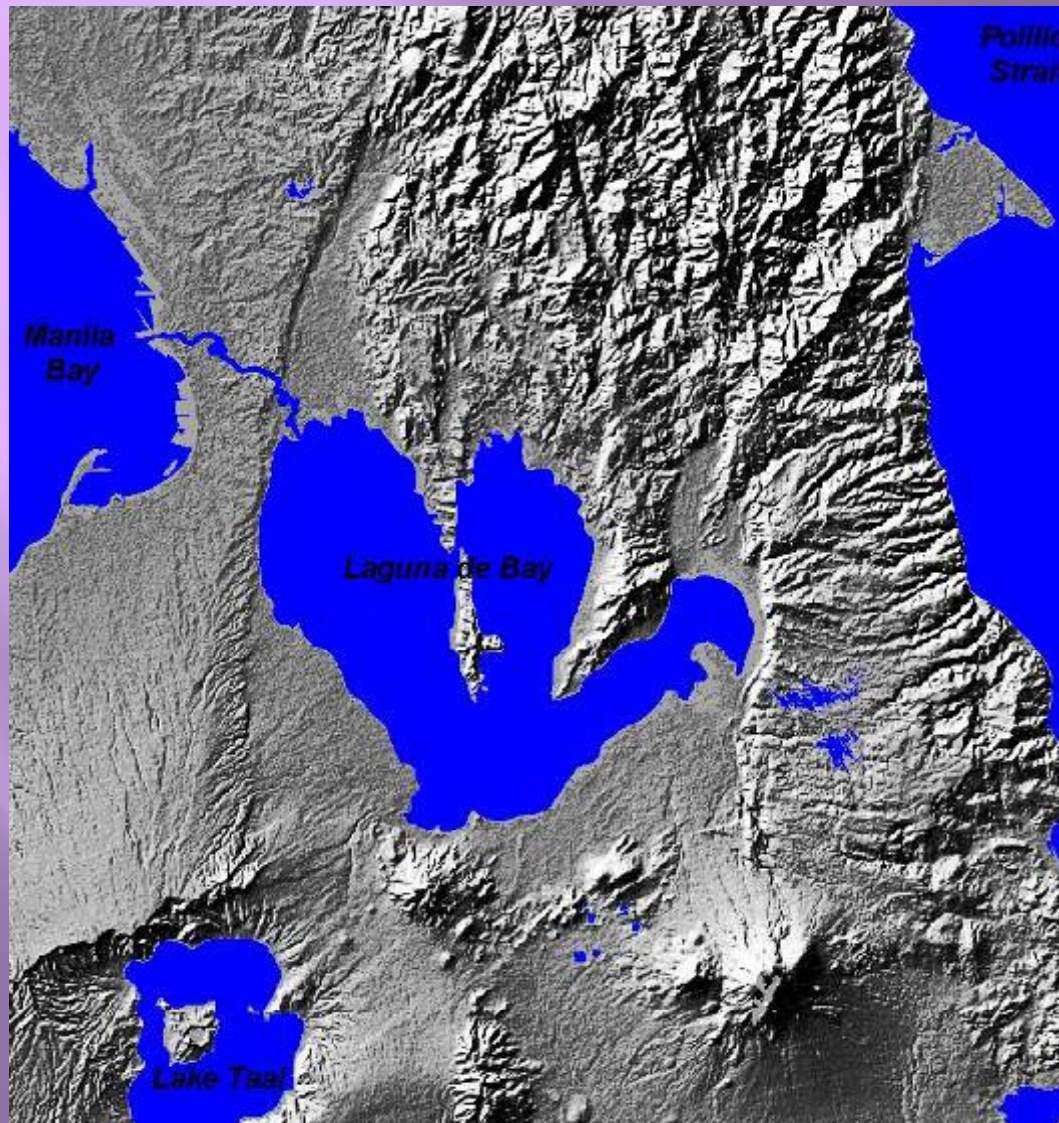
- largest lake in the Philippines
- total surface area = some 900 km²
- average depth of the lake is 2.5 meters
- shoreline length = some 285 kilometers
- 3 distinct bays, the west bay, central bay, and east bay that converge towards the south.



Laguna de Bay Watershed



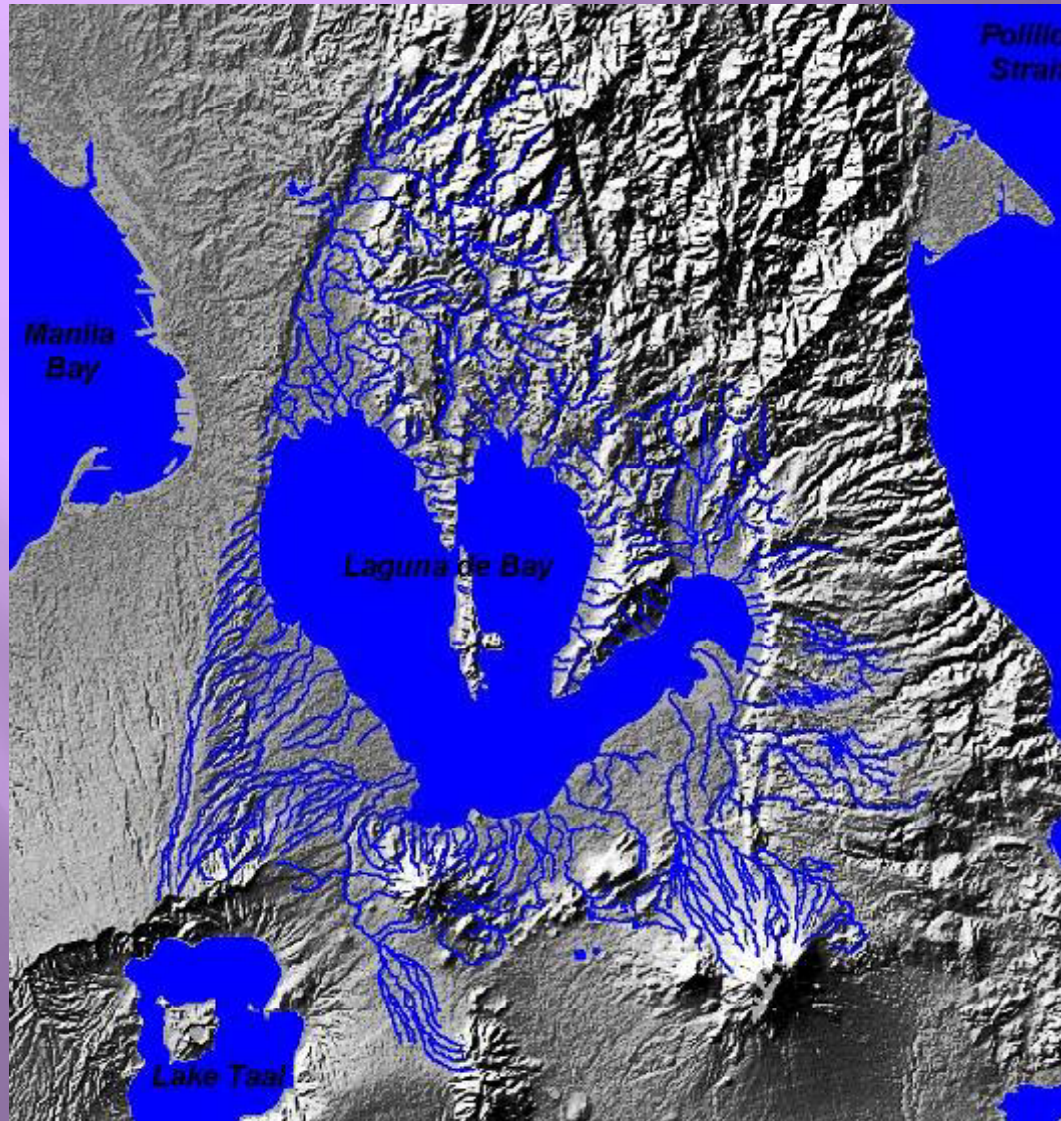
Laguna de Bay Watershed



➤ Pasig River is the only outlet of the lake

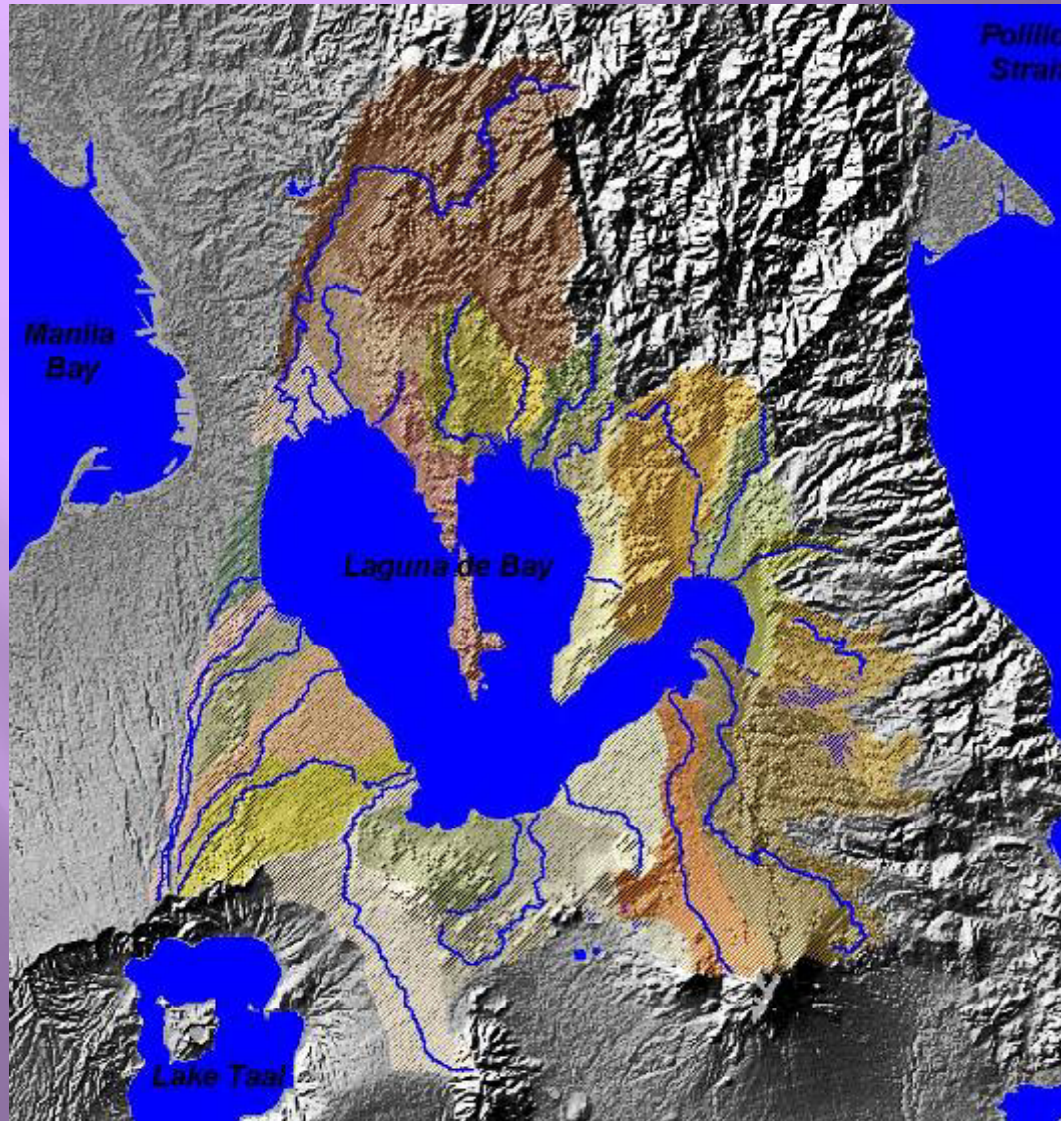


Laguna de Bay Watershed



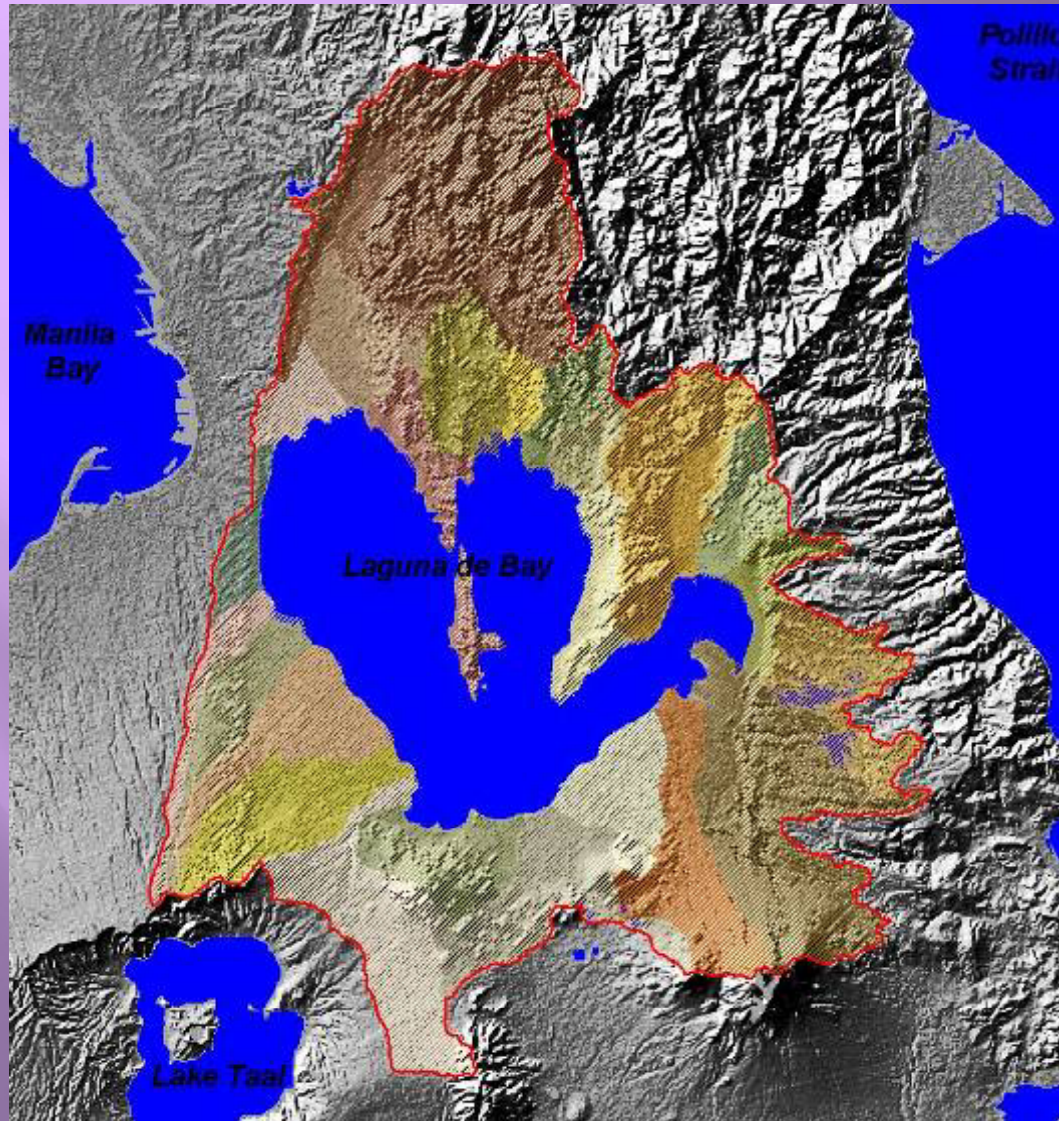
- Pasig River is the only outlet of the lake
- Some 100 streams drain into the lake

Laguna de Bay Watershed



- Pasig River is the only outlet of the lake
- Some 100 streams drain into the lake
- divided into twenty-four (24) hydrological sub-basins

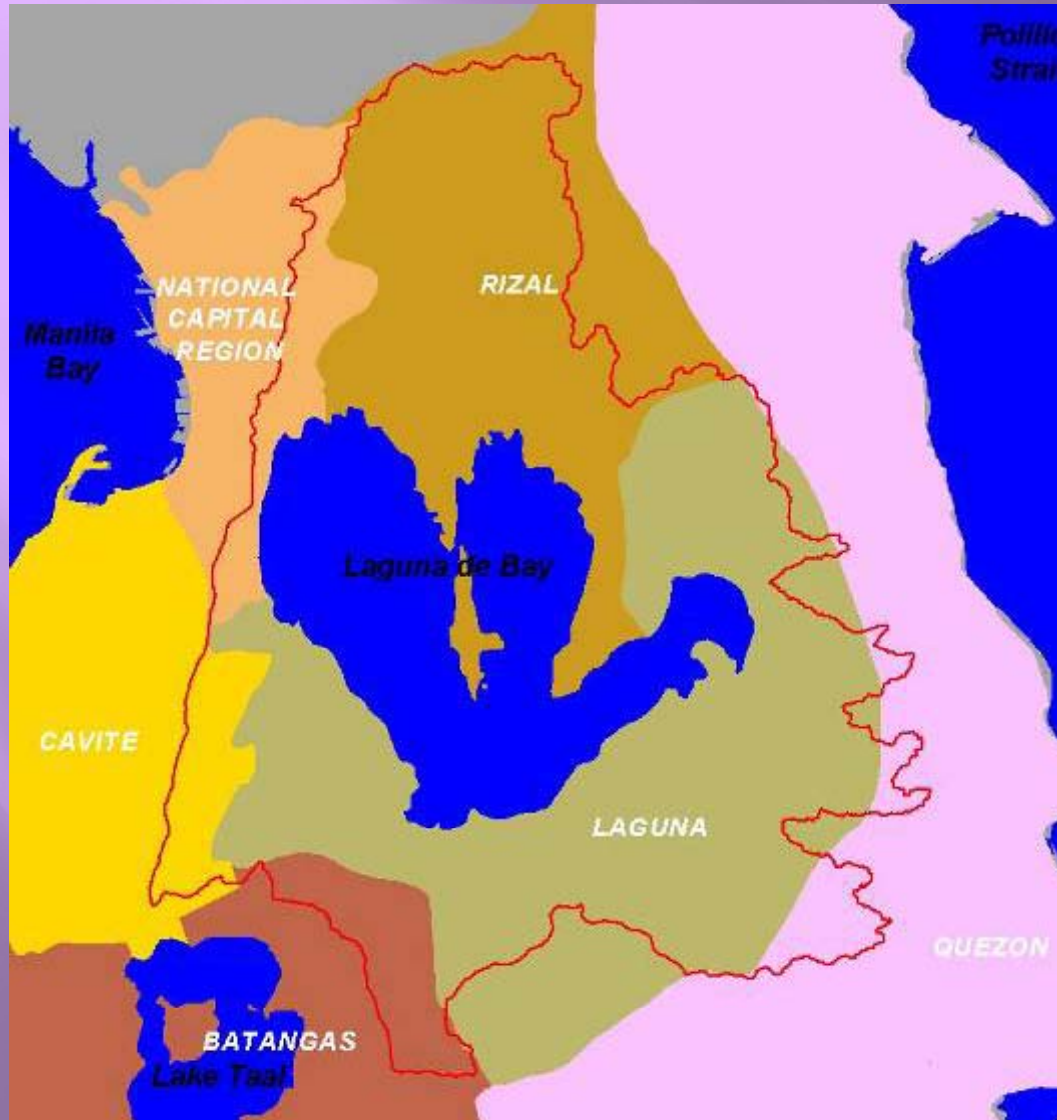
Laguna de Bay Watershed



- Pasig River is the only outlet of the lake
- Some 100 streams drain into the lake
- divided into twenty-four (24) hydrological sub-basins
- watershed area = approx. 3,820 km²



Laguna de Bay Watershed



- Pasig River is the only outlet of the lake
- Some 100 streams drain into the lake
- divided into twenty-four (24) hydrological sub-basins
- watershed area = approx. 3,820 km²
- It cradles a region encompassing 6 provinces



Laguna de Bay Watershed



- Pasig River is the only outlet of the lake
- Some 100 streams drain into the lake
- divided into twenty-four (24) hydrological sub-basins
- watershed area = approx. 3,820 km²
- It cradles a region encompassing 6 provinces, 12 cities, 49 municipalities and 2,656 barangays, 187 of which are within lakeshore
- watershed total human population = about twelve (12) million

Landsat Satellite Image
taken April 3, 2002



...a multiple use resource



Drinking Water



Fisheries



Irrigation



Transport Route

...a multiple use resource



Flood Water Reservoir



Hydro-electric Power Generation



Eco-tourism and Recreation



Industrial Cooling

Issues and Concerns

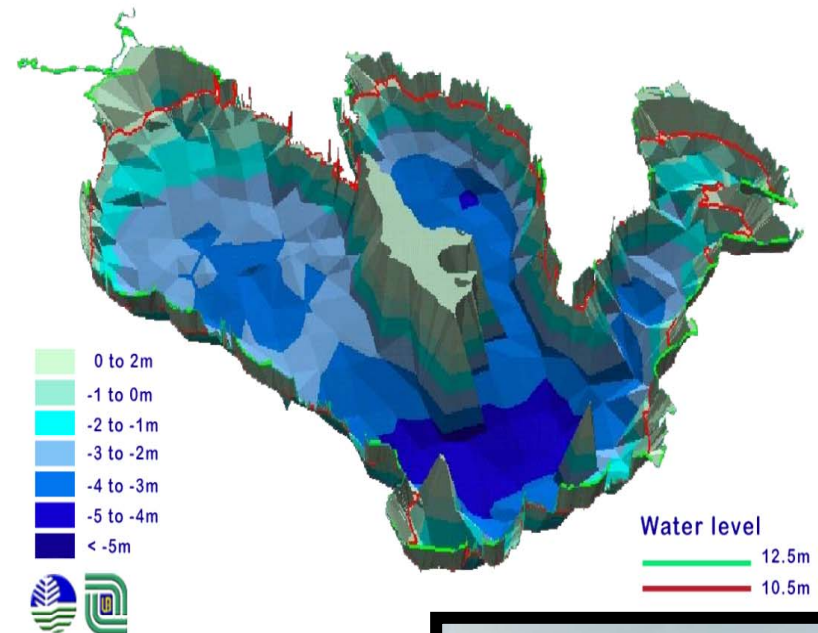
Rapid Siltation of Laguna de Bay

Bathymetry Studies 1963,
1973, 1983, 1997

Year of acquisition of bathymetry data	Shallowing Rate (mm/year)
1963 vs. 1983	3.23
1983 vs. 1997	9.68
1963 vs. 1997	8.36

The lake became shallower by 0.30 meters or about one foot (from 1960s to 1990s)

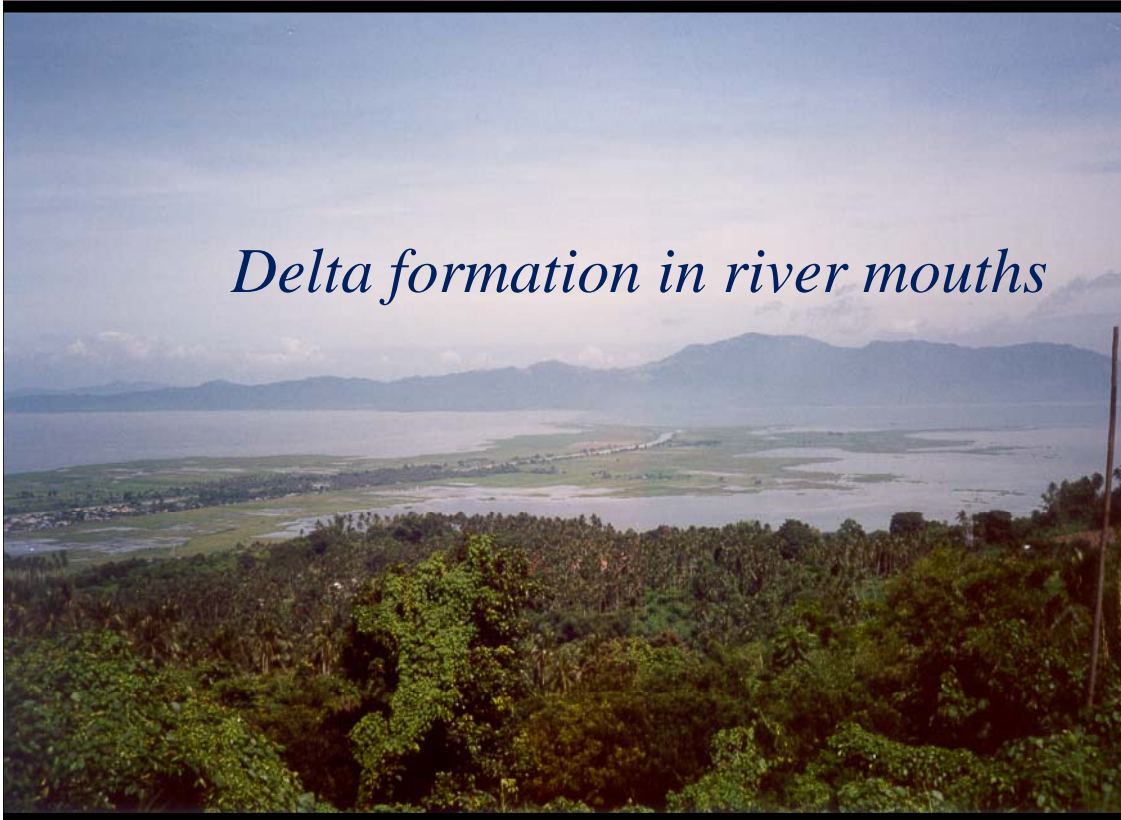
Bathymetry



Issues and Concerns

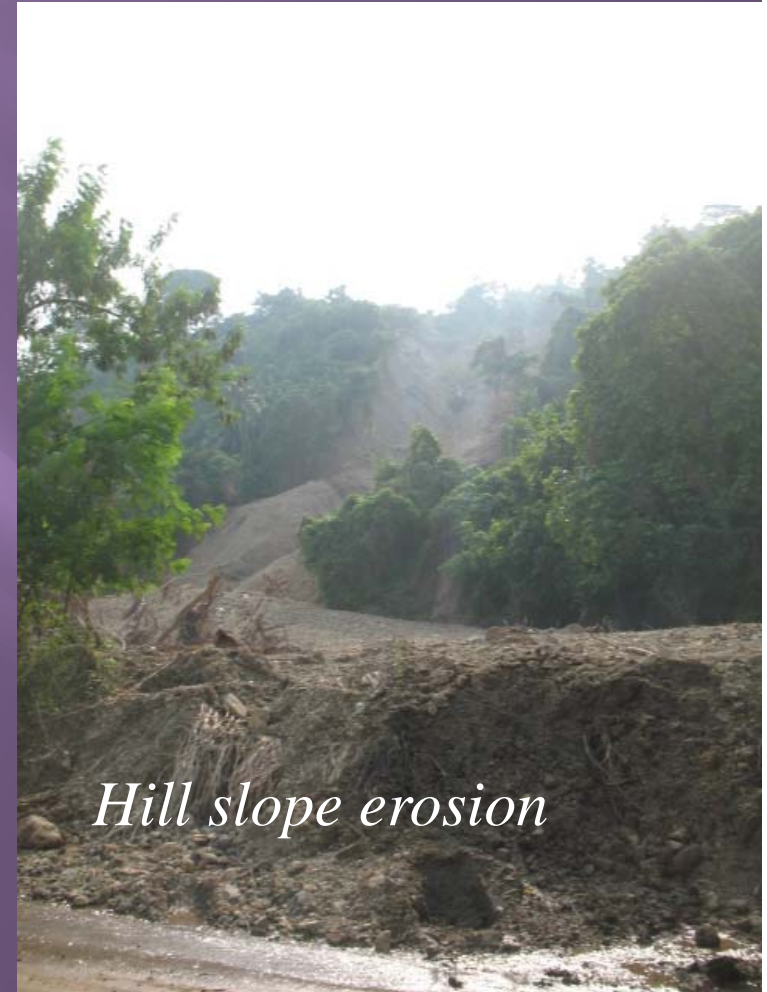
Rapid Siltation of Laguna de Bay

Delta formation in river mouths



Sediments coming from the watershed:
- about 4 million metric tons annually.

Hill slope erosion



Issues and Concerns

Watershed degradation

Slash & Burn Farming (Kaingin)



Resource Extraction (incl. quarrying)

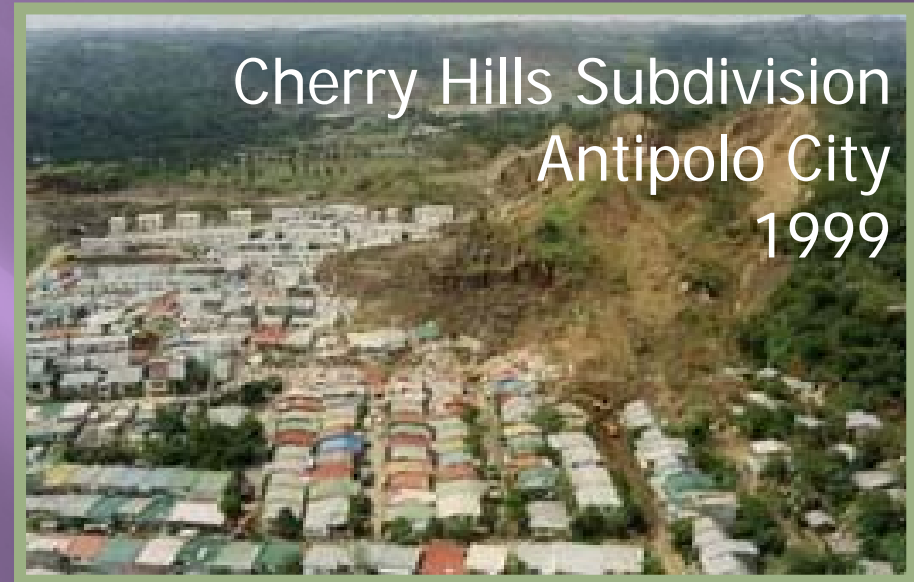


DEFORESTATION



Issues and Concerns

Uncontrolled/indiscriminate land development



Shoreland development



Issues and Concerns

Improper waste disposal



80% of families living on the river banks and lake shore land have no proper sanitation facilities, making the lake and tributaries their “pozo negro”

Some 10,000 MT of garbage generated daily in Metro Manila alone, 10% of which end up in the lake (BOD Study, 2009)



Issues and Concerns

Water pollution



- ▣ Decline in fish harvest/Fish kills
- ▣ Unsuitability of water for beneficial use
- ▣ Hazard of water for recreation
- ▣ More costly water treatment



Issues and Concerns



LAGUNA LAKE

MANGGAHAN
FLOODWAY

Flooding Problems

Typhoon Ketsana (Ondoy)

Sept 27, 2009



Issues and Concerns

Flooding Problems

Typhoon Marinae (Santi)
October 31, 2009



LLDA Programs and Projects:

“... ..Sustaining our water resources thru the following watershed protection and conservation projects and programs..”

1. Environmental Management Program
Water Quality Monitoring
Environmental Users Fee System
2. Watershed Development Program
Reforestation and Tree Planting
River Rehabilitation
3. Fisheries Development Program
Aquaculture Operation
The Fisheries and Aquatic Resource Management Council
4. Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) Project



LLDA Water Quality Monitoring Programs

- ▣ **Industrial Wastes Monitoring:**
 - Industries
 - commercial establishments
 - clustered residential units

- ▣ **Surface Water Quality Monitoring:**
 - lakes
 - rivers



Environmental User Fee System

In 1997, the LLDA started the implementation of the Environmental User Fee System within the Laguna de Bay region to control and abate water pollution from the industrial sector and to generate revenues to support such an implementation.

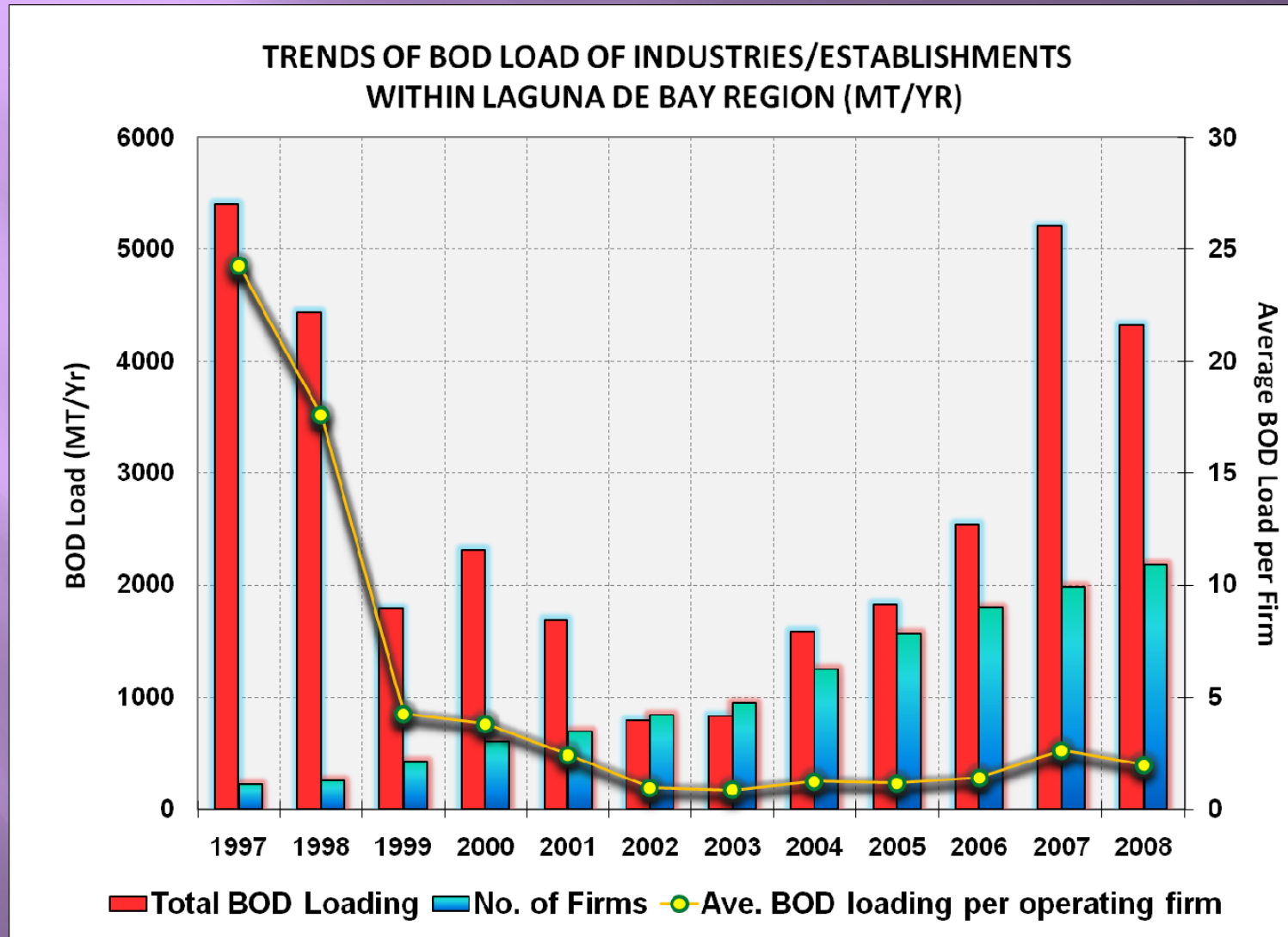


Environmental User Fee System

It is a fee that is paid for the amount of pollution that is discharged into Laguna de Bay (following the polluter-pay-principle). It is composed of a fixed fee, covering the administrative and inspection costs, and a variable fee, depending on the volume and concentration of the waste water discharge.

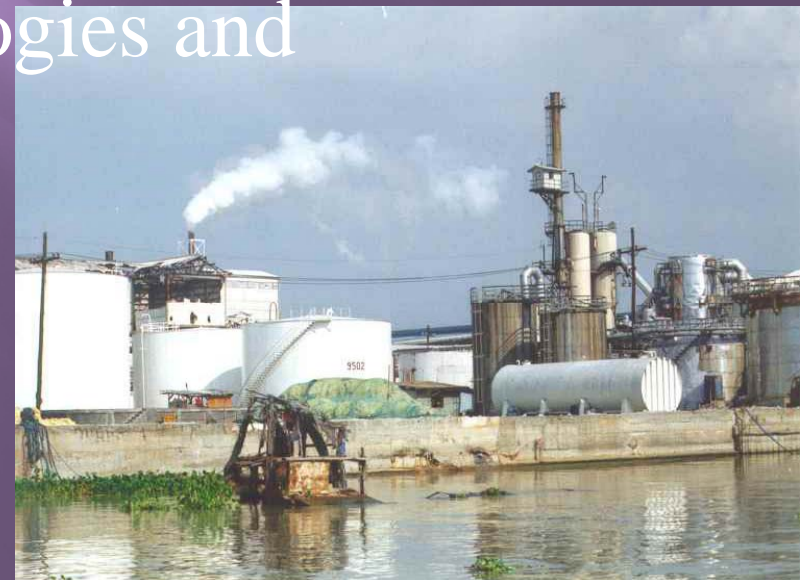


Trends of Industrial BOD Loads



Positive Response from the industrial sector:

- ▣ significant reduction of BOD5 loading
- ▣ upgrading of existing treatment facilities
- ▣ adoption of waste minimization strategies
- ▣ set-up of cleaner technologies and waste recycling



Laguna de Bay routine (water quality) monitoring programs

Objectives of the LLDA monitoring programs:

1. To accurately assess the suitability of the lake for all its present and intended beneficial uses;
2. To evaluate the impacts of development activities on the lake's water quality that will serve as important criteria for environmental planning and management.



Routine Monitoring Stations



Station	Description
I	Central West Bay
II	East Bay
IV	Central Bay
V	Northern West Bay
VIII	South Bay
1	Marikina
2	Mangagate
3	Tunasan
4	San Pedro
5	Cabuyao
6	San Cristobal
7	San Juan
8	Bay
9	Santa Cruz
10	Pagsanjan
11	Pangil
12	Tanay
13	Morong

Additional lake primary productivity stations are not presented in this figure.



Parameters monitored

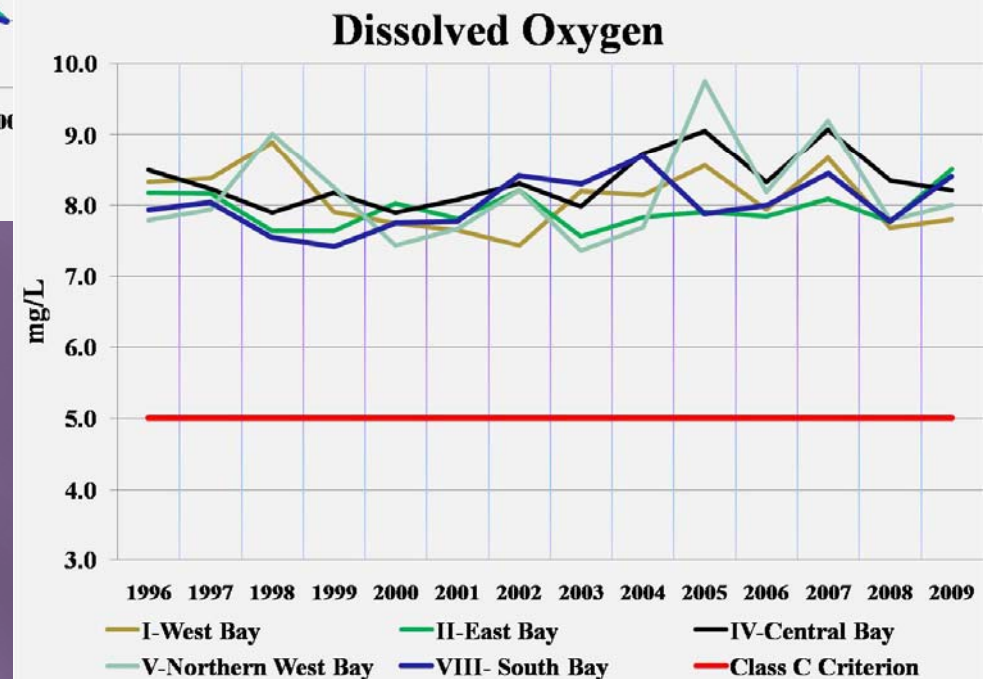
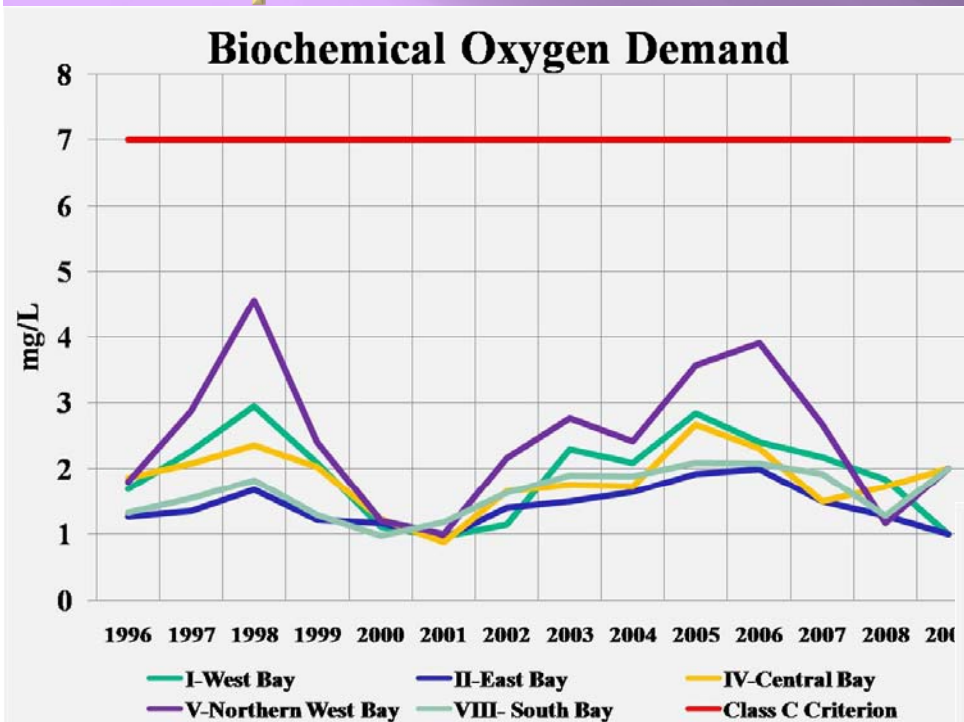
pH	Turbidity	Phytoplankton
DO	Transparency	Zooplankton
BOD	Alkalinity	Chlorophyll - a
COD	Total Hardness	Benthos
TSS	Ca Hardness	
TDS	Conductivity	
NO3	Chloride	Total/ Fecal Coliform
NH4	Inorg. Phosphate	
TN	Oil/Grease	
TP	Temperature	

Heavy Metals - Quarterly

Chromium (hexavalent)	
Copper	Lead
Nickel	Zinc
Cadmium	Iron

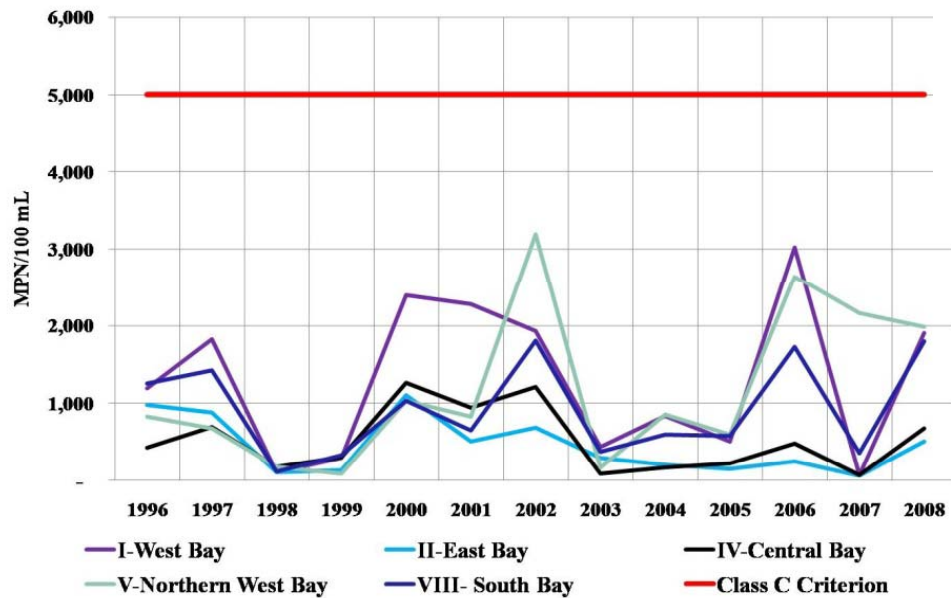


Example of Routine Monitoring Data

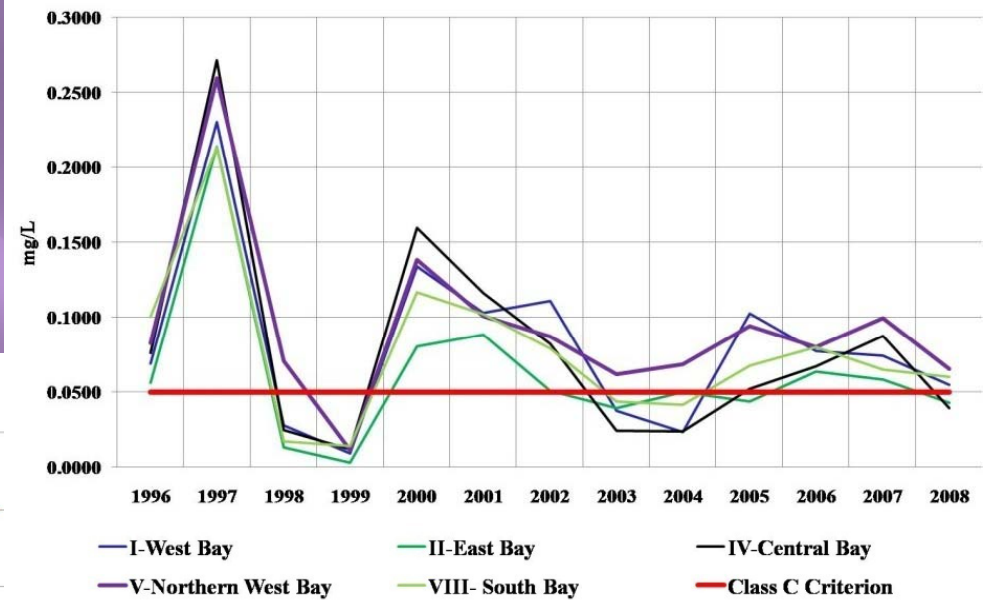


Example of Routine Monitoring Data

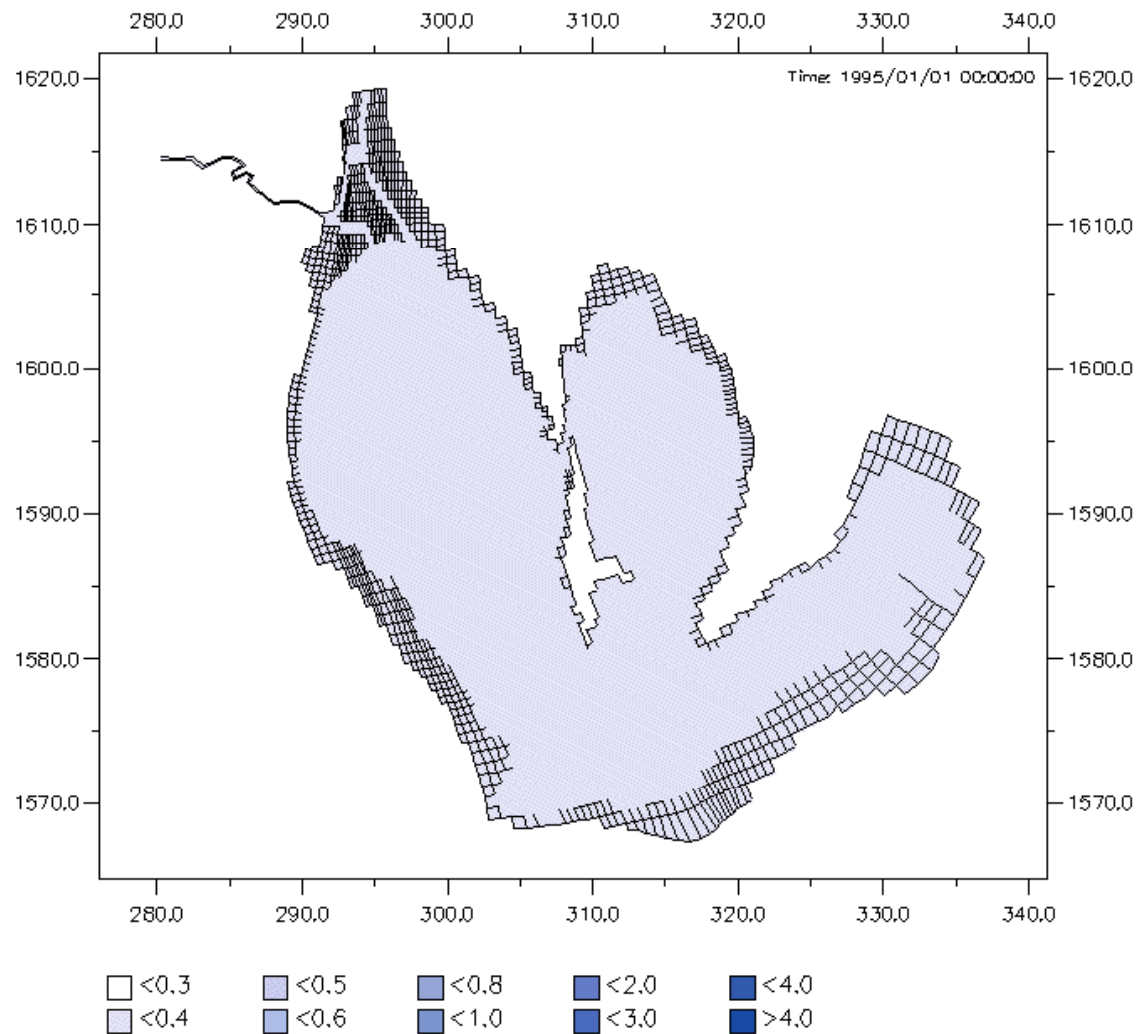
Total Coliform



Phosphate



Water Quality Modeling



**Salinity Intrusion
from Manila Bay to
Laguna Lake**



Presentation of the Laguna de Bay routine monitoring programs

Considering the vast area of Laguna de Bay and the high costs involved, these monitoring programs will inevitably be limited in their coverage, both spatially and temporally.

Without suggesting to have detailed data we would like to present to the stakeholders relevant, indicative and timely information.



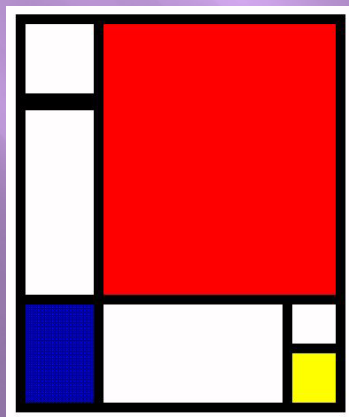
Presentation of the Laguna de Bay routine monitoring programs

In our view, a good presentation of our data should be:

- ▣ Relevant to all stakeholders
- ▣ Transparent
- ▣ Non-technical, straightforward and easy to interpret
- ▣ Timely and widely available
- ▣ Appealing
- ▣ Easy to generate

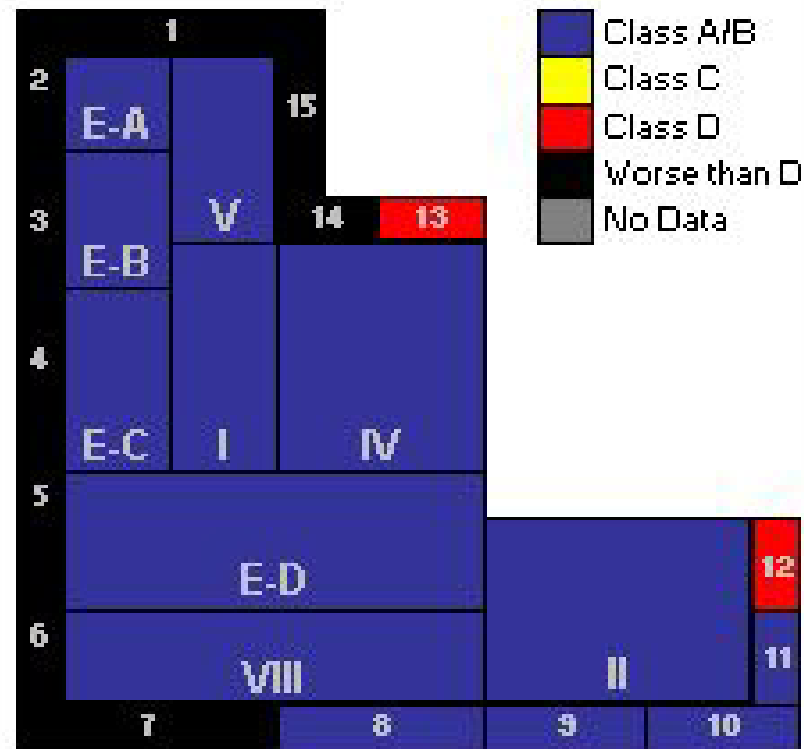


The Water Mondriaan



*Piet Mondriaan's composition
in red, yellow and blue*

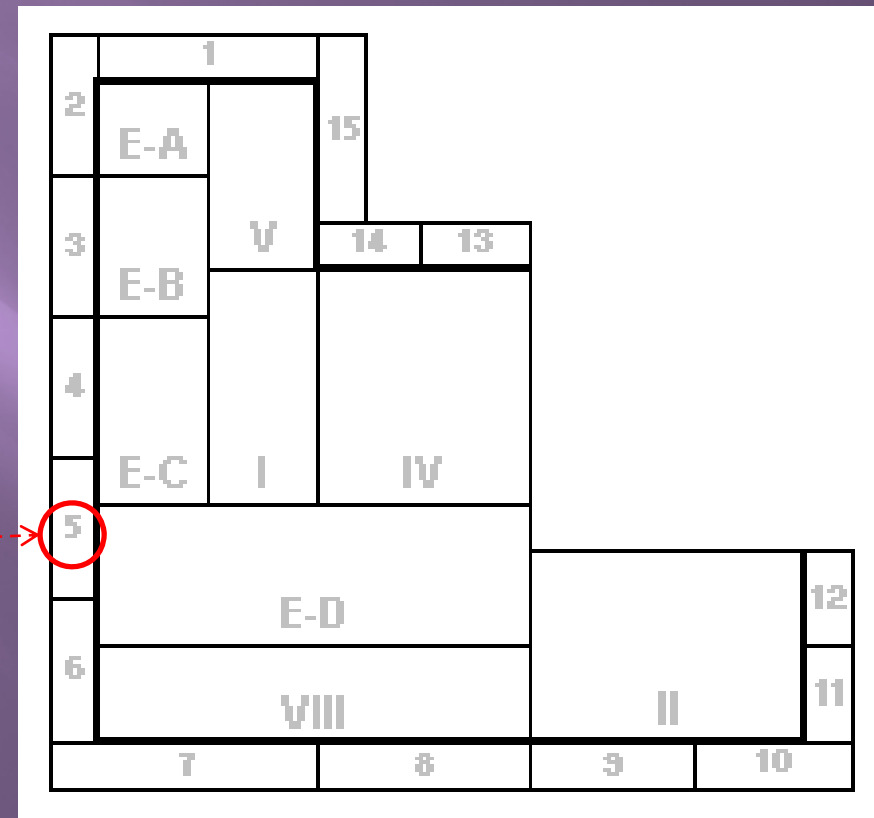
%DO Feb 2006



IDENTIFICATION		LOCATION
IWRM	EQMD	
EW-A	EW-A	Western West Bay - Taguig
EW-B	EW-B	Western West Bay - Cupang
EW-C	EW-C	Western West Bay - Cuyab
EW-D	EW-D	Western West Bay - Sta. Rosa
I	Ido_I	West Bay
II	Ido_II	East Bay
IV	Ido_IV	Central Bay
V	Ido_V	West Bay near Pasig River
VII	Ido_VII	South Bay
1	TR-Mark	Markina
2	TR-Man	Margangale
3	MT	Mouth of Tunasan
4	T3	San Pedro River
5	TR_Cab	Cabuyao
6	T3	San Cristobal River
7	T5	San Juan River
8	T8	Bay River
9	T6	Sta. Cruz River
10	T6	Pagsanjan River
11	TR-Pang	Pangl
12	TR-Sinloan	Sinloan
13	TR-Tan	Tanay
14	TR-Mor	Morong
15	TR-Sbaho	Canta, Sapang Baho



The Water Mondriaan



Schematic map of Laguna de Bay
(monitoring stations)







Focus on four categories of pollutants:

- ▣ Oxygen and oxygen demand - organic matter
- ▣ Bacterial pollution - hygienic conditions
- ▣ Eutrophic level – nutrient enrichment
- ▣ Hazardous substances - heavy metals and oils & grease



The Water Mondriaan

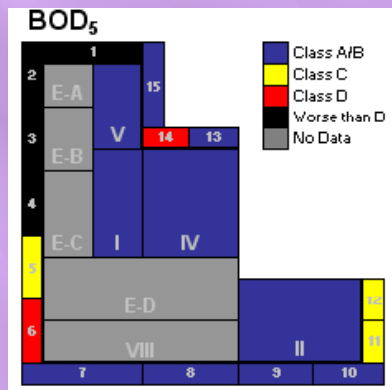
Department of Environment and Natural Resources (DENR)
water quality criteria / water usage and classification for
freshwater systems (DENR – DAO34)

Classification	Beneficial Use	Illustration	
		BOD5 (mg/L)	Water Mondriaan
Class A	Public Water Supply Class II. For sources of water supply that will require complete treatment in order to meet the NSDW.	5	
Class B	Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving.	5	
Class C	Fishery Water for the propagation and growth of fish and other aquatic resources; boating; manufacturing processes after treatment.	7	
Class D	For agriculture, irrigation, livestock, watering, industrial cooling; Other inland waters, by their quality, belong to this classification.	10	

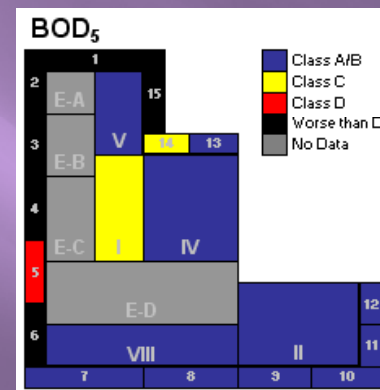


Water Quality Mondriaan Report (2010)

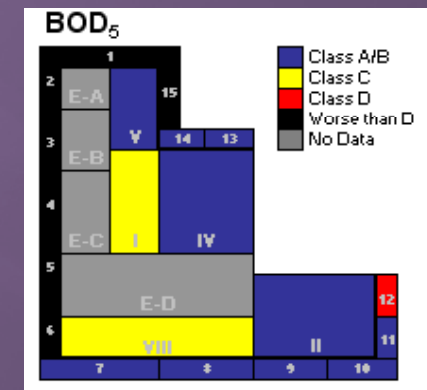
BOD₅



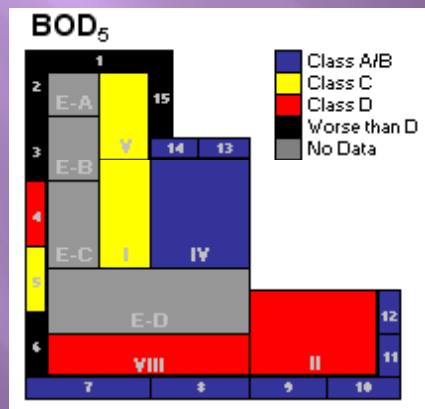
January



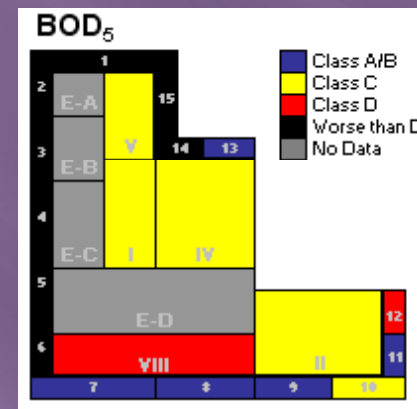
February



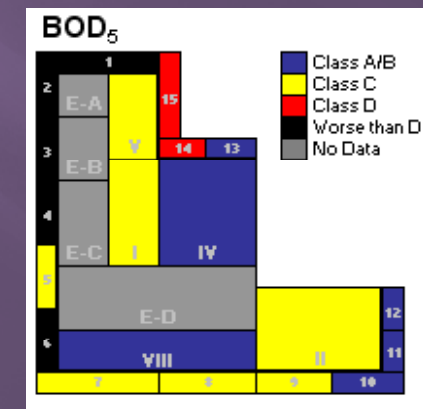
March



April



May



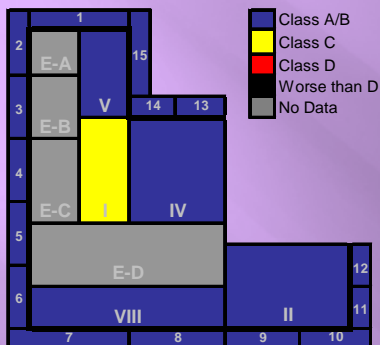
June



Water Quality Mondriaan Report (2009)

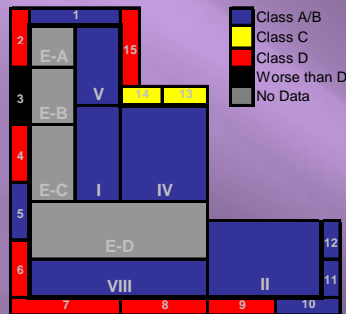
Oil and Grease

Oil and Grease



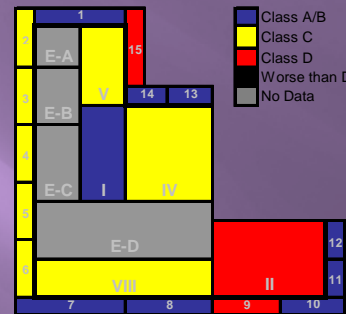
January

Oil and Grease



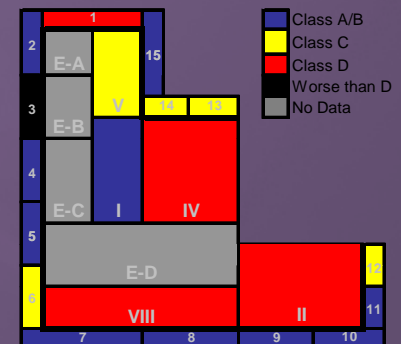
February

Oil and Grease



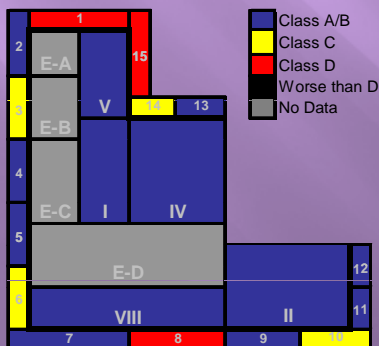
March

Oil and Grease



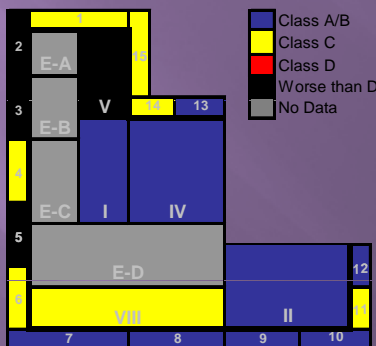
April

Oil and Grease



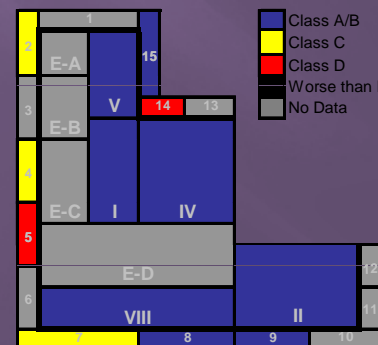
May

Oil and Grease



June

Oil and Grease

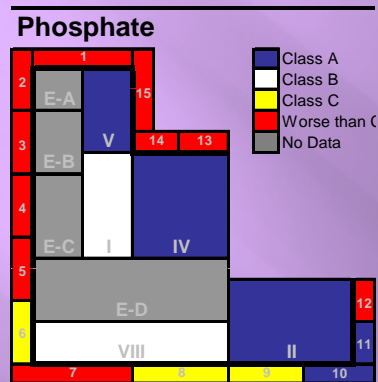


October

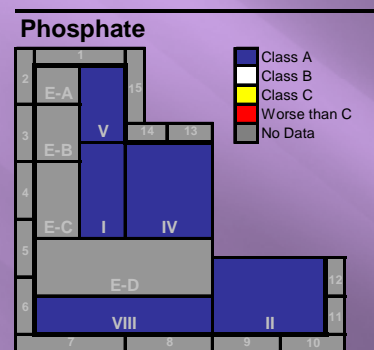


Water Quality Mondriaan Report (2009)

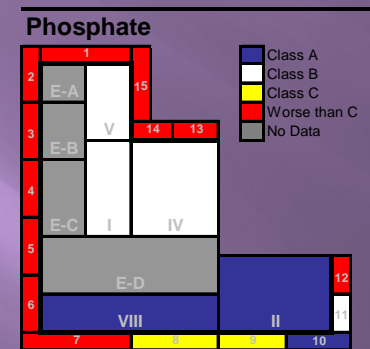
Phosphate



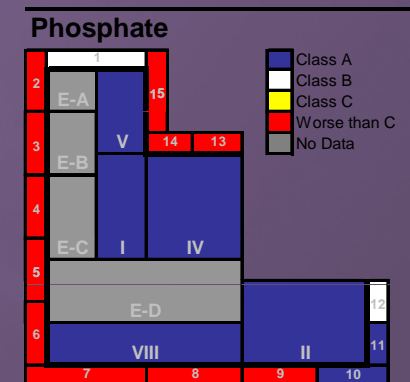
January



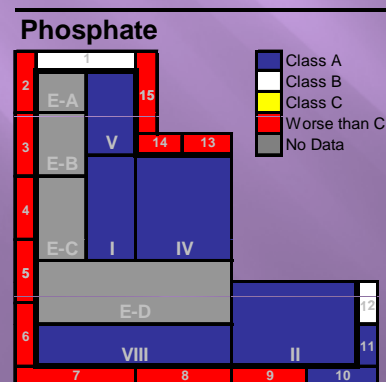
February



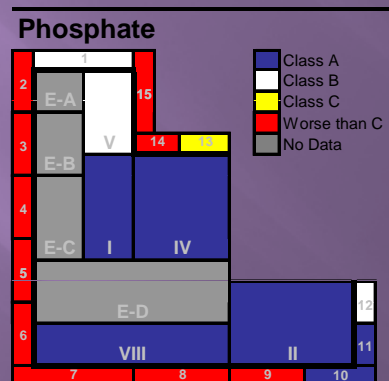
March



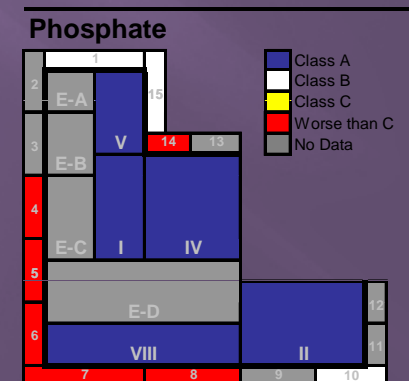
April



May



June

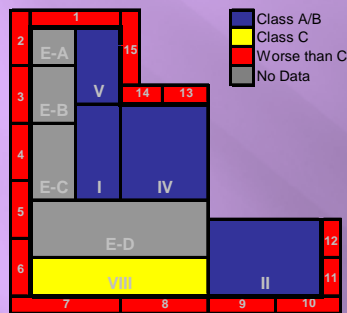


October

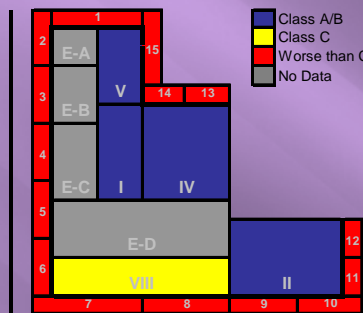


Water Quality Mondriaan Report (2009)

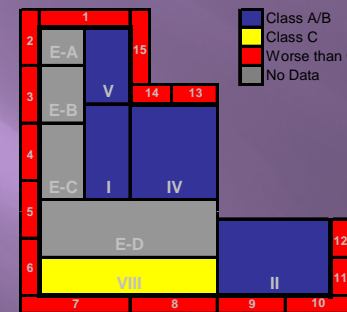
Total Coliform



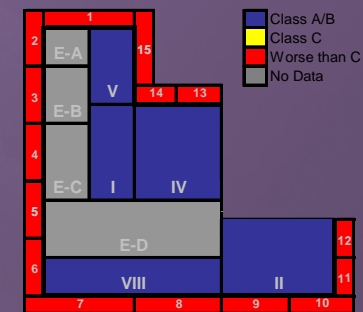
January



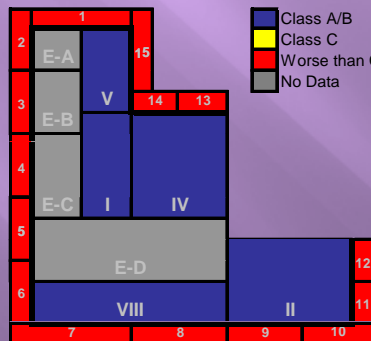
February



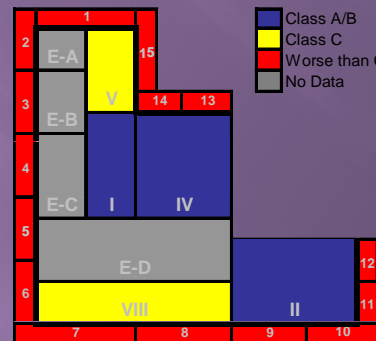
March



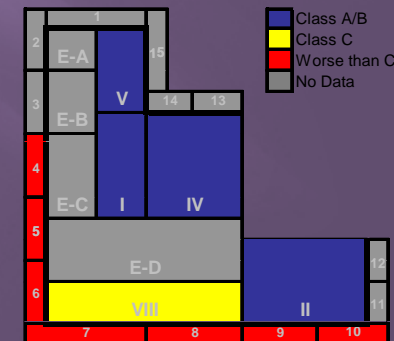
April



May



June



October

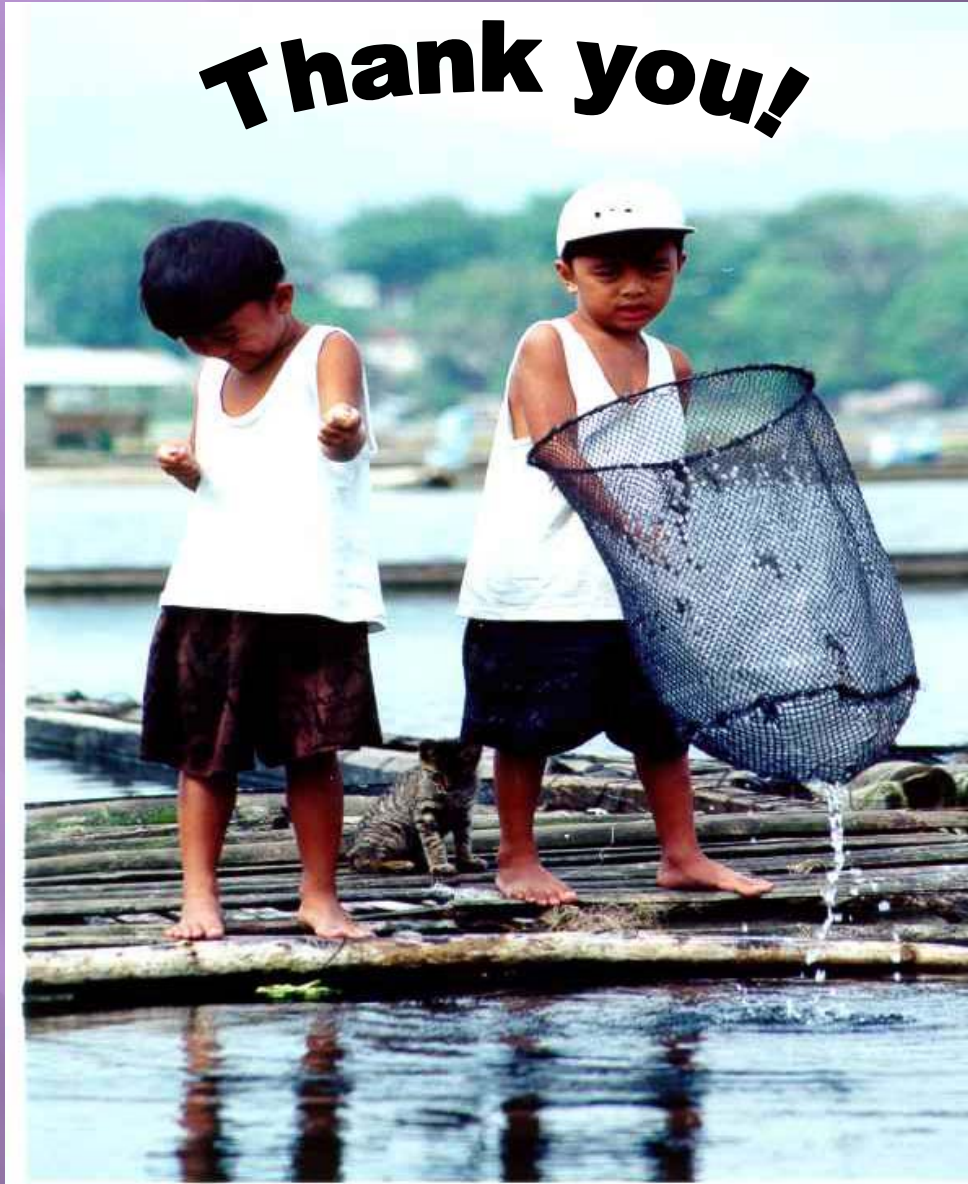


Our Laguna de Bay 'Water Mondriaan' presentation is:

- ▣ Innovative, complete, relevant and decision supportive
- ▣ Internally fully automated (from the central database)
- ▣ Available through the LLDA website (and can be disseminated to the stakeholders through local newspapers / newsletters, etc.)



Thank you!



Visit our website: www.ilda.gov.ph

