Pre-feasibility Study for Wastewater Management in the Marikina River Basin

Manila Water Company, Inc.
June 2007

I. INTRODUCTION

Objective

This Pre-feasibility study aims to assess the status of the Marikina River basin for the planning and development of interventions for wastewater management. It is intended to be used for initial project conceptualization for the river basin that will be more deeply studied by a proposed Master Plan Study and Feasibility Study for the Marikina River basin.

Manila Water is currently devising TORs for the Master Plan Study and Feasibility Study for immediate implementation.

Background

The Marikina River, whose waters were much hailed for its pristine beauty, was long used as a source of drinking water starting with the first metropolitan waterworks system, the Carriedo Waterworks, in 1878. However, due to increasing water pollution, water intake had to be progressively moved upstream until it had to be abandoned.

The booming urban population and the lack of awareness about the health and environmental effects of uncontrolled waste disposal and inadequate wastewater management system have resulted to the ultimate degradation of the Marikina River and other major river systems in Metro Manila.

The Philippines Environment Monitor 2003, a World Bank publication, pronounced the Marikina River, along with the Pasig River, as biologically dead. The same publication also reported that 31% of illnesses, for a five-year period from 1996 to 2000, were from water related diseases representing nearly 5.2 million cases.

Recent statistics point to wastewater from residential sources as the main contributor (80%) to the pollution loading into water bodies of Metro Manila where less than 8% of the population has access to proper sewage treatment.

Despite its current state Marikina River is actually one of the cleaner rivers in Metro Manila. With its narrower catchment area, appropriate interventions can have visible effects more immediately.

This visible improvement of the Marikina River is envisioned to be a pilot project for river rehabilitation in Metro Manila that can be duplicated in other river systems.

II. Location and Physical Characteristics

The Marikina River basin is located to the east of Metropolitan Manila and covers 540 km^2. The River basin is in narrow valley some 4 kilometers wide bounded by the foothills of the Sierra Madre Range and the horst of Quezon City and Pasig rising steeply to the east and west respectively.

The Marikina River begins in the Montalban watershed as the Wawa river flowing westwards across the municipality of Rodriguez before bending southwards. The rivers of San Mateo and Nangka feed the upper stretches of the river while numerous creeks feed the lower stretches as the river basin flattens out in Pasig.

The river basin historically served as a natural flood retention basin during heavy rain and high river flows. Urban developments in the river basin are especially prone to flooding.

Existing developments are low to high density, ranging from about 400 persons/km^2 in Rodriguez to 12,000 persons/km^2 in Marikina

For the purpose of the study, the Marikina River basin is subdivided into 7 sub-basins draining the six cities and towns of Rodriguez, San Mateo, Antipolo, Quezon City, Marikina and Pasig. The river basin is home to nearly 1.5 million people.

The Marikina River is a major tributary of the Pasig River. An as such, is also a major contributor of pollution loadings. The Marikina River in relation to the hydrology of Metro Manila's river system is shown in Annex A.

Catchment Areas:

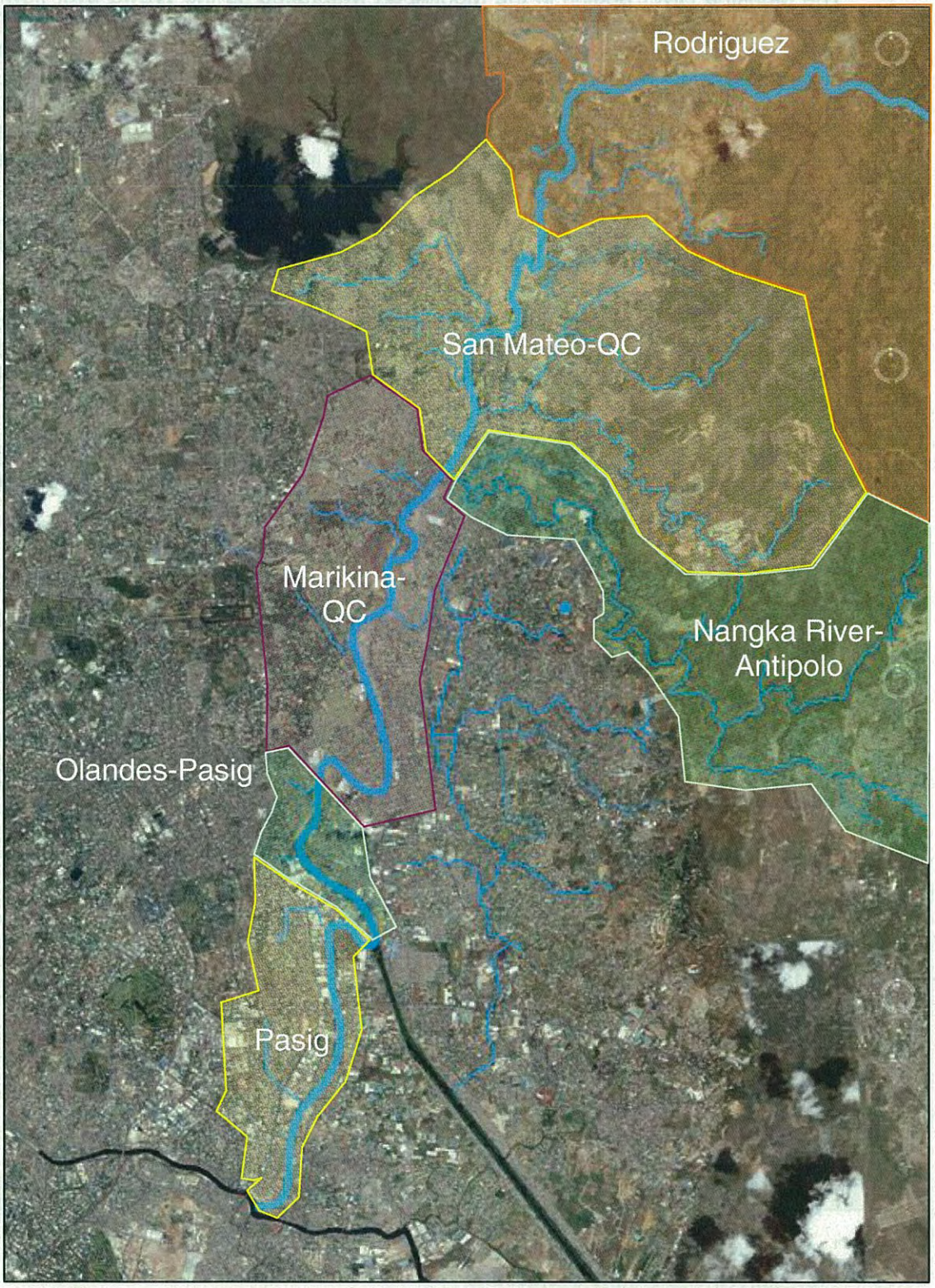
The characteristics of the 7 sub-catchments of the Marikina River basin are summarized below.

Table 1. Marikina River basin sub-catchments

Sub-catchment	Area (km^2)	Approx. Population (2006)	Projected Water Demand (MLD)[2]	Projected Dry Weather Flow (DWF) (MLD)[1]
Montalban Watershed	270	-	-	-
Rodriguez	97.0	153,000	20.0	24.0
San Mateo-QC	70.0	300,000[1]	35.0	42.0
Nangka River-Antipolo	52.0	300,000	65.0	78.0
Marikina -QC	15.0	750,000[1]	110	132.0
Olandes-Pasig	5.0	40,000	7.0	8.4
Pasig	11.0	150,000	57.0	68.4
Total	491			

[1] Manila Water Demand Projections
[2] Manila Water Demand Projections
[3] Assuming wastewater generation = 0.8 (water supply)
DWF = 1.5 * wastewater generation

Figure 1. Major Sub-catchments of the Marikina River Basin



III. Existing Sewerage and Sanitation Facilities

Most of the houses in the existing urban areas, including the majority of those inhabited by squatters, are constructed of permanent materials such as concrete or a mixture of concrete and wood.

Manila Water supplies water to almost the entire river basin except the northern portion of Quezon City which is under Maynilad. In December 2006, Manila Water supplied a total of 103.3 million liters per day (MLD) of water to approximately 100% of Marikina City, 50% of San Mateo, and 30% of Rodriguez. Manila Water does not yet reach fringes of its water network in Rodriguez, San Mateo and Antipolo. The current capital program of Manila Water aimed at extending the water network is addressing this.

Most houses are assumed to have individual septic tanks or ISTs. Septic tank effluent and sullage discharge to the natural drainage system. Moreover, since ISTs are not yet regularly desludged, the organic load entering the drainage system is akin to that of raw domestic sewage. Although observation shows that the drainage system in the urban areas is largely covered, there is evidence of blockages in certain areas with contaminated drainage flowing on some of the streets.

There is no major sewered area in the river basin aside from private STPs mandated for commercial and industrial establishments.

A septic tank desludging program is recently being intensified by Manila Water, which intends to cover 100% of the cities and municipalities within the river basin in a 5-year cycle. From 1997 to 2006, Manila Water desludged 23,946 households within the river basin. This is expected to rise with the construction of the North Septage Treatment Plant located in San Mateo, Rizal which can handle 600 m^3 of septage per day.

From 2000-2005, Manila Water implemented the Manila Second Sewerage Project or MSSP to increase sewer coverage in the East Concession. MSSP benefited more than 500,000 people representing nearly 11% of customers at the time. However, only the 9 Sewage Treatment Plants in Karangalan Village have direct impact to the Marikina River Basin.

In 2006-2010, Manila will implement the Manila Third Sewerage Project or MTSP as a follow-up to MSSP. While MSSP piloted package sewage treatment plants, MTSP will pilot combined sewer-storm drainage system. Studies show that combined sewer-storm drainage systems are most feasible in the East Concession area due to lower capital costs and less disruption that major excavations will cause.

Under MTSP component Marikina-QC Sewerage System, an STP in the riverbanks of barangay Olandes, Marikina will capture combined flows from 139.6 hectares from the communities of Industrial Valley, Cinco Hermanos, Monte Vista, Bgy Olandes in Marikina City and St. Ignatius, Blue Ridge, Bgy. Libis, Camp Atienza in Quezon City. The project is expected to benefit 33,323 people in the river basin. However, this represents less than 5% or the built-up area covered by the Marikina River basin

After MTSP, Manila Water is also set to implement a sewerage master plan that will cover 100% of the major catchments in the East Concession area. A map of the Manila Water's sewerage Master plan appears in Annex B with the Marikina River basin highlighted.

IV. Water Quality

Field sampling carried out under this study in March 2007 (during the dry season) are summarized in Table 2. The higher pollution loading values reflect the direct contribution of drainage outfalls. Most of the lower values are sampled directly from the river still showing some assimilative capacity.

Table 2. Marikina River Water Quality

Catchment	Date Taken	Sampling Point	pH[1]	Temp[1]	TSS[2],	DO[4],	BOD[5],	COD[6],	Total Coliform[7],	Fecal Coliform[7],
					mg/L	mg/L	mg/L	mg/L	MPN/mL	MPN/mL
Montalban Watershed	05/15	Wawa Dam	8.12	-	17	8.3	5	-	$>5x10^7$	$>23x10^7$
Rodriguez		CJ Resort - outfall	7.820	27.1	31	> 1	130	176	> 2419.6	> 2419.6
		CJ resort	7.872	26.8	14	6.67	12	25	> 2419.6	> 2419.6
San Mateo		San Mateo	7.636	26.2	21	0.85	55	74	> 2419.6	> 2419.6
Marikina	05/16	Riverbanks	7.765	28.5	14	< 1	40	41	> 2419.6	> 2419.6
		Purefoods	9.130	28.5	17	< 1	28	70	> 2419.6	> 2419.6
		Sampaguita	7.743	28	31	< 1	49	52	> 2419.6	> 2419.6
		Tumana - outfall	8.019	28.1	44	< 1	509	730	> 2419.6	> 2419.6
		Tumana River	7.835	28.7	26	< 1	113	286	> 2419.6	> 2419.6

Table 3. Public Market Effluent Water Quality

Catchment	Date Taken	Sampling Point	pH[1]	Temp[1]	TSS[2],	DO[4],	BOD[5],	COD[6],	Total Coliform[7],	Fecal Coliform[7],
					mg/L	mg/L	mg/L	mg/L	MPN/mL	MPN/mL
Marikina	05/24	Concepcion Market	7.4	26.5	72	<1	560	630	> 2419.6	> 2419.6
		Tumana Market	7.4	26.5	109	<1	530	1220	> 2419.6	> 2419.6
		Flor Mini Market	6.9	26.5	120	<1	580	1500	> 2419.6	> 2419.6
		TMD Market	6.9	26.5	114	< 1	540	858	> 2419.6	> 2419.6

Method Used: [1]Electrometric, [2]Gravimetric, [3]Volumetric, [4]Azide Modification, [5]Respirometric, [6]Close-Reflux, [7]Enzyme Substrate

The above sampling results are only indicative as it only captures a short time-slice of the annual wastewater loading cycles and covers only a limited span of the seven catchment areas. More samples will have to be taken for analysis under the proposed Marikina River basin Master plan and Feasibility Study

Results show that the river can still assimilate some of the pollution loadings, which are high in some areas. The northernmost samples from Rodriguez even show dissolved oxygen levels well above class C standards.

The stretch of the river from Rodriguez to Montalban mostly pass Class C standards except for bacteriological criteria. Sampling results shows appreciable presence of potentially disease-causing microorganisms making the river unfit for swimming.

Water quality progressively deteriorates downstream as more and more pollution load into the river. One drainage outfall in Marikina City has comparable BOD loadings from samples taken directly from public markets.

Public markets are also sampled under this study. Sampling results show that public markets contribute high pollution loadings to rivers. They are expected to be benchmark for the pollution loading of other public markets in the river basin. Package treatment systems specific to pre-treating public market effluents can be explored.

V. Recommendations

Sewerage

The sewerage system of the Marikina River basin is set to be implemented under the Sewerage Master Plan of Manila Water. This was originally intended to be implemented after MTSP, 2010 onwards.

Considering the urgency of addressing the Marikina River basin, Manila Water now plans to implement the Marikina River basin sewerage system ahead of all other sub-catchments of the Masterplan. Manila Water plans to implement it in the next three years.

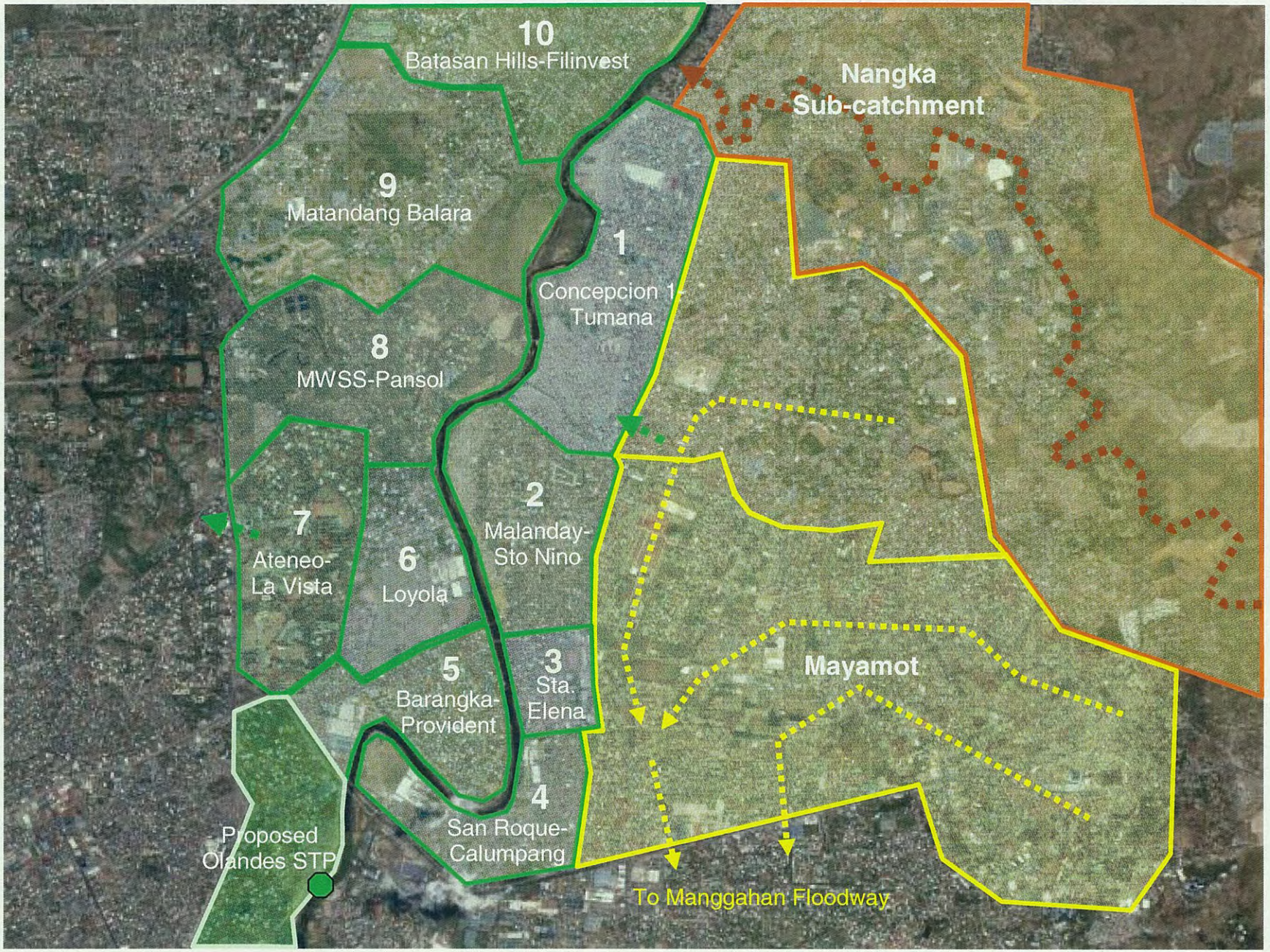
Manila Water will work on the northern sub-catchments namely Marikina-QC, San Mateo-QC and Rodriguez catchments. Considering the results water quality survey of the Marikina River, focus has to be given on the more densely populated Marikina-QC sub-catchment as river quality deteriorates the most from tributaries from this catchment.

To address the large area of the three main sub-catchments, pilots of smaller sub-catchments can be done. The major subdivisions of the Marikina-QC Sub-catchment appear in Figure 4.

Subdivisions 5 to 10 of the Marikina-QC Sub-catchment is proposed to be covered by the original East Concession Sewerage Master plan under Quezon City East catchment and Pasig North catchments. (A map of the said Master plan appears in Annex B).

The focus of this pre-feasibility study will be the east bank of Marikina River.

Figure 4 Minor Sub-catchments: Subdivision of the Marikina-QC Sub-catchment



Minor sub-catchment pilots should fit into the larger master plan, either as transfer station to a larger facility or as the expandable facility that can accept flows from other catchments. Two such promising pilot catchments are the Sta. Elena sub-catchment and the Concepcion-Tumana sub-catchments.

Both pilot areas have some available space: the eastern riverbanks for the Sta. Elena sub-catchment and the river channel for the Concepcion I-Tumana sub-catchment. The feasibility of these minor sub-catchments should be analyzed under the proposed Master Plan and Feasibility Study. These minor sub-catchments appear in the Figures 2 and 3.

Figure 2. Sta. Elena sub-catchment

The Sta. Elena sub-catchment covers the barangay of Sta. Elena including the Public Market and the City Hall Complex and Sports Park. A potential STP site is located along the riverbanks.

Manila Water, the City of Marikina and USAID are working on a pilot Sewage Treatment Plant for the Sta. Elena public market. In May 2007, Manila Water approved the Php 13 million budget for the construction of the STP as designed

under USAID technical assistance. The USAID design prescribes Upflow Anaerobic Sludge-flow Blanket (UASB) technology.

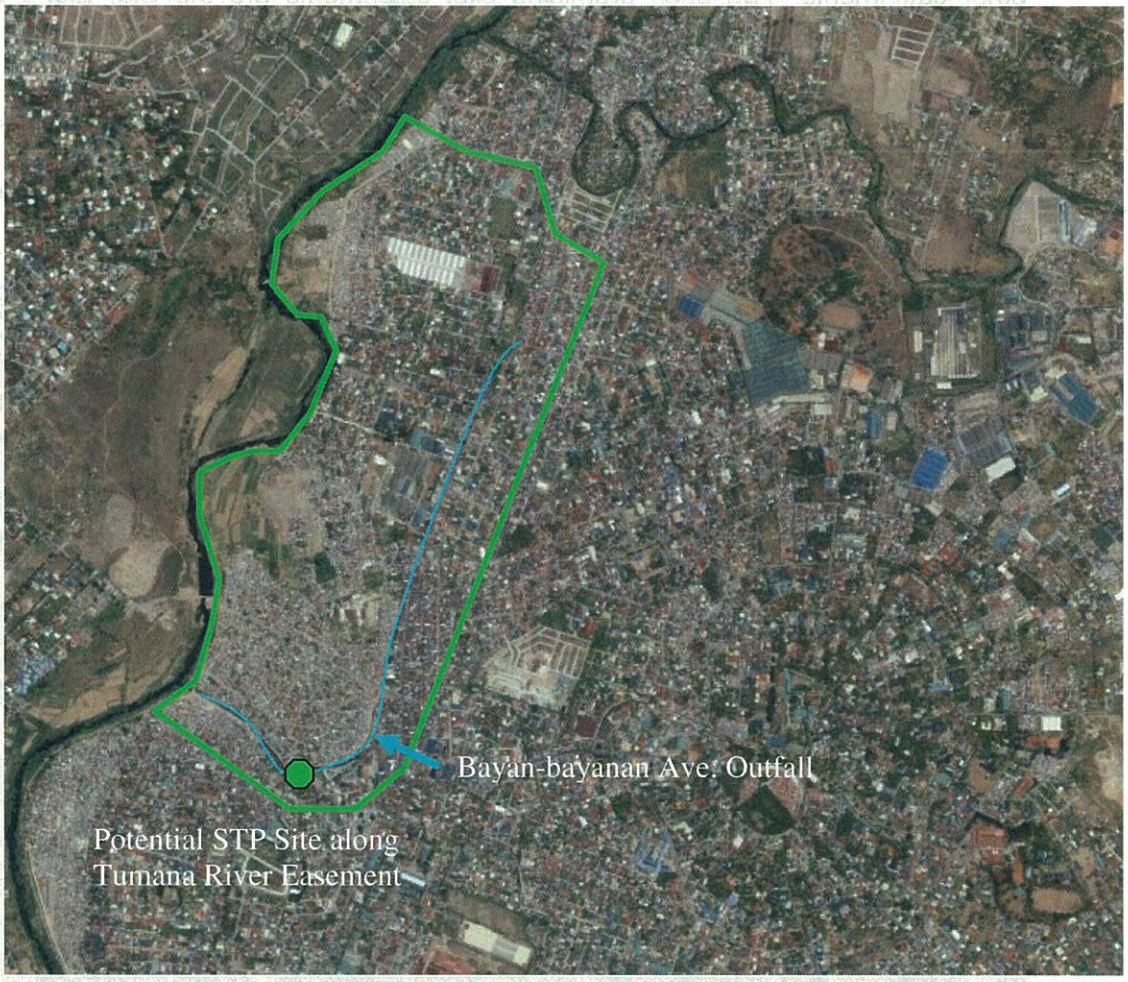


Figure 3 Concepcion 1-Tumana Sub-catchment

The Concecion 1-Tumana Sub-catchment, according to water quality analysis, produces one of the highest BOD loadings. It is slated to be also prioritized. There is an outfall draining Bayan-bayanan Avenue and a still indeterminate portion of the catchment area of Marikina Heights.

Combined sewer-drainage system can be employed in the pilot sub-catchments. Instead of laying new sewer lines, the existing drainage system will be used to convey sewage to treatment plants. During times of heavy precipitation, excess flows will bypass the treatment system to avoid damage to the treatment facility. Flood attenuation to capture a percentage of the first flush of the drainage system can be put in place.

Sanitation

Using combined sewer-drainage system still requires septic tank desludging operations as households will still maintain septic tanks. Manila Water completed the North Septage Treatment Plant in San Mateo, Rizal in May 2007 capable of treating 600 m^3/day of septage or serve nearly 300 households per day. Complemented by a fleet of desludging trucks, the whole of the river basin is expected to be serviced regularly between 3 to 5 years.

Trade Effluent or Commercial-Industrial Effluent

Manila Water's sewerage and sanitation service is limited only the households or establishments with domestic quality effluent (ex. Offices). Non-domestic establishments, i.e. industrial and commercial, are required put-up their own wastewater treatment facility to comply to existing environmental regulations.

Combined sewer-drainage catchments will also cover non-domestic facilities. Effluent from non-complying industrial and commercial facilities will discharge into the combined system potentially upsetting or damaging the treatment process not designed to treat elevated non-domestic pollution loadings.

Strict enforcement of environmental regulation for industrial and commercial establishments is necessary for combined system to work effectively. It is recommended that the Master Plan and Feasibility Study look into the details of trade effluent. The local governments and concerned agencies in the Marikina River basin should have clear plans regarding trade effluent.

VI. Cost and budget

An initial cost estimate for implementing the Marikina River basin sewerage system is presented in the following table.

Table 4. Estimated Cost of Marikina River basin Master plan

	Sub-catchment		
	Marikina	**San Mateo-QC**	**Rodriguez**
Timeline / Component	Phase 1: 2007-2008 Phase 2: 2008-2009	Phase 3: 2008-2009	Phase 4: 2009-2010
Sewage Treatment Plants, Sewer Network, & Lift Stations	988	2,480	2,686
Land	239	306	359
TOTAL	1,227	2,786	3,045
	7,058		

* Costs in Million PhP

The initial cost estimate is largely based on the population projections and CAPEX and OPEX unit costs derived from previous Manila Water projects.

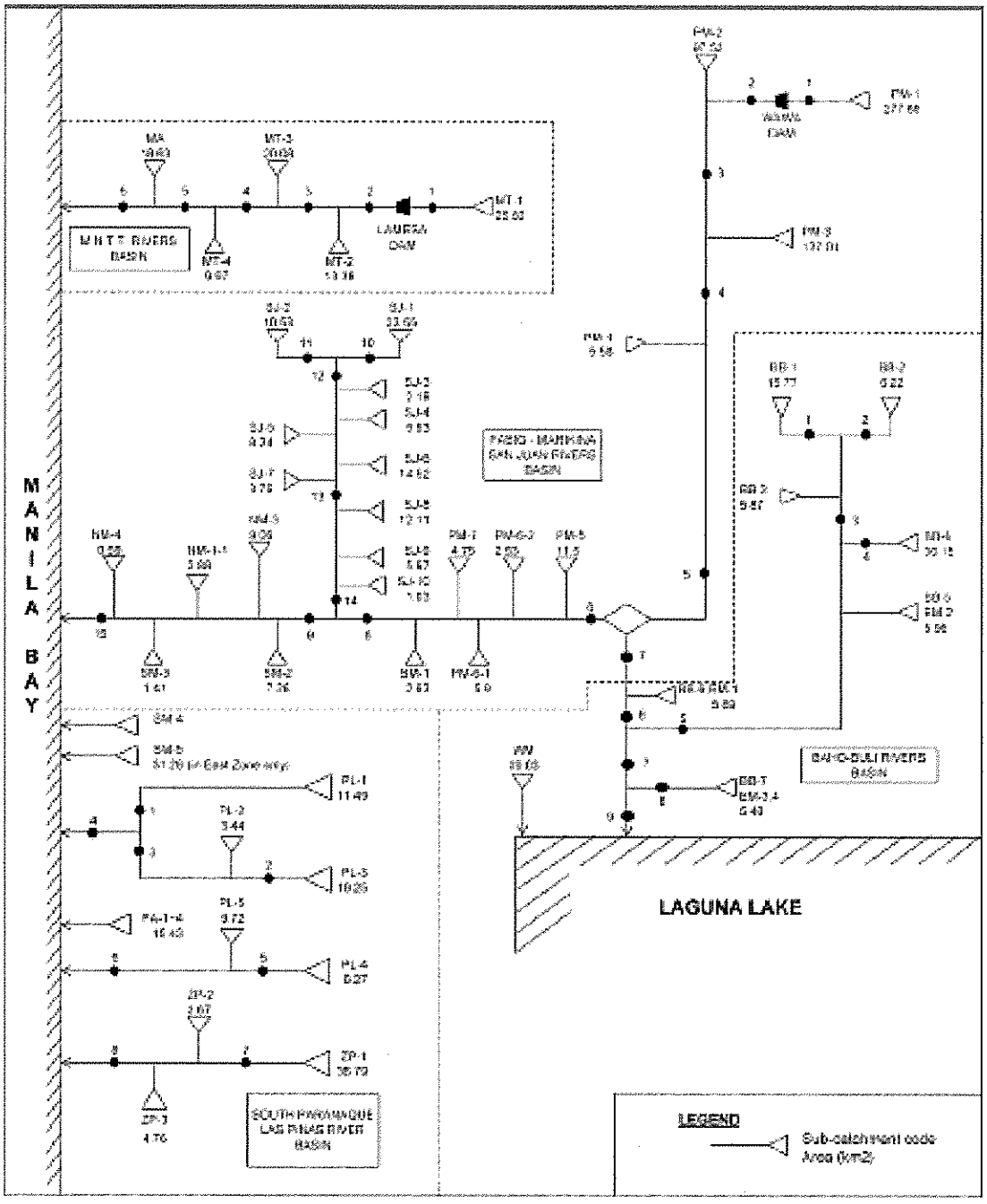
The higher cost of the San Mateo and Rodriguez sub-catchments is largely due to the significantly higher cost of lifting sewage flows from the two very large catchment areas.

This costs are only rough estimates and will have to be re-evaluated under a more detailed design of the proposed Master Plan and Feasibility Study.

Annex A
Metro Manila Catchments

Catchments

Metro Manila area is divided into drainage sub-catchments as shown in the following figure. Catchment boundaries are adopted from 1996 JICA Master Plan, which is based on the 1990 study on flood control and drainage project in Metro Manila commissioned by JICA. Areas of sub-catchments are measured on the latest CAD maps and presented in the following figure.



Annex B
East Concession Area Wastewater Master Plan