THE PHILIPPINE SUSTAINABLE SANITATION KNOWLEDGE SERIES

Water Pollution Prevention and Control Program: The Polomolok Experience

Department of Environment and Natural Resources
Philippines

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- **Water Pollution Prevention and Control Program: The Polomolok Experience**

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Acronyms and Abbreviations

BOD	Biochemical Oxygen Demand
CLUP	Comprehensive Land Use Plan
DAO	Departmental Administrative Order
cum	cubic meter
DENR	Department of Environment and Natural Resources
EMB	Environmental Management Bureau
g	gram
GenSan	General Santos City
GIS	Geographical Information System
HRT	Hydraulic Retention Time
IEC	Information, Education, and Communication
kg	kilogram
km	kilometer
LGU	Local Government Unit
M	million
mg/L	Milligrams per liter
MHO	Municipal Health Office
MOA	Memorandum of Agreement
NAA	Non-Attainment Areas
PHP	Philippine Pesos
SAU	Septage Acceptance Units
SMP	Septage Management Plan
SuSEA	Sustainable Sanitation in East Asia
TSS	Total Suspended Solids
WPPCP	Water Pollution Prevention and Control Program
WQMA	Water Quality Management Area
ZODP	Zero Open Defecation Program

The SuSEA Program

The Sustainable Sanitation in East Asia Program-Philippine Component (SuSEA) supported by the Water and Sanitation Program (WSP) of the World Bank and the Swedish International Development Cooperation Agency (SIDA), and implemented through the leadership of the Departments of Health (DOH) and Environment and Natural Resources (DENR), is geared towards increasing access by poor Filipinos, primarily low-income households, to sustainable sanitation services by addressing key demand and supply constraints. Aside from this, the program hopes to learn from local implementation of sanitation programs as basis for national policy and operational guidance.

SuSEA Philippines commenced in July 23, 2007 as a learning program to support the Government of the Philippines (GoP) update its approaches and interventions in sanitation and needs that were not present or not addressed in traditional sanitation programs that focused on two extremes: 1) toilet-bowl distribution and hygiene education and 2) centralized sewerage systems. The most important of these emerging needs are:

- Complementing interventions related to the reduction of risks of sanitation- and poverty-related diseases such as soil transmitted helminthiasis and acute gastroenteritis
- Linking sanitation interventions with environmental objectives, such as the improvement of water quality and water resources
- Sanitation in rapidly urbanizing towns and cities, including the occurrence of disease episodes that aggravate impacts of poor sanitation (such as flooding) on the economy and quality of life of city populations
- Reaching pockets of communities that comprise the remaining 20% of those without access to basic sanitation, particularly in the rural areas (among whom include indigenous peoples/cultural minorities) and urban slum communities.

SuSEA-Philippines was designed using four different models as the platform for developing specific interventions (according to themes below). The learning gained and the tools developed from these models served to assist other local governments units (LGUs), as well as informing national sanitation policy and programs for GoP-led expansion and scaling up. The four models are:

MODEL 1 Disease Prevention and Control – Sanitation interventions for the eradication/ reduction of disease

MODEL 2 Water Quality Management – Sanitation interventions for the improvement of water quality within a water quality management area

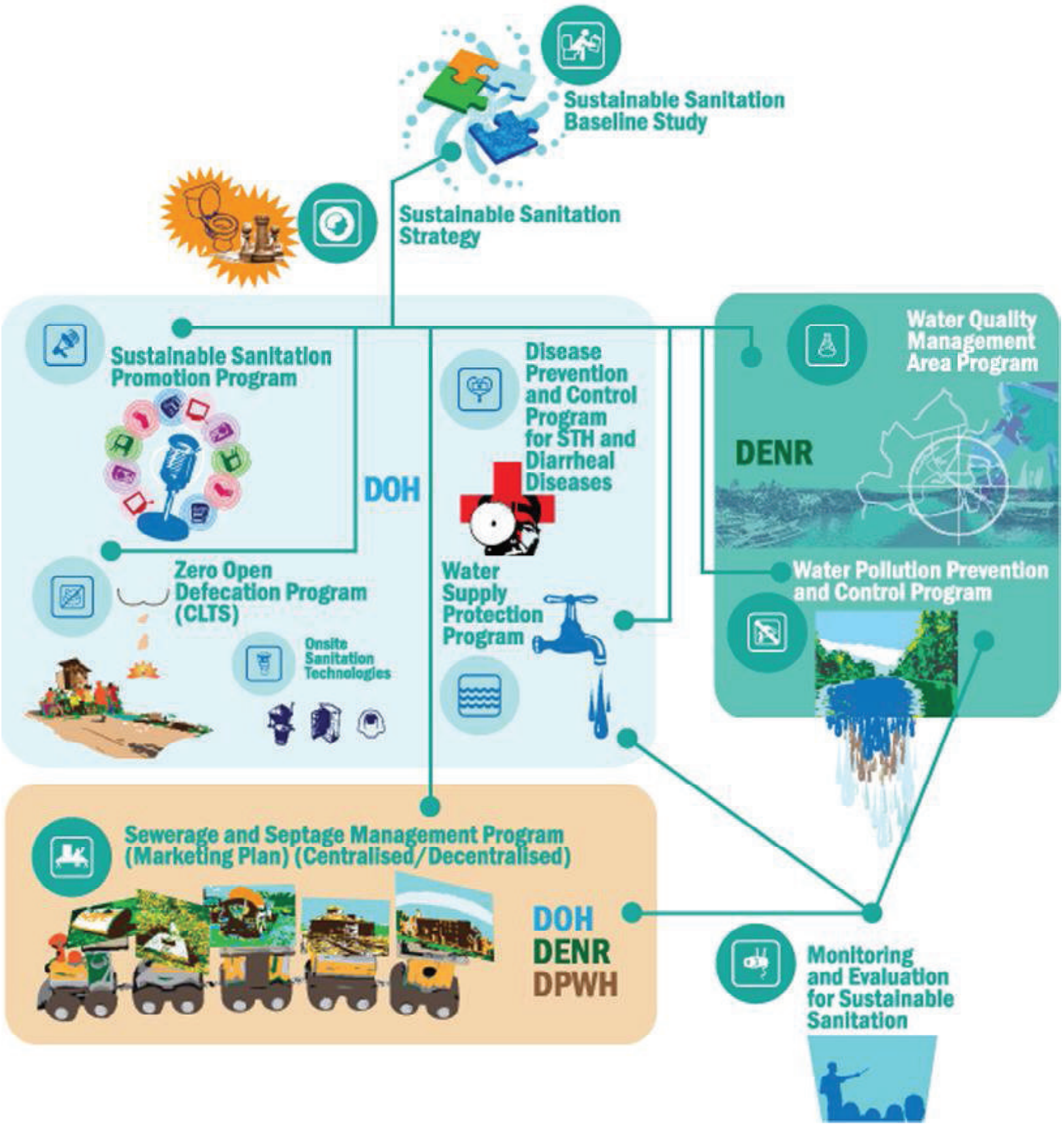
MODEL 3 Liveable Cities - Sanitation interventions for the improvement of quality of life in cities and low-income urban poor communities

MODEL 4 Sustainable Rural Livelihoods - Sanitation interventions to support sustained livelihoods in rural areas

Six sites participated in the main program sub-component of SuSEA. These are: Bauko Municipality in the Mt. Province, Dagupan City in Pangasinan Province, Guiuan Municipality in Eastern Samar Province, General Santos City and Polomolok Municipality in South Cotabato, and Alabel Municipality in Sarangani. The desired outcome in each of the project sites varied according to the model and agreements by the Program Steering Committee and the local government. While outcomes varied per site, each of the projects were additionally intended to provide the LGUs with a fount of information on developing and running their own sanitation programs based on the on-field experiences of the SuSEA team and their partners. This information has been packaged for your use in a Sustainable Sanitation Knowledge Series, to which this guidebook/report belongs. The reader is encouraged to familiarize himself/herself with all the guidebooks/reports in this series beginning with the Guidebook for Conducting a Baseline Study and followed by the Guidebook for Developing a Local Sustainable Sanitation Strategy. What guidebooks/reports you choose to utilize next will be determined by your community's particular needs and your LGU's proposed sanitation programs.

On the succeeding page, you will find an illustration of the various sustainable sanitation programs (SSPs) under the National Sustainable Sanitation Plan (NSSP). For each of these SSPs, SuSEA has also developed materials under the Philippine Sustainable Sanitation Knowledge Series, intended to guide local government units in implementing the various sanitation programs and initiatives in their own area. The information gathered in the Knowledge Series is, in turn, based on specific SuSEA projects and activities in each of the six project sites.

Sustainable Sanitation Programs



I

Background

Under the Sustainable Sanitation for East Asia (SuSEA) Philippines Component, a Water Pollution Prevention and Control Program (WPPCP) was developed in order to meet the desired outcome of reducing the biochemical oxygen demand (BOD) loading to the Silway River in South Cotabato by 10% at the end of 2010. The developed program was also intended to support the designation of the Silway River Water Quality Management Area (WQMA), which would encompass the municipalities of Polomolok, Tupi and T'boli and the city of General Santos.

The wastewater discharges coming from these areas eventually drain into the Silway River. Silway River is one of the river systems that feeds into Sarangani Bay from South Cotabato. The river's water quality directly affects the bay, which is known to be the spawning ground for tuna fingerlings and a protected seascape.

Because of Silway River's direct impact on the water quality of Sarangani Bay, SuSEA, in consultation with the various stakeholders, decided to integrate the local government units (LGUs) within the watershed into a Model 2 intervention that would institutionalize water quality management. The LGU partnership would initiate the formation of the WQMA for the Silway River watershed in line with the implementation of the Clean Water Act. The desired outcome of the support package would be the reduced pollution load of the Silway River. This WPPCP is one of the outputs of SuSEA for this area.

The program identified various projects with specific implementation plan including local sanitation capacity building, improving access to sanitation, septage management, trade effluents treatment and disposal, and capacity buildings of various stakeholders in the impact area in implementing and monitoring the program.

II

Program Objectives

This Water Pollution Prevention and Control Program (see Annex A) was developed with the ultimate objective of improving the water quality conditions of the Silway River, which runs through the municipalities of Polomolok, Tupi and T'boli and General Santos City.

The WPPCP, when implemented, will address sanitation and wastewater pollution issues to meet pollution load reduction targets for Silway River and its tributaries. Short-term strategies will embark on projects that will decrease the pollution load to Silway River by 10% at the end of 2010.

Specifically, this WPPCP accomplished the following:

- Identified the priority water pollutants affecting the general characteristics of Silway River that must be monitored and controlled;
- Identified the pollution sources and their corresponding pollution load contributions;
- Developed several projects that will mitigate further deterioration of the water quality conditions of Silway River and were presented to various stakeholders through participatory discussions and public consultations;
- Prioritized the plan of actions that will immediately reduce the pollution load to Silway River by 10% within 2010; and,
- Developed a program design matrix showing the recommended strategies along with detailed implementation plans that will enhance sanitation conditions and improve environmental compliance considering the limited resources of the stakeholders particularly the monitoring activities of the LGUs and the Department of Environment and Natural Resources - Environment Management Bureau (DENR-EMB).

III

Study Area

Environmental Conditions

The study area is located in the Southern Mindanao region. The catchment area of the Silway River includes almost the entire municipality of Polomolok, parts of T'boli, Tupi and General Santos City totalling to 56,280 hectares. It is drained by several creeks and tributaries forming the 28-kilometer Silway River. **Table 1** presents the coverage of the study area.

The geographical coordinates of the area is between 124°55' to 125°10' E and 6°03; to 6°23 N. This is within the western portion of Sarangani Province toward Mt. Parker and west of Malungon. The elevation of the area is within the range of 200 to 1,300 meters above mean sea level. The highest point is in Tupi while the lowest point is in General Santos City.

The headwater of the 28 km-Silway River is the Talcon River in Tupi while the most downstream reach discharges to Sarangani Bay in General Santos City. The tributaries are Polonoling River (Tupi), Matin-ao (Polomolok), Sinawal (GenSan) and Klinan (Polomolok-GenSan).

About 34% of the watershed is grassland while 19% is allocated each for cereals and fruit orchard. Only less than 1% is planted to rice. The land is classified as 42% timberland while 58% of Polomolok is already classified as alienable and disposable. 54% of the area is categorized as susceptible to moderate erosion.

TABLE 1: Area Covered by the Silway River Watershed

LGU in the Watershed	Hectares	%
Polomolok	29,795	52.9
General Santos	6,621	11.8
Tupi	4,966	8.8
T'boli	14,898	26.5
Total	56,280	100

The monthly average rainfall for June, July and October is about 100 mm as monitored in General Santos City. The driest month is in March with 41.8 mm of rainfall while the wettest month is June with 113 mm of rainfall. The average temperature range is 28.6 $^{\circ}$C to 36.6 $^{\circ}$C. General Santos City is considered as one of the hottest areas in the Philippines second only to Tuguegarao.

The current land uses in the watershed include coastal areas eco-zone (mangroves, marshland, settlement, beaches, foreshore lease areas), built-up areas (residential, commercial, institutional, agro-industrial, light, medium and large industries and utilities), agricultural areas, and forest/upland areas.

Issues and Concerns

As identified by the DENR-CENRO in General Santos City, the following are the environmental issues and concerns in the area:

- Increasing soil erosion and siltation of riverbeds
- Increasing occurrence of flashfloods
- Continuing scouring of riverbanks
- Drying-up of some rivers and creeks
- Dumping of garbage within waterways
- Illegal quarrying
- Increasing water pollution
- Chemical residues from agricultural land
- Fast land conversion from agricultural to residential/ industrial
- Presence of illegal settlers within river easement
- Unregulated use of surface and groundwater, etc.

Some of the recent interventions accomplished to address the identified environmental concerns included:

- Existing Municipal Local Ordinances on Environmental Protection and Conservation of the Watershed area;
- Rehabilitation of 2 hectares portion of the Watershed by Land Bank of the Philippines;
- Constructed gabion revetment structure project in Buayan River and Silway-Klinan River for river bank protection structures done by the Southern Mindanao Integrated Coastal Zone Management Project;
- Sustained apprehension of violators on Forestry Laws;
- Reforestation and Agro-forestry projects by local farmers' etc;
- Reforest 180 hectares portion of the watershed by the DENR Region XII through accredited people's organization contractors.

IV

Water Quality Assessment

Only the portion of the Silway River running through General Santos City is presently classified as Class C (EMB, as of 2004). Also, the lower reach of the Silway River already discharges to Sarangani Bay in General Santos City, a major water body with significant value for trade and commercial fishing in this region currently classified as Class SC. On recommendation of EMB XII, following a public hearing held at Polomolok, South Cotabato on December 9, 2009, the DENR classified on March 17, 2010 the Silway River in Tupi and Polomolok as Class C through Department Memorandum Circular 2010-08.

Water Quality Sampling & Monitoring

A 10-month water quality monitoring activity for the the Silway River was started in March 2009. The sampling sites were established in coordination with the EMB Region XII and the representatives from the LGUs of Tupi, Polomolok and General Santos City. The monitoring stations are located in the municipalities of Tupi and Polomolok and within General Santos City. The current physical attributes as well as sources of pollution along the Silway River were particularly observed during the ocular inspection and provided the basis for identifying the locations of the sampling stations.

There were a total of twenty four (24) sampling points. Five are in the Municipality of Tupi, nine are within Polomolok, and ten points are within the jurisdiction of General Santos City. The sampling points included several tributaries discharging to the Silway River.

Organic Pollutants

For the study area, most of the dissolved oxygen readings were way above 5.0 mg/L except for some depressions downstream of Silway River in Polomolok. The oxygen sag was supported by the elevated BOD in the same station, exceeding the 5 mg/L Class B water quality criterion for BOD. The oxygen depression and the elevated BOD may be attributed to the discharges received by the Silway River from the Poblacion and Cannery area which are the two more densely populated areas in Polomolok. With some dilution from the Klinan River, the dissolved oxygen was able to recover but BOD remained high in the lower reach of the Silway River in Polomolok towards General Santos City.

Total Suspended Solids

The total suspended solids (TSS) level remained relatively low for the entire stretch of the Silway River in Tupi and Polomolok with relatively higher TSS in P-7 and P-6 in General Santos City (downstream of Klinan confluence). There were reported quarrying activities in Klinan and this may be causing the TSS increase of the Silway River in General Santos. Also, TSS increased to more than 500 mg/L in Polomolok last August 2009 attributed mainly to previous rain events. In general, the BOD level did not follow the TSS increase manifesting that the increase in turbidity may be due to soil erosion or agricultural run-offs and not due to sewage or organic sources.

Coliforms

Almost all stations where samples were taken manifested total coliform bacteria exceeding even the 5,000 MPN/100 ml limit for Class C particularly during the dry months of March and April where flow was low. A number of stations also exceeded the 200 MPN/100 ml limit for fecal coliform for Class B waters. These elevated readings are expected due to the domestic wastewater, including backyard piggery and cattle-raising wastes and the agro-industrial discharges received by the Silway River.

Nutrients

Nitrates in the water samples in most stations of the Silway River meet the 10 mg/L limit except for the upper reach of Polomolok (March 2009) where nitrate marginally exceeded the limits. From the results of the analysis of the tributaries, Klinan River manifested higher levels of nitrate affecting the downstream water quality of the Silway River (> 15 mg/L in the May 2009 sampling). This could be attributed to domestic wastewater discharges and possible agricultural run-offs upstream of Klinan-Silway River junction.

Phosphates in almost all stations in the Silway River exceeded the 0.4 mg/l limit for Class C water. Phosphates can be attributed from cleaning chemicals associated in domestic discharges and fertilizers from agricultural sources.

Other Toxic Pollutants

For this monitoring period in the Silway River, heavy metals in the river water were not monitored. However, samples were taken for pesticides analysis. Samples were analyzed by the Bureau of Plant and Industry in Davao City. There were no traces of pesticide residues (organochlorines and organophosphates) detected during the sampling period.

Silway River Tributaries

Klinan River manifested BOD greater than 5 mg/L when monitored in June 2009. Other BOD values were generally low except for the October 2009 monitoring at downstream of Sinawal River (7 mg/L). Klinan River also registered extreme TSS during the May 2009 sampling (about 1,500 mg/L) in the upstream portion and 800 mg/L near the confluence with the Silway River.

Nitrates in Klinan were generally higher (exceeding the 10 mg/L limit in March 2009) while phosphates were also above the Class C limits in almost all tributary stations.

The impact of the water quality of the tributaries will be manifested several meters from the confluences or junctions with the Silway River. Depending on the flow and characteristics of contaminants, these tributaries influence the characteristics of the Silway River downstream.

V

Pollution Load Analysis

Methodology

The pollution load analysis quantifies the amount of pollution that is being contributed by the different sources (i.e. domestic, commercial, agro-industrial, institutional, etc.) to the Silway River.

For this study, the Biochemical Oxygen Demand or BOD was used as a standard parameter in measuring the degree of pollution in the Silway River. BOD is the amount of oxygen needed by microorganisms to decompose organic matter present within the water. Therefore, a higher BOD value in a water sample can be interpreted as 'poor' quality, while a lower BOD value can be described as 'good' quality.

In the analysis of the pollution loads per source, the following general assumptions were made:

- Average BOD values were calculated for each sector (i.e. households, restaurants, slaughterhouses, etc.) to estimate the BOD loadings, some of these values were estimated from the submitted self monitoring reports (SMRs);
- For the domestic sources, the estimated wastewater consumption was based on the reported monthly billed volume as provided by Polomolok Water District; and
- For commercial and agro-industrial wastewater, the actual flow rates (in cum/day) were based on the estimates provided by the facility representatives in their SMRs and interviews.
- Non-point sources (storm, urban and agricultural runoffs) were not included in the pollution load analysis at point of the study.

Domestic Wastewater Sources

The catchment of the Silway River encompasses several light and medium density residential areas with populated zones near town centers or poblacion. The domestic wastewater (including sewage) and drainage from these areas are received by the river through storm drainage and tributaries.

Surveys conducted for Polomolok and General Santos City provided information on waste disposal practices and available sanitation facilities. The following were gathered from the surveys:

- 91.5% of the households in urban barangays (Poblacion and Cannery) in Polomolok have their own toilet facilities; out of these, about 80.7% have septic tanks. Lower percentages are expected in rural barangays;
- About 598 households in Polomolok do not have any toilet facilities while about 2,052 households have no sanitary toilets (MHO, Polomolok 2009);
- Less than 1% of the septic tank were desludged during the past 10 years;
- In General Santos City, it was reported that 78% of households have their own toilet facilities. Out of this, 88% have septic tanks; and
- Also in General Santos City, about 92% of the households with a septic tank have never been desludged for the past 10 years.

Untreated domestic wastes may have a BOD concentration of 110 to 250 mg/L. Properly designed and maintained septic tanks provide 20 to 30% BOD removal. Inefficient septic tank systems (those which are not de-sludged regularly and are under designed) may discharge effluents with 10 to 20 times the raw sewage concentration, which is essentially septage. Those septic tanks constructed without concrete floor lining are potentially contaminating the groundwater sources with coliform and other soluble contaminants such as phosphates and nitrates. Depending on the topography and hydrological profile of the area, these pollutants from the septic tanks also contribute to the deterioration of the water quality of the Silway River.

For an estimated per capita BOD load of about 50 g BOD/day and with an estimated population of 10,000 within the direct discharge zone (i.e., areas near the Silway River and its tributaries), pollution load associated with domestic discharges can vary from 2.0 to 4.0 tons of BOD/day depending on the efficiency of the septic tank systems that collects domestic wastewaters. The effect of this pollution load may vary along with the river flow, which may be high during wet seasons but relatively low during dry months. At low river flow, this amount of pollution load to a small river system may already produce septic conditions.

Commercial & Institutional Wastewater Sources

From the latest surveys conducted in the catchment area (Polomolok and General Santos City), the number of commercial (i.e. lodging/restaurants, markets, hospitals and clinics) and institutional establishments (government offices, schools, and jails) was estimated. For this sector,

majority of the water supply is used for domestic purposes such as washing, drinking, bathing, and cooking. The assumed average BOD removal from existing environmental infrastructures (i.e., ponds, lagoons, septic tank digesters and activated sludge system) is 50%.

Agro-Industrial Wastewater Sources

The Silway River catchment is host to a number of small- to medium-scale crop and non-crop industries. These are composed of food processing facilities, piggeries and poultries, slaughter houses, and ice plants which also generate significant amounts of wastewater. Based on the 2009 survey conducted, there are about 46 establishments that belong to this sector in Polomolok. The number of similar establishments in General Santos City within the Silway River catchment was also estimated from the survey conducted.

Piggeries and slaughter houses are of special concern because of the very high concentration of organic and pathogenic constituents in their wastewaters. Meanwhile, food processing plants also use significant amounts of water for cooking and washing raw materials. Ice plants have the lowest water consumption and wastewater generation since most of the water used is converted into the product.

Agricultural and Storm Runoff

According to the claims of major plantation owners, most of the crops being planted in the area are classified as 'tropical variants', which do not require irrigation and rely only on rainfall for cultivation. Thus, the actual water usage and direct discharge of wastewater from agricultural lands are considered negligible.

However, based on various related literatures, agricultural lands are known to be non-point sources of water pollution (i.e., agricultural run-off). These run-offs may contain soil nutrients, organics, and residual pesticides. The concentrations of these pollutants depend on the

TABLE 2: Pollution Load Distribution for the Silway River

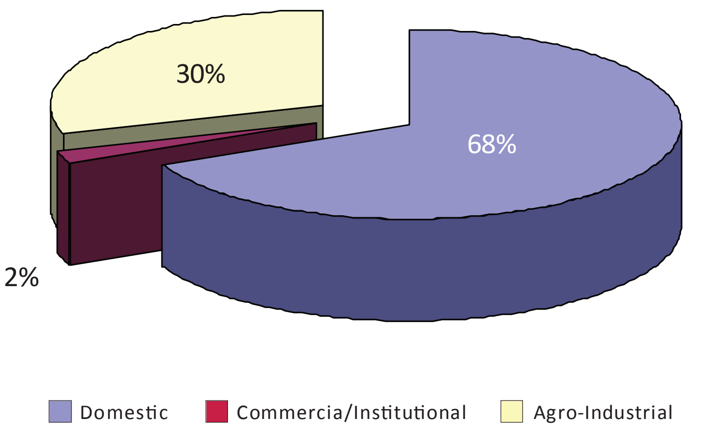
Sector	Estimated BOD Loading		Percentage
	(kg.BOD/day)	(kg.BOD/year)	(%)
Domestic	3,956.24	1,424,245.39	68
Commercial/Institutional	167.63	44,253.00	2
Agro-Industrial	2,334.01	616,178.64	30
TOTAL	6,457.87	2,084,677.03	100

water flow. With the limited information at hand, the pollution load contribution from these sources is not included in the pollution load analysis at this point.

Pollution Load Distribution

The estimated pollution loadings are summarized in the **Table 2** and illustrated in **Figure 1**.

FIGURE 1
Pollution Load Distribution for the Silway River



VI

Water Quality Considerations

To develop the action plan for the program, several facts must be considered:

- Based on the river monitoring, priority pollutants that must be addressed included BOD, fecal coliform, nitrates and phosphates.
- Households with no sufficient toilet facilities and sewage collection systems proliferate in several areas along the banks of the Silway River and its tributaries;
- There is a need to improve the design and construction of septic tanks within the catchment area to ensure significant organic load reduction from the wastewater coming from the households. In areas outside of town centers, sullage and sewage are received by open pit and are often percolated to the soil posing a threat to groundwater;
- There are a number of residential houses, which also maintain backyard piggery. The wastes are often directed to rivers, irrigation canals or to leaching grounds;
- Desludging of septic tanks are not a prevalent practice in the study area;
- Most of commercial and institutional establishments rely only on septic tanks to treat their wastewater which are not capable of significantly removing organic pollutant;
- Most of the agro-industrial facilities are using pond systems in the retention and treatment of their wastewater. Almost all of the ponds are only earth-lined and very susceptible to leaks and groundwater contamination;
- There are issues of solid waste management in the area where residents near the banks of the river still indiscriminately throw their garbage to the river;
- The EMB imposes a BOD limit of 120 to 150 mg/l to existing agro-industrial facilities since the Silway River is presently not classified. This is about 100 to 200% more than the

BOD limit of 50 mg/L for Class C waters; and

- There is a need for the EMB to re-orient the LGUs on the procedures, guidelines, and practices when inspecting facilities particularly the wastewater discharges. LGUs must be trained on how to assess and evaluate the operations of the treatment. There is a need to improve on the environmental database to facilitate water quality goal setting and improvement monitoring.

Program Prioritization

With the estimated BOD loading currently received by the study area, several goal setting exercises may be done. For every program that will be developed, a certain percentage of organic load reduction may be quantified.

With the initial target of a 10% pollution load reduction by the end of 2010, programs may be prioritized depending on several factors such as availability of resources, ease of implementation, institutional limitation, social acceptability and the stakeholders' willingness-to-comply. Also, the use of existing environmental facilities will have to be optimized (i.e., the 60 cum/day Alabel septage treatment plant and the number of existing septic tank desludgers in General Santos City).

The water classification targets must already be defined so that priority water quality parameters exceeding the criteria for such classification will be addressed. As provided for in the Clean Water Act, designation of non-attainment areas (NAA) may be done on some sections of the river to allow the immediate restoration of the water quality to its desired level.

Short-term targets may have to be defined. Programs for these targets will be developed and implemented to achieve immediate improvement on the water quality of the river by the end of 2010. Medium-term targets will be for the planning horizon between 2010 and 2015. Correspondingly, long-term targets may be set 10 years beyond 2015.

Reduction of Pollution Loads

In general, the following approach on organic load reductions may be considered:

- Enforcement of existing rules and regulations on sanitation and water pollution;
- Improvement on sanitation practices and provision of adequate and properly designed sanitation facilities for domestic wastewater sources;
- Improvement of existing wastewater treatment facilities for agro-industrial facilities with focus on protecting groundwater resources;
- Encouragement of the adoption and implementation of pollution prevention strategies that will specifically target reduction of organic load to the Silway River; and
- Provision of capacity-building measures for LGUs and the EMB in monitoring, assessment and environmental management.

VII

Program Design

The ultimate goals include the following:

- Improvement in the water quality of the Silway River, and
- General improvement in the living conditions in the area.

The program will initially aim for the immediate reduction of pollution load to the Silway River from the various wastewater sources by the end of 2010. As a consequence of the pollution load reduction, the monitored water quality of the Silway River is expected to improve particularly for BOD and fecal coliform concentrations along the monitoring points.

Five inter-dependent program outputs were identified. The milestones for each program output will rely on the successful implementation of the preceding activities. The plan of action includes the following:

- Developing the management strategies for domestic, commercial & institutional and agro-industrial wastewater sources;
- Strengthening the enforcement of existing regulations on sanitation;
- Pilot testing of selected priority projects to achieve 10% reduction on pollution loadings;
- Adoption of sustainable wastewater management strategies for the entire WQMA, and
- Capacity building among stakeholders for sustainable program implementation.

Some of the strategies may be pilot-tested or immediately implemented to meet the 2010 targets. The experiences gained in the pilot-testing and short-term projects will be used to detail the implementation plan for the medium- and long-term strategies. The program itself, when implemented, will increase the technical capacity and improve working relations among the primary stakeholders.

VIII

Short-Term Strategies for 2010 Targets

Among the interventions presented in this report, several options may be implemented immediately to meet the 10% load reduction by 2010. The pollution load analysis estimates this reduction to be equivalent to **650 kg BOD per day**. Based on the program design developed, some of the strategies may be pilot-tested but at the same time effect the required reduction in the BOD loading.

Table 3 summarizes the initial recommendations for the short-term with the potential BOD load reduction in kg BOD per day.

Improving Sanitation Condition in Communities along the Silway River

Sanitation facilities are those facilities used for the purpose of receiving and disposing of human excreta and urine located "on-site" or within the household lot. The typical forms of sanitation facilities are generally the "drop and store" sanitation and the flush and discharge sanitation.

- **Drop and Store Sanitation.** This type of sanitation facility is the least expensive and involves sitting and excreting of wastes. There are various methods to receive and store the waste excreted such as dehydration toilets, pit latrine, composting toilet, sanitation privy, aqua privy, or water sealed toilet bowl. In most types, wastewater seeps to the ground while the solid wastes accumulate in the latrine.
- **Flush and Discharge Sanitation.** This type of sanitation facilities involves the construction of more sturdy structures capable of handling and treating domestic sewage, by process of digestion and anaerobic treatment. These sanitation facilities may include traditional septic tank, anaerobic filter or the multi-baffled septic tank.

The current housing conditions and tenure status of the communities existing along the banks of the Silway River make it difficult to address sanitation problems. While the sanitation facilities must be made

TABLE 3. Recommended Short-Term Strategies for the Silway River WQMA for the 10% BOD Load Reduction by 2010

Strategy	Scope	Mode	BOD Load Reduction Potential
Improvement in Access of Sanitation	Households along the banks of the Silway River estimated at 2,000 households (75% of the reported households by MHO Polomolok)	Pilot test supported by the ODPP of Polomolok	150 kg BOD/ day
Septage Management Program	3,200 septic tanks in Polomolok and General Santos City (households in the urban barangays with septic tanks are estimated at 32,000)	Pilot ~ 10% of the total number of septic tanks in the urban barangays	280 kg BOD/ day
Communal Wastewater Treatment Plant	Polomolok Public Market and Contingent areas (approximately covering 3 hectares)	Actual Plan and Pilot test	40 kg BOD/ day
Conversion of existing ponds into wastewater treatment facility	10 representative facilities in Polomolok and General Santos directly discharging to the Silway River	Pilot test	180 kg BOD/ day
TOTAL BOD LOAD REDUCTION			**650 kg BOD/ day**

available in these areas for public health and environmental reasons, these are river embankments where any structure must not be built upon. On-site 'drop and store' sanitation is not appropriate in these areas even sufficient space is available since the seepage will just directly be received by the adjacent river. In cases where space is available, the provision of communal public toilets may be considered. Flush and discharge sanitation, such as the use of the traditional septic tank, must be used for these communities. If these houses already have latrine type toilets, construction of a communal septic tank may be appropriate. Such

an approach will entail the laying of pipes in the limited space available to collect sewage from individual households.

Sanitation in the river bank communities is best left as a responsibility of the LGU at the purok or barangay level. Installation and operation of public toilets and septic tanks could be funded through the barangay and may be maintained by the appropriate LGU department.

The lack of appropriate sanitation facilities was identified as one of the general considerations in developing the wastewater management strategies. In the pollution load analysis, it was calculated that per capita BOD load in the catchment area is about 40 to 50 g BOD/day. With the existing sanitation practices in the area, about 95% of this load is assumed to be discharged to the Silway River. The intervention to improve sanitation facilities such as the provision of toilet and septic tanks and the implementation of the Zero Open Defecation Program (ZODP) in Polomolok would decrease the load to 65%, or a 30% improvement from the existing condition. This translates to about 15 g BOD per person served with an improved access to sanitation.

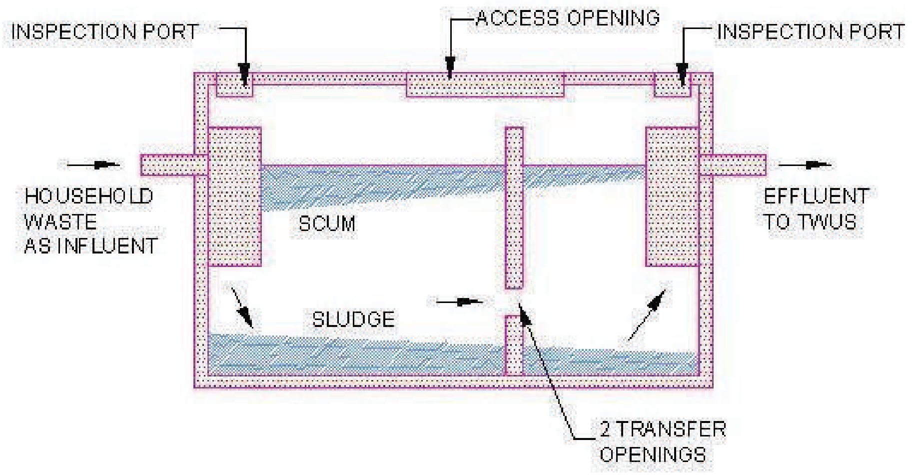
The improvement on sanitation facilities should be focused on households residing along the banks of the Silway River and those residential structures directly discharging to the Silway River. Such effort can be prioritized by the respective LGUs in Polomolok and General Santos. The Polomolok Municipal Health Office (MHO) already reported that about 2,650 households in Polomolok do not have toilet facilities (about 10% of the total households). Improvement in the 2,000 households (75% of the households which do not have toilet facilities) would translate to 150 kg BOD per day reduction to the Silway River.

Increase in the Use of Septic Tanks

From the survey conducted in Polomolok and General Santos City, it was identified that only about 80% of the households surveyed in the urban areas with toilet facilities have their own septic tanks. The percentage is expected to be lower in the rural areas. There is still a need to improve the methods on how sewage and sullage are managed at the household levels to minimize sewage contamination of the Silway River. The following are the sewage collection options, which may be considered:

- **Traditional Septic Tank.** The essential features of the septic tank are shown in **Figure 2.** Important features include: inspection and access ports, baffles, and sullage or effluent outlet. Septic tanks are designed to (a) separate solids from the wastewater flow; (b) effect an anaerobic decomposition, reduction and storage of accumulated solids; and, (c) discharge the partially treated and clarified wastewater (sullage) out of the tank, to a receiving pit or community drainage system.

FIGURE 2
Typical septic tank design (MWSS Master Plan, 2005)



- **Septic Tank/Anaerobic Filter.** The anaerobic filter is a modification of the septic tank, incorporating a solid medium (usually rocks) on which a film of anaerobic bacteria can grow. The attached film is resistant to washout of bacterial cells from the tank. An anaerobic filter treating sewage can remove about the same amount of BOD_5 as a septic tank and is more effective at removing suspended solids. After some time, the filter becomes clogged and becomes less effective as bacterial overgrowth occurs. These treatment systems consisting of a septic tank, followed by an anaerobic filter are capable of providing an effluent, which may be still above discharge limits but low suspended solids.

Improvement on Septic Tank Designs and Features

There is a need to review the design requirements imposed by LGUs in the construction of septic tanks in the study area. Based on the interviews conducted, most septic tanks have no concrete flooring (not water tight) and often without ports for cleaning and maintenance. It must be noted that improvement on the design will just maximize the removal efficiency of the septic tank and will not guarantee compliance to the regulated wastewater discharge standards. However, significant reduction of pollution load to the Silway River will be realized.

Properly designed septic tanks can effect removal of up to 30% of the BOD and 50% of suspended solids of sewage. Septic tanks are usually divided into two compartments by baffles, and access ports are provided to allow inspection and

cleaning. Two compartments are used to limit the discharge of solids in the effluent from septic tanks. Single compartment septic tanks are less expensive but also less effective at removing the suspended solids (i.e., high probability of sludge carry-over or wash-out). Recently, new septic tank designs even recommend three chambers. In order for septic tanks to operate at their designed efficiency, tanks should be properly sized and constructed. The Sanitation Code prescribed a hydraulic retention time (HRT) range of 1 to 2 days for septic tanks treating domestic wastewater.

In many instances, the septic tanks cannot be accessed because they are built under structures or have illegal structures built above them. There are also many cases wherein the septic tanks cannot be properly maintained because the streets leading to the houses are too narrow and cannot be accessed by the vacuum tankers.

Septage Management Program

Contingent to the provision of various types of sanitation facilities is the need to establish a septage management program. Septage refers to the mixture of scum, sludge (solids) and liquid removed from a domestic septic tank. Septage is characterized by a high BOD and total solids content. It has[5] low nutrient content and little volatile organic matter compared to sewage sludge in the treatment plants.

A comprehensive Septage Management Plan (SMP) for the study area will provide directions for strategies and approach in the proper handling, collection, treatment and disposal of septage to be collected from septic tanks. A septic tank, depending on its capacity, must be regularly de-sludged to maintain its treatment efficiency. Normally, de-sludging may be done once every 3 to 5 years. The failure to desludge septic tanks on a regular basis is similar to not having them and simply discharging untreated sewage directly into the drainage system.

The SpMP shall include the following components:

- Septic tank maintenance and de-sludging program
- Information, education campaigns on septic tank maintenance and de-sludging programs
- Procurement and maintenance of vacuum trucks and hauling tanks
- Identification of most viable septage treatment and disposal options

A number of methods may be adopted for the handling, treatment and subsequent disposal of sludge collected from septic tanks. These include the following:

Application to Agricultural Areas as Soil Conditioner

Septage collected by vacuum trucks and haulers may be pre-treated using screens and settlers. Inert solids such as plastics, rubber, metals, and other non-conventional materials may be deposited and

removed by screens or Imhoff tanks. During unloading from the tanker, the septage may be passed through a coarse screen to remove plastics and other large debris.

The septage may be kept at an Imhoff tank for a few hours where further settling and draining may occur (**Figure 3a**). From the Imhoff tank, the sludge may be pumped into tankers for transport to identified Department of Agriculture-approved application sites. These materials were proven to be beneficial to soil as conditioner adding further to the productivity of soil. At the disposal site, septage may be transferred to a small tanker or applicator to facilitate discharge and spreading at the application area (See **Figure 3b**). The application process must be closely monitored to comply with the standard procedures to minimize health and environmental hazards.

FIGURE 3
(a) Imhoff Tank where septage may be initially screened
(b) Sample sludge applicator in one of the government approved disposal areas (MWSS Master Plan, 2005).

Septage Treatment Plant (SpTP)

Septage may be completely processed in a septage treatment plant in order to produce biosolids as shown in **Figure 4**. Septage acceptance units (SAUs) and dewatering facilities can process septage and remove most solids while a separate biological wastewater treatment system must be installed to process filtrate. Similar plants are already installed and operational in some municipalities in Southern Mindanao (i.e., Alabel). An existing sewage treatment plant may receive septage for treatment provided SAUs and dewatering facilities are installed.

Septage Management Program for General Santos and Polomolok

A septage management plan may be developed for General Santos and Polomolok. The regular desludging of a septic tank would translate to an improvement of septic tank performance from the existing 5% to an improved 40% BOD removal efficiency for the first year. This would translate to 17.5 g BOD per capita or 87.5 g BOD reduction per septic tank desludged.

From the estimated 40,000 households in the urban barangays in the catchment area, about 80% or 32,000 have septic tanks. For the

FIGURE 4
Septage Treatment Plant (Septage Acceptance Unit, Aeration System, and Pond Systems)

initial year of the septage management program (2010), 10% or about 3,200 septic tanks may be considered for desludging. This will translate to about 280 kg BOD per day reduction in the total pollution load.

This program must be supported by a municipal ordinance in order to encourage households to mandatory desludging of septic tanks. For the initial stage in 2010, the desludgers operating in General Santos may be mobilized for the desludging and transport services. It is estimated that about 10 septic tanks may be desludged every day (assuming 300 working days in a year). This would translate to about 25 cum/day of septage, which can be easily be accommodated by the Alabel septage treatment plant. In the succeeding years, additional vacuum trucks may be needed to serve the requirements and a treatment plant nearer the service area may be required.

Communal Wastewater Treatment in Polomolok Public Market

The Polomolok Public Market wastewater treatment plant will start its operation early 2010. The sewerage system in the area contingent to the public market may be extended to include other commercial and institutional wastewater sources. The treatment plant is a high-rate system, which can impose up to 95% BOD reduction.

Depending on the extent of the sewerage coverage, this communal treatment plan has a potential of removing 40 kg/day BOD from the Silway River organic loading.

Conversion of Existing Ponds of Selected Facilities Directly Discharging to the Silway River

The pollution load analysis indicated that about 30% of the total pollution load to the Silway River is attributed to agro-industrial sources. The estimated load contribution is about 2,300 kg BOD/day.

The estimated BOD removal efficiency for most systems using ponds is only 50 to 60%. If for the initial year, about 10 facilities will improve their efficiency to 80% by upgrading the pond systems to high-rate aeration system; this would already translate to 200 kg BOD per day reduction.

Other Recommended Interventions

Other non-quantifiable measures may be implemented during the initial year of the program to ensure that the 10% BOD load reduction target is met. These are strategies that may be implemented either by the EMB or the respective LGUs. These are:

- **Strict implementation of the discharge permitting system.** With a vigilant monitoring of agro-industrial facilities, establishments will be encouraged to apply for discharge permits for their effluent discharges. This would translate to putting up their own wastewater treatment systems, which would contribute in the reduction of the BOD load to the Silway River.

- **Control on the operation of dumpsites along river banks.** Open dumpsites along the banks of the Silway River should be strictly prohibited. Leachates coming from these sources are very high in organic content. Control of this non-point source will contribute to the improvement of the water quality of the Silway River downstream.

Estimated Costs for the Short-Term Strategies

Table 4 presents initial cost estimates for the short-term strategies presented. A detailed feasibility study may be required to ascertain the actual cost requirement prior to project implementation.

TABLE 4. Estimated Costs for Short-Term Strategies (2010 Target)

Strategy	Components	Unit Cost	Estimated Cost
Improvement in Access of Sanitation	Toilet for 2,000 households	Toilet Improvement– PHP10,000 (average cost)	PHP20.0 M
Septage Management Program	3,200 septic tanks in Polomolok and General Santos City	Desludging Fee – PHP3,500 per septic tank (average considering the hauling distance to Alabel treatment plant)	PHP11.2 M
Communal Wastewater Treatment Plant	Polomolok Public Market and contingent areas (around 3 hectares)	Sewerage System [(a)] – PHP1,200,000/hectare of sewer lines by gravity flow	PHP3.6 M
Conversion of existing ponds into wastewater treatment facility	10 representative facilities using pond system in Polomolok and General Santos directly discharging to the Silway River (average 100 cum/day discharge)	Upgrade Cost – PHP15,000 to PHP25,000/cum of wastewater treated depending on the system	PHP20.0 M
TOTAL			**PHP54.8 M**
Unit Cost per kg BOD removed			**PHP84,300.00**

(a) MWCI FS estimates

IX

Institutional Mechanisms

Institutional arrangements in terms of general and basic procedures towards implementation of the program have to be made. At the municipal level, a number of institutional set-up may be used in order to ensure the successful implementation of the program. Depending on the existing organizational set-up and the resources that may be committed, the program implementation may be tasked to any of the following offices:

- Municipal Environmental & Natural Resources Office
- Waste Management Office
- Municipal Health Office

An inter-department body such as the WQMA Task Force may provide technical support and advice to the municipal mayor to ensure that the programs will be properly funded and supported.

Since the Silway River watershed encompasses other LGUs, the governing board will ultimately provide the policy direction in the management of the WQMA. Each LGU will then be asked to prepare the LGU compliance plan. This WPPCP may also serve as the working document for such LGU initiatives.

Tasks and preparations shall focus on arrangements to facilitate the support for implementation of the various activities of the program. Such LGU commitments may include:

- Passing LGU ordinances on water pollution prevention and control including septage management
- Supporting the septage management program through the following (a) "Sangguniang Bayan" ordinances on mandatory desludging of septic tanks with penal provisions, inspection and maintenance of septic tanks and charging fees; (b) Deed of Donations and/or memoranda of agreement (MOAs) for Lease/Purchase of Lots; and (c) on social marketing activities, particularly on the Information, Education and Communication (IEC) drive on communities.
- Reviewing existing local relevant policies and laws in support of the implementation of the Program.
- Finalizing the institutional set-up (i.e., designation of MENRO and LGU Pollution Control Officer) that will oversee the implementation of the project.

Annex A

A PRIMER ON DEVELOPING A WATER POLLUTION PREVENTION& CONTROL PROGRAM

What is a Water Pollution Prevention and Control Program?

A Water Pollution Prevention and Control Program (WPPCP) is a program developed with the ultimate objective of improving the water quality conditions of all receiving bodies of water within a water quality management area (WQMA). The WPPCP, when implemented, will address sanitation and wastewater pollution issues from domestic, commercial and industrial sources to meet pollution load reduction targets within the WQMA.

Specifically, the development of a WPPCP must involve the following:

- Identifying priority water pollutants affecting the general characteristics of the principal water bodies and tributaries within a WQMA;
- Identifying the pollution sources and their corresponding pollution load contributions;
- Developing several project options that will mitigate further deterioration of the quality and general conditions of the water bodies which must be presented to various stakeholders through participatory discussions and public consultations;
- Prioritizing the plan of actions to address pollution reduction targets with consideration to available resources; and,
- Developing a program design matrix showing the recommended strategies along with detailed implementation plans that will enhance sanitation conditions and improve environmental compliance.

Specific Activities and Methodologies

ACTIVITY 1: Data gathering on effluent generators

The data gathering will involve a survey of agro-industries, agro-livestock, commercial and business establishments to establish the types and volume of wastes generated from these sources. Primary sources of information include the Department of Environment and Natural Resources (DENR), the Comprehensive Land Use Plan (CLUP), census and local government unit (LGU) health and environmental profiles.

Mapping activities will involve the identification of water pollution sources through surveys and consultations with the barangays. If there are existing monitoring programs being conducted in the area, specific sampling points must be identified in relative to the location of various pollution sources. Geographical Information System (GIS) maps may be used to document the data collected.

ACTIVITY 2: Water Quality Assessment

As stated in Department Administrative Order (DAO) 34, river systems are classified based on the current best beneficial use that is expected to last, at least for the next 10 to 20 years. In special cases when dictated by political, economic, social, public health, environmental and other considerations, a certain water body may be classified to the intended or future beneficial use. The water quality assessment that preceded the classification shall provide indications on the degree of protection and mitigating measures required for the river system, its tributaries and their respective watersheds.

ACTIVITY 3: Pollution Load Analysis

The pollution load analysis quantifies the amount of pollution that is being contributed by the different sources (i.e. domestic, commercial, agro-industrial, institutional, etc.) to a particular water body. For instance, the Biochemical Oxygen Demand (BOD) may be used as a standard parameter in measuring the degree of pollution. BOD is the amount of oxygen needed by microorganisms to decompose organic matter present within the water. Therefore, a higher BOD value in a water sample can be interpreted as 'poor' quality, while a lower BOD value can be described as 'good' quality.

ACTIVITY 4: Identification of appropriate pollution prevention and control technologies

Several options in managing domestic and commercial/institutional wastewater may be developed for discussion with the various stakeholders. From these options, various stakeholders in the WQMA may select the appropriate technology or intervention to manage their discharges. With the estimated BOD loading currently received by the study area, several goal setting exercises may be conducted. For every program that will be developed, a certain percentage of organic load reduction may be quantified.

ACTIVITY 5: Meetings and consultations with stakeholders

The initial results of the previous activities must be presented to stakeholders including agro-industries, agro-livestock, commercial establishments, barangay captains and major establishments for their comments, suggestion and additional input. This will be done to ensure their understanding and ownership of the program. Workshops will be held during consultations to obtain greater participation of stakeholders especially those representing the major industries

and business establishments. Local legislators will also be invited to review the proposed provisions of the program. Their comments and recommendations will be documented and will be included in the program.

ACTIVITY 6: Development of a Water Pollution Control Program

Programs may be prioritized depending on several factors such as availability of resources, ease of implementation, institutional limitation, social acceptability and the stakeholders' willingness-to-comply. Also, the use of existing environmental facilities will have to be optimized.

The water classification targets must already be defined so that priority water quality parameters exceeding the criteria for such classification will be addressed. As provided for in the Clean Water Act, designation of non-attainment areas (NAA) may be done on some sections of the river to allow the immediate restoration of the water quality to its desired level.

ACTIVITY 7: Organize Multipartite Monitoring Committee

A Multipartite Monitoring Team will be organized to monitor industries, and commercial and business establishments on their compliance to environmental laws. The Team composition will be determined by the stakeholders and may be composed of the LGU, the DOH, the EMB and other stakeholders who are capable and interested to be part of the team. Duties and responsibilities, roles and functions will be discussed.

Implementation Arrangements

Under the Local Government Code, the Sangguniang Panlungsod is mandated to protect the environment and impose appropriate penalties for acts which endanger the environment, such as dynamite fishing and other forms of destructive fishing, illegal logging and smuggling of logs, smuggling of natural resources products and of endangered species of flora and fauna, slash and burn farming, and such other activities which result in pollution, acceleration of eutrophication of rivers and lakes, or of ecological imbalance.

The EMB under the law (Clean Air Act, Clean Water Act, EIA Law, Ecological Solid Waste Management Law, Toxic and Hazardous Substances Act) is mandated to implement environmental laws, rules, regulations and standards.

The WPCPP will only be implemented effectively if the EMB and LGU work together. Areas of cooperation and partnership of the EMB and LGUs will be established through a series of dialogues and discussion. A Memorandum of Agreement or any applicable agreement will be drafted and signed by the two parties clarifying conditions and a list of environmental management tasks and activities that the LGU can perform. It will be elevated at the national level and may serve as basis in issuing an administrative order.

Annex B

Estimated Cost of Establishing a WPPCP (in Philippine pesos)

A Meetings, Orientations	No. of pax	Meals/day	No. of days	No. of activities	Total	supplies, handouts (per person)	Documentation	Total Cost
Orientation, all stakeholders	100	300.00	1	1	30,000.00	100.00	1,500.00	**41,500.00**
Presentation of First draft Report	50	200.00	1	1	10,000.00	100.00	1,500.00	**16,500.00**
Presentation of Final Report	50	300.00	1	1	60,000.00	100.00	1,500.00	**66,500.00**
							Sub Total A	**124,500.00**
B Data Gathering								
Activities	**No. of questionnaire**			**Cost per questionnaire**				**Total Cost**
Survey of establishments	100			60.00				**6,000.00**
Survey of households	100			60.00				**6,000.00**
Analysis of results								**50,000.00**
Other data								**10,000.00**
							Sub Total B	**72,000.00**
C Travels*	**No. of pax**	**Meals/day**	**No. of days**	**No. of activities**	**Total**	**Transportation***		**Total Cost**
Individual visit to industries	10	300.00	4	2	24,000.00	10,000.00		**34,000.00**
							Total Cost	**230,500.00**

* Local cost of travel only, plane fare not included

DEFINITION OF TERMS [1]

Desludging – the process of cleaning ore removing accumulated septage from a septic tank or wastewater treatment facility

Effluent – a general term for any wastewater, partially or completely treated, or in its natural state, flowing out of a drainage canal, septic tank, building, manufacturing plant, industrial plant, and treatment plant, etc.

Sanitation – refers to the hygienic and proper management, collection, disposal or reuse of human excreta (feces and urine) and community liquid wastes to safeguard the health of individuals and communities. It is concerned with preventing diseases by hindering pathogens, or disease-causing organisms, found in excreta and wastewater from entering the environment and coming into contact with people and communities. This usually involves the construction of adequate collection and disposal or reuse facilities and the promotion of proper hygiene behavior so that facilities are effectively used at all times.[2]

Septage – the combination of scum, sludge, and liquid that accumulates in septic tanks.

Septic Tank – a watertight, multi-chambered receptacle that receives sewage from houses or other buildings and is designed to separate and store the solids and partially digest the organic matter in the sewage.

Sewage – mainly liquid waste containing some solids produced by humans, which typically consists of washing water, feces, urine, laundry wastes, and other material that flows down drains and toilets from households and other buildings.

Sewer – a pipe or conduit for carrying sewage and wastewater.

Sewerage – a system of sewers that conveys wastewater to a treatment plant or disposal point. It includes all infrastructure for collecting, transporting, and pumping sewage.

Sludge – precipitated solid matter with a highly mineralized content produced by domestic wastewater treatment processes.

Water Quality Management Area (WQMA) – focuses on sanitation interventions for the improvement of water quality within a defined water quality management area. *A Water Quality Management System* refers to the interrelated interventions, actions, activities, projects/programs that will optimize the quality of water based on the respective beneficial uses or network of solving its water quality problems.[3]

1 Most of the terms here are from the *Operations Manual on the Rules and Regulations Governing Domestic Sludge and Septage*. Department of Health. Manila: Department of Health, 2008.

2 *Philippine Sanitation Source Book and Decision Aid*. World Bank, German Technical Cooperation Agency, and Australian Agency for International Development.

3 Environmental Management Bureau. (http://www.emb.gov.ph/wqms/Draft%20Guidelines%20%20for%20the%20Designation%20of%20WQMA-for%20comments.htm).