第6章 経済財務分析

6.1 マニラッド社の財務状況

マニラッド社の直近 6 年間の財務情報を表 6.1.1 に示す。マニラウォーター社の 2014 年、2015 年の財務情報も比較のためにとりまとめた。損益計算書と貸借対照表は、後の章にて評価している。

表 6.1.1 マニラッド社とマニラウォーター社の財務情報（単価：百万ペソ）

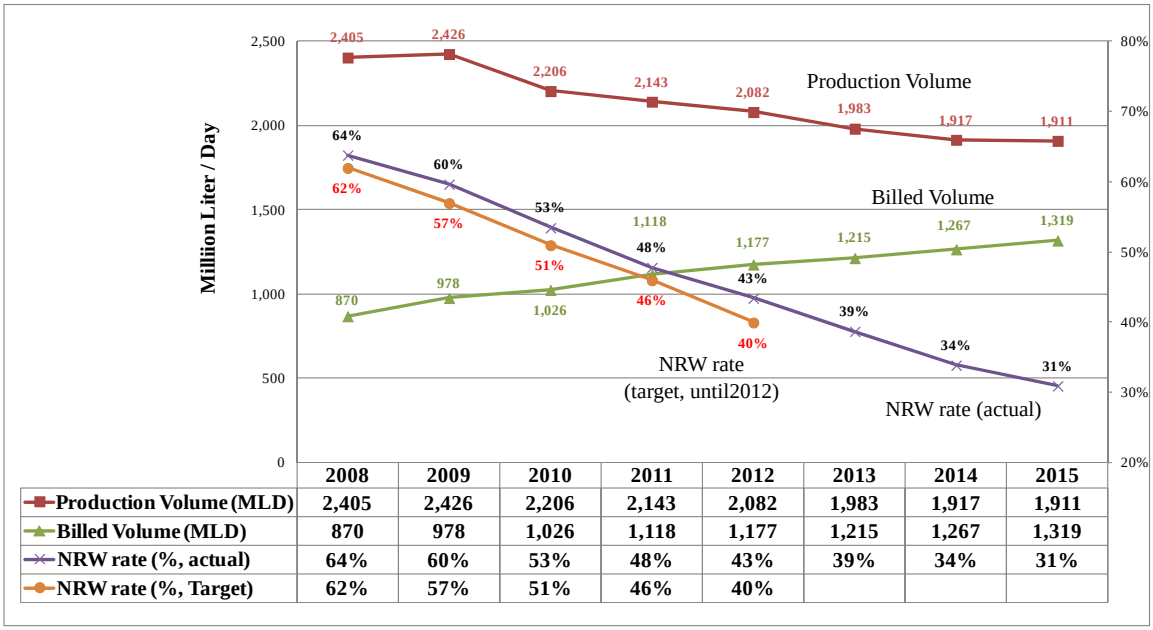
	Maynilad						Manila Water	
	2010	2011	2012	2013	2014	2015	2014	2015
Income Statement								
Operating Revenue	12,050	13,769	15,883	16,895	18,363	19,098	16,357	16,936
Water Service (Metro Manila)	9,904	11,152	12,490	13,469	14,509	15,162	11,772	11,897
Sewerage Service (sewerage and environmental charge)	1,739	2,172	2,906	2,909	3,294	3,367	2,575	2,644
Others	407	445	487	517	560	569	2,010	2,395
Costs and Expenses	4,932	5,878	6,814	7,147	7,415	7,245	7,530	8,449
Salaries, wages and benefits	1,284	1,595	1,811	2,043	2,029	1,848	1,049	1,184
Amortization of service concession assets	1,059	1,429	1,831	1,566	1,804	2,037	2,186	2,316
Utilities	565	622	745	825	847	832	1,010	911
Materials and supplies	367	245	197	193	183	224	0	0
Provision for doubtful accounts	0	155	134	143	0	-232	0	0
Repairs and maintenance	321	282	421	468	496	339	384	366
Depreciation and amortization	135	218	158	231	257	260	-50	-12
Regulatory Cost	13	29	49	63	71	94	99	126
Others	1,188	1,303	1,468	1,615	1,728	1,843	2,852	3,558
Income before Other Income (Expenses)	7,118	7,891	9,069	9,749	10,948	11,853	8,825	8,487
Other Income (Expenses)	-2,553	-2,260	-2,563	-3,219	-2,724	-2,235	-1,159	-558
Interest expense	-2,163	-2,052	-2,494	-2,571	-2,163	-1,983	-1,636	-1,458
Interest income	70	122	155	91	81	135	186	317
foreign exchange gains (losses)	1,217	1,295	960	-176	-113	-153	168	-414
Foreign currency differential adjustments	-1,271	-1,338	-960	174	110	200	-175	517
Others (net)	-406	-287	-224	-737	-639	-434	298	480
Income before Income Tax	4,565	5,631	6,505	6,529	8,224	9,618	7,666	7,929
Provision for (benefit from) deferred income tax	-215	-202	126	-407	-31	67	1,836	1,795
Net Income	4,780	5,833	6,379	6,936	8,255	9,551	5,830	6,134
Balance Sheet								
Assets	42,590	55,366	61,467	68,730	72,541	81,353	74,860	80,608
Current Assests	4,407	8,476	8,248	10,894	11,827	14,827	9,094	9,948
Noncurrent Assets	38,183	46,890	53,219	57,836	60,715	66,526	65,766	70,660
Service Concession Assets - net	36,189	44,588	50,758	54,561	56,926	62,488	55,836	60,193
Other Noncurrent Assets	1,994	2,302	2,461	3,275	3,789	4,038	9,930	10,467
Liabilities and Equity	42,590	55,366	61,467	68,730	72,541	81,353	74,860	80,608
Liabilities	34,646	43,056	44,748	48,037	44,674	45,814	39,758	40,889
Current Liabilities	10,216	12,265	13,407	14,885	13,120	14,427	7,858	12,400
Noncurrent Liabilities	24,430	30,791	31,341	33,152	31,554	31,387	31,900	28,490
Interest-bearing Loans	15,598	21,552	20,624	23,638	22,509	23,337	22,975	19,961
Service Concession Obligations	7,403	7,740	7,975	7,915	6,737	7,041	6,982	6,671
Other Noncurrent Liabilities	1,429	1,499	2,742	1,599	2,308	1,009	1,943	1,858
Equity	7,944	12,311	16,718	20,693	27,867	35,538	35,102	39,719
Financial Indicators								
Current Ratio	43%	69%	62%	73%	90%	103%	116%	80%
Indebtedness	81%	78%	73%	70%	62%	56%	53%	51%
Net Profit Margin	40%	42%	40%	41%	45%	50%	36%	36%
ROA	11.2%	10.5%	10.4%	10.1%	11.4%	11.7%	7.8%	7.6%
ROE	60.2%	47.4%	38.2%	33.5%	29.6%	26.9%	16.6%	15.4%

注：出典の項目名を用いている

出典： Annual Report of Maynilad and Manila Water (2010 - 2015)

6.1.1 損益計算書の評価

収入額の推移を把握するため、マニラッド社の生産水量、請求水量、無収水率を含む、過去推移データを表 6.1.1 に示す。



	2008	2009	2010	2011	2012	2013	2014	2015
Production Volume (MLD)	2,405	2,426	2,206	2,143	2,082	1,983	1,917	1,911
Billed Volume (MLD)	870	978	1,026	1,118	1,177	1,215	1,267	1,319
NRW rate (%, actual)	64%	60%	53%	48%	43%	39%	34%	31%
NRW rate (%, Target)	62%	57%	51%	46%	40%			

出典：マニラッド社

表 6.1.1　マニラッド社のサービス地域における生産水量、請求水量、無収水率の推移

マニラッド社のサービス地域における 2015 年の請求水量は、1,319 百万リットル/日であり、2010 年と比較して 29%増加した。直近 5 年間の平均増加率は、約 5.2%に達し、この高い増加率は、高い人口増加率とサービス拡張によってもたらされた。

無収収率（NRW rate）は、同時期の大規模な投資により、2008 年の 64%から 31%へと急激に改善した。達成された毎年の無収水率は、2008 年の料金改定時に決定された目標値より、2~3%高いが、マニラッド社は目標値に追いつくために努力を続けている。なお、無収水率の改善スピードが速かったため、マニラッド社は生産水量を 2010 年と比較して 13%削減しており、節約できた水量は、将来の需要を満たすために活用される。

損益計算書（表 6.1.1 参照）によると、合計収入は 2015 年に 19,098 百万ペソに上り、2010 年と比較すると、58%増加している。上記の請求水量の増加のみでなく、料金上昇が収入増に寄与していることが分かる。

合計支出は、2015 年で 7,245 百万ペソに上り、2010 年と比較して 47%増加している。雇用者の人件費、及び公共費用は比較的安定しているが、それに対して減価償却費が 2015 年で 2,037 百万ペソとなり、2008 年と比較すると倍増している。この高い減価償却費は、積極的な投資によりもたらされている。

2002 年のコンセッション契約変更において、為替変動リスクを緩和させるために「外貨為替調整費」が追加されている。一旦損益計算書に計上された為替変動利益（損失）は、この項目と相殺されている。

結論として、収入増加は運転費用の増加を大きく上回っており、年ごとにマニラッド社の財務状況は改善している。税引き前利益は 2015 年、2014 年において、各 9,618 百万ペソ、8,255 百万ペソと高収益をあげている。純利益率はそれぞれ 50%、46%となり、マニラウォーター社（2015 年、2014 年に各 36%）と比べても上回っている。法人税の支払は投資委員会（BOI）から承認され、2011 年から 6 年間免除されており、大部分の純利益が内部留保に積み立てられている。

6.1.2 貸借対照表の評価

表 6.1.1 の貸借対照表によると、総資産は 2015 年に 81,353 百万ペソであり、2010 年と比較して大幅に 91%増加している。総資産は年平均 78 億ペソ増加しており、近年無収水対策とサービス拡張のために大規模な投資が実施されたことを示している。

総資産の 18%が「流動資産」に分類され、残り（82%）が「固定資産」である。「固定資産」の大部分を、上下水道事業の施設価値が含まれる「コンセッションサービス資産」が占めており、MWSS が過去に実施した建設事業、及びコンセッション期間中にマニラッド社が実施した追加的な投資・改修事業が本項目に含まれている。その他の車両、オフィス家具等は「その他の固定資産」に分類されている。コンセッションサービス資産は、コンセッション期間において、定額法により減価償却が行われる。

固定負債は主に 2 つの項目から構成される。1 つ目は「有利子負債」、2 つ目が「MWSS へのコンセッションサービス支払負債」である。「有利子負債」は 2015 年で 23,337 百万ペソであり、総負債の 74%を占め、2010 年と比較して 50%増加した。マニラッド社が保有する主要な負債を表 6.1.2 に示す。

表 6.1.2 2015 年のマニラッド社の利子負担負債概要

名前	金額 (1,000 ペソ)	資金源	返済期間	金利	
				現在の金利	条件
1) PHP 21.2 billion Term Loan	16,921,639	民間銀行	2013 年から 10 年	固定 5.75%、2013 – 2018 年	以下のより高い値 (1) ベンチマーク+ 0.75%, (2) 5.75%
2) PHP 5.0 billion Corporate Notes	5,000,000	民間銀行	2013 年から 10 年（据置期間 3 年）	固定 5.75%、2015 – 2016 年	以下のより高い値 (1)ベンチマーク+ 0.75%, (2) 5.75%
3) US$ 137.5 million Loan	2,016,649 （US$建て）	世界銀行、LBP 経由	2012 年から 25 年（据置期間 3 年)	固定 2.40%、2015 – 2016 年	融資契約の利率+ 1.25%、 US$建て
4) PHP 5.2 billion Corporate Notes	1,000,000	JICA、DBP 経由	2014 年から 20 年（据置期間 5 年）	固定 6.00%、2015 – 2035 年	6%
5) Peso-denominated Bank Loan	255,000	民間銀行	2015 年から 8 年（猶予期間 2 年）	固定 5.50%、2015 – 2015 年	以下のより高い値 (1) ベンチマーク+ 1.00%, (2) 5.50%

出典：Consolidated Financial Statements of Maynilad, December 31, 2015

2013年に複数の銀行と結んだTerm Loan融資のおかげで、近年の財務費用は低く抑えられている。また、国際機関からの融資も、2012年と2014年に、公的金融機関を経由したツーステップローン形式で世界銀行とJICAより受領しており、これが財務費用の低減に貢献している。

MWSSが過去に国際機関より借り入れた負債についても、コンセッション契約に基づき、マニラッド社が返済する義務を負っており、毎年マニラッド社がMWSSに支払うコンセッションフィーで支払われている。この負債金額は、「MWSSへのコンセッションサービス支払負債」に2015年で7,041百万ペソ計上され、これは固定負債額の22%に達する。支払の条件とスケジュールは、料金改定手続きにおいてビジネスプランで決定されている。

6.2 事業に活用できる資金源

6.2.1 建設のための現在の資金源

マニラッド社が、処理場を含む建設投資に活用できる資金源は以下の3種類存在する。

1) 自己資金

2) 民間銀行からの融資

3) ODA借款（国際機関から）

「1) 自己資金」は、会社が保有する資金がある限り活用できる。資金付与が迅速であり、全ての小規模な投資に適している。

マニラッド社の利子負担負債は、6.1章に記載のとおり2015年に233億ペソに上り、そのうち過半数は「2) 民間銀行からの融資」により賄われる。この融資はより大規模な投資に活用される。「3) ODA借款」と比較すると、財務費用は市況に影響され高めとなり、返済期間は10年程度と短めになる。

「3) ODA借款」の財務費用は、政府保障が与えられることで他の方法と比べて低く抑えられる。しかしながら、ODA借款は基本的に公的機関にのみ供与されるため、マニラッド社は直接的な借入人には成ることはできない。ODA借款の利益を受容するためには、次章に述べる様に、借款が他の公的機関より移転される必要がある。

6.2.2 ODA借款の資金調達スキームの比較

現在、マニラッド社がODA借款を受領するためには、2種類の方法が存在する。1つ目の方法は、コンセッション契約の規制機関である「(1)MWSSを通した借入」であり、マニラッド社はコンセッションフィーで毎年決められた額を返済する。もう1つは、フィリピン開発銀行（DBP）やフィリピン土地銀行（LBP）といった「(ii)政府系金融機関（GFIs）を通したツーステップローン形式」である。ODA借款を調達する2種類の特徴と貸出条件を表6.2.1に示す。

表 6.2.1 ODA 借款による財務スキームの比較

方法	(i) MWSS を通した借入	(ii) 政府系金融機関を通したツーステップローン形式
長所	- より低い財務費用 - より長期の返済期間(返済期間は子セッション期間より長く設定できる) - 為替リスクが料金改定により負担される	- 迅速な手続き - より柔軟な事業実施
短所	- 手続きに時間がかかる - 事業実施において変更が柔軟でない	- 財務費用が高め - より短い返済期間（コンセッション期間終了時まで）
貸与条件案	1) ODA 借款のベース費用 (優先条件、オプション 1、30 年)* - 金利: 年利 0.25% - コミットメントチャージ: 0.1% - 償還期間: 30 年 - 据置期間: 10 年 (優先条件、オプション 2、20 年)* - 金利: 年利 0.20% - コミットメントチャージ: 0.1% - 償還期間: 20 年 - 据置期間: 6 年 (一般条件、基準、25 年)* - 金利: 年利 1.40% - コミットメントチャージ: 0.1% - 償還期間: 25 年 - 据置期間: 7 年 (一般条件、オプション 1、20 年)* - 金利: 年利 0.95% - コミットメントチャージ: 0.1% - 償還期間: 20 年 - 据置期間: 6 年 2) 追加費用 - 保証費用: 年利 1.0%	1) ODA 借款のベース費用 (優先条件、円借款)* - 金利: 年利 0.25% (30 年) 年利 0.20% (20 年) - コミットメントチャージ: 0.1% 2) 追加費用（ペソ建て融資の場合） - 保証費用: 年利 1.0% - 為替変動費: 年利 3.0% （円からペソ） - プレミアム: 年利 1.35%** - フロントエンドフィー: 0.25%** - 償還期間: 20 年 - 据置期間: 5 年 （外貨返済型円借款の実施により、ドル建てで供与される可能性もある）

* 円借款供与条件表に基づく（2015 年 4 月 1 日発行）、中所得国向け
** プレミアムレート、フロントエンドフィーは、DBP を通じて供与された環境開発事業過去案件に基づいて推定した
出典：JICA 調査団

「(1)MWSS を通した借入」を選択した方が、財務費用は低く抑えられる。為替変動による損失は、2002 年のコンセッション契約の改定により、料金改定手続きに含まれたため、円建てで貸付されたとしても、マニラッド社は為替リスクを負う必要は無くなっている。一方、本法は申請・管理手続きに時間がかかり、事業スコープの変更等は難しいといった短所がある。

「(1)MWSS を通した借入」の条件は、最新の円借款供与条件表に基づいて設定した。表には、優先条件と一般条件の返済期間の異なる条件を示している。下水道分野の事業については、優先条件の適用が期待できる。また、全ての条件において、基本的費用の

他、政府から付与される政府保証の費用として、年 1.0%が課せられる。

「(ii)GFIs（政府系金融機関）を通したツーステップローン形式」の条件は、DBP を通して実施された環境開発事業（EDP）の融資を含む過去事例を参考に推定した。借款がペソまたは US ドル建てで貸し出される場合、為替変動費が基本レートに追加される。

通常の円建ての ODA 借款に追加し、US ドル（またはユーロ）建ての通貨交換オプションが開発されている。本システムの採用により、DBP からマニラッドに提供される最終の借入金利がより低く成る場合は検討対象となる。

マニラッド社の担当者へのインタビューの結果では、「(1)MWSS を通した借入」と比べ、財務費用が比較的高くなるとしても、より柔軟性がありかつ決定後の対応が早い、「(ii) GFIs を通したツーステップローン形式」を、希望するとのことであった。マニラ首都圏の上下水道事業を規制する MWSS は、水源開発事業により特化し、下水道事業の建設事業は２つのコンセッションに実施責任を引き渡している。この状況を鑑みると、事業の資金源は「(ii) GFIs を通したツーステップローン形式」が第 1 の選択肢と成る。実際の借入条件は、事業の準備、設計期間において、慎重に確認される必要がある。

6.3 事業の財務分析

本章では、事業の財務的妥当性を評価するために、財務分析を実施した。理論的には、事業実施により評価期間中にもたらされる追加的な収入と費用が推定され、それらが比較される。比較の際、将来発生する価値には割引率が適用され、現在価値に換算される。しかしながら、現在適用されている料金体系を考慮すると、環境料金と下水道料金は、下水道処理が行われたか否かに関係無く、利用者に課せられていることから、事業を実施した場合（With Project）と実施しない場合（Without Project）において、収入額に違いが生じない状況である。

本分析においては、財務的観点から事業を評価するため、環境料金と下水道料金を追加的な収入と仮定し、FIRR、費用便益率（B/C）、純現在価値（NPV）の算出を試みた。

6.3.1 前提条件

財務分析は以下の前提条件に基づいて実施された。

(1) 評価期間

評価期間は、建設期間 4 年間を含め 19 年とした。評価の最終年は、現在のコンセッション契約が終了する 2037 年に設定した。

(2) 残存価額

土木、建設施設の耐用年数は評価期間より長いが、コンセッション契約終了時に MWSS からの供与資金等は存在しないため、残存価額は想定しなかった。

(3) 物価上昇

費用、収入双方において、物価上昇の影響は考慮しない。

(4) 割引率

事業資金は JICA の円借款を想定する。過去事業で DBP を通じ、供与されたツーステップローンの借入利率である 6.0%を、評価の割引率として採用した。

6.3.2 財務費用

事業に関連する費用は、5.3.3 章に記載されている。複数提案されているケースより、CAS-LP-1（Las Pinas）、CAS-IMS-3（Imus）、及び CAS-KWT-1（Kawit）を財務分析のモデルケースとした。

(1) 初期投資費用

投資費用は、予想される建設期間の 3.5 年、2 年、1 年において、均等に配分される想定とした。

表 6.3.1 建設費用の配分計画

（単位：百万ペソ）

	2019	2020	2021	2022	Total
1) CAS-LP-1 (Las Pinas)	866.7	1,733.4	1,733.4	1,733.4	6,066.9
2) CAS-IMS-3 (Imus)	0.0	0.0	1,933.0	1,933.0	3,866.0
3) CAS-KWT-1 (Kawit)	0.0	0.0	0.0	1,030.8	1,030.8
Total cost	866.7	1,733.4	3,666.4	4,697.2	10,963.7

出典：JICA 調査団

(2) 維持管理費

維持管理費は、5.3.3 章で記載のとおり、固定費と変動費から構成される。毎年の費用は、変動費単価（ペソ/㎥）に処理水量に乗じて求められる。処理水量は、運転の初年度に設計能力の 50%、その後毎年 3.33%ずつ増加して、運転 15 年目の 2037 年に 100%に達する想定とした。

(3) 交換費用

機材等の交換は、現実的には予定された年に実施される。しかしながら、過去の経験に基づき、年毎に平均化した費用を毎年維持管理費として計上した。

6.3.3 収入予測

環境料金と下水道料金は、「予測需要」と「マニラッド事業地域の 2015 年の平均料金」を乗じて算出された。需要は、Appendix 9 に示す、マニラッド社が想定した各自治体の

2037年までの家庭需要と商業需要を用いた。2015年の平均料金は、表6.3.2に示す2015年のデータを用い、家庭利用が4.6ペソ/㎥、商業利用が16.7ペソ/㎥と算出された。

表 6.3.2　環境料金と下水道料金の平均料金

利用者の種類	料金の種類	a: 2015年の収益 (1,000 PHP)	b: 2015年の請求水量 (MCM)	平均料金 (PHP/m3) (a/b)	
Domestic Demand (Residential, Semi-Business)	Basic Water Charge	8,771,413	387.93		22.6
	Environmental Charge	1,790,294		**4.6**	4.6
	Sewer Charge	565			0.0
	Total	**10,562,272**			**27.2**
Commercial Deman (Commercial, Industrial)	Basic Water Charge	6,287,239	93.60		67.2
	Environmental Charge	1,281,052		**16.7**	13.7
	Sewer Charge	305,887			3.3
	Total	**7,874,178**			**84.1**

出典：マニラッド社、JICA調査団がとりまとめ

水需要と、環境料金と下水道料金に関わる将来の予測収入を表6.3.3と6.3.4に示す。詳細はAppendix 9に示す。

表 6.3.3　事業地域の水需要予測

（単位：百万㎥）

市町	利用者	2016	2020	2025	2030	2035
1)Las Pinas	Domestic	25.2	28.8	34.1	41.3	42.3
	Commercial	0.7	0.9	1.2	1.6	2.0
	Total	25.9	29.7	35.3	42.9	44.3
2)Imus	Domestic	16.0	21.0	27.1	32.5	35.5
	Commercial	0.0	0.0	0.1	0.1	0.1
	Total	16.0	21.0	27.2	32.6	35.6
3)Kawit	Domestic	4.4	5.0	6.2	7.4	7.9
	Commercial	0.2	0.2	0.3	0.4	0.5
	Total	4.6	5.2	6.5	7.8	8.4

出典：JICA調査団

表 6.3.4　下水道事業に関連する収入予測

（単位：百万ペソ）

市町	顧客	2016	2020	2025	2030	2035
1)Las Pinas	Domestic	115.9	132.5	156.9	186.8	194.6
	Commercial	11.9	15.3	20.4	27.2	34.0
	Total	127.8	147.8	177.3	214.0	228.6
2)Imus	Domestic	73.6	96.6	124.7	146.3	163.3
	Commercial	0.0	0.0	1.7	1.7	1.7
	Total	73.6	96.6	126.4	148.0	165.0
3)Kawit	Domestic	19.8	23.0	28.5	33.6	36.3
	Commercial	3.4	3.4	5.1	6.8	8.5
	Total	23.2	26.4	33.6	40.4	44.8

出典：JICA調査団

6.3.4 財務分析の結果

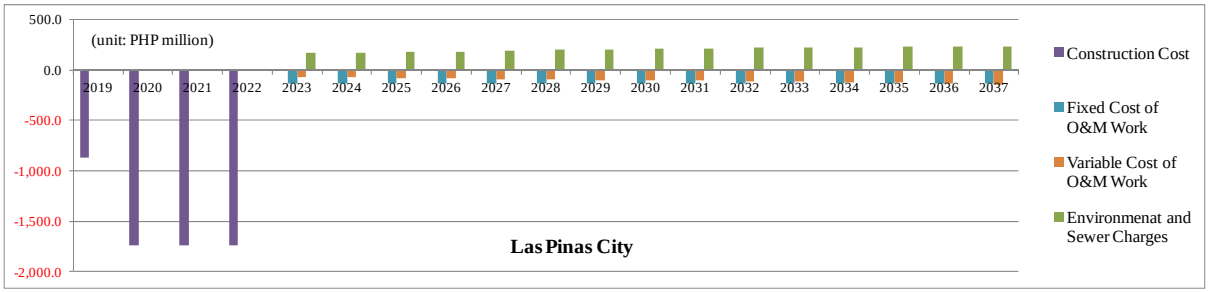
2016年から2037年における、建設費用、維持管理費、および予測収入の現在価値、および費用と収入のフローを表6.5.3と図6.3.1から6.3.3に示す。事業全体の現在価値は、

9,264 百万ペソのマイナスとなった。

表 6.3.5　財務分析の結果

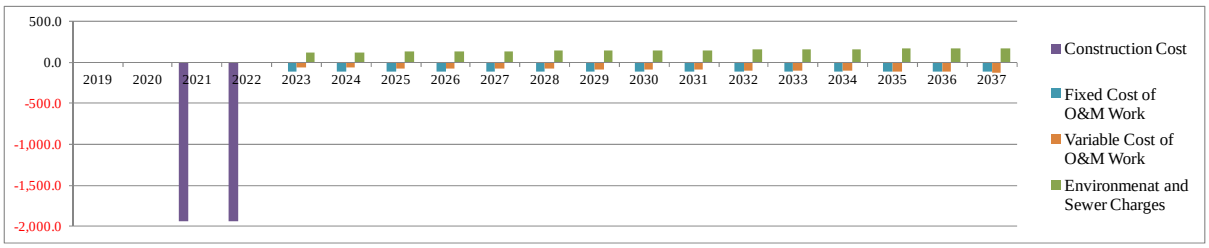
費用および収入	現在の価値 (PHP 百万)			
	1) Las Pinas	2) Imus	3) Kawit	合計
(i) Construction Cost	-4,952	-2,966	-761	-11,665
(ii) O&M Cost	-1,450	-1,246	-290	-2,986
(iii)Revenue	+1,262	+895	+244	+2,401
Total	-5,140	-3,317	-806	-9,264

出典：JICA 調査団



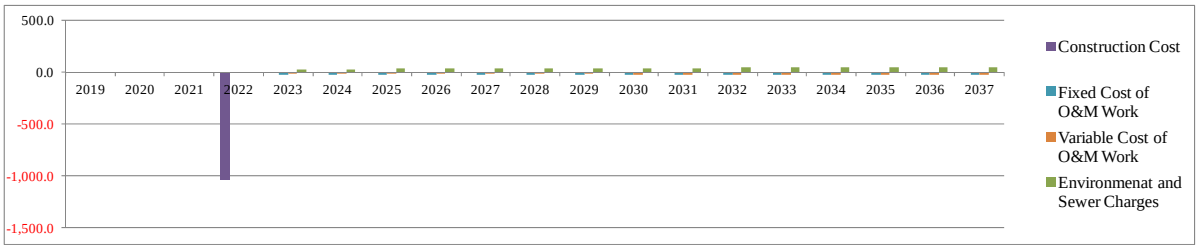
出典：JICA 調査団

図 6.3.1　Las Pinas 市の事業の収入と費用のバランス



出典：JICA 調査団

図 6.3.2　Imus 市の事業の収入と費用のバランス



出典：JICA 調査団

図 6.3.3　Kawit 町の事業の収入と費用のバランス

全ての自治体において、運転期間に収入が維持管理費用を上回ることは無く、割引率を低く設定しても収入が費用を回収できないため、FIRR は算定できなかった。

本結果は、下水道事業の収入と支出を独立して比べた場合、財務的に苦しい状況を示している。2.3.2 章で説明されたとおり、コンセッション期間である 2037 年までの収入と支出が平衡するように料金水準が厳密に調整されており、マニラッド社の財務的安定性はコンセッション契約により確保されている。従い、この結果は水道料金がクロスサブ

シディによって、下水道事業の不採算性を補っていることを示している。

利用者の理解と合意を促進するため、調査団は、既存の料金システムに内在する水道事業から下水道事業へのクロスサブシディの仕組みをより透明化し、利用者に開示することが必要であると考える。

6.4 事業の経済分析

事業実施によりもたらされる便益と費用を、経済的視点で比較するため、経済分析を実施した。結果として、経済的内部収益率（EIRR）、純現在価値（NPV）、便益費用比（B/C）を指標として算出した。その後、各種悪条件の影響を考慮するため、感度分析を実施した。

6.4.1 前提条件

(1) 評価期間

建設施設の耐用年数を考慮し、建設期間の 4 年間を含め、評価期間を 30 年間とした。

(2) 残存価額

建設される処理場と配管の耐用年数を 30 年と想定した。評価期間と耐用年数が一致しており、残存価額は計上しない。

(3) 物価上昇

費用と便益に物価上昇は考慮されていない。

(4) 割引率

割引率は 10%とした。本数値は開発途上国の開発事業に一般的に採用される物である。

(5) 経済便益と経済費用項目

経済分析で算出された経済便益と経済費用を表 6.4.1 に示す。コンセッション期間後の予想が存在しないため、2037 年以降の便益は一定とした。

表 6.4.1 分析で考慮された経済便益と経済費用

経済費用	経済便益
- 初期建設費用 - 追加的な維持管理費用（更新費、維持管理費を含む）	- 生活環境の改善 - 健康への効果 - 土地価格の上昇

出典：JICA 調査団

6.4.2 経済費用

経済費用は、基本的に 6.3.2 章で記載された財務費用を用いている。建設と維持管理費用に対し、0.9 と設定した標準変換係数（SCF）を乗じて、経済費用を求めた。

6.4.3 経済便益

事業実施により、潜在的に生じる経済便益は以下のとおりである。

- 生活環境の改善：事業実施により衛生状況が改善し、サービス利用者の生活に対する満足度が向上する
- 健康への効果：事業実施により対象地域の水因性疾患が減少し、医療費、治療にかかる生産損失、若年死が減少する
- 土地価格の上昇：対象地域の生活環境向上により、土地価格が上昇する
- 観光の増加：対象地域の環境改善により、観光客が増加し、関連セクターの利益が増加する

上から３つ目までの便益が金銭的価値として定量化され、計算に採用された。その外は効果の定量化が難しい、間接的便益として考慮された。

(1) 生活環境の改善

事業完了により、下水道と衛生環境が改善され、下水道サービス利用者の生活環境が向上する。これらの便益の金銭的価値を提唱化することは難しいため、住民が支払っている環境料金と下水道料金が、住民の生活環境改善に対する支払意志額と一致すると仮定した。6.3.3 章で試算された収入額がを、経済便益として採用した。

(2) 健康への効果

事業により衛生環境が改善し、健康改善に貢献する。本便益は、1）医療費の削減、2）生産機会損失の回避、３）若年死の回避について、の 3 項目について計算された。便益は表 6.4.2 に示す前提条件に基づいて計算された。

表 6.4.2 健康への効果算定の前提条件

便益	計算方法
i) 医療費の削減	“裨益人口” x “罹患率” x “平均治療費” x 50% - 裨益人口: 表 1.6.1 に示す (マニラッド社) - 罹患率: 0.12% (保健省, FHSIS 2014 レポート) - 平均治療費: 700 ペソ (世界銀行レポート、2008)
ii) 生産機会損失の回避	“裨益人口” x “罹患率” x “治療期間” x “労働機会率” x “平均人件費” x 50% - 治療期間: 2 日(JICA 調査団) - 労働機会率: 50% (JICA 調査団) - マニラ首都圏の平均人件費: 1,660 ペソ (1 人当たり GRDP より推定, NSO 2014 データ)
iii) 若年死の回避	“裨益人口” x “罹患率” x “若年死の発生率” x “若年死による損失” x 50% - 若年死の発生率(死亡数/罹患数): 2.5% (世界銀行レポートを元に算出、2008) - 若年死による経済的損失: 2,000,000 ペソ (middle case、世界銀行レポート、2008)

出典：JICA 調査団

過去調査の「Economic impacts of sanitation in the Philippines (World Bank 2008)[1]」では、衛生に関連した疾病として、急性水様性下痢、急性血性下痢、コレラ、腸チフツ等としている。

保健省の統計によると、これら疾病の羅漢率はフィリピン国内で徐々に低下し、表 6.4.3 に示すとおり、2014 年において総人口の 0.12%となった。

表 6.4.3　首都圏（NCR）及びフィリピン国全体の衛生関連疾患の罹患率

疾患	2013		2014	
	NCR	フィリピン	NCR	フィリピン
Diarrhea	28,671	258,493	29,583	246,987
(Sanitation related Disease)				
- Acute Watery Diarrhea	N.A.	74,876	N.A.	91,202
- Acute Bloody Diarrhea	17	27,335	31	17,125
- Typhoid/Paratyphoid	4	4,874	80	8,106
- Cholera	3	129	0	99
- Schistosomiasis	0	2,250	0	2,348
- Viral Hepatitis	151	1,407	142	1,571
- Leptospirosis	8	584	89	388
Total Number	N.A.	**111,455**	N.A.	**120,839**
% of Population	N.A.	0.11%	N.A.	0.12%

出典：　FHSIS (Field Health Service Information System) annual report 2013, 2014, DOH

事業が実施された場合、上記疾患の治療費が 50%削減できると想定する。この「１）医療費の削減」は、罹患率と、過去レポートより引用した平均的な治療費 700 ペソを乗じて算出した。

患者が出た場合、その家族や親族が面倒をみる必要が生じ、治療期間中に看護者の労働機会が損なわれる。事業実施による、この損失回避の便益を「２）生産機会損失の回避」として算出した。1 日の労働価値は、首都圏（NCR）の 2014 年の統計データより、1,660 ペソと想定した（2014 年 1 人当たり GRDP が 365,629 ペソ、年間労働日数 220 日）。失業毎の治療期間を平均 2 日とし、労働機会率を 50%とすると、疾患件数当りの損失は 1,660 ペソとなる。事業の影響として、その 50%の損失が回避される想定とした。

一般的に、若年死に関する損失の金銭価値換算は難しい。本分析においては、「３）若年死の回避」便益は、世界銀行の過去案件レポートに沿って計算した。若年死 1 件当たりの経済的損失は、Middle Case で 200 万ペソとされている。また、過去データでは、衛生に関する罹患数全体の死亡率は 2.5%である。事業実施により、その半分が回避されるとして計算を実施した。

(3)　土地価格の上昇

事業による適切な下水処理場導入は、事業地域の海域と河川の水質改善を促し、地域の固定資産向上に寄与する。世銀事業の Metro Manila Wastewater Management Project

[1] Economic Impacts of Sanitation in the Philippines (World Bank, February 2008)

(2012)[2]、及び JICA 事業の Technical Assistance of Paranaque Sewerage System Development Project (2013)によると、以下の類似した前提条件を設定している。

1) 影響を受ける地域は、海域または河川より 1,000 メートル以内である。事業対象である 3 自治体の裨益地域は、JICA 調査団の GIS システムによる分析により、Imus 市 118.4 km^2、Las Pinas 市 17.5 km^2、Kawit 町 4.5 km^2 と算出された。

2) 現在の各自治体の地価は、4.2 章に示された地価のおおよその平均値をとり、Imus 市 6,500 ペソ/m^2、Las Pinas 市 3,500 ペソ/m^2、Kawit 町 5,500 ペソ/m^2 と想定した。

3) カナダと米国で実施された過去調査を元に、土地価格の上昇幅は既存の 10%とした。これらの調査[3]では、水質が良好な地域の地価が、San Francisco において 10 年間で 11%上昇し、Hamilton Harbor では 14 年間に 18.5%上昇したと結論付けている。計算を簡略化するため、地価は運営機関の 1 年目から 10 年目において毎年 1%ずつ上昇し、11 年目以降は変化しない想定とした。

6.4.4 経済分析の結果

上記の経済便益と費用の計算の結果、事業実施に係る EIRR は Las Pinas 市 13.4%、Imus 市 9.6%、Kawit 町 23.5%となった。事業全体の EIRR は 13.1%、NPV は 10%の割引率で 1,367100 万ペソとなった。費用と便益の詳細は Appnedix11 に示す。EIRR は国際援助機関で一般的に用いられる 10%を上回り、経済的視点による事業の妥当性が証明された。

表 6.4.4 経済分析の結果

	EIRR	B/C	NPV (D.R.=10.0%)
(i) Las Pinas City	13.4 %	1.16	PHP 961 million
(ii) Imus City	9.6 %	0.99	- PHP 28 million
(ii) Kawit Town	23.5 %	1.49	PHP 452 million
Whole Project	13.1 %	1.12	PHP 1,367 million

出典：JICA 調査団

6.4.5 感度分析

前章に記載のとおり、EIRR は基本ケースにおいて規定値を上回った。しかしながら、各数値が悪化した場合、EIRR が 10%を下回る恐れがある。事業の安定性と持続性を経済的視点から評価するため、便益 10%減、費用 10%増、及び両方の発生といった複数のケースを想定し、感度分析を実施した。各ケースの結果を表 6.4.5 に示す。

[2] Project Appraisal Document for the Metro Manila Wastewater Management Project (World Bank, April 2012)
[3] The GPI water quality accounts, case study: the cots and benefits of sewege treatment and cource control for Halifax Harbour, (Sara,J,W, 2000)

表 6.4.5 感度分析結果のまとめ

状況	EIRR	B/C	NPV (D.R.=10.0%)
Base case	13.1%	1.12	PHP 1,367 million
Case1: Benefit－10%	10.6%	1.02	PHP 258 million
Case2: Cost＋10%	10.3%	1.01	PHP 122 million
Case3: Benefit－10%, Cost＋10%	7.6%	0.92	PHP -987 million

出典：JICA 調査団

便益の 10%減、費用の 10%増は EIRR と NPV に同程度の影響を与えた。最も悪いケースであるケース 3 では、EIRR は 10%を下回った。

事業の持続性を向上させるためには、建設時の慎重な予算と工程管理、及び維持管理時の費用適正化に努め、費用増加を抑えることが重要である。また、利用者が発現する便益を受容できる様、事業効果のモニタリングも重要である。事業の便益とは、関連する疾病の罹患率、地価推移、（支払意志額と関連し）下水道事業の満足度であり、これらの効果受容に課題がある場合、対応策等を検討することが必要である。

第 7 章　環境社会配慮

7.1　フィリピンの環境管理制度

7.1.1 環境に関する法的枠組み

(a) 国内法規

表 7.1.1 にフィリピン国の関連政策及び法規を示す。

表 7.1.1 環境に関する政策及び法的枠組み

分類	番号	年	名称
Policy/Framework	PD1151	1977	Philippine Environmental Policy
	PD1152	1977	Philippine Environmental Code
	EO192	1987	Reorganized the former DEENR and renamed it as DENR
	RA 9512	2008	National Environmental Awareness and Education Act of 2008
EIA	See 表 7.1.3	-	-
Environmental Conservation	PD 705	1975	Revised Forestry Code of the Philippines
	PD 1067	1976	The Water Code of the Philippines
	RA 7076	1991	People's Small-scale Mining Act of 1991
	RA 7586	1992	National Integrated Protected Areas System (NIPAS) Act of 1992
	RA 7942	1995	Philippine Mining Act of 1995
	RA 8435	1997	Agriculture and Fisheries Modernization Act of 1997
	RA 8550	1998	The Philippine Fisheries Code of 1998
	RA 9147	2001	Wildlife Resources Conservation and Protection Act
Pollution Control	RA856	1975	Sanitation Code
	PA984	1976	Pollution Control Law
	PA6969	1990	Toxic Substances, Hazardous and Nuclear Wastes Control Act
	DAO 92-26	1992	Appointment/Designation of Pollution Control Officers
	DENR AO 92-29	1992	IRR of RA 6969
	DENR AO 98-46	1998	1998 Revised Rules and Regulations for the Prevention, Control and Abatement of Air Pollution from Motor Vehicles
	RA8749	1999	Clean Air Act
	RA9003	2001	Ecological Solid Waste Management Act
	DENR AO 01-34	2001	IRR of the Philippine Ecological Solid Waste Management Act of 2000
	DAO2003-27	2003	Preparation and Submission of Self-Monitoring Report (SMR)
	RA 9275	2004	Clean Water Act
	DENR AO 10-21	2010	Revised IRR of RA 7942, otherwise known as the Philippine Mining Act of 1995
	DENR AO 15-03	2015	Revised IRR of RA No. 7076
	EMB MC 15-011	2015	Guidance Manual for DENR AO 15-09 “Rules and Procedures for the Implementation of the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals in Preparation of Safety Data Sheet (SDS) and Labelling Requirements of Toxic Chemical Substances”
Standard	NPCC MC 80-02	1980	Amendments to Article I (Noise Control Regulations), Chapter IV (Miscellaneous Regulations), Rules and Regulations of the National Pollution Control Commission (NPCC) 1978
	DENR AO 90-34	1990	Revised Water Usage and Classification/Water Quality Criteria Amending Section Nos. 68 and 69, Chapter III of the 1978 NPCC Rules and Regulations
	DENR AO 94-26A	1994	Philippine Standards for Drinking Water 1993 under the Provision of Chapter II, Section 9 of PD 856, otherwise known as the Code on Sanitation of the Philippines
	DOH AO 07-12	2007	Philippine National Standards for Drinking Water 2007

分類	番号	年	名称
	DENR AO 90-35	1990	Revised Effluent Regulations of 1990
	DENR AO 00-81	2000	IRR of the Philippine Clean Air Act of 1999
	DENR AO 03-25	2003	Hydrocarbon Standards for Motorcycles
	DENR AO 03-51	2003	Revised Emission Standards for In-Use Motor Vehicles Equipped with Spark-Ignition and Compression-Ignition Engines Except Motorcycles
	DENR AO 99-32	1999	Policy Guidelines and Standards for Mine Wastes and Mill Tailings Management
	DENR AO 00-98	2000	Mine Safety and Health Standards

PD: Presidential Decree, EO: Executive Oder, PP: President Proclamation, PAO: Presidential Administrative Order, AO: Administrative Order, DAO: DENR Administrative Order, RA: Republic Act, NPCC: National Pollution Control Commission, MC: Memorandum of Circular
出典: DENR EMB Region XI. “Overview of the Environmental Impact Assessment Process (2013)”
DENR-EMB. “The Philippine EIS System: In the Womb of Time, First National Convention of the PEISS (2013)”.
DENR Website: http://www.denr.gov.ph/, DENR-EMB Website: http://emb.gov.ph/

(b) 国際協定及び条約

フィリピン共和国が批准しているまた環境天然資源省(DENR)が締結している環境保全及び天然資源管理分野に関する国際協定及び条約を 4 分類し表 7.1.2 に整理する (詳細は添付資料 7.1 参照)。

表 7.1.2 環境分野における国際協定及び条約

No.	分類	概要
1.	UN (United Nations) conventions ratified by the Philippine Government	The United Nations Framework Conventions on Climate Change and commitments to international organizations such as the International Tropical Timber Organization (ITTO)
2.	Asia Pacific agreements, declarations and statements on environmental and natural resources	Those in the Asia-Pacific Economic Cooperation (APEC), Coral Triangle Initiative and other ENR related groups in the Asia-Pacific region
3.	Association of Southeast Asian Nations (ASEAN) and sub regional cooperational initiatives	The Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA).
4.	Bilateral or those between the Philippines and individual countries.	詳細は添付資料 7.1

出典: Office of the Undersecretary for Environment and International Environmental Affairs DENR (http://intl.denr.gov.ph/)

7.1.2 環境管理組織制度

(a) 環境天然資源省 (DENR)

フィリピン国における環境管理を担当する中心的な行政組織は、1987 年に行政指令 EONo.192 により旧環境、エネルギー天然資源省から改組された環境天然資源省（DENR）である。2016 年 4 月現在の DENR の組織図は添付資料 7.2 を参照。

(b) 環境管理局 (EMB)

DENR の環境管理局(EMB)は、以下の環境管理法規に基づき多様な責務を遂行している。

- フィリピン環境影響評価制度 (PEISS) (1987 年)(PD 1586)
- 有害廃棄物、危険廃棄物及び核廃棄物管理法(1990 年) (RA 6969)
- 大気汚染防止法(1999 年) (RA 8749)
- エコロジカル固形廃棄物法(2000 年) (RA 9003)
- フィリピン水質汚染防止(2004 年) (RA 9275)
- 環境意識改善及び環境教育法(2008 年) (RA 9512)

- 研究及び分析サービスを提供すること及び汚染事件の採決における事務局となること(行政指令 EO 192 に基づく)。
- 国連気候変動枠組条約(UNFCCC)における京都議定書の CDM のための指定された国家機関としての事務局をなること(行政指令 EO320 に基づく)。

7.1.3 フィリピン環境影響評価制度(PEISS)

(a) フィリピン国の環境影響評価（EIA）に関する法規

フィリピン国における EIA、正式名は「Philippine Environmental Impact Statement System (PEISS)」、1987 年の大統領令 PD1586 により制度化された。表 7.1.3 に PEISS の 2015 年 10 月現在における最新の法的枠組みを示す。

表 7.1.3 EIA に関する政策及び法規

発行	No.	年	政策および法規
Major Laws and Presidential Issuances	PD 1151	1977	Philippine Environmental Policy (EIS requirement for every action, project or undertaking which significantly affects environment quality)
	PD 1586	1978	Establishing an Environmental Impact Statement System (EISS) Including Other Environmental Management Related Measures and for Other Purposes
	PP 2146	1981	Proclaiming Certain Areas and Types of Projects as Environmentally Critical and Within the Scope of the EISS Established under PD 1586
	EO 291	1996	Improving the EISS
	PP 803	1996	Declaring the Construction, Development and Operation of a Golf Course as an Environmentally-Critical Project (ECP) Pursuant to PD 1586
	PAO 02-42	2002	Rationalizing the Implementation of the Philippine Environmental Impact Statement System (PEISS) and Giving Authority, In Addition to the Secretary of the Department of Environment and Natural Resources (DENR), to the Director and Regional Directors of the Environmental Management Bureau (EMB) to Grant or Deny the Issuance of Environmental Compliance Certificates (ECC)
DENR Level Issuances	AO 92-21	1992	Amending the Revised Rules and Regulations Implementing PD 1586 (EISS)
	MC 93-12	1993	Submission of the Medium-Term Forest Management Plan to the EISS and Approval of CY 1993 IAOPs
	AO 94-11	1994	Supplementing DAO 92-21 and Providing for Programmatic Compliance Procedures Within the EISS.
	AO 96-37	1996	Revising DAO 92-21 to Further Strengthen the Implementation of the EISS
	AO 97-15	1997	Strengthening the Environmental Impact Assessment (EIA) Division of the EMB
	AO 97-18	1997	Supplementing Guidelines for EIA of Forestry Projects
	AO 99-15	1999	Designating the Forest Management Bureau (FMB) as the Lead Agency in the Implementation of the EISS for Forestry Projects
	AO 99-37	1999	Implementing Rules and Regulations (IRR) governing the Environmental Revolving Fund (ERF)
	AO 00-05	2000	Revising DAO 94-11, Supplementing DAO 96-37 and Providing for Programmatic Compliance Procedures Within the EISS
	AO 00-07	2000	Provisional Guidelines for EIA of Forestry Projects
	AO 00-37	2000	Addendum to Article VIII Section 1.0 of DAO 96-37 Re: Standard Costs and Fees for Various Services of the EMB Relative to the Implementation of the PEISS
	MC 02-15	2002	Cope of Violations and Guidelines for the Imposition of Penalties for Violations under the PEISS (PD 1586)
	MC 03-21	2003	Guidelines on the Availment of the Reduction of Penalties for Projects Found Operating Without ECC in Violation of the PEISS (PD 1586)
	AO 03-30	2003	IRR for the PEISS
	MC 04-14	2004	Prescribing the Guidelines for the Review of EIS and Issuance of ECCs to the Sub-projects under the Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) Project
	AO 06-06	2006	Adoption of Initial Environmental Examination (IEE) Checklist and IEE Report on the ECC Processing of Categorized Final Disposal Facilities (Sanitary Landfill)

発行	No.	年	政策および法規
	MC 07-08	2007	Simplifying the Requirements for ECC or Certificate of Non-Coverage (CNC) Applications
	MC 08-08	2008	Clarification of the Role of Local Government Units (LGUs) in the PEISS in Relation to MC 2007-08
	AO 09-15	2009	Implementation of EIS-Information System, CNC Automated Processing System, GIS Maps of Environmentally Critical Areas (ECA)
	MC 10-14	2010	Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
	AO 15-02	2015	Harmonization of the Implementation of the PEISS and the Philippine Mining Act of 1995 in Relation to Mining Projects
EMB Issuances	MC 02-002	2002	Guidelines for the Implementation of AO 99-37 Re: ERF
	MC 02-004	2002	Telecommunication Antennas, Mobile Phone Cell Sites and Similar Facilities Projects that are Not Covered by the PEISS
	MC 03-004	2003	Amendment to the Limits on the Number of Heads of Piggery Projects that would Require an ECC
	MC 03-021	2003	Guidelines on the Availment of the Reduction of Penalties for Projects Found Operating Without ECC in Violation of the PEISS
	MC 04-001	2004	Non-requirement of barangay and/or local government unit endorsements and locational clearances for CNC applications
	MC 04-002	2004	CNC Barangay Micro Business Enterprises (BMBEs)
	MC 04-004	2004	IEE Checklist for Economic Zone Enterprise
	MC 05-001	2005	Procedural Manual for DAO 03-30
	MC 06-005	2006	Clarificatory guidelines in the implementation of DAO 03-30, IRR for the PEISS
	MC 06-003	2006	IEE Checklist for Wind Energy Projects
	MC 07-001	2007	EIA Review Manual
	MC 07-002	2007	Revised Procedural Manual for DAO 03-30
	MC 10-002	2010	Clarification to DMC 10-14 and Other EIS System Policy Issuances
	MC 10-004	2010	Guidelines for Use of Screening and ECA Map Systems
	MC 11-002	2011	Renewable Energy Projects to be Covered by the EIA System
	MC 11-005	2011	Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
	MC 13-003	2013	Establishment of Registry System for EIA Practitioners
	MC 14-004	2014	Declaring Class 1 and 2 caves as ECAs
	MC 14-005	2014	Guidelines for Coverage Screening and Standardized Requirements under the PEISS amending relevant portions of MC 07-002
	MC 15-003	2015	Implementation of Online Processing of CNC Applications for Category D Projects under the PEISS
	MC 15-008	2015	Implementation of Online Processing of ECC Applications for Category B projects requiring IEE Checklist Report Forms under the PEISS
	MC 15-009	2015	Processing and Issuance of ECC for Category B Projects
	MC 16-001	2016	Requiring online submission of Compliance Monitoring Reports (CMR) under the PEISS
	MC 16-006	2016	ECC Applicants for Mining Projects Including Sand and Gravel Quarry Projects

PD-Presidential Decree; PP-Presidential Proclamation; EO-Executive Order; PAO-Presidential Administrative Order; AO-Administrative Order; MC-Memorandum Circular

出典: DENR EMB Region XI. "Overview of the Environmental Impact Assessment Process (2013)"
DENR-EMB. "The Philippine EIS System: In the Womb of Time, First National Convention of the PEISS (2013)".
DENR Website: http://www.denr.gov.ph/, DENR-EMB Website: http://emb.gov.ph/

(b) 環境承認(ECC 及び CNC)

1) 環境承認証明書 (ECC)

大統領令 PD1586 の第 4 条は「no person, partnership or corporation shall undertake or operate any such declared environmentally critical project (ECP) or environmentally critical area (ECA) without first securing an Environmental Compliance Certificate (ECC) issued by the President or his duly authorized representative」と記している。即ち、PEISS は環境への影響が予測される事業及び活動には、建設及び実施前の必要要件として DENR から ECC(環境承認証明書)を取得する

必要がある。

2) 非適応証明書(CNC)

非適応証明書（CNC: Certificate of Non-Coverage）は、事業概要書の提出に基づき、当該事業が PEISS の適応外であること及び ECC を取得する必要はないことを証明する制度である。即ち CNC は、環境への影響が特段想定されないすべての事業に対し DENR から発行されるものである。

(c) 環境上重要な事業/ 環境上重要な地域(ECP/ECA)

大統領宣言 PP2146(1981 年)、及び 803(1996)により規定されている環境上重要な事業（ECP : Environmentally Critical Project）及び環境上重要な地域（ECA : Environmentally Critical Areas）の分類を表 7.1.4 に示す。

表 7.1.4 ECP の種類と ECA の分類

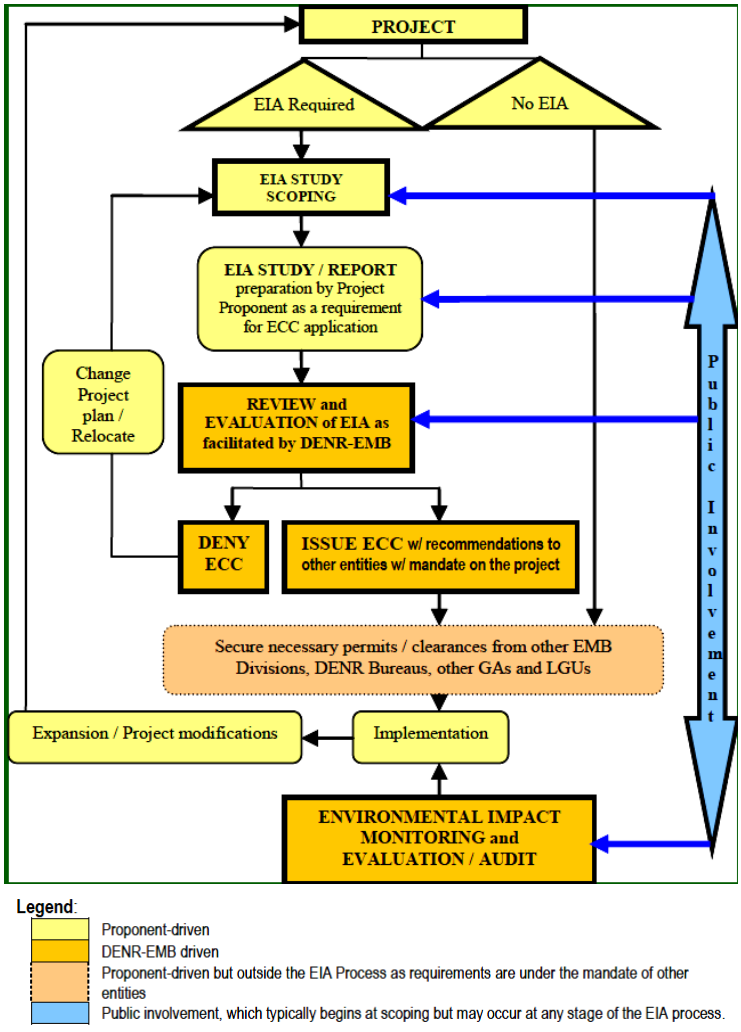
ECP/ECA	法規	概要	
ECP種類	PP2146 (1981)	1.	Heavy Industries – Non-ferrous Metal Industries, Iron and Steel Mills, Petroleum and Petro-chemical Industries including Oil and Gas, Smelting Plants
		2.	Resource Extractive Industries – Major Mining and Quarrying Projects, Forestry Projects (logging, major wood processing projects, introduction of fauna (exotic animals) in public and private forests, forest occupancy, extraction of mangrove products, grazing), Fishery Projects (dikes for/ and fishpond development projects)
		3.	Infrastructure Projects – Major Dams, Major Power Plants (fossil-fueled, nuclear fueled, hydroelectric or geothermal), Major Reclamation Projects, Major Roads and Bridges
	PP803 (1996)	4.	All golf course projects
ECA カテゴリー	PP2146 (1981)	1.	All areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries
		2.	Areas set aside as aesthetic potential tourist spots
		3.	Areas which constitute the habitat of any endangered or threatened species of Philippine wildlife (flora and fauna)
		4.	Areas of unique historic, archaeological, or scientific interests
		5.	Areas which are traditionally occupied by cultural communities or tribes
		6.	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)
		7.	Areas with critical slopes
		8.	Areas classified as prime agricultural lands
		9.	Recharged areas of aquifers
		10.	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities
		11.	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.
		12.	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastline

ECP: Environmentally Critical Project, ECA: Environmentally Critical Area, PP: Presidential Proclamation
出典: DAO 03-30, Aug. 2007, EMB/DENR

(d) EIA プロセス

DAO03-30 改定手続マニュアルに基づき、EIA プロセスは以下の通り整理される。

- PEISS への申請は EIA プロセスの規定された段階を順守することが求められる。
- EIA の各段階における要求事項は申請する事業グループや種別により多様となる。
- EIA プロセスの要約したフローチャートを図 7.1.1 に、その概要説明を添付資料 7.3 に示す。
- フィリピンの EIA プロセスは 6 つの連続した段階、即ち、１．スクリーニング、２．スコーピング、３．EIA 調査及び報告書の作成、４．EIA 報告書レビューと評価、５．意思決定、及び６．ECC 発行後モニタリング、検証と評価及び監査、である。
- 段階 1, 2, 3 及び 6a は事業提案者が実施するもので、段階 4, 5 及び 6b は DENR-EMB が実施する段階となる。
- 最初の 5 段階は、事業提案者が ECC あるいは CNC を申請する際に適応される。



出典: Revised Procedural Manual for DAO03-30 (Aug. 2007) EMB/DENR

図 7.1.1 EIA プロセスのフローチャート

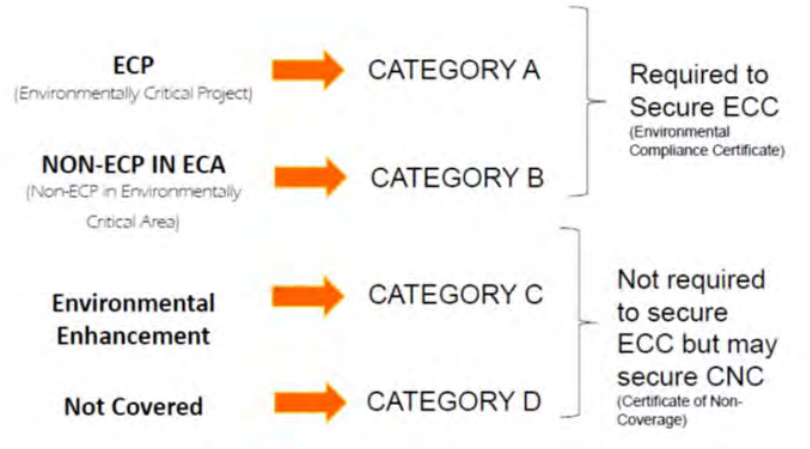
(e) 事業分類による適応範囲決定のためのスクリーニング

EMB 回状 MC 005 (2014 年)の第 1 条は、PEISS に基づく適応範囲をけっているために、提案事業あるいは活動は表 7.1.5 に示す事業分類によりスクーリングを実施しなければならないと規定している。その分類を表 7.1.5 に図示する（ECP 及び ECA については表 7.1.4 参照）。

表 7.1.5 PEISS における事業分類

分類	概要
A	• Projects or undertakings which are classified as Environmentally Critical Projects (ECPs) under Presidential Proclamation No. 2146 (1981), Proclamation No. 803 (1996), and any other projects that may later be declared as such by the President of the Philippines. • Proponents of these projects implemented from 1982 onwards are required to secure an ECC.
B	• Projects or undertakings which are not classified as ECP under Category A, but which are likewise deemed to significantly affect the quality of the environment by virtue of being located in Environmentally Critical Area (ECA) as declared under Proclamation 2146 and according to the parameters set forth in the attached guidelines. • Proponents of these projects implemented from 1982 onwards are required to secure an ECC.
C	• Projects or undertakings not falling under Category A or B which are intended to directly enhance the quality of the environment or directly address existing environmental problems.
D	• Projects or undertakings that are deemed unlikely to cause significant adverse impact on the quality of the environment according to the parameters set forth in the Screening Guidelines. • These projects are not covered by the Philippine EIS system and are not required to secure an ECC. • However, such non-coverage shall be construed as an exemption from compliance with other environmental laws and government permitting requirements.

出典: EMB Memorandum Circular No. 2014-005



出典: CNC Online Application/Screening Guidelines LGU Orientation on PEISS March 12, 2015 EMB/DENR

図 7.1.2 事業分類概略図

(f) 標準要件（Standardized Requirements）

EMB 回状 EC005(2014 年)の第 2 条は ECC/CNC の要件を以下の通り規定している。

- すべての ECC 申請は、EIS(Environmental Impact Statement) の様式による EIA 報告書、初期環境影響調査(IEE : Initial Environmental Examination)チェックリスト報告書、環境パフォーマンス報告書及び環境管理計画（EPEMP: Environmental Performance Report and Management Plan）、プログラム化 EIA あるいはプログラム化 EIA の提出が必要となる。

- CNC 申請は、ガイドライン(Revised Guidelines for Coverage Screening and Standardized Requirements, MC005 July 2014 EMB DENR)の Annex C に指定されている定型化された事業概要書（pro-forma project description）の提出が求められる。
- 表 7.1.6 に、事業の分類、種類、実施状況に基づき、申請事業、ECC/CNC 申請文書、及び意思決定組織を示す。

表 7.1.6　ECC/CNC 文書とプロセス及び意思決定組織

<table>
<tr><th colspan="2">分類</th><th>申請事業</th><th>ECC/CNC 申請に必要な文書</th><th>プロセス及び意思決定組織</th></tr>
<tr><td rowspan="4">A. ECPs</td><td rowspan="2">A-1. New</td><td>Co-located projects</td><td>Programmatic EIS</td><td rowspan="4">EMB Central Office</td></tr>
<tr><td>Single Project</td><td>EIS</td></tr>
<tr><td rowspan="2">A-2. Existing and to be expanded, modified and/or rehabilitated

A-3. Operating without ECC</td><td>Co-located projects</td><td>Programmatic EPRMP</td></tr>
<tr><td>Single Project</td><td>EPRMP in case monitoring data are available
EIS if no monitoring data are available</td></tr>
<tr><td rowspan="4">B. Non-ECPs</td><td rowspan="2">B-1. New</td><td>Co-located projects</td><td>Programmatic EIS</td><td rowspan="5">EMB Regional Office in the region where the proposed project is located</td></tr>
<tr><td>Single Project</td><td>EIS
IEE Checklist</td></tr>
<tr><td rowspan="2">B-2. Existing and to be expanded, modified and/or rehabilitated

B-3. Operating without ECC</td><td>Single Project</td><td>EPRMP
EPRMP Checklist</td></tr>
<tr><td>Co-located projects</td><td>PEPRMP (in case Programmatic monitoring data are available) *</td></tr>
<tr><td>C. Environmental Enhancement or Direct Mitigation</td><td>-</td><td>Co-located or Single projects</td><td>Project Description (Parts I and II) (to confirm non-coverage of further classify as either Category A or B)</td></tr>
<tr><td>D. Not Covered</td><td>-</td><td>-</td><td>Project Description (part I only)
Project prior to 1982- Project Description (Part I only) and Proof of Project Implementation prior to 1982 without expansion/ alteration/ modification (if applying for CNC)</td></tr>
</table>

*: Optional, subject to laws, rules and regulations

ECP: Environmentally Critical Project, ECA: Environmentally Critical Area, ECC: Environmental Compliance Certificate, CNC: Certificate of Non-Coverage, EIS: Environmental Impact Statement, EPRMP: Environmental Performance Report and Management Plan, PEMPRMP: Programmatic Environmental Performance Report and Management Plan

出典: EMB Memorandum Circular No. 2014-005 (MD005 2014)

(g) ECC 申請レビュー

DENR 回状 DMC14 (2010 年)は、ECC 申請をレビューするためのガイドラインを以下の通り規定している。

- EIA 報告書の内容の追加情報/説明は 1 回のみ認められる。事業提案者は 5 日以内に回答する必要があり、さもなければ、EMB/DENR は提出済みの情報に基づき決定を行うことができる。

- ECC 申請への承認は、申請文書と必要なプロセス及びレビューに係る費用の支払いの公的な受領後に、表 7.1.1 に示す規定されている期限より発行される。
- すべての ECP に発行させる ECC はグーリーン計画（Greening Program）構築の条件が含まれる。

表 7.1.7 ECC 承認機関及び期限

ECC 申請種類		承認機関	承認に係る最大期限
ECP	Co-located applying for Programmatic ECC	DENR Secretary/ EMB Director	40 working days
	Mining Projects		
	Forestry Projects		
Non-ECP	EIS or PEPRMP-based	EMB Regional Director	20 working days
	IEE, EPEMP-based		

ECP: Environmentally Critical Project, ECC: Environmental Compliance Certificate, EIS: Environmental Impact Statement, PEMPRMP: Programmatic Environmental Performance Report and Management Plan, IEE: Initial Environmental Examination, EPEMP: Environmental Performance Report and Management Plan

出典: DENR Memorandum Circular (DMC14, 2010)

なお、EMB/DENR によれば、表 7.1.7 の各期限は事業影響の特性や度合いにより、（廃止済）行政令 AD42(2002 年)を参考して、変更（より長くなる）される場合がある。

(h) PEISS における下水道システム事業に対する適応範囲

フィリピンにおける開発事業は PEISS の EIA プロセスのスクリーニング工程を実施することになる。事業を分類（カテゴリ）を決めるためのマトリックス式ガイドランとして「Annex A Project Thresholds for Coverage Screening and Categorization」が「Revised Guidelines for Coverage Screening and Standardized Requirements under the PEISS, EMB MC 005 July 2004, EMB/DENR」に添付されている。

下水道システム事業は、表 7.1.8 に示すとおり、「Annex A」の第 3 章「Infrastructure Projects」のサブ項目 3.8「Waste Management Projects」の小項目 3.8.5「Domestic wastewater treatment facility」に記されている範囲が適応される。

表 7.1.8 PEISS における下水道システム事業の適応範囲

Projects/Description	Covered (Required to secure ECC)			Not covered (may secure CNC)	Project size parameters/ Remarks
	Category A: ECP	Category B: Non-ECP		Category D	
	EIS	EIS	IEE Checklist	PD (*Part I only*)	
3. INFRASTRUCTURE PROJECTS					
3.8 Waste Management Projects					
3.8.5 Domestic wastewater treatment facility (inducing septage treatment facility)	None	≧5,000m^3	>30m^3 but <5,000m^3	≦30m^3	Based on system capacity

出典: Excerpt from “Annex A Project Thresholds for Coverage Screening and Categorization” in the Revised Guidelines for Coverage Screening and Standardized Requirements under the PEISS, EMB MC 005 July 2004, EMB/DENR

即ち、下水道システム事業は、ECP の「カテゴリ A」ではなく、事業規模や能力により、非 ECP の「カテゴリ B または C」、あるいは非適応（CNC 適応される場合がある）の「カテゴリ D」が適応されることになる。

(i) CNC/ECC/CMR のオンライン申請

環境影響評価制度（EIS）の改善の一つとして、2015 年に DENR は CNC と ECC のオンライン申請システムを開始した。また、その翌年の 2016 年には、オンラインによる CRM(Compliance Monitoring Report)の申請システムの実施を開始した。

1) CNC オンライン

EMB 回状 MC003(2015 年)に基づき、すべてのカテゴリ D 事業（ECC 適応外の 1ha 未満の土地開発事業を含む）に対し CNC オンライン申請が EMB のホームページ上（CNC Online; http://119.92.161.13/projectchecker/onlineapplication.aspx）からできるシステムが導入されている。

CNC オンライン利用者マニュアルは具体的なオンライン手続きの詳細が示してある（添付資料 7.4 参照）。

2) ECC オンライン

EMB 回状 MC008(2015 年)に基づき、IEE チェックリストが求められるカテゴリ B 事業（新規及び単体事業のみ）に対し、ECC オンライン申請が EMB のホームページ上（ECC Online; https://119.92.161.21/live/）からできるシステムが導入されている。

なお、EIS が求められる又は複合事業、拡張や変更事業の非 ECP のその他のカテゴリ B 事業すべては、事業提案地域を管轄する当該 EMB 地域事務所に従来どおり手交にて申請する必要があり。

ECC オンライン利用者マニュアルは具体的なオンライン手続きの詳細が示してある（添付資料 7.5 参照）。

3) CMR オンライン

EMB 回状 MC001(2016 年)に基づき、EMB 中央オフィスが発行した ECC を持つ ECPs (Environmentally-Critical Projects)は CMR(Compliance Monitoring Report)のオンライン申請ができるようになっている。

第 1 及び第 2 四半期の第 1 期 CMR は 7 月までに、一方第 3 及び第 4 四半期の第 2 期 CMR は翌年の 1 月までにオンライン申請をする必要がある。

EMB 回答 MC001(2016 年)に基づく CMR 提出手続きは添付資料 7.6 に示すとおりである。

7.2 フィリピンにおける用地取得及び住民移転制度

7.2.1 用地取得及び住民院展に関する法的枠組

(a) 基本政策及び基本法

表 7.2.1 にフィリピンにおける用地取得及び住民移転に係る基本政策及び基本法を整理する。

表 7.2.1 用地取得及び住民移転に関する基本政策及び基本法

関連政策及び法	概要
Constitution of the Philippines (1987)	• Private property shall not be taken for public use without just compensation. (Article III, Section 9) • Free access to the courts and quasi-judicial bodies and adequate legal assistance shall not be denied to any person by reason of poverty. (Article III, Section 11) • The State shall, by law, and for the common good, undertake, in cooperation with the private sector, a continuing program of urban land reform and housing which will make available at affordable cost, decent housing and basic services to under-privileged and homeless citizens in urban centers and resettlement areas. (Article VIII, Section 9) • No resettlement of urban or rural dwellers shall be undertaken without adequate consultation with them and the communities where they are to be relocated. (Article VIII, Section 10). • The State…shall protect the rights of indigenous cultural communities to their ancestral lands to ensure their economic, social, and cultural well-being. By an act of Congress, customary laws governing property rights or relations can be applied in determining the ownership and extent of ancestral domains. (Article XII, Section 5) • Urban or rural poor dwellers shall not be evicted nor their dwellings demolished, except in accordance with the law and in a just humane manner. No resettlement of urban or rural dwellers shall be undertaken without adequate consultation with them and the communities where they are to be relocated. (Article XIII, Section 10)
RA 7160 (Local Government Code) (1991)	• A LGU may exercise the power of eminent domain for public use, or purpose or welfare for the benefit of the poor and the landless, upon payment of just compensation, pursuant to the provisions of the Constitution and pertinent laws • Provided, however, that the power of eminent domain may not be exercised unless a valid and definite offer has been previously made to the owner, and such offer was not accepted • Provided, further, that the LGU may immediately take possession of the property upon the filing of the expropriation proceedings and upon making a deposit with the proper court of at least fifteen percent (15%) of the fair market value of the property based on the current tax declaration of the property to be expropriated • Provided, finally, that, the amount to be paid for the expropriated property shall be determined by the proper court, based on the fair market value at the time of the taking of the property.
RA 7279 (Urban Development and Housing Act) (1992)	• The policy of the State to undertake, in cooperation with the private sector, a comprehensive and continuing Urban Development and Housing Program which shall be; - Uplift the conditions of the underprivileged and homeless citizens in urban areas and in resettlement areas by making available to them decent housing at affordable cost, basic services, and employment opportunities - Provide for the rational use and development of urban land - Adopt workable policies to regulate and direct urban growth and expansion towards a dispersed urban net and more balanced urban-rural interdependence - Provide for an equitable land tenure system that shall guarantee security of tenure to Program beneficiaries but shall respect the rights of small property owners and ensure the payment of just compensation - Encourage more effective people's participation in the urban development process - Improve the capability of local government units in undertaking urban development and housing programs and projects.
RA 8974 (An Act to Facilitate the Acquisition of ROW, Site or Location for National Government Infrastructure Projects) (2000)	• IRR of RA 8974 provides the different bases for land valuation for the modes of acquisition: negotiated sale and expropriation. • The IRR of this law state that the Implementing Agency shall negotiate with the owner for the purchase of the property by offering first the current zonal value issued by the Bureau of Internal Revenue for the area where the private property is located. • The law also states that valuation of the improvements and/or structures on the land to be acquired shall be based on the replacement cost which is defined as the amount necessary to replace the structure or improvement based on the current market prices for materials, equipment, labor, contractor's profit and overhead, and all other attendant costs associated with the acquisition
IPRA (1997)	• IPRA sets conditions, requirements, and safeguards for plans, programs, and projects

関連政策及び法	概要
	affecting Indigenous Peoples. It spells out and protects the rights of Indigenous Peoples.

RA: Republic Act, IRR: Implementing Rules and Regulations, LGU: Local Government Unit, IPRA: Indigenous Peoples' Rights Act

出典: Constitution, RA 7160, RA 7279, Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP) Department of Public Works and Highways Republic of the Philippines Revised March 23, 2007

(b) 他の関連法規

公共事業道路章（DPEH）の「用地取得、住民移転、再建及び先住民（LAPRIPP: Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy）」は、表 7.2.2 に示すとおり用地取得及び住民移転に関するその他の法規を整理している。

表 7.2.2 用地取得及び住民移転に関する他の法規

法規	概要
CA 141 Section 112 or Public Land Act	A twenty (20) meter strip of land reserved by the government for public use, with damages being paid for improvements only.
PD 635 amended Section 112 of CA 141	Increasing the width of the reserved strip of twenty (20) meters to sixty (60) meters.
EO 113 (1995) and EO 621(1980)	a. National Roads shall have an ROW width of at least 20 meters in rural areas, which may be reduced to 15 meters in highly urbanized areas; b. ROW shall be at least 60 meters in unpatented public land; and c. ROW shall be at least 120 meters through natural forested areas of aesthetic or scientific value.
EO 1035	a. Financial assistance to displaced tenants, indigenous peoples, and settlers equivalent to the average annual gross harvest for the last 3 years and not less that PhP15, 000 per ha. b. Disturbance compensation to agricultural lessees equivalent to 5 times the average gross harvest during the last 5 years. c. Compensation for improvements on land acquired under Commonwealth Act 141. d. Government has the power to expropriate in case agreement is not reached.
MO 65, Series of 1983	a. Easement of ROW where the owner is paid the land value for the Government to use the land but the owner still retains ownership over the land. b. Quit claim where the Government has the right to acquire a 20 to 60 m width of the land acquired through CA 141. Only improvements will be compensated.
RA 6389 of 1971	Provides for disturbance compensation to agricultural lessees equivalent to 5 times the average gross harvest in the last 5 years.
Article 141, Civil Code	Real actions over immovable prescribe after thirty (30) years. This provision is without prejudice to what is established for the acquisition of ownership and other real rights by prescription (1963).
NCIP Administrative Order No. 1, Series of 2006 or the Free, Prior and Informed Consent Guidelines of 2006	The Free and Prior Informed Consent (FPIC) Guidelines of 2006 spells out the procedure for obtaining the Free and Prior Informed Consent for affected communities. It details the process for conducting Field Based Investigation (FBI) and obtaining the Certification Precondition from the NCIP attesting that the applicant has complied with the requirements for securing the affected ICC/IP's FPIC. It also provides the procedure for validating projects solicited/initiated by Indigenous Peoples.

CA: Commonwealth Act, PD: Presidential Decree, EO: Executive Oder, MO: Memorandum Order, NCIP: National Commission on Indigenous Peoples, ROW: Right of Way

出典: Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP) Department of Public Works and Highways Republic of the Philippines Revised March 23, 2007

7.3 環境社会配慮に関するその他のガイドライン

7.3.1 環境社会セーフガード・フレームワーク(ESSF)

環境社会セーフガード・フレームワーク（ESSF: The Environment and Social Safeguards Framework）が 2012 年 2 月、世銀メトロマニラ下水管理事業に用いるために作成された。

ESSF によると、作成はフィリピン・ランドバンク（LBP)、マニラウォータ社（MWCI）及び Manyilad ウォーターサービス社（MWSI）から構成されるチームにより実施された。

(a) スコープと目的

ESSF のスコープと目的を以下に示す。

- 本事業で資金手当てされるサブ事業の環境社会スクリーニング、レビュー、承認及び実施のための明確な手続き及び方法を確立する。
- サブ事業に関する環境社会への懸念に対する管理及びモニタリング実施の適切な運用及び責任、そして必要なレポーティング手続きを明確にする。

(b) 適応政策

環境社会セーフガードに適応される政策を表 7.3.1 に整理する。

表 7.3.1 環境社会セーフガードに適応される政策

政策	環境セーフガード	社会セーフガード
World Bank (WB)	• As per WB's classification, this project has been categorized as a Financial Intermediary (FI) and LBP as a Borrower will ensure that the WB's policies and national regulations on the environment are followed, and appropriate instruments prepared. • Under the FI category, it is possible to have sub-projects belonging to environmental categories A, B, and C as per the WB's classification. • The procedures outlined for each of these types of environmental categories will be followed by the Concessionaires (MWCI and MWSI) and LBP.	• WB's Policy on Involuntary Resettlement (OP 4.12) is applicable which is summarized as follows. - Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs. - Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. - Displaced Persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs. - Displaced Persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.
Philippines	• The following national laws and regulations* provide the basis for the overall framework of ESSF. - PD 1586 (1978) - RA 9275 (2004)	• The key legal and administrative policies* relevant to involuntary resettlement are as follows. - Constitution of the Philippines (In Article III, Section 1 and Section 9)

政策	環境セーフガード	社会セーフガード
	- PP 2146 (1981) - AO 42 (2002) - DAO 30 (2003) - MC 14 (2010) - RA 9003 (2000)	- EO 1035 (1985) - CA 141 (1936) - SCR (1987) - RA 6389 (1971) - RA 8974 (2000) - RA 7279 (1992) - RA 7160 (1991)

* Refer to 表 7.1.1, 7.1.2, 7.2.1 and 7.2.2
AO: Administrative Order, PD: Presidential Decree, PP: Presidential Proclamation, RA: Republic Act, EO: Executive Order, SCR: Supreme Court Ruling, DAO: DENR Administrative Order, MC: Memorandum Circular, CA: Commonwealth Act
出典: Environment and Social Safeguards Framework (ESSF) 2012

(c) ESSF における住民移転政策フレームワーク(RPF)

1) フィリピンと世銀の住民移転政策における主要なギャップ

非自発的住民移転に関し、ESSF はフィリピン国の関連法規と世銀の非自発的住民移転政策（OP4.12）（表 7.3.1 参照）とのギャップを以下の通り整理している。

✓ フィリピン憲法第 XIII 章、第 10 項：法的及び人道的方法に基づく場合を除き、都市あるいは地方の貧困居住者を退去及び居住施設の取り壊しをしてはならない。都市貧困は UDHA（Urban Development and Housing Act of 1992）に従い取り組む。地方の貧困層は、小作農を除き、一定の支援及び保護を与える。

✓ RA8974 の第８、9、10 及び 13 項は、公平な市場価格に基づく非影響資産への補償を規定している。しかしながら、民有地取得の最初のアプローチは用地寄付である。

✓ 最高裁より規定されているのにもかかわらず、再定住コストでの補償を明記している法規は見当たらない。

✓ 収入回復／復旧支援は、政府の社会化住宅（government’s socialized housing）の再定住受益者に限定されている。

✓ 事業停止や移転を強いられ移転を余儀なくされる露天商や焼酎規模事業の雇用者への政策が存在しない。

2) 住民移転政策フレームワーク (RPF)

世銀の非自発的住民移転政策（OP4.12）の条項とフィリピンの関連法規のギャップ、即ち非自発的な用地取得及び住民移転を解消するために住民移転政策フレームワーク（RPF）が ESSF の Annex10 として以下に示すように整備された。

- RPF は、影響を受けた用地や他の資産への補償は、事業により生計手段の機会を失う可能性のある者を含めすべての移住者に対し、再取得価格で支払われるとした明確な条項が含まれている。
- サブ事業により思いもよらない 200 あるいはそれ以上の世帯の物理的な移転において政府及び非政府組織は、RPF の条項に従い及び世銀の OP4.12 の条項を順守し、生計回復及び復旧支援に対する密接に活動し調整する。

- RPF は世銀の OP4.12 とフィリピンの関連国内法規と整合を取っている。

7.3.2 JICA 環境社会配慮ガイドラン

(a) 目的

JICA による借款や無償で資金援助された事業は、フィリピンにおける PEISS のような被援助国の関連法規に加え、JICA 環境社会配慮ガイドライン（2010 年 4 月）（以下、「JICA ガイドライン」とする）を順守することになる。

JICA ガイドランの目的は以下の通りである。

- 相手国等に求める要件を示すことにより、相手国等に対し、適切な環境社会配慮の実施を促す。
- JICA が行う環境社会配慮支援・確認の適切な実施を確保する。

さらに JICA が行う環境社会配慮の責務と手続き､相手国等に求める要件を示すことにより;

- JICA が行う環境社会配慮の責務と手続き、相手国等に求める要件を示す。
- これにより JICA は、JICA が行う環境社会配慮支援･確認の透明性・予測可能性・アカウンタビリティーを確保することに努める。

(b) JICA ガイドラインによる事業カテゴリ

JICA ガイドラインによる要求事項は、以下に示す JICA ガイドラインに規定されている「事業カテゴリ」に基づいている。

- 事業を、その概要、規模、立地等を勘案して、表 7.3.2 に示すように環境・社会的影響の程度に応じて 4 段階のカテゴリ分類を行う。
- 事業の進捗に伴い配慮すべき環境社会影響が新たに判明した場合など、必要に応じてカテゴリ分類を変更する。

表 7.3.2 JICA ガイドランによる事業カテゴリ

カテゴリ	概要
A	• Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. • Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. • These impacts may affect an area broader than the sites or facilities subject to physical construction. • Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas.
B	• Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. • Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.
C	• Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.
FI	• Proposed projects are classified as Category FI if they satisfy all of the following requirements: - JICA's funding of projects is provided to a financial intermediary or executing agency; - The selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be

カテゴリ	概要
	specified prior to JICA's approval of funding (or project appraisal); and, - Those sub-projects are expected to have a potential impact on the environment.

出典: JICA Guidelines for Environmental and Social Considerations (April 2010)

各カテゴリの JICA 環境社会配慮手続きの例を添付資料 7.7 に整理している。

7.3.3 フィリピン開発銀行（DBP）の環境政策及び要求事項

フィリピン開発銀行（DBP）は、フィリピン国にける主要な金融仲介機関の一つで、衛生分野事業における DBP の環境政策及び環境要求事項を以下に整理するとおり定めている。

(a) 環境政策

表 7.3.3 に DBP の環境に関する政策を示す。

表 7.3.3 DBP の環境政策

政策	概要
Environmental Initiatives	• DBP vigorously pursues its commitment to environmental protection and sustainable development. • DBP is one of the first Philippine banks to integrate environmental considerations in all aspects of its operations. • DBP provides financing as well as technical assistance to projects that are environmentally sound. • The Bank also plays an active role in encouraging clients, and its participating financial institutions under its wholesale lending program, to include environmental considerations in their businesses and thrusts.
Environmental Policy Statement	• The DBP, in its developmental mission and initiatives, is committed to environmental protection and sustainable development and shall integrate and implement environmental considerations into all aspects of its operations and services, asset management, and business decisions. • In pursuit of the policy statement, DBP commits to: - Develop, implement and continually improve an Environmental Management System; - Encourage other institutions to pursue environmental protection and pollution prevention through the Bank's lending and technical assistance programs, and pursue environmental management practices, including environmental due diligence inquiry in risk assessment and management; - Comply with relevant environmental laws, regulations and agreements to which DBP subscribes; - Set and review environmental objectives and targets along identified significant environmental aspects; and - Ensure that all employees at all levels are made aware of and are actively involved in the Bank's Environmental Policy and programs through appropriate training and information

出典: DBP (https://www.devbnkphl.com/devbanking.php?cat=5&d671c2e74ba54512d937720f508dd1f6)

(b) 衛生分野事業における環境要求事項

表 7.3.4 に DBP の衛生分野事業における環境要求事項を示す。

表 7.3.4 衛生分野事業における DBP の環境要求事項

融資事業	環境要求事項
Sanitation Sector	1. For basic sanitation facilities – project proposal or program of works indicating among others, the project description and implementation schedule of the project components. 2. For Sewerage and Septage Management Project: Full blown feasibility study to include the following information: a. Profile of Service Provider b. Proposed Project c. Alternative schemes of development: comparison of alternatives and cost, economic analysis

	d. Recommendations – to include detailed cost estimates 3. ECC or CNC (EMB/DENR): certifies that the recipient has complied with all the requirements of PEISS and has committed to implement its approved Environmental Management Plan 4. Discharge Permit issued by EMB/DENR or LLDA 5. Environmental Sanitation Clearance issued by the Department of Health 6. For Water Districts - Local Water Utilities Administration Waiver on the proposed project 7. Provincial/City/Municipal Ordinance on Sanitation The requirements under items 3 to 6 are not applicable to basic sanitation facilities, i.e. toilets.

出典: DBP (https://www.devbnkphl.com/devbanking.php?cat=212)

7.4 環境及び社会状況

Las Pina 市、Imus 市、及び Kawit 町の環境及び社会状況を把握するため、JICA 調査団は主に以下に示す資料、他の関連報告書や関連文書のレビュー及び現地踏査を実施した。

- Las Pinas City Comprehensive Land Use Plan 2016-2025
- Imus City Comprehensive Land Use Plan (CLUP) 2007-2017
- Comprehensive Land Use Plan 2012-2022, Kawit Municipality

表 7.4.1 にレビューを実施した環境及び社会状況の項目を示す。

- **表 7.4.1 環境及び社会状況把握レビュー項目**

分野	レビュー項目	
Pollution	(1) Air Pollution	(4) Soil Characteristic
	(2) Water Pollution	(5) Noise
	(3) Waste	-
Natural Conditions	(1) Climate	(4) Protected Areas
	(2) Geology	(5) Flora and Fauna
	(3) Topographical Aspect	(6) Hydrology
Social Conditions	(1) Demographic Situation and Community	(3) Heritage
	(2) Land Use	-

出典: 調査団

本レビューにより、把握した各市の環境及び社会の状況を添付資料 7.8 に示す。

7.5 初期環境影響調査（IEE）

本情報収集確認調査で収集したデータ及び情報に基づき、また JICA ガイドラインを参考とすることで、予備的スコーピング、環境社会配慮調査の仕様書(TOR)案、及び留意点を整備することで初期環境影響調査（IEE）の実施を以下の通り試みた。

7.5.1 事業構成及び用地

(a) 事業構成

事業対象 3 市における事業は表 7.5.1 に整理するとおり、下水処理施設（STP)、下水道システム（ポンプ施設及び下水道）及び STP の用地から構成される。

表 7.5.1 事業構成

市	下水処理施設（STP）		下水道システム（ポンプ施設及び下水道）	
	処理法	計画容量 (m^3/day)	ポンプ場数	管の全長(km)
Las Pinas	CAS with Digestion	113,200	50 (3)	92.4
Imus	CAS with Digestion	93,600	6 (2)	23.5
Kawit	CAS with Digestion	22,000	8 (0)	6.7

Note: Inside brackets for pumping stations show number of larger scale (maximum approximately 10 m× 10 m dimension) pumping stations requiring lands for pump houses. Other pump stations will be installed in underground (underwater)

出典: 調査団

(b) 事業用地

対象 3 市（Las Pinas, Imus 及び Kawit）における各 STP 事業用地の環境及び社会状況を表 7.5.2、表 7.5.3 および表 7.5.4 に示す。

表 7.5.2 STP 用地の環境社会状況(Las Pinas)

STP 用地 Las Pinas 市	用地 No.	総面積 (ha)	必要面積 (ha)	取得状況	所有者
	L-A	3.25	2.55	取得済み	マイニラッド
環境状況	• Flat land • Basically Vacant land • West: V.A.A. Builders' property • East: Zapote river				
社会状況	• A guard house operated by Las Pinas City to oversee the city motor pool, garbage compactors and vehicle impounding are, was permitted by Maynilad within their acquired land for a while. • Maynilad already gave the City Government a formal notice to vacate their land before stating STP. • Maynilad is waiting for Las Pinas City Government's plans of relocating the office to a new location within the boundaries of Coastal Road, C-5.				
写真	 Zapote River	 V.A.A Buliders' Property	 A Guard House		

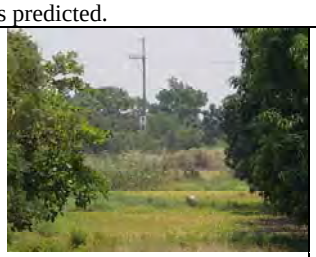
出典: 調査団

表 7.5.3 用地の環境社会状況 (Imus)

STP 用地 Imus 市	用地 No. C-B	総面積 (ha) 5.60	必要面積 (ha) 2.34	取得状況 取得済み	所有者 私有地
環境状況	• Flat land • Basically Vacant land with some trees • Flood prone area in typhoon seasons (water immersion: about 1m from GL)				
社会状況	• In the both sides of approach area for the land, there are two houses (two households but one extended family of total 16 people are living). • Those families are living on the premises as a land keeper for the land assigned by the landowner without land rent. • However, this portion of the land will be outside of STP premises. • The landowner has willingness to sell this portion as soon as*. • In addition, the family has willingness to relocate their houses due to frequent flooding*. • In cases where the land is sold, the owner will make necessary arrangements for the family relocations*				
写真	 One of the Two Houses	 Approach Area	 Land for STP		

*: Results of on-site interview surreys
出典: 調査団

表 7.5.4 用地の環境社会状況 (Kawit)

STP 用地 Kawit 町	用地 No. K-3	総面積 (ha) 1.59	必要面積 (ha) 1.20	取得状況 未取得	所有者 私有地
環境状況	• Flat land • Basically Vacant land with some trees • East: Antero Soriano Highway				
社会状況	• In the approach area for the land, there are two small shanties (not households but tool shads) • Therefore, no resettlement is predicted.				
写真	 Approach Area	 Land for STP (East Side)	 Land for STP (South Side)		

出典: 調査団

✓ STP 処理技術及び用地の選定プロセス及び代替案比較は第 5 章に整理。

✓ 大規模ポンプ施設に関し、本事業で採用されている基本的用地取得政策により Las Pinas 市及び Imus 市に大規模ポンプ施設の用地を取得することになる。

7.5.2 ゼロ・オプション(事業を実施しない)

提案事業のゼロ・オプションを選択する場合は以下の帰結が考えられる。

- ✓ STP 用地としてマイニラッド社により既に購入さている Las Pinas の用地（L-A）は使用されなくなる。
- ✓ 対象 3 市における提案事業の建設及び運転で引き起こされる環境及び社会への影響はまったく発生しない（事業を実施しないため)。
- ✓ マイニラッド社は、各市の汚水処理の要求を満たすための新たな下水処理システム事業の調査実施及び必要な用地を探すことになり、そのための更なる予算が必要となる。

本提案事業により引き起こされる軽微な環境及び社会への影響（以下の項参照）及びマイニラッド社の財政上の制約を考えるとゼロ・オプション（本事業を実施しない）の選択は現実的でない。

7.5.3 スコーピング

「スコーピング」とは「検討すべき代替案と重要な及び重要と思われる評価項目の範囲並びに調査方法について決定することをいう」と JICA ガイドラインで定義つけられている。表 7.5.5 に対象各市の事業に関する予備的スコーピング結果を示す。

表 7.5.5 対象各市の事業に関する予備的スコーピング結果

分類	No.	環境社会項目	評価		理由
			建設時	運転時	
Pollution Control	1	Air Quality	B-	D	Construction Phase: Worsening of surrounding ambient air caused by exhaust gases and dusts emitted from operation of heavy vehicles, equipment and trucks is predicted during periods of construction of DSP and installation of sewage collection facilities (including pumping stations).
					Operation Phase: There is no possibility of generation of air pollutants which have negative impacts on ambient air caused by the operation of STPs and the sewage collection facilities which are basically constructed under the existing roads.
	2	Water Quality	C	D	Construction Phase: Water pollution caused by construction work and installation work, operation of heavy vehicles, equipment and trucks, and waste water of workers and labors is predicted.
					Operation Phase: There is no possibility of groundwater pollution caused by STP operations and sewage collection facilities.
	3	Wastes	B-	C	Construction Phase: Generation of construction waste soil, demolition waste and debris are expected.
					Operation Phase: Generations of domestic waste from STPs are expected.
	4	Soil Contamination	C	D	Construction Phase: There is possibility of soil contamination due to oil spills from relevant construction vehicles and equipment, and transport trucks.
					Operation phase: There is no possibility of soil pollution caused by operation of STPs and sewage collection facilities.
	5	Noise and Vibration	C	C	Construction Phase: Generation of noise caused by construction vehicles and heavy equipment is expected.
					Operation Phase: Earth-based pumping facilities will discharge noise
	6	Subsidence	D	D	Construction Phase: Construction works and installation works which cause of subsidence are not predicted.
					Operation Phase: Ground water is not used for operation of DSP and sewer lines s at all.
	7	Odor	D	C	Construction Phase: Construction work and installation work of STPs and swage collection facilities which cause of bad odor are not expected
					Operation Phase: Operation of STPs of CAS with digestion processes

分類	No.	環境社会項目	評価		理由
			建設時	運転時	
					may discharge bad odor if designs of STPs do not consider odor control equipment and layouts.
Natural Environment	8	Protected Areas	D	D	Protected area and national parks are not existed in and around STP sites, and sewage collection facilities.
	9	Ecosystem	D	D	Rare and protected species and habitats of flora and fauna have not been identified in and around the STP sites, and sewage collection facilities.
	10	Hydrology	C	D	Construction Phase: There is no river stream and river at all on the premises of the STP sites. Therefore, not impact on hydrology in the DSP construction site is expected. On the other hand, sewer lines are planned to be installed under the existing roads by which there may have possibilities that several rivers in each city/municipality may be got across. Therefore, there may be some impacts on such rivers during the construction phase.
					Operation Phase: No impact on hydrology is expected by the operation of STPs and the sewage collection facilities.
	11	Topography and Geology	D	D	Large scale excavation and earth fill are not expected due to construction of STP facilities and installation of sewage collection facilities.
Social Environment	12	Land Acquisition /Resettlement	D/C	D	1. STP Land in Las Pinas: The land of L-A for STP in Las Pinas has been acquired by the Maynilad based on the World Bank Safeguard Policy and ESSF (Environmental and Social Safeguards Framework) for which a Land.
					2. STP Land in Kawit: The land of K-3 for STP in Kawit is a vacant land by which involuntary resettlement is not expected at all. The land of K-3 will be acquired in accordance with the Maynilad policy of ESSF by considering the World Bank Safeguard Policy (OP 4.12).
					3. STP Land in Imus: The land of C-B for STP in Imus is a vacant land. However, in the both sides of approach area for the land there are two houses (two households but one extended family of total 16 people are living). Those families are living on the premises as a land keeper for the land assigned by the landowner without land rent. - However, this portion of the land will be outside of STP premises. - The landowner has willingness to sell this portion as soon as*. - In addition, the family has willingness to relocate their houses due to frequent flooding*. - In cases where the land is sold, the owner will make necessary arrangements for the family relocations* Therefore, possible involuntary resettlement of the family lives in the both sides of approach are for the land may be expected depending on a land layout to be acquired for the STP in Imus. The land of K-3 shall be acquired in accordance with the Maynilad policy of ESSF by considering the World Bank Safeguard Policy (OP 4.12).
					4. Lands for the larger scale pumping stations in Las Pinas and Imus: Necessary sites will be vacant lands which will be procured based on the WB policy and ESSF. Therefore, no resettlement will be predicted in the lands for such pumping stations
	13	Impoverished Peoples Ethnic Minorities and Indigenous Peoples	D	D	Impoverished (absolute deprivation) people and PAPs are not identified in the project site. As well ethnic minorities and indigenous peoples are not identified in and around the project site.
	14	Living and Livelihood	B+/-	B+	Construction Phase: A temporary employment of the surrounding villagers is expected for the construction work and installation work. There may have negative social impacts on the surroundings of the existing roads (negative impacts on traffic and commercial activities) caused by installation of sewer lines.
					Operation Phase: Employments (security guards, gardeners and others) of the surrounding villagers of STP sites are expected in the Operation Phase.

分類	No.	環境社会項目	評価		理由
			建設時	運転時	
	15	Land use and Regional Resources	B-	C	Construction Phase: There is possibility of negative impact on surrounding environment caused by discharge of waste water from construction work and installation work, and worker's office and sleeping quarters (if any). Operation Phase: No impact on land use and regional resources is predicted by the operation of the STPs and Sewage Collection Facilities.
	16	Water Right/Use of Water	D	D	Construction Phase: There is no irrigation channel and surface stream at all in the STP sites. Operation Phase: No impact on groundwater in the site at all.
	17	Social Infrastructures and Services	B-	D	Construction Phase: Negative impacts on surrounding road traffic congestion by increase in the number of heavy vehicles, equipment and transport trucks are temporally predicted during construction period for STPs and sewage collection facilities. Operation Phase: No impact on social infrastructure and services is predicted in the operation phase.
	18	Heritage	D	D	Local archeological, historical, cultural, and religious heritages are not existed in the propose STP sites, existing roads for the sewer lines and lands for larger scale pumping station for which vacant lands will be selected based on the basic policy of the land acquisition for such pumping stations.
	19	Social Capital and Social Organization such as decision making bodies	D	D	Any impacts on social capital and social organization are not expected by the projects
	20	Damage and Benefit	D	D	The project is construction and operation of STP facilities and sewage collection facilities by which such inequality of damage and benefit is not predicted around the project sites
	21	Landscape	D	D	Any negative impacts on the surrounding landscape are not expected by the construction of STP facilities (Planned Capacity: 113,200 m3/day in Las Pinas, 93,600 m3/day in Imus, 22,000m3/day in Kawit) in the flat and vacant lands, sewer lines (including underwater pumps) which are planned to be constructed under existing roads, and the maximum size of larger scale pumping stations will be 10mX10m..
	22	Gender Issue	D	D	Any impacts on gender are not expected by the project
	23	Rights of the Child	D	D	Any impacts on rights of the child are not expected by the project
	24	Risk of infectious diseases such as HIV/AIDS	B-	D	Construction Phase: Temporary influxes of migrant labors increase the risks of STD such as HIV/AIDS during the construction period. Operation Phase: No migrant labors are expected in the operation phase of the projects
	25	Working Conditions/ Work Safety	C	D	Construction Phase: Deterioration of occupational safety and working condition associated with the construction work is anticipated if not properly managed. Operation Phase: There will be general educational related activities for STP staff during the operation phase. Therefore, it is considered that the working conditions for the staff will be moderate.
Others	26	Accidents	C	C	Construction Phase: Accidents associated with construction work are predicted Operation Phase: Accidents associated with operation work are predicted
	27	Transboundary or Global Issues	D	D	This project is construction and operation of STP facilities of CAS with digestion process and sewer lines by which such impacts on transboundary or global issues such as climate change practically are not predicted during construction and operation phases

A+/-	: Significant positive/negative impact is expected.
B+/-	: Positive/negative impact is expected to some extent.
C+/-	: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D	: No impact is expected.

Note: Con. Phase: Construction Phase (includes Construction work and Installation work), Ope. Phase: Operation Phase

出典：調査団

7.5.4 環境及び社会状況調査の TOR(案)

表 7.5.5 に整理した予備的スコーピング結果に基づき、環境及び社会状況調査の仕様書(TOR)案を参考として表 7.5.6 に示す。

表 7.5.6 環境及び社会状況調査の TOR 案

環境社会項目	調査項目	調査方法
Air Pollution	i. Present traffic volume ii. Air quality in and around the site iii. Impact during construction and installation	i. Review of existing available data and others ii. Review of existing data and others, site reconnaissance and monitoring surveys (if necessary) iii. Based on the above surveys, simple calculation of necessary numbers of construction vehicles and equipment, and trucks to be used for the construction and installation is evaluated.
Water Pollution	i. Water quality in and around the site ii. Impacts during construction and operation phases	i. Review of existing data and others and site reconnaissance ii. Based on the reviews and reconnaissance as well as construction methods, the impacts during construction and operation are evaluated.
Wastes	i. Construction solid waste management ii. Domestic solid waste management	i. Interviews with relevant official entities ii. Interviews with relevant official entities
Soil Contamination	i. Construction method to be applied ii. Construction vehicle and equipment to be used	i. Site reconnaissance and construction plans ii. Site reconnaissance and construction plans
Noise and Vibration	i. Construction method to be applied ii. Construction vehicle and equipment to be used iii. Pump facilities	i. Site reconnaissance and construction plans and designs ii. Site reconnaissance and construction plans iii. Site reconnaissance and construction plans and designs
Odor	i. Designs of STPs	i. Site reconnaissance and construction plans, designs and layouts
Ecosystem	i. Present condition of flora and fauna in the project site and surrounding marine environment	i. Review of existing data, field reconnaissance and review of DPR/EIA
Hydrology	i. River crossing points in the sewer line routs ii. Construction method and period in such points	i. Site reconnaissance ii. Construction plans
Land Acquisition/ Resettlement	i. Land Acquisition plans for STPs in Imus and Kawit ii. Land Acquisition plans for earth-based pump stations in Las Pinas and Imus iii. Resettlement Action Plan for Imus STP site (if required)	i. Site reconnaissance ii. Construction plans and layouts iii. Stakeholder meetings
Living and Livelihood	i. Project policy ii. Impacts on Livelihood	i. Discussion with relevant official entities ii. Prediction of impacts on livelihood
Land use and Regional Resources	i. Construction method and equipment ii. Waste water treatment facility	i. Site reconnaissance and construction plan ii. Site reconnaissance and construction plan
Social Infrastructures and Services	i. Present traffic volume ii. Construction vehicle and equipment to be used	i. Review of existing data and construction plan ii. Site reconnaissance and construction plan
Risk of infectious diseases such as HIV/AIDS	i. Heath situation in the project area and the Philippines ii. Health education activates	i. Review of relevant documents ii. Review of relevant laws and regulations
Working Conditions/Work Safety	i. Occupational safety systems ii. Relevant to law and regulation	i. Review of relevant laws and regulations ii. Review of relevant documents
Accidents	i. Present traffic volume	i. Review of existing data and interviews

出典: 調査団

7.5.5 留意点

(a) ECC/CNC 手続き

- 事業を分類（カテゴリ）を決めるためのマトリックス式ガイドラインとして「Annex A Project Thresholds for Coverage Screening and Categorization」が「Revised Guidelines for Coverage Screening and Standardized Requirements under the PEISS, EMB MC 005 July 2004, EMB/DENR」に添付されている。 下水道システム事業は、「Annex A」の第 3 章「Infrastructure Projects」のサブ項目 3.8「Waste Management Projects」の小項目 3.8.5「Domestic wastewater treatment facility」に記されている範囲が適応される（表 7.1.8 参照）。
- 下水道システムに関し、EMB/DENR によれば、下水道は STP 施設の一部とみなされる。
- 従って、下水道システムを含む提案事業は Category B (Non-ECP)である。
- なお、Las Pinas、Imus 及び Kawit の事業用地は DAO03-30 に規定されている自然災害が頻繁に引き起こされる地域「Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity etc.)」に位置している。
- 従って、Las Pinas、Imus 及び Kawit における各提案事業は環境的に重要な地域(ECAs)に位置することになる。

✓ ECC/CNC における留意点は以下の通り。

- 上記の認識により、ECA 地域におけるカテゴリ B 事業は ECC 手続きが求められることになる。

(b) STP における悪臭対策

EMB/DENR が以下に回答するとおり STP の悪臭対策に適応されている特別な基準は存在しない。

- フィリピン大気汚染防止法の IRR に基づく国家大気質基準における、硫化水素(H_2S)基準（100μg/Ncm, 0.07ppm, Averaging time of 30 min）が参考にされる。
- これ以外、いかなる工業施設からの臭いは周辺コミュニティーが「大変に不快でない」ことを確保することが求められるという以外、悪臭発生の基準等は存在しない。

同様に、マイニラッドの環境管理局（EMD: Environmental Management Department）にも独自の悪臭基準や、STP の悪臭防止基準等は存在しない。

一方、マイニラッドは以下に示す請負業者への悪臭対策に関するガイドラインを準備している。

1) 施設悪臭管理システムための雇用者要求事項

- 処理全プロセス通じ及び事業用地周辺から発生する悪臭空気は専用の悪臭対策処理装置で収集及び処理しなければならない。

- 悪臭対策装置は、生物学的プロセスタイプのものでかつ、表 7.5.7 に示す最大悪臭レベル状況に適合できるように継続的に確実に設計されて設置されなければならない。
- 請負業者は提案処理プロセスに基づく設計負荷状況を見積もること及び仮説に基づく大きさとデザインについてのみ責任を持つ必要がある。
- 全ての悪臭排気ダクトは、FRP あるいは承認された品質のものでなければならない。

表 7.5.7 悪臭基準概要

悪臭物質	単位	コメント
Ammonia (At the Stack/ Discharge Point)	0.50ppm	• Using Nesslerization/ Indo Phenol of analysis/ measurement[2] (Averaging Time, 30mins)[1] • Continuously monitored by gas detector at the stack (four times per hour, once every 15mins). • The Contractor shall install the gas detector for Ammonia gas monitoring with calibration certification.
Hydrogen Sulfide (At the Stack/ Discharge Point)	0.10ppm	• Using Methylene Blue of analysis/measurement[2] (Averaging Time, 30mins)[1] • Continuously monitored by gas detector at the stack (four times per hour, once every 15mins). • The Contractor shall install the gas detector for Hydrogen Sulfide gas monitoring with calibration certification.
Ammonia (At the Site Boundary)	0.28ppm	• 30 Averaging Time, minutes*1, using Nesslerization/ Indo Phenol method of analysis/measurement*2.
Hydrogen Sulfide (At the Site Boundary)	0.02ppm	• 30 Averaging Time, minutes*[1], using Methylene Blue method of analysis/measurement*[2]
1: Ninety-eight percentile (98%) values of 30-minute sampling measured at 25oC and one atmosphere pressure. 2: Other equivalent methods approved by the DENR may be used.		

出典: マイニラッド

- 悪臭対策装置設計には、表 7.5.7 に示した悪臭基準の順守に加えて主要な施設やプロセスに対する定期的なモニタリング及び管理を実施することが求められる。
- 請負業者は、評価をするために、専用の悪臭管理装置がある場合には予測される化学物質の消費率、化学物質及びエネルギー使用コストを提供する必要がある。
- 事業用地には一つの中央悪臭管理施設を設置することが想定される。
- 悪臭管理装置は以下の最低限の条件を満たす必要がある。

1. 常用及び予備再循環ポンプ
2. 主設備の予備的ユニットを伴う排出ファン
3. 室内カバー、囲いの悪臭配管の接続
4. 悪臭管理施設に接続されている全ての閉鎖空間や囲い部分から排出される汚染された空気の流れの接続及バランス確保を容易にする悪臭配管（FRP あるいは承認された素材）及び制御ダンパーの設置。
5. 特定の悪臭管理パネルと関連した電気設備の設置。
6. 施設 SCADA（Supervisory Control And Data Acquisition）システムへの接続を含む、必要機器、モニタリング及びデータ記録装置の設置。
7. 電源及び機器配線。

8. 排水管及び均等化タンク

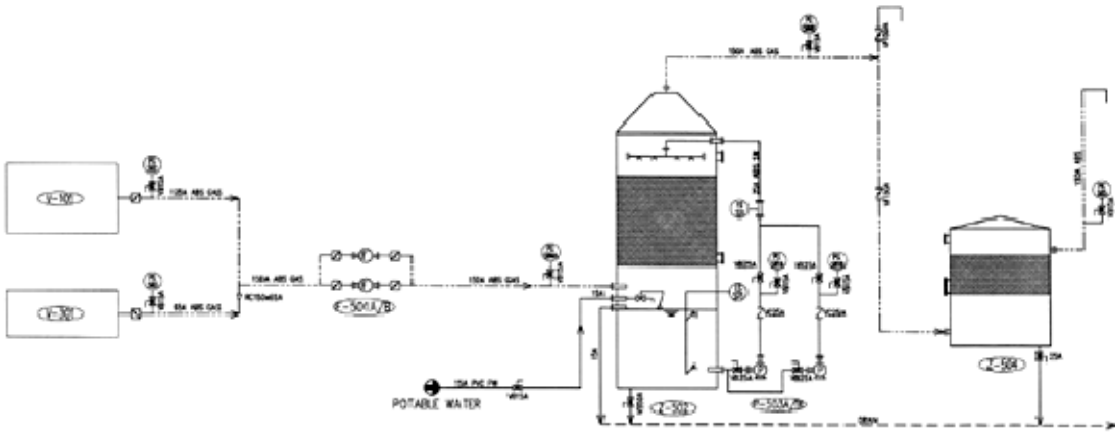
- 悪臭管理装置はシステムのプロセス・アクセプタンス試験の一部としてテストされなければならない。
- 悪臭管理装置の重点管理点（CCP: Critical control points）は SCADA インターフェース上で目視され、悪臭大気量、機械故障及びワンポイント・オンライン・クオリティ計測が提供されなければならない
- 試運転間に、請負業者は、コンピューター・シミュレーションによる悪臭管理装置の効率を実演しなければならない。

(出典: マイニラッド)

2) Talayan 事業悪臭管理装置（参考）

- 脱臭装置は、連続 2 ユニットで構成され、洗浄脱臭装置は原則化学物質を使用しないタイプで、活性炭脱臭装置によりさらに大気からの悪臭を回収する。
- STP で発生した悪臭大気は、悪臭基準を満たすように脱臭装置で捕集及び処理される。
- 沈砂池及び排気スラッジ貯蔵タンクの悪臭は ABS 素材のパイプで捕集される。
- 脱臭ファンを用いた脱臭装置により悪臭ガスを捕集する
- 洗浄脱臭装置はネット・パッキング・リング、スプレーノズル、脱臭ポンプを設置した洗浄タンクで構成され、悪臭はノズルからの噴射による洗浄水と接触する様に移動させられる。
- 上記装置により、悪臭気と水の接触が促進される。悪臭大気はすぐに水に吸収されその後、水媒体中の微生物の同化と異化作用により有機物が分解される。
- 洗浄水は装置の中で循環され蒸発に対応するため上水が自動的に供給される。洗浄水の排水は週に 1 回あるいは必要に応じて実施される。
- 上記作業は、水処理装置に接続されている排水バルブの開閉により行われる。
- 洗浄脱臭装置で処理された空気は活性炭脱臭装置（ACD: Activated Carbon Deodorizer）へ更なる脱臭のため送られる。
- ACD は吸着作用により悪臭気の中の多くの汚染ガスを除去する。
- 悪臭気からの汚染ガスは活性炭の表面に付着する。
- 時として活性炭上の付着ガスが飽和状態になるためその際には媒体の取替えが必要となる。

(出典: マイニラッド)



出典: マイニラッド

図 7.5.1　配管と計装図

✓　悪臭管理における留意点を以下に示す。

- STP の設計に関し、事業で契約される請負業者はマイニラッドの請負業者への悪臭対策に関するガイドライン「Employer's Requirement for Plant Odor control system」を利用させる必要がある。
- マイニラッドの過去の STP の悪臭管理装置の設計デザインを本事業の参照とする。

(c)　環境管理体制

事業実施において、JICA、DBP の様な金融仲介機関及びマイニラッド社の全ての関連政策及び環境社会配慮ガイドラインを満たすための環境管理制度が組織されている。

マイニラッド社は、表 7.5.8 に示すとおり、環境管理局（EMD: Environmental Management Department）が同社の事業における環境社会配慮活動を実施している。

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表 7.5.8 マイニラッド社の環境管理制度

部局	主な活動
Environmental Management Department (EMD)	• Conducting environmental impact assessments of Maynilad's projects and where necessary, in determining control measures and programs to mitigate their impacts unto the environment; • Establishing policies, programs and procedures for compliance to applicable environmental laws and regulations, and achieve the company's environmental mission; • Monitoring compliance of the company's processes and facilities to environmental statutory and regulatory requirements including processing and renewal of related permits, licenses and certificates; • Conducting tests and measurements of related environmental parameters to determine the company's compliance to regulatory standards, and where necessary, initiate improvements to achieve compliance; • Identifying potential environmental risk and liabilities of the company's processes and facilities and where necessary, initiate corrective and preventive actions to mitigate environmental impacts; • Providing assistance to other business units in the effective implementation, successful certification and maintenance of their management system certifications, including processing of permits and licenses, preparation and submission of periodic reports and in the organization and conduct of prescribed trainings;

部局	主な活動
	• Organizing and/ or provision of prescribed trainings to appointed Pollution Control Officers of the different business units of Maynilad including assistance in their accreditation with relevant regulatory bodies; • Addressing emerging environmental problems which were not foreseen during project planning; and • Ensuring that the company is compliant to new/ amended laws and regulations relating to the environment.

出典: マイニラッド

✓ メトロマニラ西における本下水道システム事業における環境社会配慮上の留意点を表 7.5.9 に示す。

表 7.5.9 下水道システム事業における環境社会配慮上の留意点

市	環境配慮			社会配慮					
	悪臭管理			用地取得			住民移転		
	Pre.	Con.	Op.	Pre.	Con.	Op.	Pre.	Con.	Op.
Las Pinas	-	-	STP	STP, PS	-	-	-	-	-
Imus	-	-	STP	STP, PS	-	-	STP*	STP*,**	STP*,**
Kawit	-	-	STP	STP, PS	-	-	-	-	-

Pre.: Preparation Phase, Con. Construction Phase, Op.: Operation Phase, STP: Sewerage Treatment Plant, PS: Pump Station

*: Depending on land acquisition plan, resettlement will be necessary.
**: In cases where resettlement is necessary, after care of the resettled households is required based on relevant guidelines and laws and regulations

出典: 調査団

7.5.6 環境チェックリスト (JICA ガイドライン No. 15 汚水事業)

JICA ガイドラインに基づき、予備的な環境チェックリスト（No.15 汚水事業）を整備した（添付資料 7.9 参照）。

第8章 結論

8.1 対象地域の下水道システム

8.1.1 集水区域の統合

過去において、マイニラッド社の上下水道プロジェクトは小規模な処理場システムが計画されていた。しかし数多くの小規模下水処理場の土地買収は困難であることが分かった。マニラ首都圏の人口は急速に増加しており、多くの小規模処理場の運営管理を行うことは負担が重い。このような理由から、現在では、分散型のシステムより集水域を統合することによる集中型の中～大規模の下水道システムが望ましいと見なされている。結果的に、フィージビリティ調査で計画された Las Piñas 市、Imus 市の 3 つの下水処理場を 1 つの下水処理場に統合する。

8.1.2 高度処理プロセス

マニラ湾の清浄化の為、環境天然資源省（DENR）による環境ガイドラインに従い、窒素やリンの除去のような高度処理プロセスが必要となる。現在、マイニラッド社は新しい下水道基準を作成中である。マイニラッド社の新基準では、DENR の基準を基にして、窒素の許容濃度は NO_3<14mg/L、NH_3-N<0.5mg/L、リンの許容濃度は P<1.0mg/L となる。そのため、全下水処理場で高度処理を行う必要があり、高度処理プロセスのない下水処理場は、東マニラ首都圏においては採用できない。

8.1.3 有望な下水処理法のオプション

(1) 下水処理

第 5 章で検討したように、下記の理由から深層式標準活性汚泥（CAS）法のオプションが最も適していると考えられる。

- ✓ 各地域において 1 つの下水処理場しか必要せず、土地買収が複数の用地を必要とする他のオプションに比べてはるかに容易である。
- ✓ 近年、マイニラッド社は CAS 法を複数の処理場で採用しており、十分な経験を有している。そのため熟練した担当者が適切な運転管理を行うことができる。
- ✓ 高度下水処理において、CAS 法は回分式活性汚泥（SBR）法に比べて容易である。
- ✓ CAS 法は、その他のオプションに比較してライフサイクルコスト（LCC）の点で利点がある。

特に、Las Piñas 市の場合、下水処理場の用地は既に取得済みである。マイニラッド社は、土地買収の過程が必要なく、予定通りに次の実施段階に進む事が可能である。

また、性能の向上を図るために、第 5.2 節で紹介した省エネ設備を CAS 法と併せてと導入することもできる。

(2) 汚泥処理

消化プロセスは発生汚泥量および臭気の影響を削減するのに有効であり、導入が推奨される。しかし消化ガスによる発電は小規模であり、建物内で使用する程度である。マイニラッド社で将来的に下水処理場での導入を考慮して検討する。

また焼却プロセスは確実に汚泥量の削減に寄与するが、第 3.3.4 節で示したように、本調査とは別に、調査地域だけではなく全体地域における発生汚泥の効率的な処理を確立するためにサービス地域全体の焼却汚泥管理計画が必要となる。

(3) 管路システム

Las Piñas 市 において L-22 および L-C 流域で発生する下水は Alabang-Zapote Road と Quirino Avenue に布設する追加幹線で L-A 下水処理場へ流下することができる。これらの道路は交通量の多い幹線道路であるため、建設中の交通および周辺地域への影響を軽減するため長距離推進工法を提案した。これにより Las Piñas 市長による道路掘削許可を早期に取得できることが期待される。

Imus 市においてはその地形的優位性により上流域である IC 流域および IB 流域で発生する下水を General Yengco Street に布設する追加幹線のみにより IA 流域まで流下でき、追加ポンプ場は不要となる。Imus 市は F/S で提案された 3 流域を 1 流域に統合する上で理想的な条件と言える。

Kawit 町は F/S レポートでの提案下水道計画に対し、最下流幹線での調整のみで K-3 下水処理場まで全域の下水を送ることができる。

また、特に Kawit 町においては一部の地域において排水路が設置されていないことから、現時点ではインターセプター方式が採用できない箇所が存在する。そのため、今後、詳細設計前に LGU 等との関係機関と排水路の建設について協議する必要がある。結果によっては個別接続（分流式）の採用も考えられる。

8.2 優先プロジェクトにおけるプロジェクト評価

各地域におけるスキーム案のうち、CAS-LP-1（Las Piñas 市）、CAS-IMS-3（Imus 市）および CAS-KWT-1（Kawit 町）を経済および財務分析のモデルケースとして選ぶ。

8.2.1 経済分析結果

上記モデルケースの経済的フィージビリティ評価の為、経済分析が行われた。事業実施による発生する利益 i) 生活環境の改善、ii) 医療費の削減、iii) 土地価格の上昇を考慮に入れると、経済的内部収益率（EIRR）は、Las Piñas 市が 13.4%、Imus 市が 9.6%、Kawit 町が 23.5%となる。事業全体の EIRR は、13.1%となり、10%を上回り、事業の経済的視

点における妥当性が証明された。事業の妥当性の向上の為に、適切な工程管理および事業効果のモニタリングが重要である。

8.2.2 財務分析結果

現在利用者に課されている環境料金および下水道料金を追加的な収入として、2037 年までの収入および事業に関連する費用を財務分析において比較した。現在の料金水準は低く設定されており、下水処理場の年間の運営管理費を賄えない状況であることが分かった。マニラッド社の財務的安定性はコンセッション契約により確保されており、水道料金がクロスサブシディによって、下水道事業の不採算性を補っていることを示している。調査チームは、料金システムの透明化を図ることを提案する。

8.2.3 資金調達

マイニラッド社には、1)自己資金、2)民間銀行からの融資、3)ODA 借款の 3 種類の資金調達方法がある。マイニラッド社が望む ODA 借款は他の方法と比べて費用を低く抑えられる。JICA およびその他のドナーは直接的に民間企業に融資はできない為、マニラ首都圏上下水道供給公社（MWSS）や政府金融機関（GFIs）を通じて借り入れを行う必要がある。マイニラッド社は GFIs を通じたツーステップローン形式を望んでいる。ローンの基本的な条件はメインリポートにおいて記述する。

8.2.4 料金改定の現況

2016 年 7 月時点において、2013 年から 2017 年の料金を設定する手続きは完了していない。MWSS およびマイニラッド社は 2012 年から協議を続けている。2014 年に、マイニラッド社は料金における最初の仲裁手続きを終えたが、MWSS はさらに約 3 ペソ/㎥の値下げを求めた。マイニラッド社はこの要求を不服として、財務省（DOF）を通じて 2013 年より収集できていない料金額を補てんするよう求めた。新たな仲裁手続きが実施され、2016 年末に仲裁結果が出る予定である。

8.3 マイニラッド社による次の展開

本調査による下水処理システムの検討から、既存フィージビリティ調査で計画された下水処理場の集水域を統合し、深層式 CAS 法の採用によって、下水処理場の数を 1 つに削減できることが明らかになった。

これにより、土地買収の厳しい状況によって遅れている下水処理場建設の状況を改善することができる。

下水処理場の施設レイアウトプランおよび費用の推定は、異なる特徴を持つ候補地に対して、CAS 法を含む 4 つの下水処理法から最も適したオプションを選択して行われる。

これは様々な状況下で将来的に行われる下水道改善計画の指標となる。

本調査は、土地が限定された状況における処理能力の高い処理場の効果的な処理方法として深層式 CAS 法が存在することを示した。この結果をマイニラッド社に示すことによって、CAS 法は将来的な処理計画の第一のオプションとなる。

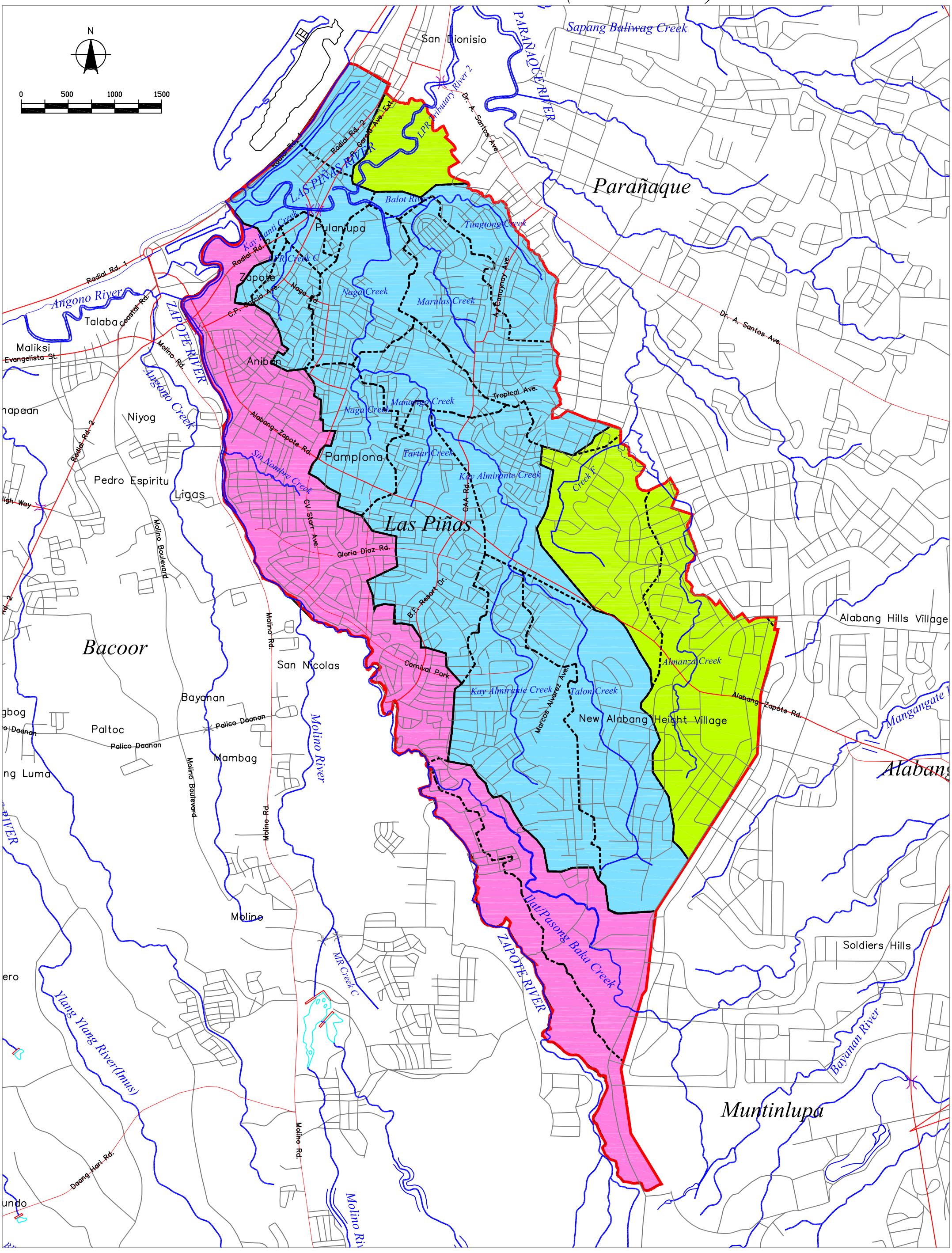
本調査結果は、対象地域だけではなく、東マニラ首都圏においても下水道改善計画の参考となり、将来的な開発および環境改善に寄与すると考えられる。

巻末資料

Appendix 1

Information and Data of River

RIVER CATCHMENT MAP (LAS PIÑAS)

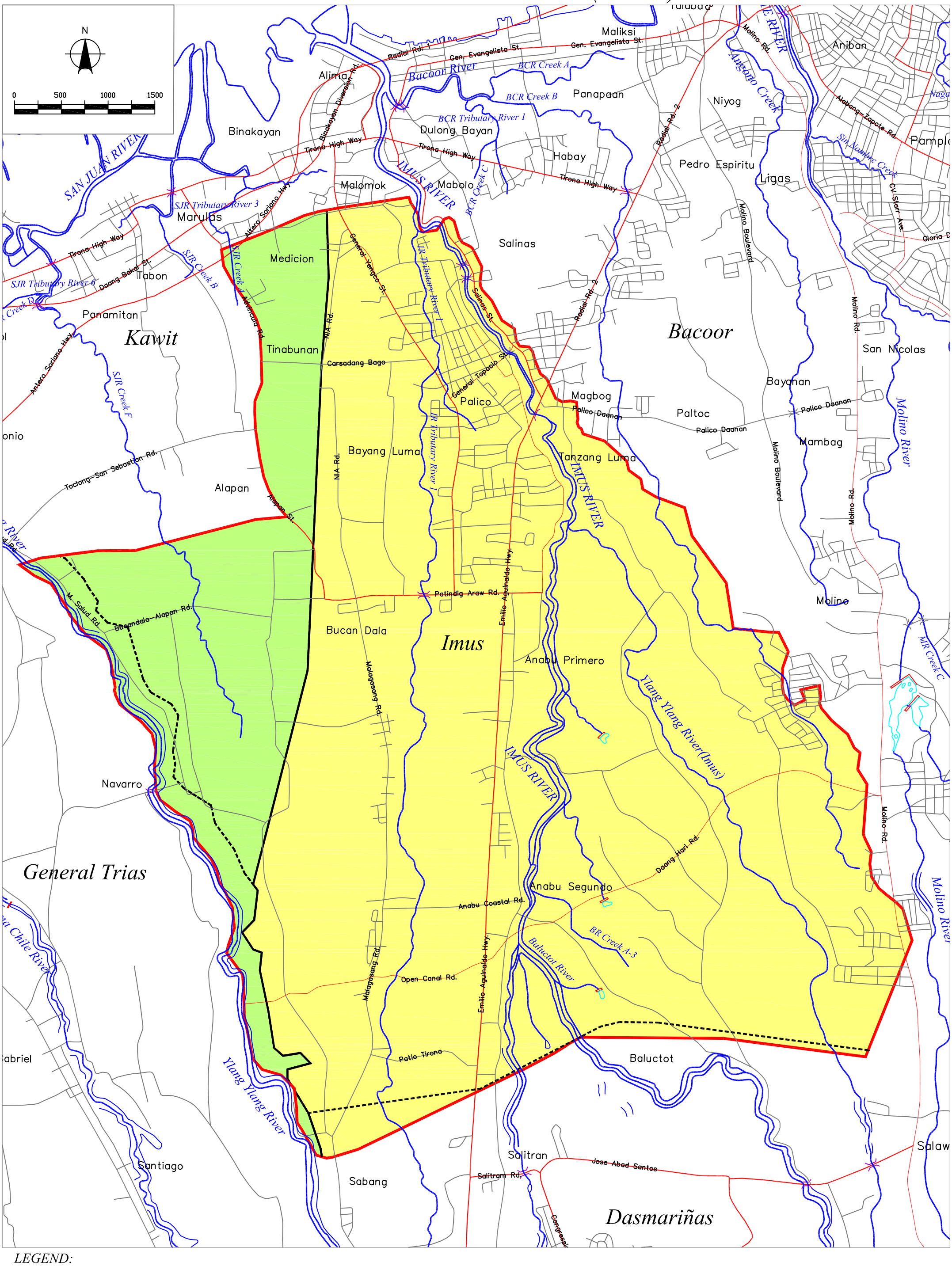


LEGEND:

- *Catchment of Las Piñas River & its Tributaries*
- *Catchment of Zapote River & its Tributaries*
- *Catchment of Parañaque River & its Tributaries*
- *City/Municipal Boundary*
- *Sub-Catchment Boundary*
- *Rivers/Creeks*
- *Major Roads*
- *Secondary Roads*

App1-1

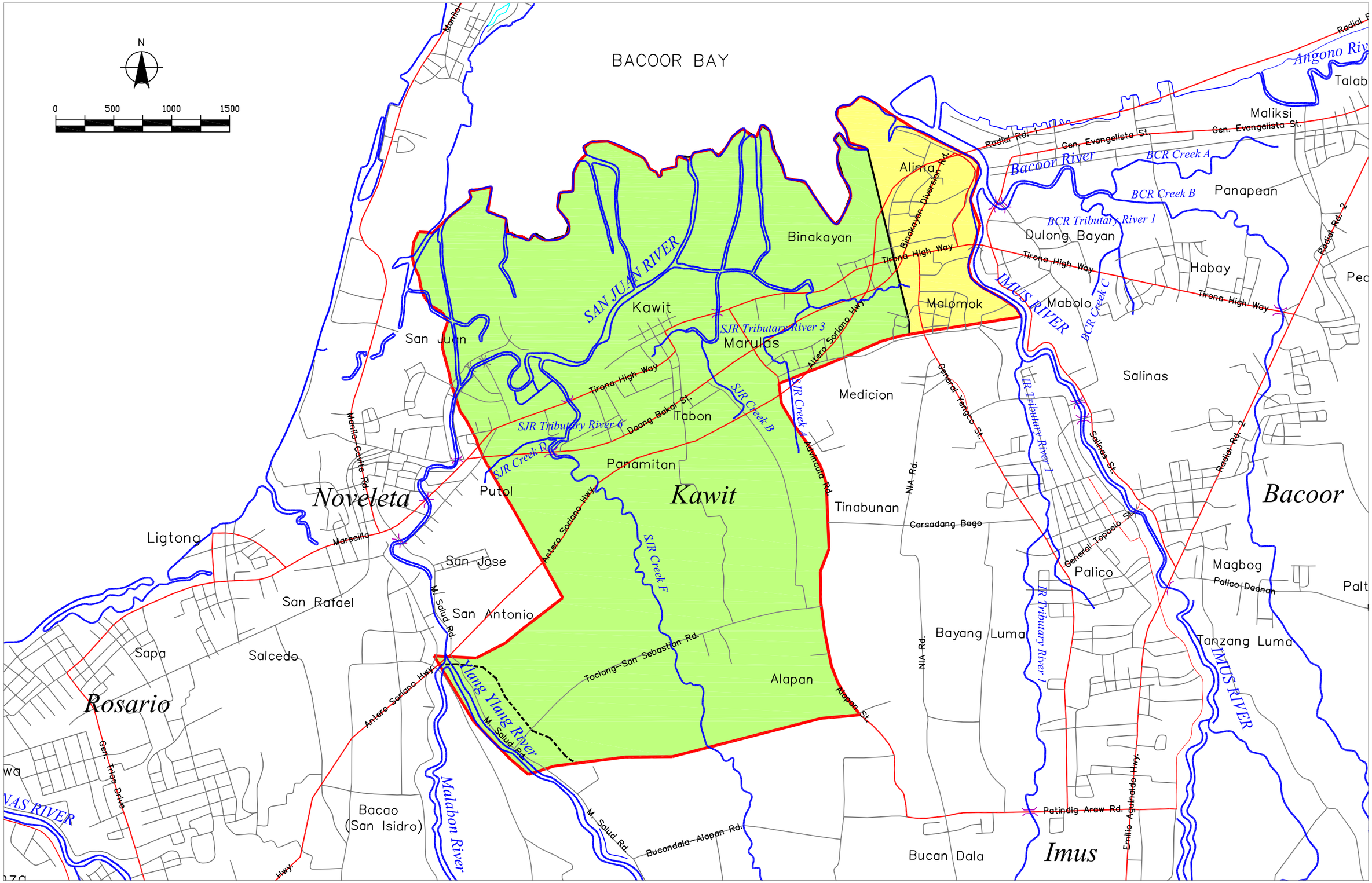
RIVER CATCHMENT MAP (IMUS)



LEGEND:

- *Catchment of Imus River & its Tributaries*
- *Catchment of San Juan River, Ylang-ylang River & its Tributaries*
- *City/Municipal Boundary*
- *Sub-Catchment Boundary*
- *Rivers/Creeks*
- *Major Roads*
- *Secondary Roads*

RIVER CATCHMENT MAP (KAWIT)



LEGEND:

- *Catchment of San Juan River, Ylang-ylang River & its Tributaries*
- *Catchment of Imus River & its Tributaries*
- *City/Municipal Boundary*
- *Sub-Catchment Boundary*
- *Rivers/Creeks*
- *Major Roads*
- *Secondary Roads*

City/Town: Las Pinas

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
Las Piñas River		2,297.90	52.40	5.29	LPR		
	LPR Tributary River 1 (Kay Kanti Creek)	305.75			C-LPR-TR-1	281822.85	1601221.58
	Creek C	1,092.28					
	LPR Tributary River 2	2,007.40			C-LPR-TR-2	282490.07	1601401.45
	LPR Tributary River 3 (Balot Creek)	569.64			C-LPR-TR-3	282822.36	1601204.27
	LPR Creek A (Tungtong Creek)	2,391.90			C-LPR-A	283321.49	1601220.91
	LPR Creek B (Marulas Creek)	2,013.84			C-LPR-A	283321.49	1601220.91
	LPR Creek B-1	252.03			C-LPR-A1	283155.77	1600991.24
	Naga Creek	2,410.40	18.31	2.15	C-LPR-TR-3	282822.36	1601204.27
	Manarigo Creek	1,293.78	10.83	3.48	C-LPR-B	282636.41	1599450.14
	LPR Creek D	856.47			C-LPR-B	282636.41	1599450.14
	Kay Almirante Creek	5,890.27			C-LPR-C	283385.51	1598970.54
	LPR-Creek H-1	366.50			C-LPR-D1	284100.60	1596655.10
	LPR Creek E (Tartar Creek)	1,391.43			C-LPR-C	283385.51	1598970.54
	Talon Creek	4,863.95			C-LPR-D	284238.99	1597360.48
	LPR Creek I	533.46			C-LPR-E	285218.93	1596507.10
	LPR Creek J	365.17			C-LPR-F	285167.66	1595968.36
Paranaque River	Creek F	1,347.52					
	Creek G (Almansa Creek)	4,408.82					
Zapote River		5,678.46	59.20	5.44	ZR		
	ZR Tributary River 1	254.50			C-ZR-TR-1	281354.96	1600958.06
	ZR Creek A	7,139.16			C-ZR-A	281063.26	1599313.19
	ZR Creek A-1	1,728.38			C-ZR-A1	281203.73	1596376.08
	ZR Creek A-2	560.27			C-ZR-A2	281143.29	1595241.21
	ZR Creek A-3	343.16			C-ZR-A3	281123.45	1594657.35
	ZR Creek B (Sin Nombre Creek)	1,135.96			C-ZR-B	281178.95	1598643.64
	ZR Creek C	1,490.93			C-ZR-C	281823.02	1597108.08
	Ilat Creek	7,146.92	25.23	0.81	C-IC	282024.10	1596964.33
	IC Creek A	562.14			C-IC-A	282686.68	1596557.24
	IC Creek B	5,010.25			C-IC-B	282987.49	1595405.23
	IC Creek B-1	869.37			C-IC-B1	283909.78	1592052.50
	IC Creek C	10,438.14			C-IC-C	283359.60	1595228.16
	IC Creek C-1	5,183.75			C-IC-C1	283860.61	1593579.83
	IC Creek C-1A	210.03			C-IC-C1A	284267.85	1592440.66
	IC Creek C-1B	1,212.13			C-IC-C1B	284637.77	1591615.92
	IC Creek C-2	2,419.29			C-IC-C2	285197.92	1591078.88
	IC Creek C-3	612.05			C-IC-C3	285329.24	1590869.16
	Molino River	12,643.11	18.82	2.11	C-MR	282024.10	1596964.33
	MR Creek A	1,224.36			C-MR-A	282062.20	1596565.45
	MR Creek B	1,058.98			C-MR-B	282130.40	1595317.68
	MR Creek C	3,295.48			C-MR-C	282355.56	1593551.49
	MR Creek C-1	200.72			C-MR-C1	282427.34	1593402.71
	MR Creek C-2	800.24			C-MR-C2	283097.88	1591739.03
	MR Creek D	579.25			C-MR-D	283143.04	1590704.46
	MR Creek E	1,189.20			C-MR-E	283388.91	1590434.19

City/Town: Las Pinas

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
	MR Creek F	578.17			C-MR-F	284076.55	1588774.15
	Salopan Creek	1,338.79	14.04	0.88	C-SC	284118.01	1588524.10
	SC Creek A	495.01			C-SC-A	283889.81	1587699.24

Notes:

C - Confluence
TR - Tributary River
LPR - Las Piñas River
AR - Angono River
ZR - Zapote River
MR - Molino River
SC - Salopan Creek

City/Town: Imus

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
Imus River		17,670.40	109.19	3.76	IR		
	IR Tributary River 1	1,669.48			C-IR-TR1	277062.09	1597610.86
	IR Creek A	11,845.50			C-IR-A	276899.37	1597530.98
	IR Creek A-1	141.85			C-IR-A1	276518.89	1594849.59
	IR Creek A-2	279.00			C-IR-A2	276344.99	1594407.32
	IR Creek A-2A	662.79			C-IR-A2A	276488.68	1594389.02
	IR Creek A-3	4,213.22			C-IR-A3	276171.02	1594184.15
	IR Creek A-3A	2,978.40			C-IR-A3A	275833.30	1595362.42
	IR Creek A-3B	895.61			C-IR-A3B	275755.83	1595335.61
	IR Creek A-3B1	3,884.06			C-IR-A3B1	275798.49	1594451.06
	IR Creek B	10,791.22			C-IR-B	277231.63	1596322.17
	IR Creek B-1	2,245.26			C-IR-B1	276983.32	1595395.32
	IR Creek B-2	1,463.74			C-IR-B2	276713.89	1594654.67
	IR Creek B-3	2,168.95			C-IR-B3	276685.42	1594598.07
	IR Creek B-4	996.85			C-IR-B4	276853.31	1593912.63
	IR Creek B-5	814.81			C-IR-B5	277069.59	1592172.97
	IR Creek B-5A	1,309.73			C-IR-B5A	277197.26	1592126.42
	IR Creek B-6	1,638.84			C-IR-B6	277023.99	1592101.68
	IR Creek B-7	2,214.24			C-IR-B7	276973.07	1590796.33
	IR Creek B-8	777.92			C-IR-B8	276978.39	1590250.40
	IR Creek B-8A	878.78			C-IR-B8A	277128.36	1590227.29
	IR Creek B-9	1,025.67			C-IR-B9	276967.26	1589835.36
	IR Creek B-9A	671.83			C-IR-B9A	276993.38	1589792.04
	IR Creek B-9B	768.91			C-IR-B9B	277022.32	1589714.04
	IR Creek B-9C	344.03			C-IR-B9C	277342.48	1589404.08
	IR Creek B-10	1,871.04			C-IR-B10	276796.67	1589652.06
	IR Creek B-11	1,866.84			C-IR-B11	276720.03	1588783.78
	IR Creek B-11A	673.17			C-IR-B11A	276828.83	1588420.57
	IR Creek B-11B	778.54			C-IR-B11B	277002.98	1588303.38
	IR Creek B-12	1,576.50			C-IR-B12	276697.65	1588529.33
	IR Creek B-12A	1,078.64			C-IR-B12A	276782.01	1588226.76
	IR Creek B-12B	469.43			C-IR-B12B	277012.20	1587586.71
	IR Creek B-13	1,467.15			C-IR-B13	276687.52	1588431.71
	IR Creek C	360.96			C-IR-C	277261.10	1597531.58
	IR Creek D	6,786.63			C-IR-D	278358.13	1593694.52
	IR Creek D-1	711.77			C-IR-D1	278021.87	1592971.09
	IR Creek D-2	1,781.72			C-IR-D2	278017.61	1590210.63
	IR Creek D-3	1,041.77			C-IR-D3	277894.65	1588799.42
	IR Creek D-4	1,714.44			C-IR-D4	277873.55	1588237.27
	IR Creek D-4A	627.59			C-IR-D4A	277652.98	1588432.06
	IR Creek D-4B	190.14			C-IR-D4B	277269.63	1588670.66
	IR Creek D-5	775.37			C-IR-D5	277626.36	1587951.11
	IR Creek D-6	298.78			C-IR-D6	277486.27	1587698.67
	IR Creek D-6A	315.68			C-IR-D6A	277593.42	1587624.18
	IR Creek E	450.76			C-IR-E	278432.89	1593400.46
	IR Creek F	2,592.66			C-IR-F	278399.67	1593160.25
	IR Creek G	382.57			C-IR-G	278576.57	1592688.84
	IR Creek H	732.69			C-IR-H	278573.30	1592652.11
	IR Creek I	1,301.56			C-IR-I	278281.83	1591956.82
	IR Creek J	947.55			C-IR-J	278591.42	1591510.34
	IR Creek K	1,328.06			C-IR-K	278544.44	1591408.83
	IR Creek K-1	1,063.67			C-IR-K1	278556.37	1591336.65

City/Town: Imus

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
	IR Creek L	2,596.53			C-IR-L	278274.44	1591061.59
	IR Creek L-1	771.10			C-IR-L1	278292.33	1591045.82
	IR Creek L-1A	784.40			C-IR-L1A	278515.98	1591031.13
	IR Creek L-1B	480.92			C-IR-L1B	278779.46	1590531.12
	IR Creek M	2,787.53			C-IR-M	278053.39	1589151.08
	IR Creek M-1	1,174.54			C-IR-M1	278387.07	1589081.98
	IR Creek N	1,430.27			C-IR-N	278093.54	1588580.63
	IR Creek N-1	93.45			C-IR-N1	277931.83	1588176.82
	IR Creek N-2	37.93			C-IR-N1	278079.65	1587397.53
	IR Creek O	1,522.70			C-IR-O	278128.07	1588527.64
	IR Creek O-1	1,469.60			C-IR-O1	278128.07	1588527.64
	IR Creek O-1A	547.99			C-IR-O1A	278208.71	1588709.98
	IR Creek P	947.58			C-IR-P	278091.30	1588365.30
	IR Creek Q	388.00			C-IR-Q	278189.24	1587543.38
	Ylang-ylang River	9,813.26	16.89	1.36	C-YR	278642.15	1594481.75
	YR Creek A	1,182.89			C-YR-A	278699.14	1594329.31
	YR Creek A-1	408.80			C-YR-A1	278682.98	1594223.95
	YR Creek A-2	297.67			C-YR-A2	278614.01	1593966.34
	YR Creek A-2A	525.28			C-YR-A2A	278804.33	1593973.14
	YR Creek A-3	716.67			C-YR-A3	278587.61	1593643.72
	YR Creek A-3A	923.96			C-YR-A3A	278737.33	1593636.32
	YR Creek A-3B	6,667.58			C-YR-A3B	278939.48	1593462.02
	YR Creek A-3B1	625.69			C-YR-A3B1	279704.07	1591390.99
	YR Creek A-3B2	1,139.06			C-YR-A3B2	280271.55	1590987.50
	YR Creek A-3B3	1,139.48			C-YR-A3B3	280111.77	1589426.59
	YR Creek B	5,181.74			C-YR-B	279459.35	1593474.21
	YR Creek B-1	910.20			C-YR-B1	279458.03	1593994.34
	YR Creek B-2	5,609.70			C-YR-B2	279587.13	1594378.76
	YR Creek B-2A	1,110.21			C-YR-B2A	279711.94	1594371.56
	YR Creek B-2B	4,171.70			C-YR-B2B	280075.27	1593383.21
	YR Creek B-3	842.88			C-YR-B3	279563.41	1594695.98
	YR Creek B-4	3,225.60			C-YR-B4	279571.01	1594697.38
	YR Creek B-5	383.99			C-YR-B5	279795.21	1594998.20
	YR Creek B-6	3,373.41			C-YR-B6	280857.54	1594664.68
	YR Creek B-7	1,178.44			C-YR-B7	280909.14	1594449.56
	YR Creek B-8	1,224.00			C-YR-B8	281009.58	1594209.25
	YR Creek B-9	1,381.48			C-YR-B9	281658.06	1593902.76
	YR Creek C	2,372.52			C-YR-C	279516.27	1593419.32
	YR Creek C-1	3,661.11			C-YR-C1	279977.93	1592752.05
	YR Creek C-1A	1,016.97			C-YR-C1A	280500.94	1591876.13
	YR Creek D	2,933.92			C-YR-D	280497.81	1590779.88
	YR Creek D-1	890.98			C-YR-D1	280374.37	1589601.37
	YR Creek E	2,053.78			C-YR-E	281379.15	1589721.70
	YR Creek E-1	481.10			C-YR-E1	281721.96	1589312.48
	Baluctot River	5,602.38	17.04	4.18	C-BR	278096.26	1589946.33
	BR Creek A	2,084.36			C-BR-A	278485.76	1589483.97
	BR Creek A-1	543.76			C-BR-A1	278716.41	1589454.64
	BR Creek A-2	321.33			C-BR-A2	278712.83	1589664.74
	BR Creek A-3	729.76			C-BR-A3	278644.71	1590051.11
	BR Creek A-3A	1,019.13			C-BR-A3A	278857.80	1589754.33
	BR Creek B	996.72			C-BR-B	278522.73	1589406.80
	BR Creek C	1,925.97			C-BR-C	278796.07	1588831.71
	BR Creek C-1	510.36			C-BR-C1	278927.41	1588337.84

City/Town: Imus

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
	BR Creek C-2	946.10			C-BR-C2	279301.64	1587844.63
	BR Creek C-3	285.39			C-BR-C3	279370.14	1587478.66
	BR Creek C-4	95.99			C-BR-C4	279388.19	1587414.46
	BR Creek D	1,492.36			C-BR-D	279863.91	1588385.78
	BR Creek D-1	766.78			C-BR-D1	280337.80	1587868.02

Notes:

C - Confluence
TR - Tributary River
IR - Imus River
BCR - Bacoor River
YR - Ylang-ylang River
BR - Baluctot River

City/Town: Kawit

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
San Juan River		4,410.37	60.00	9.66	SJR		
	SJR Tributary River 1	589.71			C-SJR-TR1	274716.59	1598364.10
	SJR Tributary River 2	758.11			C-SJR-TR2	274443.82	1598382.84
	SJR Tributary River 3	2,173.33			C-SJR-TR3	274434.53	1598339.70
	SJR Tributary River 4	741.20			C-SJR-TR4	274050.40	1598404.73
	SJR Tributary River 5	996.04			C-SJR-TR5	273617.80	1598171.61
	SJR Tributary River 6	1,901.05			C-SJR-TR6	272865.05	1597612.93
	SJR Creek A	1,413.26			C-SJR-A	275216.88	1598252.28
	SJR Creek B	10,504.80			C-SJR-B	274310.46	1597774.04
	SJR Creek B-1	1,713.38			C-SJR-B1	274614.79	1597211.82
	SJR Creek B-2	723.03			C-SJR-B2	274650.44	1595730.13
	SJR Creek B-3	245.06			C-SJR-B3	274652.07	1595701.14
	SJR Creek B-4	518.17			C-SJR-B4	275049.47	1594620.57
	SJR Creek B-5	1,144.30			C-SJR-B5	275444.62	1594124.75
	SJR Creek B-6	1,148.25			C-SJR-B6	275464.77	1593150.29
	SJR Creek B-7	658.18			C-SJR-B7	275501.83	1592819.28
	SJR Creek B-8	636.66			C-SJR-B8	275501.29	1592563.77
	SJR Creek B-9	3,058.70			C-SJR-B9	275607.97	1591667.09
	SJR Creek B-9A	926.50			C-SJR-B9A	275815.04	1591253.73
	SJR Creek B-9B	682.09			C-SJR-B9B	275756.73	1590510.39
	SJR Creek B-10	755.18			C-SJR-B10	275391.78	1591280.36
	SJR Creek B-11	557.15			C-SJR-B11	275323.06	1591221.99
	SJR Creek B-12	478.92			C-SJR-B12	275325.22	1591088.93
	SJR Creek B-12A	247.02			C-SJR-B12A	275128.26	1591049.24
	SJR Creek B-13	901.45			C-SJR-B13	275400.50	1590506.11
	SJR Creek B-13A	752.18			C-SJR-B13A	275268.45	1590483.63
	SJR Creek B-14	413.93			C-SJR-B14	275571.76	1589758.04
	SJR Creek B-15	529.08			C-SJR-B15	275628.39	1589419.31
	SJR Creek B-16	576.49			C-SJR-B16	275719.40	1589206.06
	SJR Creek B-16A	2,427.33			C-SJR-B16A	275360.92	1589203.10
	SJR Creek C	3,754.89			C-SJR-C	273768.73	1597296.59
	SJR Creek C-1	375.94			C-SJR-C1	273668.96	1596962.50
	SJR Creek C-2	1,331.35			C-SJR-C2	274061.57	1596498.68
	SJR Creek C-3	1,466.78			C-SJR-C3	274466.95	1595359.42
	SJR Creek C-4	428.88			C-SJR-C4	274710.32	1594848.28
	SJR Creek D	1,123.71			C-SJR-D	272937.00	1596841.74
	SJR Creek D-1	198.65			C-SJR-D1	272638.25	1596856.50
	SJR Creek D-2	812.16			C-SJR-D2	272554.58	1596751.89
	SJR Creek D-3	615.62			C-SJR-D3	272308.15	1596540.08
	SJR Creek E	4,257.58			C-SJR-E	272943.37	1596762.89
	SJR Creek E-1	2,310.00			C-SJR-E1	273003.00	1596330.17
	SJR Creek E-1A	299.30			C-SJR-E1A	273567.49	1594869.69
	SJR Creek E-2	1,357.53			C-SJR-E2	272757.62	1596053.26
	SJR Creek E-2A	118.31			C-SJR-E2A	272380.91	1595960.85
	SJR Creek E-2B	291.16			C-SJR-E2B	272450.97	1595728.00
	SJR Creek E-2C	90.70			C-SJR-E2C	272194.95	1595634.33
	SJR Creek E-2D	477.35			C-SJR-E2D	272283.51	1595373.22
	SJR Creek E-3	1,183.38			C-SJR-E3	272892.09	1595718.14
	SJR Creek E-4	2,030.45			C-SJR-E4	272774.09	1595419.82
	SJR Creek E-4A	307.03			C-SJR-E3A	272635.60	1595332.31
	SJR Creek E-4B	288.64			C-SJR-E3B	272511.92	1595302.61

City/Town: Kawit

RIVER INFORMATION							
Main River	Tributary River/Waterway	Length (m)	Width (m)		Confluence		
			Max.	Min.	ID	N	E
	SJR Creek E-4C	501.00			C-SJR-E3C	272319.70	1594956.09
	SJR Creek E-4C1	236.51			C-SJR-E3C1	272708.15	1595053.00
	SJR Creek E-5	752.24			C-SJR-E5	272883.78	1595319.02
	SJR Creek E-6	333.52			C-SJR-E6	273284.99	1594634.78
	SJR Creek E-6A	728.11			C-SJR-E6A	273171.62	1594521.27
	SJR Creek E-6B	869.27			C-SJR-E6B	273089.55	1594436.57
	SJR Creek E-7	798.75			C-SJR-E7	273780.95	1593720.92
	SJR Creek E-7A	968.02			C-SJR-E7A	273635.77	1593637.62
	SJR Creek E-7B	1,295.14			C-SJR-E7B	273678.30	1593227.09
	SJR Creek F	7,463.07			C-SJR-F	273326.61	1596529.29
	SJR Creek F-1	762.40			C-SJR-F1	273414.30	1596401.38
	SJR Creek F-1A	216.30			C-SJR-F1A	273242.05	1596275.76
	SJR Creek F-2	1,543.28			C-SJR-F2	273539.14	1596359.38
	SJR Creek F-3	1,416.41			C-SJR-F3	274110.85	1594454.76
	SJR Creek F-3A	371.49			C-SJR-F4	274091.63	1594427.56
	SJR Creek F-4	3,470.14			C-SJR-F5	274476.82	1594074.54
	SJR Creek F-4A	1,423.87			C-SJR-F5A	274629.20	1591631.38
	SJR Creek F-5	706.94			C-SJR-F6	274655.79	1593777.02
	SJR Creek F-6	727.06			C-SJR-F7	274826.95	1592811.88
	SJR Creek F-7	1,145.50			C-SJR-F8	275096.13	1592262.61
	SJR Creek F-8	1,117.73			C-SJR-F9	275097.44	1592149.54
	SJR Creek F-9	480.34			C-SJR-F10	275102.76	1592000.87
	Ylang-ylang River	14,859.41	40.76	1.48	C-YYR	272136.09	1597373.00
	YYR Creek A	1,196.79			C-YYR-A	273399.68	1593257.10
	YYR Creek A-1	397.22			C-YYR-A1	273349.74	1592946.58
	YYR Creek A-2	1,516.27			C-YYR-A2	273345.05	1592913.18
	YYR Creek A-3	167.68			C-YYR-A3	273354.47	1592734.07
	YYR Creek B	853.85			C-YYR-B	273698.92	1593098.99
	YYR Creek C	1,232.05			C-YYR-C	275440.16	1588501.09

Notes:

C - Confluence
TR - Tributary River
SJR - San Juan River
YYR - Ylang-ylang River

River Mouth Info (Las Pinas River)

Site Location

Site Photos

IMG_4294

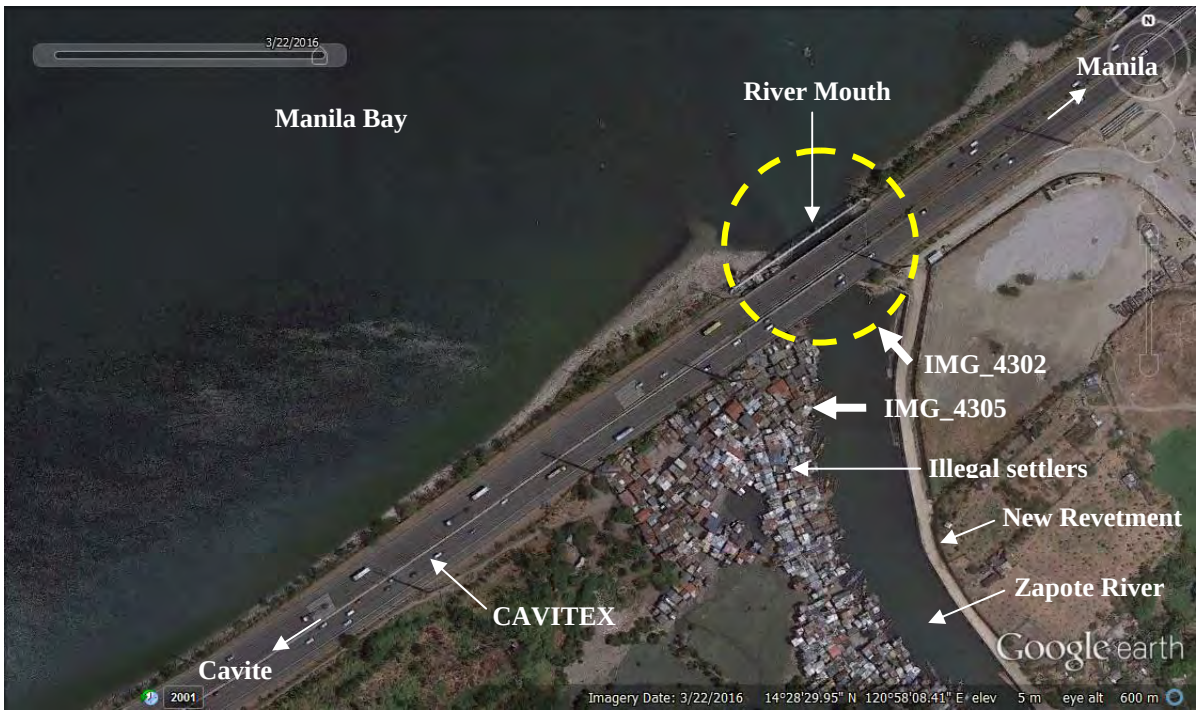
IMG_4300

Site Condition

1. Coordinates: N 14-28-34.7 E 120-58-19.4
2. On-going DPWH bridge construction beside CAVITEX bridge.
3. Temporary access road upstream of CAVITEX bridge for bridge construction use.
4. Small boats dock under the bridge.
5. New concrete revetment wall along the left bank of the river
6. Presence of mangrove trees along the right bank of the river.
7. Floating trash and dark color of water was observed near the river mouth.
8. Approximately 50m wide river mouth opening under the bridge.
9. River mouth location can be accessed from Quirino Avenue through Carlos P. Garcia Avenue Extension

River Mouth Info (Zapote River)

Site Location



Site Photos

IMG_4302

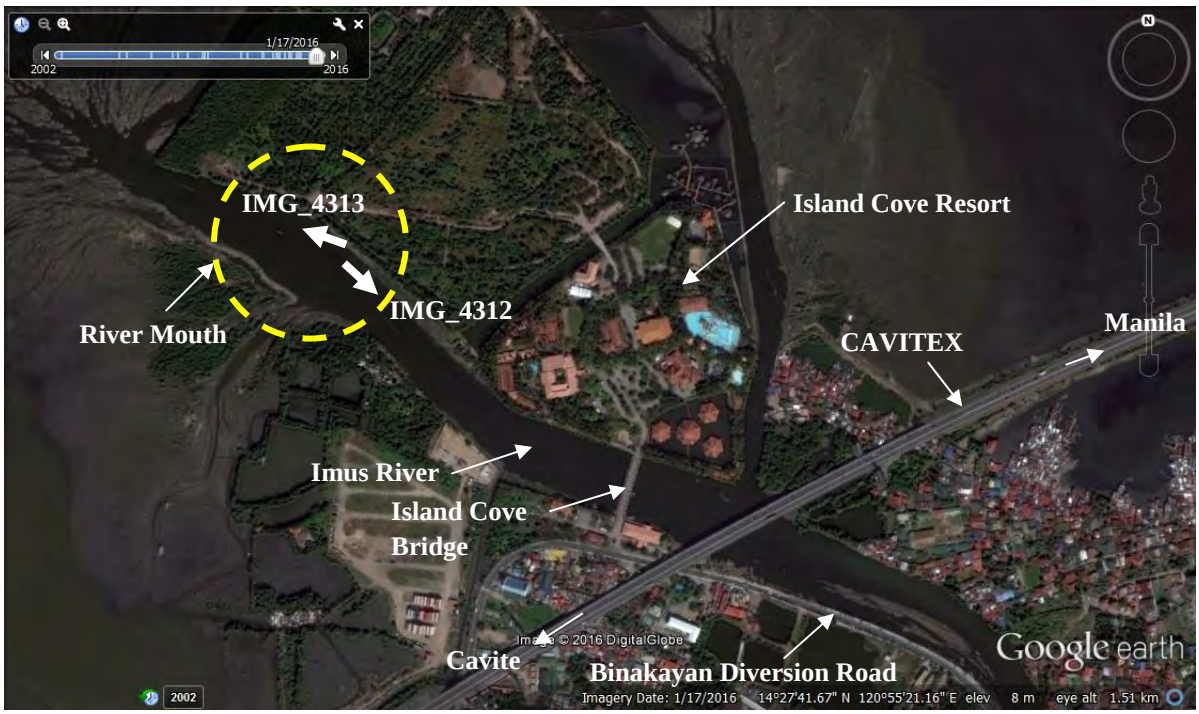
IMG_4305

Site Condition

1. Coordinates: N 14-28-29.5 E 120-58-14.2
2. Presence of illegal settlers along the left river bank near the river mouth.
3. Floating trash and dark color of water were observed near the river mouth.
4. On-going construction of revetment wall and concrete access road along the right river bank under DPWH.
5. River mouth location can be accessed from Quirino Avenue through Carlos P. Garcia Avenue Extension

River Mouth Info (Imus River)

Site Location



Site Photos

IMG_4313

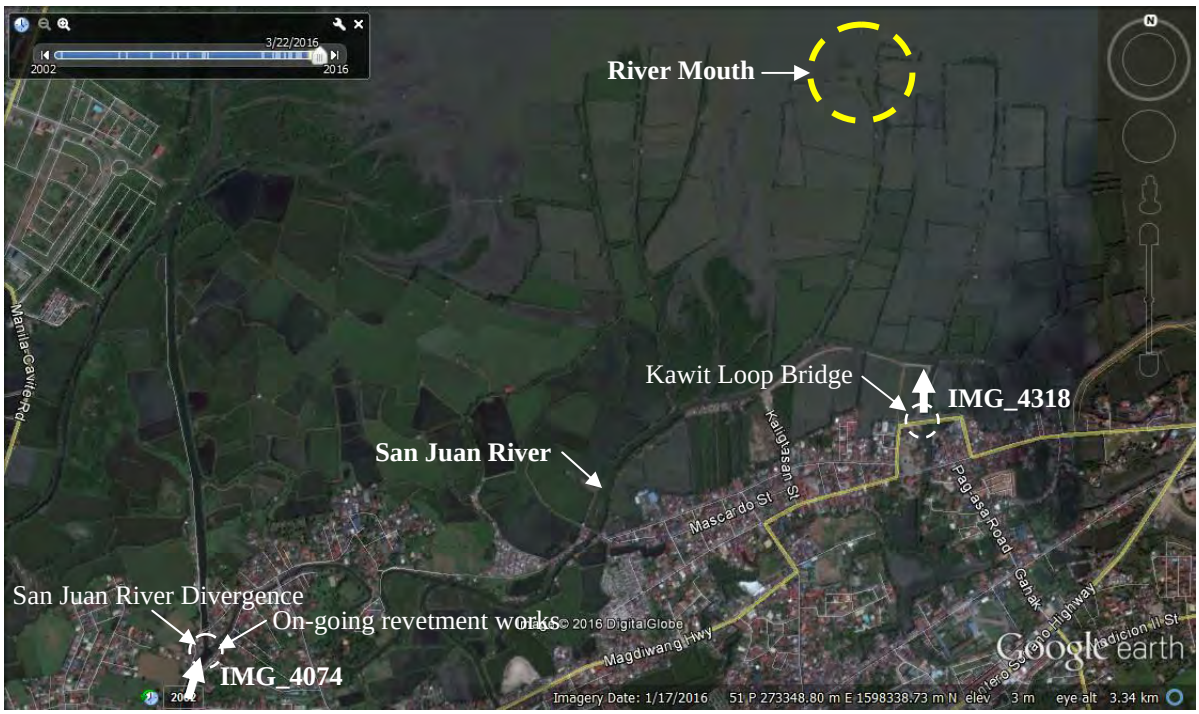
IMG_4312

Site Condition

1. Coordinates: N 14-27-47.7 E 120-55-8.7
2. Floating trash and murky water was observed near the river mouth.
3. Water with foul odor.
4. River mouth location can be accessed from Binakayan diversion road through the Island Cove resort bridge and road network.

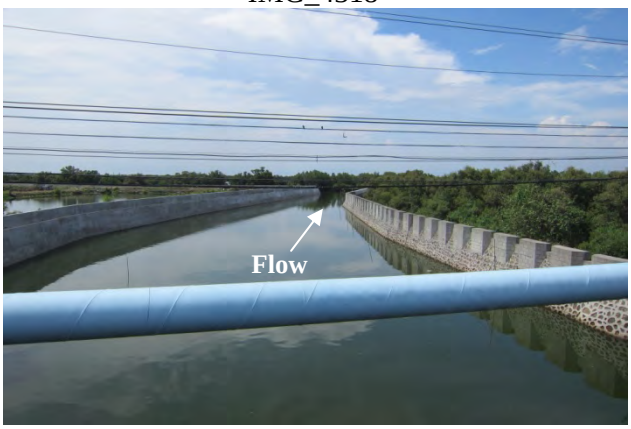
River Mouth Info (San Juan River)

Site Location



Site Photos

IMG_4318



IMG_4074

Site Condition

1. Kawit Loop Bridge, Coordinates: N 14-26-48.90 E 120-54-26.00
    a) Dark color of water
    b) Stagnant water
    c) Both banks with revetment protection
    d) Mangrove trees located at the downstream end of revetment

2. San Juan River Divergence, Coordinates: N 14-26-21.21 E 120-53-9.85
    a) Dark color of water
    b) Stagnant water
    c) On-going construction of revetment on the right river branch
    d) Houses built beside riverbanks

Appendix 2

Existing STP Effluent Data

EFFLUENT

CAS

ASTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	4	4	2	1	2	1	7	4	3	4	<1	6
Chemical Oxygen Demand, mg/L	9.5	30	9.7	19	29	20	11	10	10	12	<5	24
Total Suspended Solids, mg/L	6	22	16	15	27	21	9	16	6	11	10	6
Oil and Grease, mg/L	0.7	1.1	0.5	0.6	1.4	0.5	1	<1	<1	1.3	<1	1.2
Total Coliform, MPN/100mL	4.5	1100	9200	33	460	5400	5400	2	5400	540	4.5	< 1.8

TYSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L				<1	8	3	1	3	<1	5	<1	<1
Chemical Oxygen Demand, mg/L				39	20	20	10	9.7	<2	12	16	28
Total Suspended Solids, mg/L				16	15	16	5	6	5.5	13	3.5	<2.5
Oil and Grease, mg/L				1	0.4	0.7	0.4	0.4	0.5	0.3	<0.3	0.8
Total Coliform, MPN/100mL				110	1600	49	<1.8	4.5	13	2	<1.8	<1.8

BTSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	19	16	10	45	13	29	21	20	2	9	13	
Chemical Oxygen Demand, mg/L	59	78	72	83	47	49	52	32	46	24	37	
Total Suspended Solids, mg/L	12	20	9	11	8	5	13	14	15	5	8	
Oil and Grease, mg/L	2.1	3.2	2.8	2.8	1.5	1.5	2.1	2.5	2.2	4.9	<1.5	
Total Coliform, MPN/100mL	7.8	1600	1.8	1.8	1600	1.8	350	<1.8	<1.8	<1.8	<1.8	

STM

BSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	13	6	9	3	4	6	7	21	18	14	14	7
Chemical Oxygen Demand, mg/L	29	50	87	39	10	30	17	43	40	44	48	27
Total Suspended Solids, mg/L	17	22	45	35	22	27	9	66	27	12	25	3
Oil and Grease, mg/L	0.9	1	0.7	0.9	1.2	0.7	1	1.1	<1	<1	<1	3
Total Coliform, MPN/100mL	920	23	240	5400	350	2400	140	79	<1.8	170	<1.8	<1.8

TSSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L		<1	2	<1	16	2	5	<1	10	15	6	7
Chemical Oxygen Demand, mg/L		15	19	4.9	32	9.9	17	<5	20	34	26	24
Total Suspended Solids, mg/L		14	18	9	13	15	15	4	10	2	9	16
Oil and Grease, mg/L		0.6	0.6	0.6	0.4	0.7	1	<1	<1	<1	<1	4.1
Total Coliform, MPN/100mL		<1.8	79	<1.8	<1.8	13	2	7.8	<1.8	<1.8	<1.8	<1.8

SSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	<1	9	9	2	<1	1	<1	4	2	2	<1	<1
Chemical Oxygen Demand, mg/L	34	40	20	40	30	10	10	10	10	29	30	<7
Total Suspended Solids, mg/L	10	7	12	<5	<5	5	<5	5	<5	<5	<5	<5
Oil and Grease, mg/L	0.6	2.4	<1	<1	<1	1	<1	<1	<1	<1	<1	<1
Total Coliform, MPN/100mL	33	<1.8	1.8	<1.8	<1.8	1.8	<1.8	7900	130	<1.8	<1.8	<1.8

SBR

Proj 7 STP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	12	<1	2	7	8	1	<1	10	18	7	7	8
Chemical Oxygen Demand, mg/L	20	20	9.7	9.8	29	20	<5	32	45	20	14	15
Total Suspended Solids, mg/L	11	5	5	7	5	7	16	11	1	3	1	2
Oil and Grease, mg/L	0.5	0.9	0.7	0.8	0.6	0.5	<1	<1	<1	<1	<1	1.2
Total Coliform, MPN/100mL	<1.8	1600	<1.8	6.8	2	1.8	1600	110	<1.8	49	47	2

CSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	2	3	1	1	1	2	6	<1	<1	5	4	4
Chemical Oxygen Demand, mg/L	15	9.7	19	9.7	5	5	17	<5	<5	10	8	8
Total Suspended Solids, mg/L	5	15	3.5	4.5	8	6	5	9	2	3	2	5
Oil and Grease, mg/L	0.4	0.7	0.6	1.2	1.5	0.4	<1.0	<1	<1	<1	<1	2.3
Total Coliform, MPN/100mL	240	33	<1.8	240	540	1.8	<1.8	2	<1.8	2	5	540

TTSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	<1	2	8	2	3	1	6	<1	6	11	3	<1
Chemical Oxygen Demand, mg/L	19	47	42	9.8	9.7	20	15	<5	15	20	10	<5
Total Suspended Solids, mg/L	<0.1	29	44	16	8.5	13	30	9	5	1	1	1
Oil and Grease, mg/L	0.7	0.8	0.9	0.5	0.4	0.7	<1.0	<1	<1	<1	<1	<1
Total Coliform, MPN/100mL	<1.8	33	240	2	23	1.8	920	<1.8	<1.8	9200	540	<1.8

BGSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	1	5	13	1	1	1	<1	<1	<1	2	<1	4
Chemical Oxygen Demand, mg/L	10	20	20	10	20	7	19	<7	<7	10	<7	11
Total Suspended Solids, mg/L	6.5	3	<5	<5	5	5	<5	<5	<5	<5	<5	3
Oil and Grease, mg/L	1	<0.1	<1	<1	1	1	<1	<1	<1	<1	<1	<1
Total Coliform, MPN/100mL	<1.8	<1.8	<1.8	<1.8	1.8	1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

LSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	6	<1	7	2	4	2	6	<1	9	7	6	4
Chemical Oxygen Demand, mg/L	20	10	9.8	19	29	20	12	<5	20	24	10	6
Total Suspended Solids, mg/L	15	8	6	5	27	4	5	2	4	3	6	5
Oil and Grease, mg/L	0.6	0.7	0.5	0.6	0.5	0.4	1	<1	<1	<1	<1	<1
Total Coliform, MPN/100mL	<1.8	<1.8	1.8	2	2	1.8	4.5	2	<1.8	<1.8	<1.8	<1.8

GSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	2	<1	6	3	3	3	4	<1	6	<1	6	<1
Chemical Oxygen Demand, mg/L	9.8	30	9.8	9.7	20	9.9	7	<5	10	<5	12	<5
Total Suspended Solids, mg/L	9	4	7	5	10	5	3	3	1	2	1	1
Oil and Grease, mg/L	0.6	0.7	0.5	0.6	0.4	0.4	1	<1	<1	<1	<1	<1
Total Coliform, MPN/100mL	2	170	49	<1.8	920	13	1.8	<1.8	<1.8	4.5	<1.8	2

MBBR

SASTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	6	3	7	3	4	7	<1	6	16	8	2	5
Chemical Oxygen Demand, mg/L	20	30	39	30	29	20	<5	17	30	29	16	10
Total Suspended Solids, mg/L	14	17	9	16	14	24	12	5	5	7	5	5
Oil and Grease, mg/L	0.9	1.3	0.7	0.8	0.6	0.8	<1	<1	<1	1.1	<1	<1
Total Coliform, MPN/100mL	9200	79	79	280	33	1700	79	79	70	79	49	79

DMSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	8	4	4	5	3			7	9	11	3	4
Chemical Oxygen Demand, mg/L	29	9.7	20	30	29			11	30	29	6	9
Total Suspended Solids, mg/L	9	10	7.5	12	9			4	3	3	3	2
Oil and Grease, mg/L	0.5	0.8	0.5	0.6	0.4			<1	<1	1.3	<1	1.1
Total Coliform, MPN/100mL	33	9200	220	94	33			4.5	130	33	22	170

PSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	8	1	5	11	4	4	7	9	16	<1	12	<1
Chemical Oxygen Demand, mg/L	19	20	48	19	9.7	19	12	20	30	<5	25	<5
Total Suspended Solids, mg/L	11	15	6	4	14	6	7	18	4	11	21	25
Oil and Grease, mg/L	0.4	0.8	0.7	0.7	0.7	0.8	<1	1	2	<1	<1	<1
Total Coliform, MPN/100mL	2400	2	17	49	1,700	33	9200	33	540	49	1600	<1.8

PKSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	20	2	2	6	9	1	<1	5	9	9	<1	5
Chemical Oxygen Demand, mg/L	38	36	19	20	46	9.9	<5	14	15	27	<5	9
Total Suspended Solids, mg/L	<3	8	3.5	7	5	8	6	4	2	4	1	2
Oil and Grease, mg/L	<1.5	0.7	0.9	0.5	0.4	0.5	<1	<1	<1	1.3	<1	<1
Total Coliform, MPN/100mL	<1.8	31	46	11	13	6.8	79	110	79	2	7.8	4.5

KSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L					<1	3	1	<1	2	4	2	1
Chemical Oxygen Demand, mg/L					20	20	10	20	19	19	10	56
Total Suspended Solids, mg/L					<5	16	10	26	14	27	12	10
Oil and Grease, mg/L					<1	0.7	<1	<1	<1	<1	<1	1
Total Coliform, MPN/100mL					<1.8	49	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

Waste stabilization pond

DDSTP	2015											
Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Biochemical Oxygen Demand, mg/L	5	6	5	10	25	6	7	9	<1	9	5	5
Chemical Oxygen Demand, mg/L	48	39	40	29	46	46	17	21	<5	20	29	8
Total Suspended Solids, mg/L	15	20	9	17	11	28	13	13	11	10	11	6
Oil and Grease, mg/L	0.7	1.3	0.8	1.2	2	1.3	1.1	1.2	2.2	1.2	1.1	<1
Total Coliform, MPN/100mL	1600	3500	920	540	540	540	79	920	130	9200	49	5400

Appendix 3

Company Interview on Sewerage Technologies and Business Activities

Appendix 3 Company Interview on Sewerage Technologies and Business Activities

The interviews has been conducted with the companies who have several water and sewer related technologies as well as more than 10 companies includes Japanese companies who have active business operations in the Philippines and other Southeast Asian nations.

1. Status of the Philippines Market Entry of Japanese Companies and their Activities (Table A3.1 and Table A3.2)

- The number of companies who have already received orders from local companies (Maynilad, Manila Water Inc., etc.,) is still small. (4 companies)
- Company A has successfully won a lot of projects for wastewater treatment plants and sludge treatment plants relating to the sewerage business of Maynilad who has utilized 2 STEP loans provided by JICA. However, this greatly results from the company's efforts to shorten the construction period and lower the price by taking good advantage of its experience of working in the Philippines in other fields in the past, not because of leveraging the Japanese schemes.
- JICA verification project for Company B's sludge dehydration machine in Cebu city is the only case where effective business promotion was carried out using an ODA scheme and presenting the advantages of its own products.
- At the sewerage technologies seminar cosponsored by JICA and LWUA in July, 2015, many Japanese companies had opportunities to make presentations to local people who involves in the sewerage business from DPWH, LWUA, local governments, Maynilad and other companies. Before the seminar, each company had a chance individually to present to local companies, it was an effective initiative to introduce Japanese high level technologies to those local people concerned.

Table A3.1 Japanese companies' activities and past records in Metro Manila

No.	Company Name	Description
(1)	The companies who have received orders from local water and sewer service companies	
1	Company A	• already received a lot of orders, for example Maynilad Paranaque wastewater treatment plant (76,000m^3/day in 2014). (28 places in total as of July, 2015.) • entered the market from a small size wastewater treatment plant project operated by MWSS back then. • received the first order from Manila Water Company Inc., in 2006. • received the first order from Maynilad Water Service Inc., in 2013. • presented on the general matters regarding sewerage and sludge treatment plants at the sewerage technologies seminar cosponsored by JICA/LWUA (hereinafter reoffered to as "JICA seminar") where Maynilad also joined (July 2015).

No.	Company Name	Description
2	Company B	• already delivered 3 sludge dehydrators for Maynilad Project-7 wastewater treatment plant. (2011) • will deliver 1 machine (demonstration experiment) for Manila Water San Mateo wastewater treatment plant. • presented on the sludge dehydrator at the JICA seminar. (July, 2015)
3	Company C	• received an order for a septic tank (Maynilad community domestic wastewater treatment, 410 m3 /day, however, it has stopped the business activities as it cannot expect new orders. • performed a demonstration experiment of the sludge dehydrator at a Maynilad facility together with other country's technology and received the best evaluation, however, it failed in the bidding. • delivered several MBR membrane units for mainly industrial wastewater treatment. (it has delivered pumps for rainwater drainage, service water and irrigation, besides for sewers.) • presented on the effluent treatment technology using MBR membrane at the Philippines Infrastructure Seminar (organized by METI, Feb, 2015).
4	Company D	• delivered 3 thrusters about 20 years ago. • made a presentation to assigned employees from Marubeni to Maynilad. • made a presentation to Manila Water twice but not yet to the top management. • considering to perform a verification test of the long-distance thrusting method in the Manilad zone.
(2) The companies who have received orders from other local companies.		
5	Company E	• received an order for an aerator from a Japanese chemicals plant. (1998) • presented on the aerator at the JICA seminar (July, 2015)
6	Company F	• delivered equipment for non-sewerage usage. (2009 and 2012)
(3) The companies who have presented to local companies at a local seminar.		
7	Company G	• presented on PTF method at the JICA seminar (July, 2015)
8	Company H	• presented on MBR at the JICA seminar (July, 2015)
9	Company I	• presented on the power generation technology using methane fermentation at the JICA seminar (July, 2015)
(4) The companies who have joined a local exhibition.		
10	Company J	• joined the exhibition, Water Philippines in Metro Manila to introduce their measurement tools and control systems (May, 2015). Mainly working on water supply systems now. • set up a local subsidiary in 1995.
(5) The company who has made a presentation to local companies in Japan.		
11	Company K	• presented on the high performance manhole iron cover to a general manager of the sewer line department of Maynilad when he visited Japan for training.

Source：JICA Study Team

Table A3.2 Japanese companies' activities and past records in regional areas

No.	Company name	Description
(1) The company who has received orders from local water and sewer service companies for the sewer service field.		
	N/A	-

No.	Company name	Description
(2) The company who has received orders from local water and sewer service companies for the water supply service field.		
1	Company J	• received an order for a SCADA system from a Japanese company for JICA Cebu metropolitan water system improvement project. (2015) • set up a local subsidiary in 1995. established 5 sales branches including the local head office and developing its business.
(3) The company who has conducted a verification project using a Japanese scheme.		
2	Company B	• performing a JICA demonstration for a septic tank for a sludge treatment facility in Cebu city. • presented on the sludge dehydrator to people in charge of the sewer service in major regional cities like Baguio at the JICA seminar. (July, 2015) • received a favorable evaluation from Cebu city, LWUA and DPWH, and started approaching other cities. • DPWH has sent out a recommendation letter on the company's products.
(4) The companies who have made a presentation to local companies at a local seminar.		
3	Company G	• presented on PTF method at the JICA seminar. (July, 2015) • joined the bid for water supply service field in Cebu city but failed to pass the prequalification.
4	Company A	• presented on general matters about treatment plants at the JICA seminar. (July, 2015)
5	Company E	• presented on the aerator at the JICA seminar. (July, 2015)
6	Company H	• presented on MBR at the JICA seminar. (July, 2015)
7	Company I	• presented on the power generation technology using methane fermentation at the JICA seminar. (July, 2015)

Source：JICA Study Team

2. Japanese Companies' Expectations for Public Institutions

Japanese companies have voiced their great expectations on the following matters to Japanese public institutions.

- Expansion of the applicable area of ODA schemes or STEP yen-loan financed projects in order to break out of the price competition and allow high quality products to be used.
- Involvement in creating business opportunities and making specifications. (Spec-in)
- Support to revise the Philippines legislative system (encourage the Philippines to improve the situations by making proposals through JICA research or the specialists dispatch scheme.)
- Expansion of the applicable area of JICA scheme besides SMES because it can help reduce the big burden of verification projects imposing on Japanese companies.
- Introduction of Japanese technologies at local seminars.
- Regarding the bidding system and the evaluation method, request the Philippines to increase the evaluation components like LCC evaluation and select comprehensively sophisticated technologies and processes, instead of just choosing the low initial cost.

Appendix 4

Condition and Dimension List of STP Facilities for Each Option

Appendix 4 Condition and Dimension List of STP Facilities for Each Option

1. CAS

				Wastewater Treatment Facility																												Sludge Treatment Facility										
				Equalizing Tank							Primary Sedimentation Tank							Reactor							Final Sedimentation Tank									Thickening Tank					Digestion Tank					Dewatering Machine House				
Area Name (Required Capacity)	Option	Site	Process	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	SL (m3/m2/d)	Number	Recuired area (m2)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	SL (m3/m2/d)	Number	Recuired area (m2)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	stories	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Capacity (m3/hr)	Number	Length (m)	Width (m)	Area (m2)
Las Pinas (113,200m3/day)	CAS-LP-1	C-A	CAS with Digestion Process	0.6	1	2,844	2	5.0	36.0	15.8	100	4	1,132	5	4.0	31.5	9.0	5.0	4	23,616	5	10.0	65.6	9.0	36	4	3,144	5	3.0	44.2	9.0	3	9.4	4	21.0	26.0	546	21.0	4	55.0	45.0	2,475	30.0	4	13.0	50.0	650
	CAS-LP-2	C-A	CAS without Digestion Process	0.6	1	2,844	2	5.0	36.0	15.8	100	4	1,132	5	4.0	31.5	9.0	5.0	4	23,616	5	10.0	65.6	9.0	36	4	3,144	5	3.0	44.2	9.0	3	9.4	4	21.0	26.0	546						50.0	3	15.0	50.0	750
Imus (93,600m3/day)	CAS-IMS-1	C-A	CAS with Digestion Process	0.6	1	2,340	2	5.0	20.0	23.4	100	6	936	7	4.0	14.2	11.0	6.0	6	23,430	7	10.0	35.5	11.0	36	6	2,600	7	3.0	23.2	11.0	3	8.6	4	51.0	9.0	459	19.2	4	98.0	20.0	1,960	20.0	4	12.5	50.0	625
	CAS-IMS-2	C-A	CAS without Digestion Process	0.6	1	2,340	2	5.0	20.0	23.4	100	6	936	7	4.0	14.2	11.0	6.0	6	23,430	7	10.0	35.5	11.0	36	6	2,600	7	3.0	23.2	11.0	3	8.6	4	24.0	20.0	480						30.0	4	13.0	54.0	702
	CAS-IMS-3	C-B	CAS with Digestion Process	0.6	1	2,340	2	5.0	20.0	23.4	100	6	936	7	4.0	14.2	11.0	6.0	6	23,430	7	10.0	35.5	11.0	36	6	2,600	7	3.0	23.2	11.0	3	8.6	4	51.0	9.0	459	19.2	4	49.0	44.0	2,156	20.0	4	12.5	50.0	625
	CAS-IMS-4	C-B	CAS without Digestion Process	0.6	1	2,340	2	5.0	20.0	23.4	100	6	936	7	4.0	14.2	11.0	6.0	6	23,430	7	10.0	35.5	11.0	36	6	2,600	7	3.0	23.2	11.0	3	8.6	4	51.0	9.0	459						30.0	4	13.0	54.0	702
Kawit (22,000m3/day)	CAS-KWT-1	K-3	CAS with Digestion Process	0.6	1	550	2	5.0	20.0	5.5	75	3	293	4	4.0	19.6	5.0	6.0	3	5,505	4	10.0	36.7	5.0	36	3	611	4	3.0	30.4	5.0	2	6.1	2	20.0	7.0	140	13.6	2	38.0	14.0	532	7.0	3	10.0	35.0	350
	CAS-KWT-2	K-3	CAS without Digestion Process	0.6	1	550	2	5.0	20.0	5.5	75	3	293	4	4.0	19.6	5.0	6.0	3	5,505	4	10.0	36.7	5.0	36	3	611	4	3.0	30.4	5.0	2	6.1	2	20.0	7.0	140						10.0	3	10.0	35.0	350

(**) Include high-rate plate settler module effect

2. MBR

				Wastewater Treatment Facility																												Sludge Treatment Facility										
				Equalizing Tank							Anoxic Tank							Aeration Tank							Membrane Tank									Thickening Tank					Digestion Tank					Dewatering Machine House				
Area Name (Required Capacity)	Option		Process	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	HRT (hr)	Number	Volume (m6)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)			Number	Length (m)	Width (m)	Area (m2)	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Capacity (m3/hr)	Number	Length (m)	Width (m)	Area (m2)
Las Pinas (113,200m3/day)	MBR-LP-1	L-A	MBR with Digestion Process	1.7	1	7,920	1	5.0	66.0	24.0	1.7	5	8,018	6	5.5	27.0	9.0	1.3	5	6,131	6	5.4	21.0	9.0	1.6	10	7,546	12	5.2	28.0	4.3			3	10.0	10.0	300	25.0	3			1,473			15.0	60.0	900
	MBR-LP-2	L-A	MBR without Digestion Process	1.7	1	7,920	1	5.0	66.0	24.0	1.7	5	8,018	6	5.5	27.0	9.0	1.3	5	6,131	6	5.4	21.0	9.0	1.6	10	7,546	12	5.2	28.0	4.3			3	10.0	10.0	300								15.0	60.0	900
Imus (93,600m3/day)	MBR-IMS-1	C-A	MBR with Digestion Process	1.7	1	6,240	1	6.0	65.0	16.0	1.7	5	6,630	6	6.1	20.0	9.0	1.3	5	5,070	6	5.9	16.0	9.0	1.6	10	6,240	12	5.5	22.0	4.3			3	9.0	9.0	243	24.0	3			1,357			15.0	60.0	900
	MBR-IMS-2	C-A	MBR without Digestion Process	1.7	1	6,240	1	6.0	65.0	16.0	1.7	5	6,630	6	6.1	20.0	9.0	1.3	5	5,070	6	5.9	16.0	9.0	1.6	10	6,240	12	5.5	22.0	4.3			3	9.0	9.0	243								15.0	60.0	900
	MBR-IMS-3	C-B	MBR with Digestion Process	1.7	1	6,240	1	6.8	57.0	16.0	1.7	5	6,630	6	6.1	20.0	9.0	1.3	5	5,070	6	5.9	16.0	9.0	1.6	10	6,240	12	5.5	22.0	4.3			3	9.0	9.0	243	24.0	3			1,357			15.0	60.0	900
	MBR-IMS-4	C-B	MBR without Digestion Process	1.7	1	6,240	1	6.8	57.0	16.0	1.7	5	6,630	6	6.1	20.0	9.0	1.3	5	5,070	6	5.9	16.0	9.0	1.6	10	6,240	12	5.5	22.0	4.3			3	9.0	9.0	243								15.0	60.0	900
Kawit (22,000m3/day)	MBR-KWT-1	K-2	MBR with Digestion Process	1.7	1	1,440	1	6.0	30.0	8.0	1.7	2	1,558	3	5.2	11.0	9.0	1.3	2	1,192	3	5.5	8.0	9.0	1.6	2	1,466	3	4.6	12.0	9.0			1	7.0	7.0	49	21.0	1			346			10.0	40.0	400
	MBR-KWT-2	K-2	MBR without Digestion Process	1.7	1	1,440	1	6.0	30.0	8.0	1.7	2	1,558	3	5.2	11.0	9.0	1.3	2	1,192	3	5.5	8.0	9.0	1.6	2	1,466	3	4.6	12.0	9.0			1	7.0	7.0	49								10.0	40.0	400
	MBR-KWT-3	K-3	MBR with Digestion Process	1.7	1	1,440	1	6.0	30.0	8.0	1.7	2	1,558	3	5.2	11.0	9.0	1.3	2	1,192	3	5.5	8.0	9.0	1.6	2	1,466	3	4.6	12.0	9.0			1	7.0	7.0	49	21.0	1			346			10.0	40.0	400
	MBR-KWT-4	K-3	MBR without Digestion Process	1.7	1	1,440	1	6.0	30.0	8.0	1.7	2	1,558	3	5.2	11.0	9.0	1.3	2	1,192	3	5.5	8.0	9.0	1.6	2	1,466	3	4.6	12.0	9.0			1	7.0	7.0	49								10.0	40.0	400

3. SBR

				Wastewater Treatment Facility																												Sludge Treatment Facility										
				Equalizing Tank														Reactor														Thickening Tank					Digestion Tank					Dewatering Machine House				
Area Name (Required Capacity)	Option		Process	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)								HRT (hr)	Number	Volume (m5)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)								Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Capacity (m3/hr)	Number	Length (m)	Width (m)	Area (m2)
Las Pinas (113,200m3/day)	SBR-LP-1	L-A	SBR with Digestion Process	0.6	6	1,452	8	5.5	2.2	20.0								14.4	6	33,990	8	5.5	51.5	20.0								6.6	4	25.0	15.0	375	14.6	4	42.0	31.0	1,302	10.0	4	10.0	45.0	450
		L-C		0.6	6	1,452	8	5.5	2.2	20.0								14.4	6	33,990	8	5.5	51.5	20.0								6.6	4	25.0	15.0	375	14.6	4	42.0	31.0	1,302	10.0	4	10.0	45.0	450
	SBR-LP-2	L-A	SBR without Digestion Process	0.6	6	1,670	8	5.5	2.2	23.0								14.4	6	39,013	8	5.5	51.4	23.0								6.9	4	20.0	15.0	300						20.0	4	12.5	60.0	750
		L-C		0.6	6	1,254	8	5.5	1.9	20.0								14.4	6	29,040	8	5.5	44.0	20.0								6.0	4	19.0	14.0	266						15.0	4	10.0	50.0	500
Imus (93,600m3/day)		C-2	WTF	0.6	8	1,478	10	5.5	1.6	21.0								14.4	8	34,742	10	5.5	37.6	21.0																						
	SBR-IMS-1	C-A	STF with Digestion Process																													6.6	4	30.0	10.0	300	14.6	4	42.0	31.0	1,302	10.0	4	10.0	45.0	450
		C-3	SBR with Digestion Process	0.6	6	926	8	5.5	1.7	16.5								14.4	6	21,508	8	5.5	39.5	16.5								7.0	2	20.0	8.0	160	11.7	4	40.0	25.0	1,000	15.0	3	10.0	40.0	400
	SBR-IMS-2	C-2	WTF	0.6	8	1,478	10	5.5	1.6	21.0								14.4	8	34,742	10	5.5	37.6	21.0																						
		C-A	STF without Digestion Process																													6.6	4	30.0	10.0	300						15.0	4	10.0	45.0	450
		C-3	SBR without Digestion Process	0.6	6	926	8	5.5	1.7	16.5								14.4	6	21,508	8	5.5	39.5	16.5								7.0	2	20.0	8.0	160						15.0	3	10.0	40.0	400
	SBR-IMS-3	C-A	SBR with Digestion Process	0.6	6	1,290	8	5.5	2.3	17.0								14.4	6	30,014	8	5.5	53.5	17.0								8.4	2	25.0	10.0	250	13.3	4	41.0	31.0	1,271	10.0	4	10.0	45.0	450
		C-3		0.6	6	1,122	8	5.5	1.7	20.0								14.4	6	26,202	8	5.5	39.7	20.0								5.8	4	20.0	15.0	300	12.8	4	40.0	29.0	1,160	10.0	4	10.0	45.0	450
	SBR-IMS-4	C-A	SBR without Digestion Process	0.6	6	1,458	8	5.5	2.6	17.0								14.4	6	34,726	8	5.5	61.9	17.0								9.0	2	25.0	10.0	250						15.0	4	12.0	47.0	564
		C-3		0.6	6	926	8	5.5	1.7	16.5								14.4	6	21,508	8	5.5	39.5	16.5								7.0	2	20.0	8.0	160						15.0	3	10.0	40.0	400
	SBR-IMS-5	C-B	SBR with Digestion Process	0.6	14	2,426	16	5.5	2.1	15.0								14.4	14	56,249	16	5.5	48.7	15.0								8.1	4	23.0	18.0	414	18.0	4	49.0	38.0	1,862	20.0	4	13.0	54.0	702
	SBR-IMS-6	C-B	SBR without Digestion Process	0.6	14	2,426	16	5.5	2.1	15.0								14.4	14	56,249	16	5.5	48.7	15.0								8.1	4	23.0	18.0	414						30.0	4	13.0	54.0	702
Kawit (22,000m3/day)	SBR-KWT-1	K-3	SBR with Digestion Process	0.6	4	561	6	5.5	1.7	15.0								14.4	4	13,200	6	5.5	40.0	15.0								5.8	2	20.0	10.0	200	12.7	2	36.0	13.0	468	7.0	3	10.0	35.0	350
	SBR-KWT-2	K-3	SBR without Digestion Process	0.6	4	561	6	5.5	1.7	15.0								14.4	4	13,200	6	5.5	40.0	15.0								5.8	2	20.0	10.0	200						10.0	3	10.0	35.0	350

WTF: Water Treatment Facilities, STF: Sludge Treatment Facilities

4. MBBR

				Wastewater Treatment Facility																																		Sludge Treatment Facility										
				Equalizing Tank							Primary Sedimentation Tank							Reactor							Final Sedimentation Tank									Thickening Tank					Digestion Tank					Dewatering Machine House				
Area Name (Required Capacity)	Option		Process	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	SL (m3/m2/d)	Number	Recuired area (m2)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	HRT (hr)	Number	Volume (m3)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	SL (m3/m2	Number	Recuired area (m2)	Facility (Stream) number	Effective depth (m)	Length (m)	Width (m)	stories	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Diameter (m)	Number	Length (m)	Width (m)	Area (m2)	Capacity (m3/hr)	Number	Length (m)	Width (m)	Area (m2)
Las Pinas (113,200m3/day)	MBBR-LP-1	L-A	MBBR with Digestion Process	0.6	1	2,000	2	5.0	20.0	20.0	100	4	800	5	4.0	20.0	10.0	5.5	4	18,348	5	5.5	83.4	10.0	36	4	2,222	5	3.0	33.6	10.0	3	8.5	4	24.0	19.0	456	19.1	4	51.0	40.0	2,040	20.0	4	13.0	50.0	650
		L-C		0.6	1	830	2	5.0	8.3	20.0	100	4	332	5	4.0	13.9	6.0	5.5	4	7,616	5	5.5	57.7	6.0	36	4	922	5	3.0	27.9	6.0	3	7.9	2	20.0	8.0	160	17.5	2	45.0	18.0	810	15.0	3	10.0	40.0	400
	MBBR-LP-2	L-A	MBBR without Digestion Process	0.6	1	2,830	2	5.0	28.3	20.0	100	4	1,132	5	4.0	28.3	10.0	5.5	4	25,960	5	5.5	118.0	10.0	36	4	3,144	5	3.0	41.2	10.0	3	10.0	4	27.0	22.0	594						50.0	3	15.0	55.0	825
		L-C																																												
Imus (93,600m3/day)		C-2	WTF	0.6	1	830	2	5.0	8.3	20.0	100	4	332	5	4.0	13.9	6.0	5.5	4	7,616	5	5.5	57.7	6.0	36	4	922	5	3.0	27.9	6.0	3																
	MBBR-IMS-1	C-A	STF with Digestion Process																													7.9	2	20.0	8.0	160	17.5	2	45.0	18.0	810	15.0	3	10.0	40.0	400
		C-3	MBBR with Digestion Process	0.6	1	1,510	2	5.0	15.1	20.0	100	8	604	9	4.0	12.6	6.0	5.5	8	13,860	9	5.5	52.5	6.0	36	8	1,678	9	3.0	21.7	6.0	3	7.4	4	22.0	17.0	374	16.5	4	46.0	35.0	1,610	15.0	4	10.0	45.0	450
	MBBR-IMS-2	C-2	WTF	0.6	1	830	2	5.0	8.3	20.0	100	4	332	5	4.0	13.9	6.0	5.5	4	7,616	5	5.5	57.7	6.0	36	4	922	5	3.0	27.9	6.0	3																
		C-A	STF without Digestion Process																													7.9	2	20.0	8.0	160						20.0	3	13.0	40.0	520
		C-3	MBBR without Digestion Process	0.6	1	1,510	2	5.0	15.1	20.0	100	8	604	9	4.0	12.6	6.0	5.5	8	13,860	9	5.5	52.5	6.0	36	8	1,678	9	3.0	21.7	6.0	3	7.4	4	22.0	17.0	374						20.0	4	13.0	45.0	585
	MBBR-IMS-3	C-A	MBBR with Digestion Process	0.6	1	1,630	2	5.0	16.3	20.0	100	6	650	7	4.0	18.1	6.0	5.5	6	14,909	7	5.5	75.3	6.0	36	6	1,806	7	3.0	31.8	6.0	3	7.8	4	22.0	18.0	396	19.6	3	87.0	21.0	1,827	15.0	4	10.0	40.0	400
		C-3		0.6	1	720	2	5.0	7.2	20.0	100	4	286	5	4.0	14.3	5.0	5.5	4	6,556	5	5.5	59.6	5.0	36	4	794	5	3.0	29.9	5.0	2	7.3	2	20.0	8.0	160	16.4	2	43.0	18.0	774	10.0	3	10.0	35.0	350
	MBBR-IMS-4	C-A	MBBR without Digestion Process	0.6	1	2,340	2	5.0	23.4	20.0	100	8	936	9	4.0	19.5	6.0	5.5	8	21,436	9	5.5	81.3	6.0	36	8	2,600	9	3.0	28.1	6.0	3	9.1	4	10.0	53.0	530						30.0	4	13.0	55.0	715
		C-3																																												
	MBBR-IMS-5	C-B	MBBR with Digestion Process	0.6	1	2,340	2	5.0	23.4	20.0	100	8	936	9	4.0	19.5	6.0	5.5	8	21,436	9	5.5	81.3	6.0	36	8	2,600	9	3.0	28.1	6.0	3	9.1	4	10.0	53.0	530	20.3	4	54.0	43.0	2,322	30.0	3	13.0	50.0	650
	MBBR-IMS-6	C-B	MBBR without Digestion Process	0.6	1	2,340	2	5.0	23.4	20.0	100	8	936	9	4.0	19.5	6.0	5.5	8	21,436	9	5.5	81.3	6.0	36	8	2,600	9	3.0	28.1	6.0	3	9.1	4	10.0	53.0	530						30.0	4	13.0	55.0	715
Kawit (22,000m3/day)	MBBR-KWT-1	K-3	MBBR with Digestion Process	0.6	1	550	2	5.0	5.5	20.0	100	3	220	4	4.0	14.7	5.0	5.5	3	5,049	4	5.5	61.2	5.0	36	3	611	4	3.0	23.6	5.0	3	6.5	2	20.0	7.0	140	14.3	2	40.0	15.0	600	7.0	3	10.0	35.0	350
	MBBR-KWT-2	K-3	MBBR without Digestion Process	0.6	1	550	2	5.0	5.5	20.0	100	3	220	4	4.0	14.7	5.0	5.5	3	5,049	4	5.5	61.2	5.0	36	3	611	4	3.0	23.6	5.0	3	6.5	2	20.0	7.0	140						10.0	3	10.0	35.0	350

Appendix 5

Preliminary Quantity List of Sewer Network Facilities for Each Option

Appendix 5: Preliminary Quantity List of Sewer Network Facilities for Each Option

1. CAS

Area Name (Required Capacity)	Option	Site	Process	Peak Flow (m3/day)	Sewer Network Facility – Gravity Sewer (Dia. mm) – Trenching Method 200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1400	Sub-total	Pipe Jacking Method 1000	1100	1200	Sub-total	Total (m)	Grand Total (m)	Manholes (nos.) Internal Dia. (cm) 120	150	180	220	Total	Pumping Main (Dia. mm) Trenching Method 100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	Total (m)	Pumping Station PS (Type-3) -	Manhole Pumping Station (Type-1,2) Nos. Capacity (lps) 0-100	100-200	200-400	400-600	Total
Las Pinas (113,200m3/day)	CAS-LP-1	C-A	CAS with Digestion Process	192,000	27,590	6,340	7,880	4,460	4,720	3,280	2,450	2,500	10,590	1,100	2,090	0	0	0	0	73,000	2,200	0	3,900	6,100	79,100	79,100	1,183	36	33	0	1,252	3,790	2,510	1,860	1,900	300	780	0	580	0	1,600						13,320	3	41	3	2	0	46
	CAS-LP-2	C-A	CAS without Digestion Process	192,000	27,590	6,340	7,880	4,460	4,720	3,280	2,450	2,500	10,590	1,100	2,090	0	0	0	0	73,000	2,200	0	3,900	6,100	79,100	79,100	1,183	36	33	0	1,252	3,790	2,510	1,860	1,900	300	780	0	580	0	1,600						13,320	3	41	3	2	0	46
Imus (93,600m3/day)	CAS-IMS-1	C-A	CAS with Digestion Process	158,000	4,585	0	300	0	3,680	0	973	1,700	600	943	235	0	4,412	2,410	1,710	21,548				0	21,548	21,548	215	39	21	15	290										934	775				243	1,952	2	1	1	2	0	4
	CAS-IMS-2	C-A	CAS without Digestion Process	158,000	4,585	0	300	0	3,680	0	973	1,700	600	943	235	0	4,412	2,410	1,710	21,548				0	21,548	21,548	215	39	21	15	290										934	775				243	1,952	2	1	1	2	0	4
	CAS-IMS-3	C-B	CAS with Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	213	39	21	14	287										934	775				243	1,952	2	1	1	2	0	4
	CAS-IMS-4	C-B	CAS without Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	213	39	21	14	287										934	775				243	1,952	2	1	1	2	0	4
Kawit (22,000m3/day)	CAS-KWT-1	K-3	CAS with Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8
	CAS-KWT-2	K-3	CAS without Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8

2. MBR

Area Name (Required Capacity)	Option	Site	Process	Peak Flow (m3/day)	Sewer Network Facility – Gravity Sewer (Dia. mm) – Trenching Method 200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1400	Sub-total	Pipe Jacking Method 1000	1100	1200	Sub-total	Total (m)	Grand Total (m)	Manholes (nos.) Internal Dia. (cm) 120	150	180	220	Total	Pumping Main (Dia. mm) Trenching Method 100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	Total (m)	Pumping Station PS (Type-3) -	Manhole Pumping Station (Type-1,2) Nos. Capacity (lps) 0-100	100-200	200-400	400-600	Total
Las Pinas (113,200m3/day)	MBR-LP-1	L-A	MBR with Digestion Process	192,000	27,590	6,340	7,880	4,460	4,720	3,280	2,450	2,500	10,590	1,100	2,090	0	0	0	0	73,000	2,200	0	3,900	6,100	79,100	79,100	1,183	36	33	0	1,252	3,790	2,510	1,860	1,900	300	780	0	580	0	1,600						13,320	3	41	3	2	0	46
	MBR-LP-2	L-A	MBR without Digestion Process	192,000	27,590	6,340	7,880	4,460	4,720	3,280	2,450	2,500	10,590	1,100	2,090	0	0	0	0	73,000	2,200	0	3,900	6,100	79,100	79,100	1,183	36	33	0	1,252	3,790	2,510	1,860	1,900	300	780	0	580	0	1,600						13,320	3	41	3	2	0	46
Imus (93,600m3/day)	MBR-IMS-1	C-A	MBR with Digestion Process	158,000	4,585	0	300	0	3,680	0	973	1,700	600	943	235	0	4,412	2,410	1,710	21,548				0	21,548	21,548	215	39	21	15	290										934	775				243	1,952	2	1	1	2	0	4
	MBR-IMS-2	C-A	MBR without Digestion Process	158,000	4,585	0	300	0	3,680	0	973	1,700	600	943	235	0	4,412	2,410	1,710	21,548				0	21,548	21,548	215	39	21	15	290										934	775				243	1,952	2	1	1	2	0	4
	MBR-IMS-3	C-B	MBR with Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	213	39	21	14	287										934	775				243	1,952	2	1	1	2	0	4
	MBR-IMS-4	C-B	MBR without Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	213	39	21	14	287										934	775				243	1,952	2	1	1	2	0	4
Kawit (22,000m3/day)	MBR-KWT-1	K-2	MBR with Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	500	0	0	0	0	4,472				0	4,472	4,472	67	4	0	0	71					428				1,007			10				1,445	0	2	1	3	2	8
	MBR-KWT-2	K-2	MBR without Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	500	0	0	0	0	4,472				0	4,472	4,472	67	4	0	0	71					428				1,007			10				1,445	0	2	1	3	2	8
	MBR-KWT-3	K-3	MBR with Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8
	MBR-KWT-4	K-3	MBR without Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8

3. SBR

Area Name (Required Capacity)	Option	Site	Process	Peak Flow (m3/day)	Sewer Network Facility – Gravity Sewer (Dia. mm) – Trenching Method 200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1400	Sub-total	Pipe Jacking Method 1000	1100	1200	Sub-total	Total (m)	Grand Total (m)	Manholes (nos.) Internal Dia. (cm) 120	150	180	220	Total	Pumping Main (Dia. mm) Trenching Method 100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	Total (m)	Pumping Station PS (Type-3) -	Manhole Pumping Station (Type-1,2) Nos. Capacity (lps) 0-100	100-200	200-400	400-600	Total
Las Pinas (113,200m3/day)	SBR-LP-1	L-A	SBR with Digestion Process	95,900	14,300	2,450	4,880	2,160	1,020	2,980	2,450	1,470	8,260	1,100	1,410					42,480	3,900			3,900	46,380	78,560	685	12	0	0	696	2,530	1,010	860	550	300	780	0	580	0	1,600						8,210	2	23	3	3	0	29
		L-C		95,900	12,630	3,790	3,000	1,950	3,360	200	300	1,610	2,660	680	1,800	200				32,180				0	32,180		503	17	0	0	520	1,260	1,500	1,000	1,350												5,110	1	18	1	0	0	19
	SBR-LP-2	L-A	SBR without Digestion Process	110,000	14,300	2,450	4,880	2,160	1,020	2,980	2,450	1,470	8,260	1,100	1,410					42,480		3,900		3,900	46,380	78,560	685	12	0	0	696	2,530	1,010	860	550	300	780	0	580	0	1,600						8,210	2	23	3	3	0	29
		L-C		81,900	12,630	3,790	3,000	1,950	3,360	200	300	1,610	2,660	680	1,800	200	0	0	0	32,180					32,180		503	17	0	0	520	1,260	1,500	1,000	1,350	0	0	0	0	0	0						5,110	1	18	1	0	0	19
Imus (93,600m3/day)	SBR-IMS-1	C-2	WTF	97,800	4,585	0	0	0	3,680	0	243	0	0	580	0	2,070	4,412	0	0	15,570				0	15,570	21,178	151	54	0	0	205										744	0					744	2	1	0	1	0	2
		C-3	SBR with Digestion Process	60,600	0	0	300	0	0	0	1,700	0	600	363	235	0	310	2,100	0	5,608				0	5,608		49	5	18	0	71										190	775					965	1	0	1	1	0	2
	SBR-IMS-2	C-2	WTF	97,800	4,585	0	0	0	3,680	0	243	0	0	580	0	2,070	4,412	0	0	15,570				0	15,570	21,178	151	54	0	0	205										744	0					744	2	1	0	1	0	2
		C-3	SBR without Digestion Process	60,600	0	0	300	0	0	0	1,700	0	600	363	235	0	310	2,100	0	5,608				0	5,608		49	5	18	0	71										190	775					965	1	0	1	1	0	2
	SBR-IMS-3	C-A	SBR with Digestion Process	84,600	4,585	0	0	0	3,680	0	973	0	0	580	0	1,710	4,412	0	0	15,940				0	15,940	21,548	164	51	0	0	215										744	0					744	2	1	0	1	0	2
		C-3		73,800	0	0	300	0	0	0	1,700	0	600	363	235	0	310	2,100	0	5,608				0	5,608		49	5	18	0	71										190	775					965	1	0	1	1	0	2
	SBR-IMS-4	C-A	SBR without Digestion Process	97,800	4,585	0		0	3,680	0	973	0	0	580	0	0	6,122	0	0	15,940				0	15,940	21,548	164	51	0	0	215										744	0					744	2	1	0	1	0	2
		C-3		60,600	0	0	300	0	0	0	0	1,700	600	363	235	0	310	2,100	0	5,608				0	5,608		49	5	18	0	71										190	775					965	1	0	1	1	0	2
	SBR-IMS-5	C-B	SBR with Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	211	39	20	13	283										934	775				243	1,952	2	1	1	2	0	4
	SBR-IMS-6	C-B	SBR without Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	211	39	20	13	283										934	775				243	1,952	2	1	1	2	0	4
Kawit (22,000m3/day)	SBR-KWT-1	K-3	SBR with Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8
	SBR-KWT-2	K-3	SBR without Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8

WTF: Water Treatment Facilities, STF: Sludge Treatment Facilities

4. MBBR

Area Name (Required Capacity)	Option	Site	Process	Peak Flow (m3/day)	Sewer Network Facility – Gravity Sewer (Dia. mm) – Trenching Method 200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1400	Sub-total	Pipe Jacking Method 1000	1100	1200	Sub-total	Total (m)	Grand Total (m)	Manholes (nos.) Internal Dia. (cm) 120	150	180	220	Total	Pumping Main (Dia. mm) Trenching Method 100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	Total (m)	Pumping Station PS (Type-3) -	Manhole Pumping Station (Type-1,2) Nos. Capacity (lps) 0-100	100-200	200-400	400-600	Total
Las Pinas (113,200m3/day)	MBBR-LP-1	L-A	MBBR with Digestion Process	136,000	14,300	2,450	4,880	2,160	1,020	2,980	2,450	1,470	8,260	1,100	1,410	0	0	0	0	42,480			3,900	3,900	46,380	78,560	685	12	0	0	696	2,530	1,010	860	550	300	780		580		1,600						8,210	2	23	3	3	0	29
		L-C		56,300	13,290	3,890	3,000	1,950	3,660	200	300	1,430	1,780	680	1,800	200	0	0	0	32,180			0	0	32,180		503	17	0	0	520	1,260	1,500	1,000	1,350	0	0										5,110	1	18	0	0	0	18
	MBBR-LP-2	L-A	MBBR without Digestion Process	95,900	14,300	2,450	4,880	2,160	1,020	2,980	2,450	1,470	8,260	1,100	1,410	0	0	0	0	42,480	3,900	0	0	3,900	46,380	78,560	685	12	0	0	696	2,530	1,010	860	550	300	780	0	580	0	1,600						8,210	2	23	3	3	0	29
		L-C		95,900	12,630	3,790	3,000	1,950	3,360	200	300	1,610	2,660	680	1,800	200	0	0	0	32,180	0	0	0	0	32,180		503	17	0	0	520	1,260	1,500	1,000	1,350	0	0	0	0	0	0						5,110	1	18	1	0	0	19
Imus (93,600m3/day)	MBBR-IMS-1	C-2	WTF	56,100	4,585		0		3,680		243	0	0	2,650	0	0	4,412	0		15,570				0	15,570	21,178	186	37	0	0	223										744			0		243	987	2	1	0	1	0	2
		C-3	MBBR with Digestion Process	102,000	0		300		0		0	1,700	600	0	310	0	363	2,335		5,608				0	5,608		43	6	19	0	68										190			775		0	965	2	0	1	1	0	2
	MBBR-IMS-2	C-2	WTF	56,100	4,585	0	0	0	3,680	0	243	0	0	2,650	0	0	4,412	0	0	15,570				0	15,570	21,178	186	37	0	0	223										744			0		243	987	2	1	0	1	0	2
		C-3	MBBR without Digestion Process	102,000	0	0	300	0	0	0	0	1,700	600	0	310	0	363	2,335	0	5,608				0	5,608		43	6	19	0	68										190			775		0	965	2	0	1	1	0	2
	MBBR-IMS-3	C-A	MBBR with Digestion Process	110,000	4,585		0		3,680		973	0	0	580	0	0	4,412	1,710		15,940				0	15,940	21,548	164	37	14	0	215										744			0		243	987	2	1	0	1	0	2
		C-3		48,300	0		300		0		0	1,700	600	363	235	0	0	2,410		5,608				0	5,608		49	2	20	0	71										190			775		0	965	1	0	1	1	0	2
	MBBR-IMS-4	C-A	MBBR without Digestion Process	158,000	4,585	0	300	0	3,680	0	973	1,700	600	943	235	0	4,412	2,410	1,710	21,548				0	21,548	21,548	215	39	21	14	289										934	775				243	1,952	2	1	1	2	0	4
	MBBR-IMS-5	C-B	MBBR with Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	211	39	20	13	283										934	775				243	1,952	2	1	1	2	0	4
	MBBR-IMS-6	C-B	MBBR without Digestion Process	158,000	4,585	0	300	0	3,680	0	843	1,700	600	943	235	0	4,412	2,410	1,550	21,258				0	21,258	21,258	211	39	20	13	283										934	775				243	1,952	2	1	1	2	0	4
Kawit (22,000m3/day)	MBBR-KWT-1	K-3	MBBR with Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8
	MBBR-KWT-2	K-3	MBBR without Digestion Process	37,200	1,590	0	0	0	0	0	1,186	0	1,196	0	1,300	0	0	0	0	5,272				0	5,272	5,272	67	11	0	0	78					428				1,007			10				1,445	0	2	1	3	2	8

Appendix 6

Comparative Study on STP Options

Table 1.1 Comparative Study on CAS for Las Piñas City (1/1)

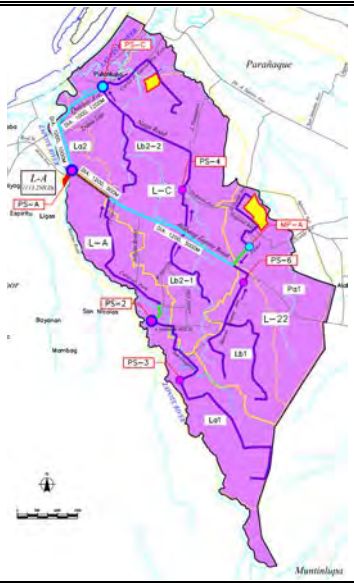
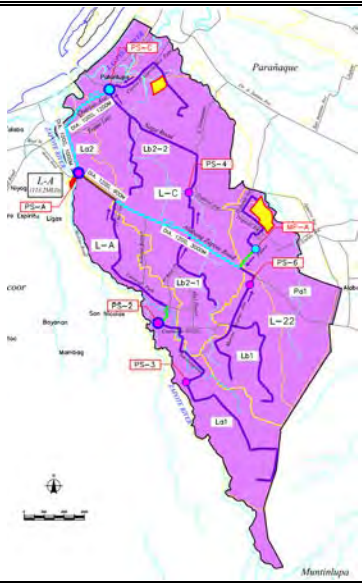
		Option CAS-LP-1: CAS with Digestion Process (113,200m^3/day)	Option CAS-LP-2: CAS without Digestion Process (113,200m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	**L-A** 
3	**Capacity (m^3/day)**	113,200	113,200
4	**Required Area (ha)**	2.55	2.55
5	**Feature**	• The land has been already acquired and the access road has been constructed. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Laspinas City can be treated at L-A site. • Digestion process can reduce the volume of generated sludge. • Digestion gas can be utilized for power generation and used inside STP. • Effluent water body is close to STP and the access road has been constructed.	• The land has been already acquired and the access road has been constructed. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Laspinas City can be treated at L-A site. • Digestion process is not included in this option.
6	**Initial Cost Total (mil. Php)**	6,066.90	6,041.29
	Land	0.00 (Already purchased)	0.00 (Already purchased)
	Construction cost (Tax excluded)	1. STP (2,229.97) 2. Collection (3,836.93)	1. STP (2,229.97) 2. Collection (3,836.93)
7	**O&M (mil. Php/yr)**	271.56	252.24
	Energy (mil. Php/yr)	STP: 117.34, Collection: 14.88	STP: 117.34, Collection: 14.88
	Chemical (mil. Php/yr)	STP: 2.97	STP: 2.97
	Disposal (mil. Php/yr)	STP: 4.42	STP: 3.54
	Manpower (mil. Php/yr)	STP: 11.31	STP: 11.31
	Maintenance and Repair (mil. Php/yr)	STP: 92.20, Collection: 28.43	STP: 73.76, Collection: 29.24
8	**Construction Duration (yr)**	3.5	3.0
9	**Advantage**	• All wastewater in Laspinas city can be treated at only one (1) STP which land has been already acquired. • No other site for STP is necessary. Therefore, the sewerage development work in Laspinas city can be planned easily • Efficient operation can be conducted because only one STP is operated in Laspinas city.	• Same as CAS-LP-1.
10	**Disadvantage**	• The facilities will be installed deeply. (3 stories underground.) Therefore, the large scale retaining wall will be necessary. • Operation and maintenance of digestion facility is complicated. The skilled operator will be required.	• The facilities will be installed deeply. (3 stories underground.) Therefore, the large scale retaining wall will be necessary. • Generated sludge will be more than CAS-LP-1, because no digestion process is installed.

Table 1.2 Comparative Study on MBR for Las Piñas City (1/1)

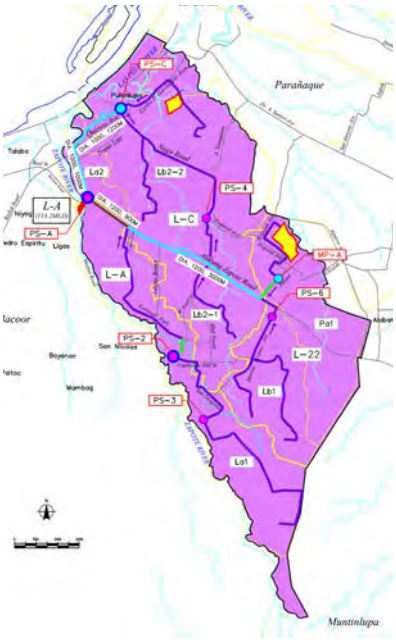
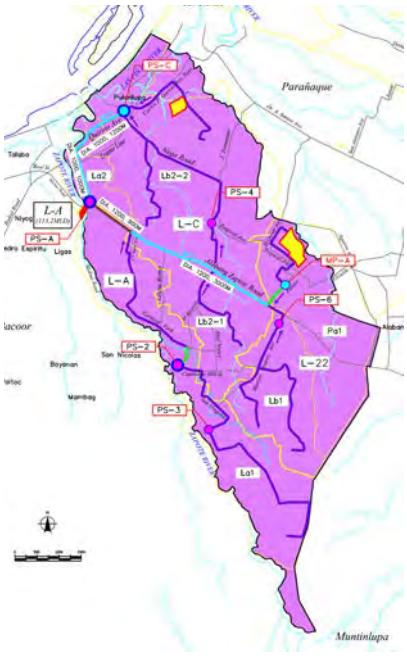
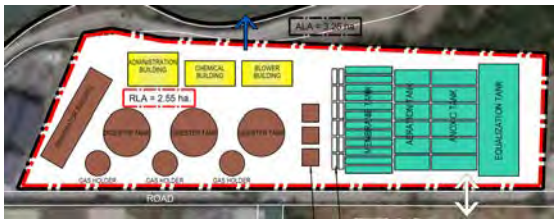
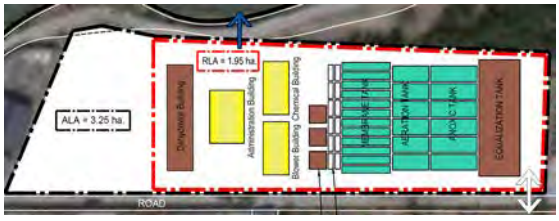
		Option MBR-LP-1: MBR with Digestion Process (113,200m^3/day)	Option MBR-LP-2: MBR without Digestion Process (113,200m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	**L-A** 
3	**Capacity (m^3/day)**	113,200	113,200
4	**Required Area (ha)**	2.55	1.95
5	**Feature**	• The land has been already acquired and the access road has been constructed. • All wastewater generated in Laspinas City can be treated at L-A site. • Digestion process can reduce the volume of generated sludge. • Digestion gas can be utilized for power generation and used inside STP. • Effluent water body is close to STP and the access road has been constructed.	• Same as MBR-LP-1 • Digestion process is not included in this option. Therefore, the required land will be smaller than MBR-LP-1.
6	**Initial Cost Total (mil. Php)**	6,695.91	6,658.87
	Land	0.0	0.0
	Construction cost (Tax excluded)	1. STP (2,858.98) 2. Collection (3,836.93)	1. STP (2,821.94) 2. Collection (3,836.93)
7	**O&M (mil. Php/yr)**	386.13	379.75
	Energy (mil. Php/yr)	STP: 132.01, Collection: 14.88	STP: 132.01, Collection: 14.88
	Chemical (mil. Php/yr)	STP: 40.54	STP: 40.54
	Disposal (mil. Php/yr)	STP: 2.89	STP: 2.31
	Manpower (mil. Php/yr)	STP: 11.31	STP: 11.31
	Maintenance and Repair (mil. Php/yr)	STP: 156.07, Collection: 28.43	STP: 150.27, Collection: 29.24
8	**Construction Duration (yr)**	3.5	3.0
9	**Advantage**	• All wastewater in Laspinas city can be treated at only one (1) STP which land has been already acquired. • No other site for STP is necessary. Therefore, the sewerage development work in Laspinas city can be planned easily.	• Same as MBR-LP-1 • There is an enough area for STP. The space can be utilized effectively.
10	**Disadvantage**	• The construction cost and O&M cost is the highest among the options.	• The construction cost and O&M cost is higher than the other options.

Table 1.3 Comparative Study on SBR for Las Piñas City (1/2)

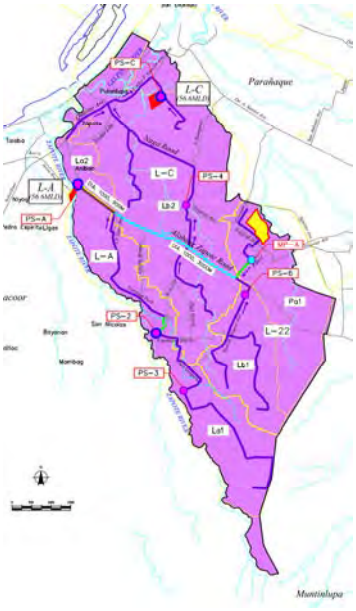
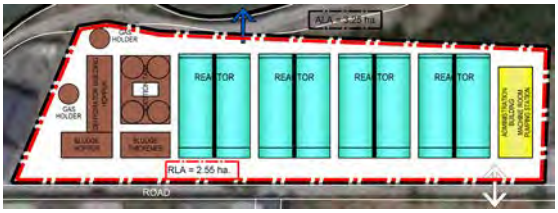
		Option SBR-LP-1: SBR with Digestion Process (113,200m^3/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	**L-C** 
3	**Capacity (m^3/day)**	56,000	56,000
4	**Required Area (ha)**	2.55	2.99
5	**Feature**	• The STP with half capacity is constructed in L-A site. • Digestion process can reduce the volume of generated sludge. • Digestion gas can be utilized for power generation and used inside STP. • Effluent water body is close to STP and the access road has been constructed.	• The STP with half capacity is constructed in L-C site. • Only a part of the available area will be required for STP. • Effluent water body and the existing road are close to STP.
6	**Initial Cost Total (mil. Php)**	5,883.63	
	Land	0.00	113.62
	Construction cost (Tax excluded)	1. STP (1,236.55) 2. Collection (2,311.89)	1. STP (1,362.37) 2. Collection (972.82)
7	**O&M (mil. Php/yr)**	290.18	
	Energy (mil. Php/yr)	STP: 66.01, Collection: 8.56	STP: 66.01, Collection: 4.17
	Chemical (mil. Php/yr)	STP: 1.49	STP: 1.49
	Disposal (mil. Php/yr)	STP: 1.98	STP: 1.98
	Manpower (mil. Php/yr)	STP: 6.06	STP: 6.06
	Maintenance and Repair (mil. Php/yr)	STP: 50.94, Collection: 16.31	STP: 50.94, Collection: 8.18
8	**Construction Duration (yr)**	2.0	2.0
9	**Advantage**	• Construction cost will be cheaper than other options.	
10	**Disadvantage**	• 2 STPs are required. Therefore, O&M cost is higher than CAS-LP-1 and CAS-LP-2.	

Table 1.4 Comparative Study on SBR for Las Piñas City (2/2)

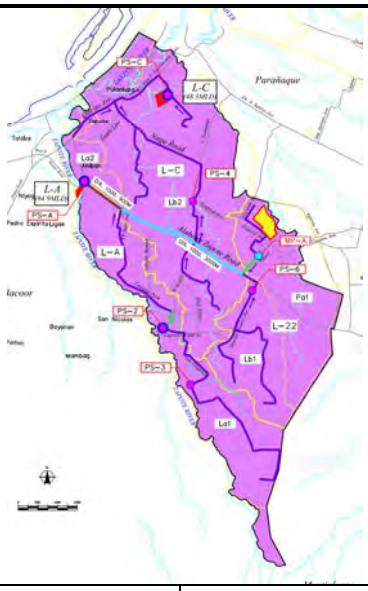
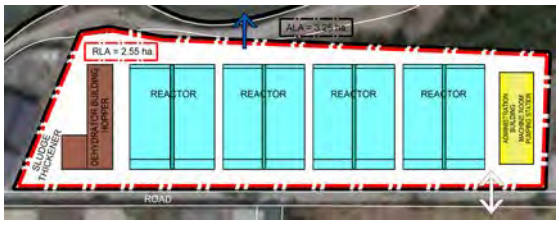
		Option SBR-LP-2: SBR without Digestion Process (113,200m³/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	**L-C** 
3	**Capacity (m³/day)**	64,900	48,300
4	**Required Area (ha)**	2.55	2.53
5	**Feature**	• No digestion process • The STP with larger scale than SBR-LP-1 can be constructed in L-A. • Effluent water body is close to STP and the access road has been constructed.	• No digestion process • Only a part of the available area will be required for STP. • Effluent water body and the existing road are close to STP.
6	**Initial Cost Total (mil. Php)**	5,951.13	
	Land	0.00	96.14
	Construction cost (Tax excluded)	1. STP (1,392.70) 2. Collection (2,439.92)	1. STP (1,154.50) 2. Collection (964.02)
7	**O&M (mil. Php/yr)**	290.18	
	Energy (mil. Php/yr)	STP: 75.68, Collection: 8.88	STP: 56.33, Collection: 3.50
	Chemical (mil. Php/yr)	STP: 1.71	STP: 1.27
	Disposal (mil. Php/yr)	STP: 1.82	STP: 1.35
	Manpower (mil. Php/yr)	STP: 6.84	STP: 5.28
	Maintenance and Repair (mil. Php/yr)	STP: 46.73, Collection: 17.20	STP: 34.78, Collection: 7.65
8	**Construction Duration (yr)**	2.0	1.5
9	**Advantage**	• Construction cost will be cheaper than other treatment method.	
10	**Disadvantage**	• 2 STPs are required. Therefore, O&M cost is higher than CAS-LP-1 and CAS-LP-2. • The scale of collection system for L-A is larger than SBR-LP-1. The total construction cost is higher than SBR-LP-1.	

Table 1.5 Comparative Study on MBBR for Las Piñas City (1/2)

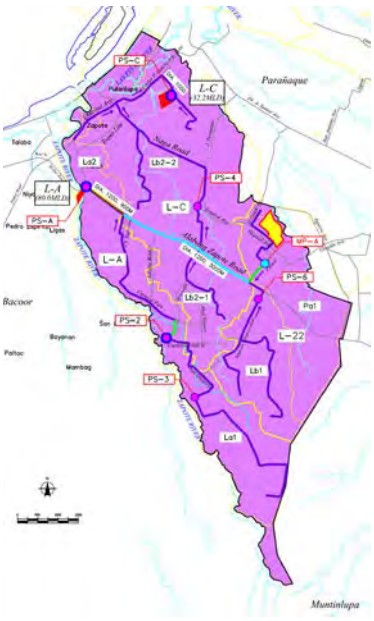
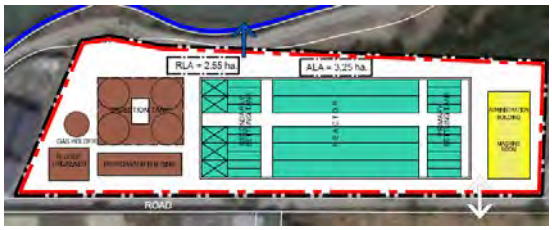
		Option MBBR-LP-1: MBBR with Digestion Process (113,200m³/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	**L-C** 
3	**Capacity (m³/day)**	80,000	33,200
4	**Required Area (ha)**	2.55	1.32
5	**Feature**	• Digestion process can reduce the volume of generated sludge. • Digestion gas can be utilized for power generation and used inside STP. • Effluent water body is close to STP and the access road has been constructed.	• Only a part of the available area will be required for STP. • Effluent water body and the existing road are close to STP.
6	**Initial Cost Total (mil. Php)**	6,304.87	
	Land	0.00	50.16
	Construction cost (Tax excluded)	1. STP (1,898.18) 2. Collection (2,586.02)	1. STP (909.07) 2. Collection (911.61)
7	**O&M (mil. Php/yr)**	299.27	
	Energy (mil. Php/yr)	STP: 62.20, Collection: 9.91	STP: 25.81, Collection: 2.67
	Chemical (mil. Php/yr)	STP: 2.10	STP: 0.87
	Disposal (mil. Php/yr)	STP: 3.59	STP: 1.49
	Manpower (mil. Php/yr)	STP: 8.26	STP: 3.83
	Maintenance and Repair (mil. Php/yr)	STP: 108.07, Collection: 18.73	STP: 44.85, Collection: 6.68
8	**Construction Duration (yr)**	3.0	1.5
9	**Advantage**	• Total initial cost will be almost same as CAS-LP-1 even 2 STPs are required for this option.	
10	**Disadvantage**	• O&M cost is higher than CAS and SBR system due to the maintenance of membrane in 2 STPs.	

Table 1.6 Comparative Study on MBBR for Las Piñas City (2/2)

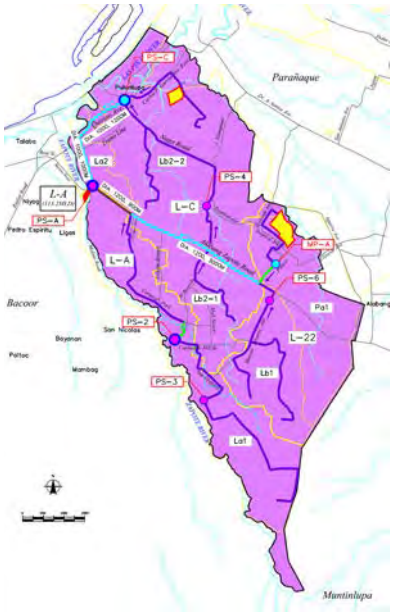
		Option MBBR-LP-2: MBBR without Digestion Process (113,200m³/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**L-A** 	
3	**Capacity (m³/day)**	113,200	
4	**Required Area (ha)**	2.55	
5	**Feature**	• All wastewater generated in Laspinas City can be treated at L-A site. • No digestion process • The land has been already acquired and the access road has been constructed. • Effluent water body is close to STP and the access road has been constructed.	
6	**Initial Cost Total (mil. Php)**	6,421.49	
	Land	0.00	
	Construction cost (Tax excluded)	1. STP (2,584.56) 2. Collection (3,836.93	
7	**O&M (mil. Php/yr)**	291.09	
	Energy (mil. Php/yr)	STP: 88.01, Collection: 14.88	
	Chemical (mil. Php/yr)	STP: 2.97	
	Disposal (mil. Php/yr)	STP: 4.07	
	Manpower (mil. Php/yr)	STP: 11.31	
	Maintenance and Repair (mil. Php/yr)	STP: 141.43, Collection: 28.43	
8	**Construction Duration (yr)**	3.5	
9	**Advantage**	• Only 1 STP with MBBR is necessary for Las Pinas city; No another land is required.	
10	**Disadvantage**	• Total cost is higher than CAS and SBR because the media should be maintained. • No digestion process. Therefore, sludge volume reduction cannot be conducted.	

Table 2.1 Comparative Study on CAS for Imus City (1/2)

		Option CAS-IMS-1: CAS with Digestion Process (93,600m^3/day)	Option CAS-IMS-2: CAS without Digestion Process (93,600m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-A** 	**C-A** 
3	**Capacity (m^3/day)**	93,600	93,600
4	**Required Area (ha)**	2.18	1.90
5	**Feature**	• The site is close to the existing road and creek. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Imus City can be treated at C-A site. • Digestion gas can be utilized for power generation and used inside STP.	• The site is close to the existing road and creek. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Laspinas City can be treated at C-A site. • Digestion process is not included in this option. Some area will remain.
6	**Initial Cost Total (mil. Php)**	3,650.21	3,622.19
	Land	65.40	65.40
	Construction cost (Tax excluded)	1. STP (1,947.14) 2. Collection (1,947.14)	1. STP (1,919.12) 2. Collection (1,703.07)
7	**O&M (mil. Php/yr)**	211.37	195.05
	Energy (mil. Php/yr)	STP: 97.03, Collection: 4.69	STP: 97.03, Collection: 4.69
	Chemical (mil. Php/yr)	STP: 2.46	STP: 2.46
	Disposal (mil. Php/yr)	STP: 3.66	STP: 2.92
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 77.92, Collection: 16.05	STP: 62.34, Collection: 16.05
8	**Construction Duration (yr)**	3.0	3.0
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily. • Total cost will be lower than other treatment method.	• Same as CAS-IMS-1. • A part of the area will remain. The space can be used for stock yard, etc.
10	**Disadvantage**	• The facilities will be installed deeply. (2 stories underground.) Therefore, the retaining wall will be necessary.	• The facilities will be installed deeply. (2 stories underground.) Therefore, the large scale retaining wall will be necessary. • Generated sludge will be more than CAS-IMS-1.

Table 2.2 Comparative Study on CAS for Imus City (2/2)

		Option CAS-IMS-3: CAS with Digestion Process (93,600m^3/day)	Option CAS-IMS-4: CAS without Digestion Process (93,600m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-B** 	**C-B** 
3	**Capacity (m^3/day)**	93,600	93,600
4	**Required Area (ha)**	2.34	1.74
5	**Feature**	• The site is close to the existing road and creek. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Imus City can be treated at C-B site. • Digestion gas can be utilized for power generation and used inside STP.	• The site is close to the existing road and creek. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Imus City can be treated at C-B site. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option CAS-IMS-3.
6	**Initial Cost Total (mil. Php)**	3,618.94	3,570.70
	Land	46.80	34.80
	Construction cost (Tax excluded)	1. STP (1,947.52) 2. Collection (1,671.42)	1. STP (1,899.28) 2. Collection (1,671.42)
7	**O&M (mil. Php/yr)**	210.94	194.62
	Energy (mil. Php/yr)	STP: 97.03, Collection: 4.58	STP: 97.03, Collection: 4.58
	Chemical (mil. Php/yr)	STP: 2.46	STP: 2.46
	Disposal (mil. Php/yr)	STP: 3.66	STP: 2.92
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 77.92, Collection: 15.73	STP: 62.34, Collection: 15.73
8	**Construction Duration (yr)**	3.0	2.5
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily. • Total cost will be lower than other treatment method.	• Same as CAS-IMS-3
10	**Disadvantage**	• The large area will be unnecessary in the available area, however, it may be difficult to purchase the required area.	• Same as CAS-IMS-3 • Generated sludge will be more than CAS-IMS-3, because no digestion process is installed.

Table 2.3 Comparative Study on MBR for Imus City (1/2)

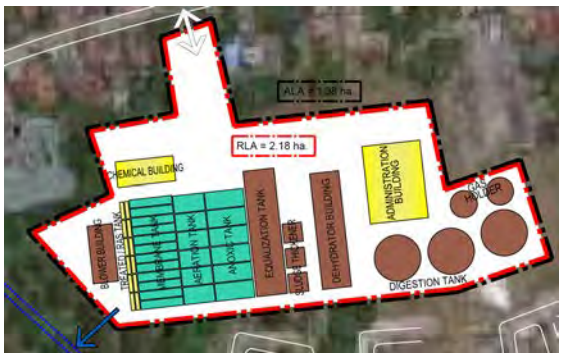
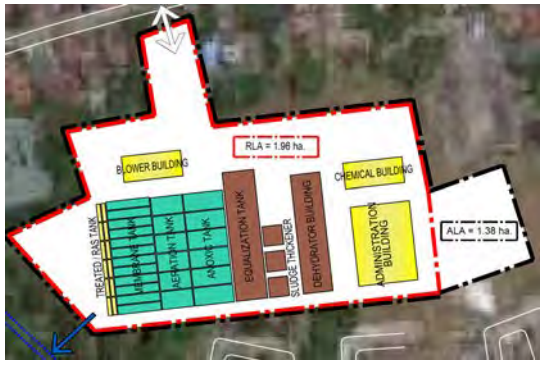
		Option MBR-IMS-1: MBR with Digestion Process (93,600m^3/day)	Option MBR-IMS-2: MBR without Digestion Process (93,600m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-A** 	**C-A** 
3	**Capacity (m^3/day)**	93,600	93,600
4	**Required Area (ha)**	2.18	1.96
5	**Feature**	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-A site. • Digestion gas can be utilized for power generation and used inside STP.	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-A site. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBR-IMS-1.
6	**Initial Cost Total (mil. Php)**	4,492.73	4,596.71
	Land	65.40	65.40
	Construction cost (Tax excluded)	1. STP (2,879.65) 2. Collection (1,703.07)	1. STP (2,757.77) 2. Collection (1,703.07)
7	**O&M (mil. Php/yr)**	320.98	315.53
	Energy (mil. Php/yr)	STP: 109.15, Collection: 4.69	STP: 109.15, Collection: 4.69
	Chemical (mil. Php/yr)	STP: 33.10	STP: 33.10
	Disposal (mil. Php/yr)	STP: 2.39	STP: 1.91
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 146.03, Collection: 16.05	STP: 141.05, Collection: 16.05
8	**Construction Duration (yr)**	3.0	2.5
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily.	• Same as MBR-IMS-1
10	**Disadvantage**	• Both construction cost and O&M cost are much higher than other treatment method.	• Same as MBR-IMS-1 • Generated sludge will be more than MBR-IMS-1, because no digestion process is installed.

Table 2.4 Comparative Study on MBR for Imus City (2/2)

		Option MBR-IMS-3: MBR with Digestion Process (93,600m^3/day)	Option MBR-IMS-4: MBR without Digestion Process (93,600m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-B** 	**C-B** 
3	**Capacity (m^3/day)**	93,600	93,600
4	**Required Area (ha)**	2.05	1.67
5	**Feature**	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-B site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBR-IMS-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBR-IMS-1.
6	**Initial Cost Total (mil. Php)**	4,445.31	4,400.62
	Land	41.00	33.40
	Construction cost (Tax excluded)	1. STP (2,773.88) 2. Collection (1,671.42)	1. STP (2,729.20) 2. Collection (1,671.42)
7	**O&M (mil. Php/yr)**	320.55	315.10
	Energy (mil. Php/yr)	STP: 109.15, Collection: 4.58	STP: 109.15, Collection: 4.58
	Chemical (mil. Php/yr)	STP: 33.10	STP: 33.10
	Disposal (mil. Php/yr)	STP: 2.39	STP: 1.91
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 146.03, Collection: 15.73	STP: 141.05, Collection: 15.73
8	**Construction Duration (yr)**	3.0	2.5
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily.	• Same as MBR-IMS-3
10	**Disadvantage**	• Both construction cost and O&M cost are much higher than other treatment method.	• Same as MBR-IMS-3 • Generated sludge will be more than MBR-IMS-3, because no digestion process is installed.

Table 2.5 Comparative Study on SBR for Imus City (1/5)

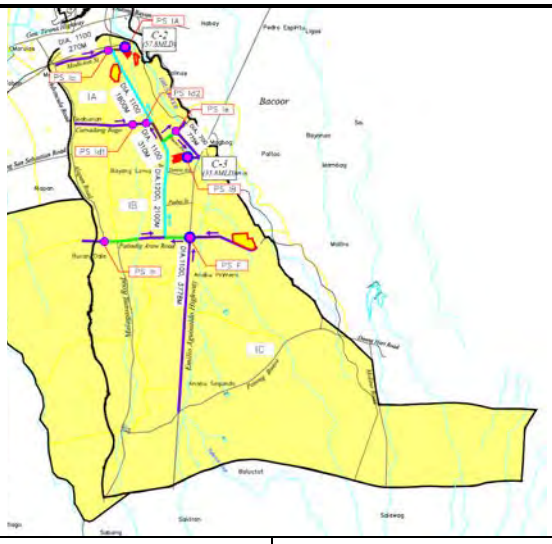
		Option SBR-IMS-1: SBR with Digestion Process (93,600m^3/day)		
1	**Location of Sewerage System**			
2	**General Facility Layout Plan**	**C-2** 	**C-A**	**C-3** 
3	**Capacity (m^3/day)**	57,800	-	35,800
4	**Required Area (ha)**	1.75	0.77	1.90
5	**Feature**	• Wastewater treatment facility is installed. • No sludge treatment process due to narrow access road.	• Sludge treatment facility is installed. • Sludge pipe is connected across the creek.	• STP will be constructed just beside the shopping mall.
6	**Initial Cost Total (mil. Php)**	3,809.65		
	Land	54.00	23.10	52.25
	Construction cost (Tax excluded)	1. STP (1,341.10) 2. Collection (1,003.29)		1. STP (891.95) 2. Collection (573.45)
7	**O&M (mil. Php/yr)**	229.47		
	Energy (mil. Php/yr)	STP: 67.40 , Collection: 2.77		STP: 41.75 , Collection: 1.76
	Chemical (mil. Php/yr)	STP: 1.52		STP: 0.94
	Disposal (mil. Php/yr)	STP: 2.03		STP: 1.25
	Manpower (mil. Php/yr)	STP: 6.19		STP: 3.95
	Maintenance and Repair (mil. Php/yr)	STP: 52.02 , Collection: 9.17		STP: 33.83, Collection: 4.88
8	**Construction Duration (yr)**	2.0	1.0	1.5
9	**Advantage**	• C-2 can be used to install wastewater treatment facility without sludge treatment process.		
10	**Disadvantage**	• The construction permission will be required to install the sludge pipe across the creek. It may take a certain time for approval. • STP will be closer to the shopping mall. The odor should be controlled for sounding residential area.		

Table 2.6 Comparative Study on SBR for Imus City (2/5)

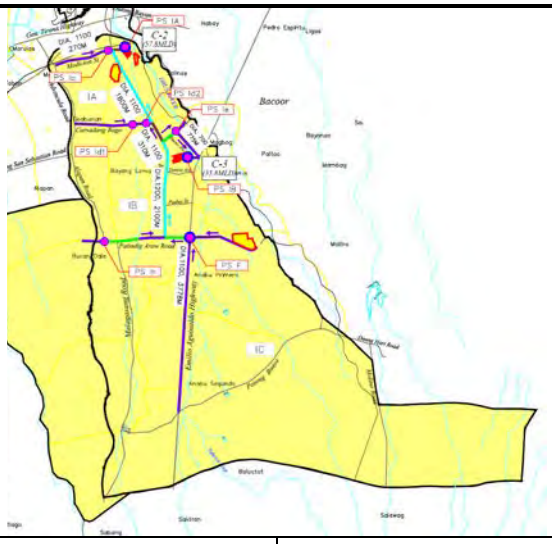
		Option SBR-IMS-2: SBR without Digestion Process (93,600m^3/day)		
1	**Location of Sewerage System**			
2	**General Facility Layout Plan**	**C-2** 	**C-A**	**C-3** 
3	**Capacity (m^3/day)**	57,800	-	35,800
4	**Required Area (ha)**	1.75	0.34	1.82
5	**Feature**	• Wastewater treatment facility is installed. • No sludge treatment process due to narrow access road.	• Sludge treatment facility is installed. • Sludge pipe is connected across the creek.	• STP will be constructed just beside the shopping mall. • The required land will be smaller than SBR-IMS-1.
6	**Initial Cost Total (mil. Php)**	3,767.64		
	Land	54.00	10.20	50.05
	Construction cost (Tax excluded)	1. STP (1,311.03) 2. Collection (1,003.29)		1. STP (879.87) 2. Collection (573.45)
7	**O&M (mil. Php/yr)**	211.64		
	Energy (mil. Php/yr)	STP: 67.40 , Collection: 2.77		STP: 41.75 , Collection: 1.76
	Chemical (mil. Php/yr)	STP: 1.52		STP: 0.94
	Disposal (mil. Php/yr)	STP: 1.62		STP: 1.00
	Manpower (mil. Php/yr)	STP: 6.19		STP: 3.95
	Maintenance and Repair (mil. Php/yr)	STP: 41.62, Collection: 9.17		STP: 27.06 , Collection: 4.88
8	**Construction Duration (yr)**	2.0	1.0	1.5
9	**Advantage**	• C-2 can be used to install wastewater treatment facility without sludge treatment process.		
10	**Disadvantage**	• The construction permission will be required to install the sludge pipe across the creek. It may take a certain time for approval. • STP will be closer to the shopping mall. The odor should be controlled for sounding residential area because no digestion process is installed.		

Table 2.7 Comparative Study on SBR for Imus City (3/5)

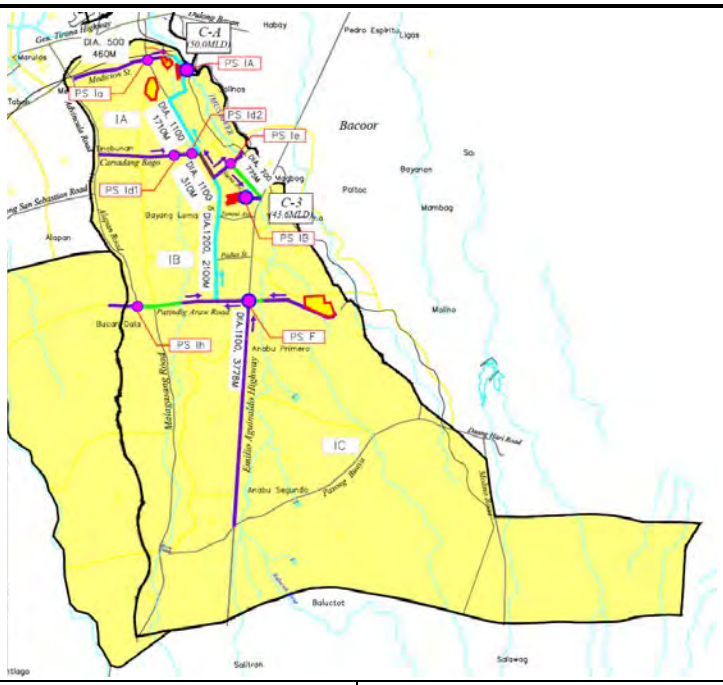
		Option SBR-IMS-3: SBR with Digestion Process (93,600m³/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-A** 	**C-3** 
3	**Capacity (m³/day)**	50,000	43,600
4	**Required Area (ha)**	2.18	2.07
5	**Feature**	• The site is close to the existing road and creek. • The shape of the land is suitable for STP. • Digestion gas can be utilized for power generation and used inside STP.	• STP will be constructed just beside the shopping mall. • Digestion gas can be utilized for power generation and used inside STP.
6	**Initial Cost Total (mil. Php)**	3,866.02	
	Land	65.40	56.93
	Construction cost (Tax excluded)	1. STP (1,195.42) 2. Collection (997.71)	1. STP (1,080.57) 2. Collection (592.33)
7	**O&M (mil. Php/yr)**	233.33	
	Energy (mil. Php/yr)	STP: 58.31 , Collection: 3.15	STP: 50.85 , Collection: 1.90
	Chemical (mil. Php/yr)	STP: 1.31	STP: 1.15
	Disposal (mil. Php/yr)	STP: 1.75	STP: 1.53
	Manpower (mil. Php/yr)	STP: 5.41	STP: 4.77
	Maintenance and Repair (mil. Php/yr)	STP: 47.25, Collection: 9.63	STP: 41.20, Collection: 5.14
8	**Construction Duration (yr)**	2.0	2.0
9	**Advantage**	• It will be easier to control/maintain STPs comparing with SBR-IMS-1 and SBR-IMS-2 because only 2 STPs are required.	
10	**Disadvantage**	• STP will be closer to the shopping mall. The odor should be controlled for sounding residential area.	

Table 2.8 Comparative Study on SBR for Imus City (4/5)

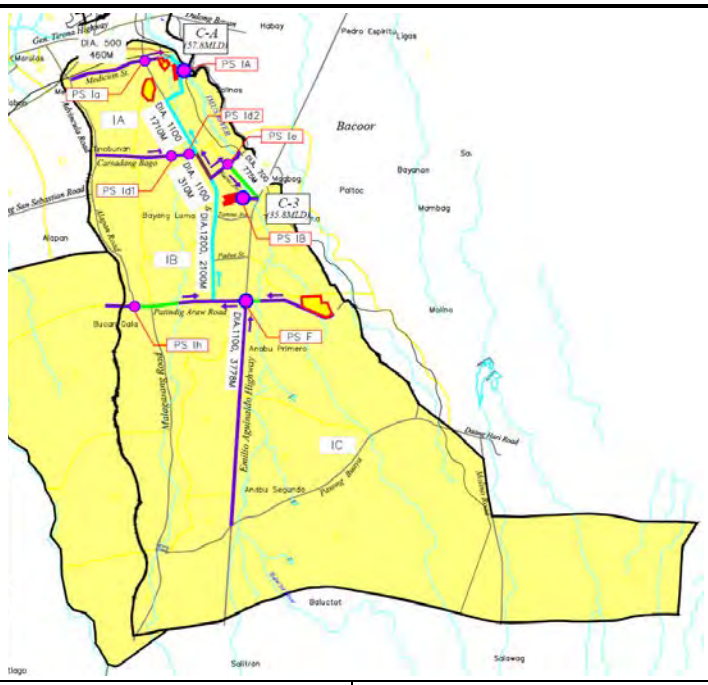
		Option SBR-IMS-4: SBR without Digestion Process (93,600m^3/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-A** 	**C-3** 
3	**Capacity (m^3/day)**	57,800	35,800
4	**Required Area (ha)**	2.18	1.82
5	**Feature**	• No digestion process • The site is close to the existing road and creek. • The shape of the land is suitable for STP.	• No digestion process • STP will be constructed just beside the shopping mall.
6	**Initial Cost Total (mil. Php)**	3,853.02	
	Land	65.40	50.05
	Construction cost (Tax excluded)	1. STP (1,350.42) 2. Collection (1,049.28)	1. STP (879.87) 2. Collection (573.45)
7	**O&M (mil. Php/yr)**	233.32	
	Energy (mil. Php/yr)	STP: 67.40, Collection: 3.25	STP: 41.75, Collection: 1.76
	Chemical (mil. Php/yr)	STP: 1.52	STP: 0.94
	Disposal (mil. Php/yr)	STP: 2.03	STP: 1.00
	Manpower (mil. Php/yr)	STP: 6.19	STP: 3.95
	Maintenance and Repair (mil. Php/yr)	STP: 43.70, Collection: 10.05	STP: 27.06, Collection: 4.88
8	**Construction Duration (yr)**	2.0	1.5
9	**Advantage**	• It will be easier to control/maintain STPs comparing with SBR-IMS-1 and SBR-IMS-2 because only 2 STPs are required.	
10	**Disadvantage**	• Sludge generation volume will be more than SBR-IMS-3 because no digestion process is installed. • STP will be closer to the shopping mall. The odor should be controlled for sounding residential area.	

Table 2.9 Comparative Study on SBR for Imus City (5/5)

		Option SBR-IMS-5: SBR with Digestion Process (93,600m³/day)	Option SBR-IMS-6: SBR without Digestion Process (93,600m³/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-B** 	**C-B** 
3	**Capacity (m³/day)**	93,600	93,600
4	**Required Area (ha)**	3.27	3.21
5	**Feature**	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-B site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBR-IMS-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBR-IMS-5.
6	**Initial Cost Total (mil. Php)**	3,649.27	3,625.02
	Land	65.40	64.20
	Construction cost (Tax excluded)	1. STP (1,977.85) 2. Collection (1,671.42)	1. STP (1,953.60) 2. Collection (1,671.42)
7	**O&M (mil. Php/yr)**	224.80	208.14
	Energy (mil. Php/yr)	STP: 109.15, Collection: 4.58	STP: 109.15, Collection: 4.58
	Chemical (mil. Php/yr)	STP: 2.46	STP: 2.46
	Disposal (mil. Php/yr)	STP: 3.28	STP: 2.62
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 80.03, Collection: 15.73	STP: 64.02, Collection: 15.73
8	**Construction Duration (yr)**	3.0	2.5
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily.	• Same as MBR-IMS-5
10	**Disadvantage**	• Both construction cost and O&M cost are slightly higher than CAS.	• Same as MBR-IMS-5 • Generated sludge will be more than MBR-IMS-5, because no digestion process is installed.

Table 2.10 Comparative Study on MBBR for Imus City (1/5)

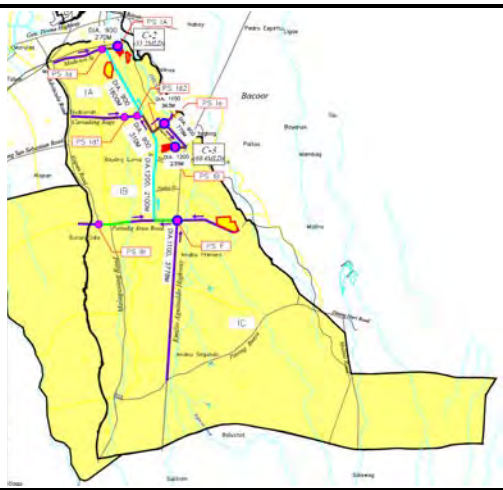
		Option MBBR-IMS-1: MBBR with Digestion Process (93,600m^3/day)		
1	**Location of Sewerage System**			
2	**General Facility Layout Plan**	**C-2**	**C-A**	**C-3**
				
3	**Capacity (m^3/day)**	33,200	-	60,400
4	**Required Area (ha)**	1.23	0.72	2.06
5	**Feature**	• Wastewater treatment facility is installed. • No sludge treatment process due to narrow access road.	• Sludge treatment facility is installed. • Sludge pipe is connected across the creek.	• STP will be constructed just beside the shopping mall.
6	**Initial Cost Total (mil. Php)**	4,052.51		
	Land	36.90	21.60	67.10
	Construction cost (Tax excluded)	1. STP (918.00) 2. Collection (934.90)		1. STP (1533.85) 2. Collection (665.77)
7	**O&M (mil. Php/yr)**	236.79		
	Energy (mil. Php/yr)	STP: 25.81, Collection:2.32		STP: , Collection:
	Chemical (mil. Php/yr)	STP: 0.87		STP: 1.59
	Disposal (mil. Php/yr)	STP: 1.49		STP: 2.71
	Manpower (mil. Php/yr)	STP: 3.83		STP: 6.47
	Maintenance and Repair (mil. Php/yr)	STP: 44.04, Collection: 8.18		STP: 80.13, Collection: 8.73
8	**Construction Duration (yr)**	1.5	1.0	2.5
9	**Advantage**	• C-2 can be used to install wastewater treatment facility without sludge treatment process.		
10	**Disadvantage**	• The construction permission will be required to install the sludge pipe across the creek. It may take a certain time for approval. • STP will be closer to the shopping mall. The odor should be controlled for sounding residential area.		

Table 2.11 Comparative Study on MBBR for Imus City (2/5)

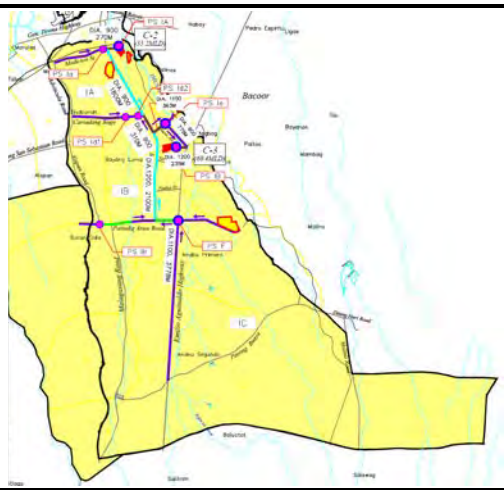
		Option MBBR-IMS-2: MBBR without Digestion Process (93,600m³/day)		
1	**Location of Sewerage System**			
2	**General Facility Layout Plan**	**C-2** 	**C-A**	**C-3** 
3	**Capacity (m³/day)**	33,200	-	60,400
4	**Required Area (ha)**	1.23	0.34	1.91
5	**Feature**	• Wastewater treatment facility is installed. • No sludge treatment process due to narrow access road.	• Sludge treatment facility is installed. • Sludge pipe is connected across the creek.	• STP will be constructed just beside the shopping mall. • The sludge generation volume will be more than MBBR-IMS-1.
6	**Initial Cost Total (mil. Php)**	3,987.90		
	Land	36.90	10.20	52.53
	Construction cost (Tax excluded)	1. STP (894.36) 2. Collection (934.90)		1. STP (1,492.88) 2. Collection (665.77)
7	**O&M (mil. Php/yr)**	211.11		
	Energy (mil. Php/yr)	STP: 25.81, Collection:2.32		STP: 46.96, Collection: 3.66
	Chemical (mil. Php/yr)	STP: 0.87		STP: 1.59
	Disposal (mil. Php/yr)	STP: 1.19		STP: 2.17
	Manpower (mil. Php/yr)	STP: 3.83		STP: 6.47
	Maintenance and Repair (mil. Php/yr)	STP: 35.24, Collection: 8.18		STP: 64.10, Collection: 8.73
8	**Construction Duration (yr)**	1.5	1.0	2.5
9	**Advantage**	• C-2 can be used to install wastewater treatment facility without sludge treatment process.		
10	**Disadvantage**	• The construction permission will be required to install the sludge pipe across the creek. It may take a certain time for approval. • STP will be closer to the shopping mall. The odor should be controlled for sounding residential area because no digestion process is installed.		

Table 2.12 Comparative Study on MBBR for Imus City (3/5)

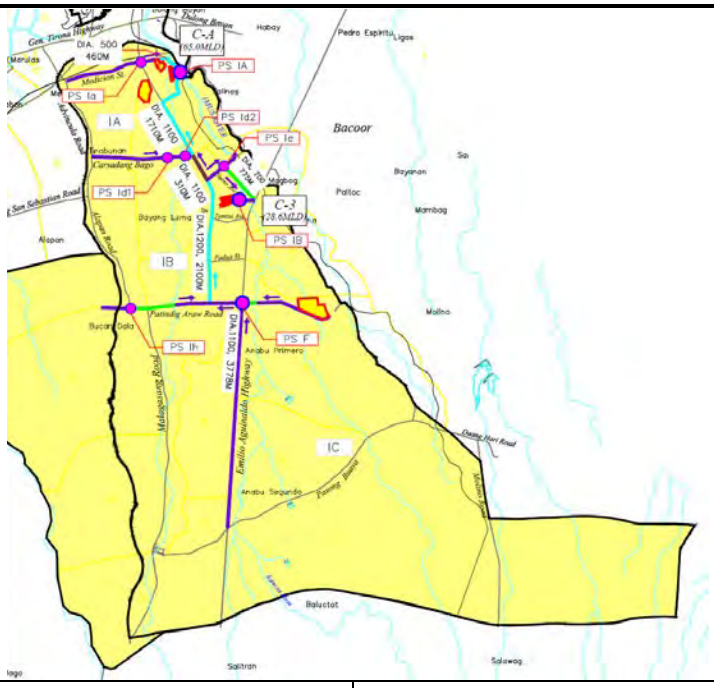
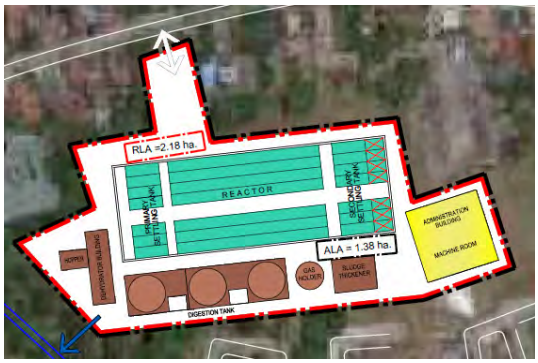
		Option MBBR-IMS-3: MBBR with Digestion Process (93,600m^3/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	C-A 	C-3 
3	**Capacity (m^3/day)**	65,000	28,600
4	**Required Area (ha)**	2.18	1.27
5	**Feature**	• The site is close to the existing road and creek. • The shape of the land is suitable for STP. • Digestion gas can be utilized for power generation and used inside STP.	• STP will be constructed just beside the shopping mall. • Digestion gas can be utilized for power generation and used inside STP.
6	**Initial Cost Total (mil. Php)**	4,091.19	
	Land	65.40	34.93
	Construction cost (Tax excluded)	1. STP (1,637.23) 2. Collection (1,099.13)	1. STP (783.13) 2. Collection (571.69)
7	**O&M (mil. Php/yr)**	236.03	
	Energy (mil. Php/yr)	STP: 50.53 Collection: 3.20	STP: 22.24, Collection: 1.52
	Chemical (mil. Php/yr)	STP: 1.71	STP: 0.75
	Disposal (mil. Php/yr)	STP: 2.92	STP: 1.28
	Manpower (mil. Php/yr)	STP: 6.85	STP: 3.35
	Maintenance and Repair (mil. Php/yr)	STP: 87.41, Collection: 11.34	STP: 38.46, Collection: 4.47
8	**Construction Duration (yr)**	2.5	1.0
9	**Advantage**	• It will be easier to control/maintain STPs comparing with MBBR-IMS-1 and MBBR-IMS-2 because only 2 STPs are required.	
10	**Disadvantage**	• STP will be closer to the shopping mall. The odor should be controlled for sounding residential area.	

Table 2.13 Comparative Study on MBBR for Imus City (4/5)

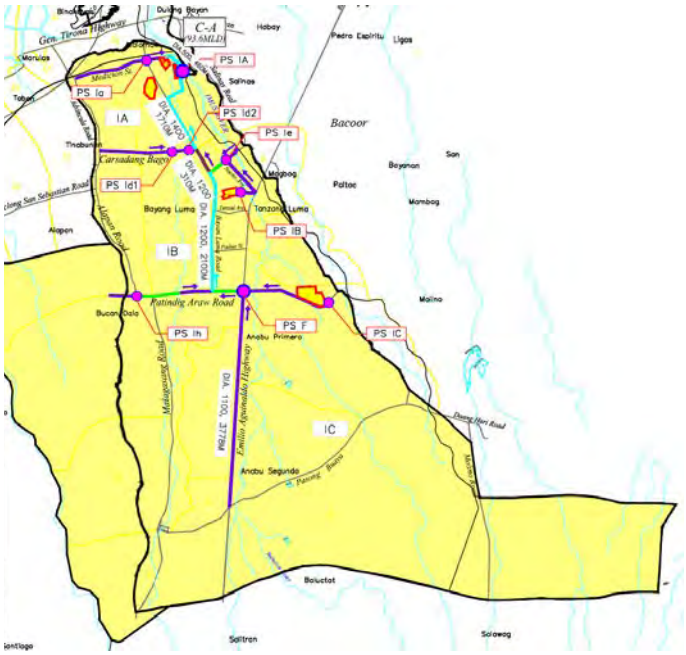
		Option MBBR-IMS-4: MBBR without Digestion Process (93,600m^3/day)	
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-A** 	
3	**Capacity (m^3/day)**	93,600	
4	**Required Area (ha)**	2.18	
5	**Feature**	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-A site. • Digestion process is not included in this option.	
6	**Initial Cost Total (mil. Php)**	3,903.62	
	Land	65.40	
	Construction cost (Tax excluded)	1. STP (2,200.55) 2. Collection (1,703.07)	
7	**O&M (mil. Php/yr)**	223.54	
	Energy (mil. Php/yr)	STP: 72.77, Collection: 4.69	
	Chemical (mil. Php/yr)	STP: 2.46	
	Disposal (mil. Php/yr)	STP: 2.33	
	Manpower (mil. Php/yr)	STP: 9.56	
	Maintenance and Repair (mil. Php/yr)	STP: 115.67, Collection: 16.05	
8	**Construction Duration (yr)**	3.0	
9	**Advantage**	• Only 1 STP with MBBR is necessary for Imus; No another land is required.	
10	**Disadvantage**	• Total cost is higher than CAS and SBR because the media should be maintained. • No digestion process. Therefore, sludge volume reduction cannot be conducted.	

Table 2.14 Comparative Study on MBBR for Imus City (5/5)

		Option MBBR-IMS-5: MBBR with Digestion Process (93,600m^3/day)	Option MBBR-IMS-6: MBBR without Digestion Process (93,600m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**C-B** 	**C-B** 
3	**Capacity (m^3/day)**	93,600	93,600
4	**Required Area (ha)**	2.71	2.58
5	**Feature**	• The site is close to the existing road and creek. • All wastewater generated in Imus City can be treated at C-B site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBBR-IMS-5. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBBR-IMS-5.
6	**Initial Cost Total (mil. Php)**	3,913.98	3,883.63
	Land	54.20	51.60
	Construction cost (Tax excluded)	1. STP (2,242.56) 2. Collection (1,703.07)	1. STP (2,212.20) 2. Collection (1,703.07)
7	**O&M (mil. Php/yr)**	230.52	224.14
	Energy (mil. Php/yr)	STP: 72.77, Collection: 4.58	STP: 72.77, Collection: 4.58
	Chemical (mil. Php/yr)	STP: 2.46	STP: 2.46
	Disposal (mil. Php/yr)	STP: 4.20	STP: 3.36
	Manpower (mil. Php/yr)	STP: 9.56	STP: 9.56
	Maintenance and Repair (mil. Php/yr)	STP: 121.21, Collection: 15.73	STP: 115.67, Collection: 15.73
8	**Construction Duration (yr)**	3.0	2.5
9	**Advantage**	• All wastewater in Imus city can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Imus city can be planned easily.	• Same as MBBR-IMS-5
10	**Disadvantage**	• Both construction cost and O&M cost are slightly higher than CAS.	• Same as MBBR-IMS-5 • Generated sludge will be more than MBBR-IMS-5, because no digestion process is installed.

Table 3.1 Comparative Study on CAS for Kawit Town (1/1)

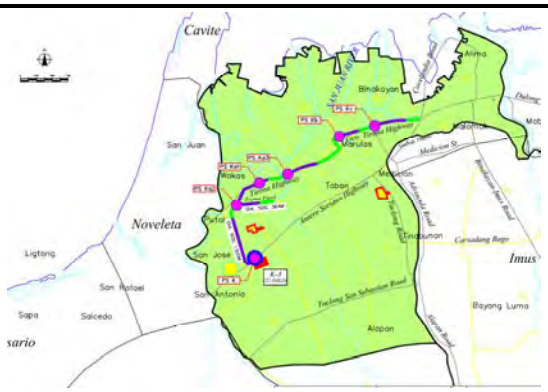
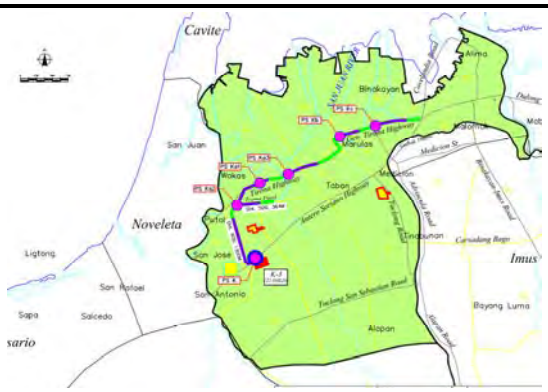
		Option CAS-KWT-1: CAS with Digestion Process (22,000m^3/day)	Option CAS-KWT-2: CAS with Digestion Process (22,000m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**K-3** 	**K-3** 
3	**Capacity (m^3/day)**	22,000	22,000
4	**Required Area (ha)**	1.59	0.90
5	**Feature**	• The site is close to the existing road, however, the creek is far from STP. • The required STP area can be minimized by adoption of the deep type CAS. • All wastewater generated in Kawit City can be treated at K-3 site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as CAS-KWT-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option CAS-KWT-1.
6	**Initial Cost Total (mil. Php)**	1,030.77	968.77
	Land	111.30	63.00
	Construction cost(Tax excluded)	1. STP (772.78) 2. Collection (308.00)	1. STP (660.78) 2. Collection (308.00)
7	**O&M (mil. Php/yr)**	53.83	49.59
	Energy (mil. Php/yr)	STP: 22.81, Collection: 2.35	STP: 22.81, Collection: 2.35
	Chemical (mil. Php/yr)	STP: 0.58	STP: 0.58
	Disposal (mil. Php/yr)	STP: 0.86	STP: 0.69
	Manpower (mil. Php/yr)	STP: 2.67	STP: 2.67
	Maintenance and Repair (mil. Php/yr)	STP:20.33, Collection: 4.24	STP:16.26, Collection: 4.24
8	**Construction Duration (yr)**	1.0	1.0
9	**Advantage**	• All wastewater in Kawit town can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Kawit town can be planned easily. • Efficient operation can be conducted because only one STP is operated in Kawit town.	• Same as CAS-KWT-1
10	**Disadvantage**	• The whole area will be unnecessary in the available area, however, it may be difficult to purchase only the required area. (negotiation with the land honor is necessary)	• Same as CAS-KWT-1 • Generated sludge will be more than CAS-KWT-1, because no digestion process is installed.

Table 3.2 Comparative Study on MBR for Kawit Town (1/2)

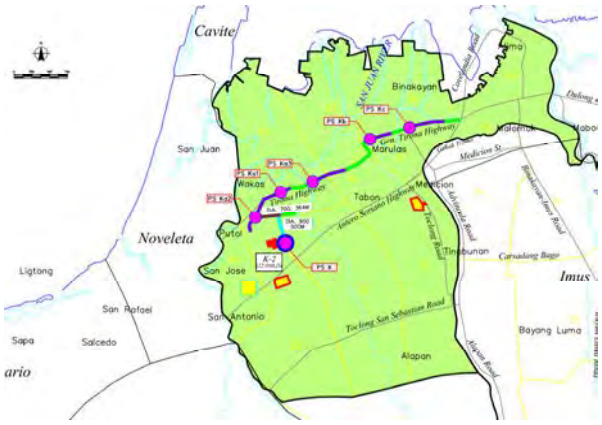
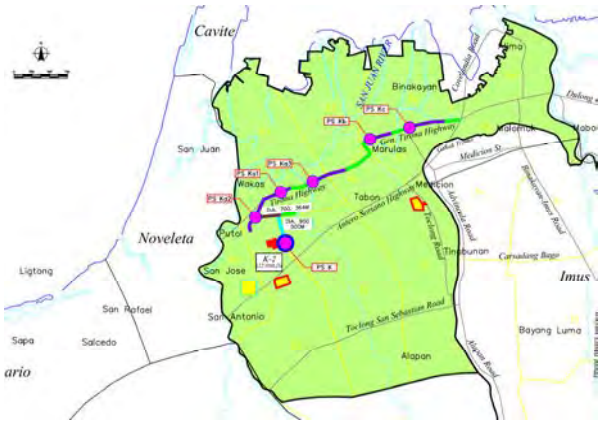
		Option MBR-KWT-1: MBR with Digestion Process (22,000m^3/day)	Option MBR-KWT-2: MBR without Digestion Process (22,000m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**K-2** 	**K-2** 
3	**Capacity (m^3/day)**	22,000	22,000
4	**Required Area (ha)**	0.91	0.91
5	**Feature**	• The site is close to the existing road, however, the creek is far from STP. • All wastewater generated in Kawit City can be treated at K-2 site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBR-KWT-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBR-KWT-1.
6	**Initial Cost Total (mil. Php)**	1,196.33	1,183.38
	Land	44.46	44.46
	Construction cost (Tax excluded)	1. STP (948.82) 2. Collection (247.51)	1. STP (935.87) 2. Collection (247.51)
7	**O&M (mil. Php/yr)**	88.34	86.81
	Energy (mil. Php/yr)	STP: 26.80, Collection: 2.34	STP: 26.80, Collection: 2.34
	Chemical (mil. Php/yr)	STP: 8.75	STP: 8.75
	Disposal (mil. Php/yr)	STP: 0.56	STP: 0.45
	Manpower (mil. Php/yr)	STP: 2.67	STP: 2.67
	Maintenance and Repair (mil. Php/yr)	STP:43.38, Collection: 3.84	STP:41.96, Collection: 3.84
8	**Construction Duration (yr)**	1.0	1.0
9	**Advantage**	• All wastewater in Kawit town can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Kawit town can be planned easily. • Efficient operation can be conducted because only one STP is operated in Kawit town.	• Same as MBR-KWT-1
10	**Disadvantage**	• The whole area will be unnecessary in the available area, however, it may be difficult to purchase only the required area. (negotiation with the land honor is necessary)	• Same as CAS-KWT-1 • Generated sludge will be more than MBR-KWT-1, because no digestion process is installed.

Table 3.3 Comparative Study on MBR for Kawit Town (2/2)

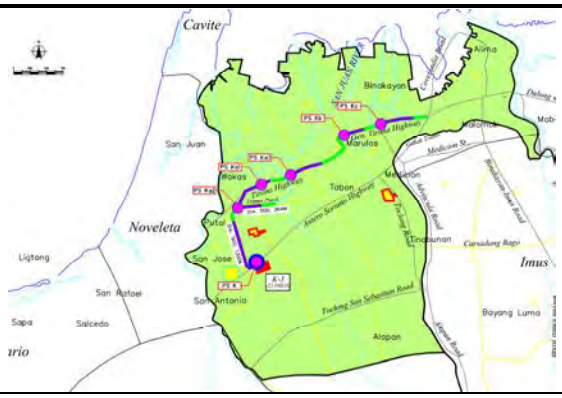
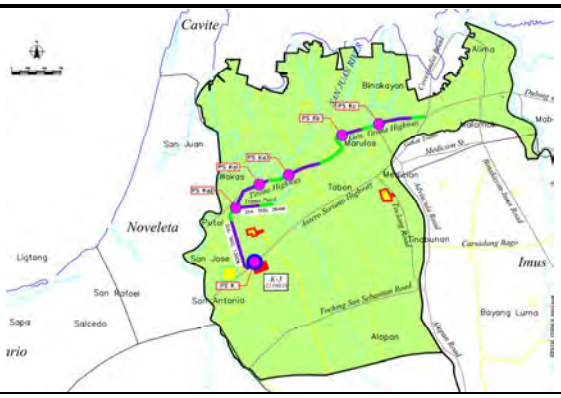
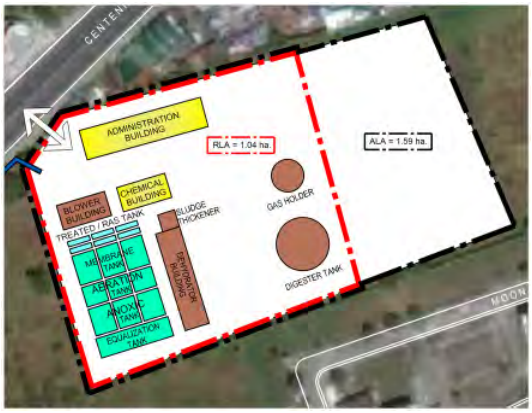
		Option MBR-KWT-3: MBR with Digestion Process (22,000m^3/day)	Option MBR-KWT-4: MBR without Digestion Process (22,000m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**K-3** 	**K-3** 
3	**Capacity (m^3/day)**	22,000	22,000
4	**Required Area (ha)**	1.04	0.81
5	**Feature**	• The site is close to the existing road, however, the creek is far from STP. • All wastewater generated in Kawit City can be treated at K-3 site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBR-KWT-3. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBR-KWT-3.
6	**Initial Cost Total (mil. Php)**	1,288.89	1,258.45
	Land	72.80	56.70
	Construction cost (Tax excluded)	1. STP (980.89) 2. Collection (308.00)	1. STP (950.46) 2. Collection (308.00)
7	**O&M (mil. Php/yr)**	88.75	87.22
	Energy (mil. Php/yr)	STP: 26.80, Collection: 2.35	STP: 26.80, Collection: 2.35
	Chemical (mil. Php/yr)	STP: 8.75	STP: 8.75
	Disposal (mil. Php/yr)	STP: 0.56	STP: 0.45
	Manpower (mil. Php/yr)	STP: 2.67	STP: 2.67
	Maintenance and Repair (mil. Php/yr)	STP:43.38, Collection: 4.24	STP:41.96, Collection: 4.24
8	**Construction Duration (yr)**	1.0	1.0
9	**Advantage**	• All wastewater in Kawit town can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Kawit town can be planned easily. • Efficient operation can be conducted because only one STP is operated in Kawit town.	• Same as MBR-KWT-3
10	**Disadvantage**	• The whole area will be unnecessary in the available area, however, it may be difficult to purchase only the required area. (negotiation with the land honor is necessary)	• Same as CAS-KWT-3. • Generated sludge will be more than MBR-KWT-3, because no digestion process is installed.

Table 3.4 Comparative Study on SBR for Kawit City (1/1)

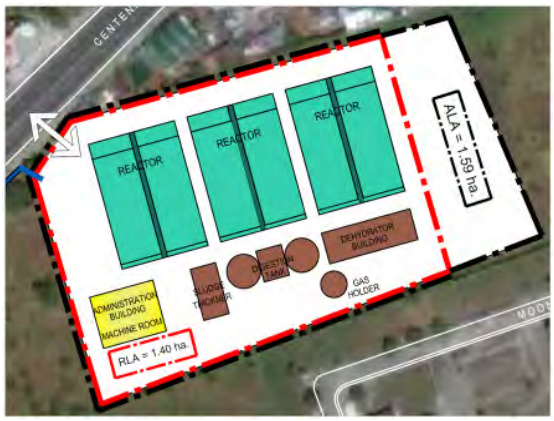
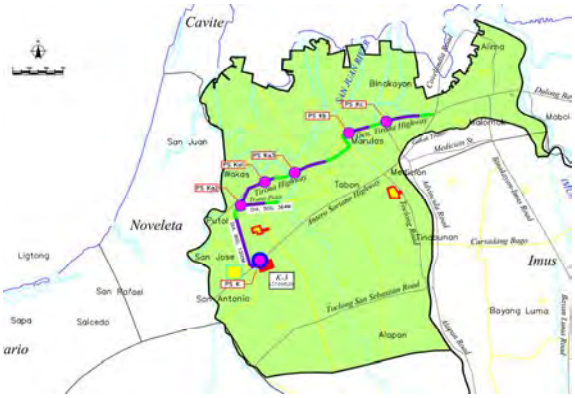
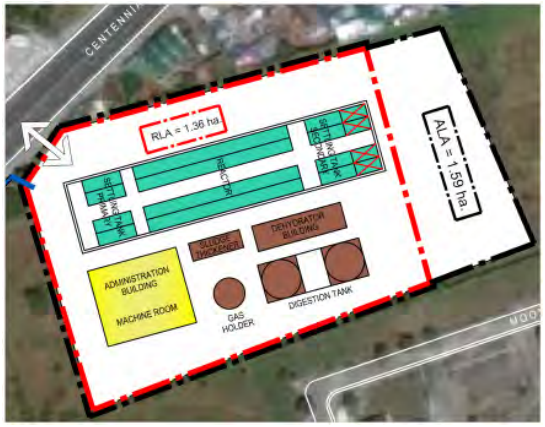
		Option SBR-KWT-1: SBR with Digestion Process (22,000m³/day)	Option SBR-KWT-2: SBR without Digestion Process (22,000m³/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**K-3** 	**K-3** 
3	**Capacity (m³/day)**	22,000	22,000
4	**Required Area (ha)**	1.40	1.29
5	**Feature**	• The site is close to the existing road, however, the creek is far from STP. • All wastewater generated in Kawit City can be treated at K-3 site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as SBR-KWT-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option SBR-KWT-1.
6	**Initial Cost Total (mil. Php)**	967.02	959.76
	Land	111.30	111.30
	Construction cost (Tax excluded)	1. STP (659.03) 2. Collection (308.00)	1. STP (651.77) 2. Collection (308.00)
7	**O&M (mil. Php/yr)**	56.59	52.37
	Energy (mil. Php/yr)	STP: 25.66, Collection: 2.35	STP: 25.66, Collection: 2.35
	Chemical (mil. Php/yr)	STP: 0.58	STP: 0.58
	Disposal (mil. Php/yr)	STP: 0.77	STP: 0.62
	Manpower (mil. Php/yr)	STP: 2.67	STP: 2.67
	Maintenance and Repair (mil. Php/yr)	STP:20.33, Collection: 4.24	STP:16.26, Collection: 4.24
8	**Construction Duration (yr)**	1.0	1.0
9	**Advantage**	• All wastewater in Kawit town can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Kawit town can be planned easily. • Efficient operation can be conducted because only one STP is operated in Kawit town.	• Same as SBR-KWT-1
10	**Disadvantage**	• The whole area will be unnecessary in the available area, however, it may be difficult to purchase only the required area. (negotiation with the land honor is necessary)	• Same as SBR-KWT-1. • Generated sludge will be more than SBR-KWT-1, because no digestion process is installed.

Table 3.5 Comparative Study on MBBR for Kawit City (1/1)

		Option MBBR-KWT-1: MBBR with Digestion Process (22,000m^3/day)	Option MBBR-KWT-2: MBBR without Digestion Process (22,000m^3/day)
1	**Location of Sewerage System**		
2	**General Facility Layout Plan**	**K-3** 	**K-3** 
3	**Capacity (m^3/day)**	22,000	22,000
4	**Required Area (ha)**	1.36	0.99
5	**Feature**	• The site is close to the existing road, however, the creek is far from STP. • All wastewater generated in Kawit City can be treated at K-3 site. • Digestion gas can be utilized for power generation and used inside STP.	• Same as MBBR-KWT-1. • Digestion process is not included in this option. The required area to be purchased will be smaller than Option MBBR-KWT-1.
6	**Initial Cost Total (mil. Php)**	1,026.65	972.80
	Land	111.30	69.30
	Construction cost (Tax excluded)	1. STP (718.65) 2. Collection (308.00)	1. STP (664.80) 2. Collection (308.00)
7	**O&M (mil. Php/yr)**	55.68	54.55
	Energy (mil. Php/yr)	STP: 17.10, Collection: 2.35	STP: 17.10, Collection: 2.35
	Chemical (mil. Php/yr)	STP: 0.58	STP: 0.58
	Disposal (mil. Php/yr)	STP: 0.99	STP: 0.79
	Manpower (mil. Php/yr)	STP: 2.67	STP: 2.67
	Maintenance and Repair (mil. Php/yr)	STP:27.75, Collection: 4.24	STP:26.82, Collection: 4.24
8	**Construction Duration (yr)**	1.0	1.0
9	**Advantage**	• All wastewater in Kawit town can be treated at only one (1) STP. • No other site for STP is necessary. Therefore, the sewerage development work in Kawit town can be planned easily. • Efficient operation can be conducted because only one STP is operated in Kawit town.	• Same as MBBR-KWT-1
10	**Disadvantage**	• The whole area will be unnecessary in the available area, however, it may be difficult to purchase only the required area. (negotiation with the land honor is necessary)	• Same as MBBR-KWT-1. • Generated sludge will be more than MBBR-KWT-1, because no digestion process is installed.

Appendix 7

Information and Data of Existing Outfall

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

Date Surveyed: 13 & 17 May 2016 City/Town: **Las Pinas** Weather: Fair - Cloudy - Rainy

Notes:

N1 - Water Depth (Full / PartlyFull)
N2 - Water Depth (Half)
N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
LP - Las Pinas
LPR - Las Pinas River
IC - Ilet Creek

Outfall Identification
LP-OF000
outfall number
City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Zapote River		LP-OF1	1600478.96	281172.44	14	28	5.59	120	58	11.43	X			X				X		X	X	4.00m wide box culvert crossing Diego Cera Avenue, catchment area - residential & commercial, on-going construction of sluiceway and bridge D/S of box culvert	4088, 4089
Las Piñas River		LP-OF2/LSP-OF003	1601179.76	282053.89	14	28	28.64	120	58	40.65												0.30m dia pipe culvert, no water flowing, catchment area - residential	4091
Las Piñas River		LP-OF3/LSP-OF004	1601180.74	282046.71	14	28	28.67	120	58	40.41												0.30m dia pipe culvert, no water flowing, catchment area - residential	4091
Las Piñas River		LP-OF4/LSP-OF007	1601159.01	282175.62	14	28	28.00	120	58	44.72	X			X				X			X	0.50m wide concrete box conduit located U/S of Pulang Lupa bridge, under the house, cannot confirm depth of channel, catchment area - residential	4095, 4096
Las Piñas River		LP-OF5/LSP-OF008	1601259.87	282520.67	14	28	31.38	120	58	56.21												0.60m dia pipe culvert U/S of bridge, no water flowing, about 80% clog at the outlet, catchment area - residential	4098, 4099
Las Piñas River		LP-OF6/LSP-OF009	1601283.69	282503.81	14	28	32.15	120	58	55.64												0.60m dia pipe culvert D/S of bridge, no water flowing, catchment area - open area	4100, 4101
	LPR Tributary River-2	LP-OF7	1601798.64	283024.73	14	28	49.05	120	59	12.88			X					X		X		0.70m dia pipe culvert located D/S of bridge, outlet partly submerge, catchment area - open area	4102, 4103
	LPR Tributary River-2	LP-OF8	1601790.41	283016.57	14	28	48.78	120	59	12.61			X					X		X		0.70m dia pipe culvert located D/S of bridge, outlet partly submerge, catchment area - open area	4104, 4105
	LPR Tributary River-2	LP-OF9	1601780.55	283054.22	14	28	48.47	120	59	13.87			X					X		X		0.70m dia pipe culvert located U/S of bridge, outlet partly submerge, catchment area - open area	4107
	LPR Tributary River-2	LP-OF10	1601770.46	283047.85	14	28	48.14	120	59	13.66			X					X		X		0.70m dia pipe culvert U/S of bridge, outlet partly submerge, catchment area - open area	4108

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N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
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OUTFALL INFORMATION																								
Main River	Tributary River/Waterway	ID	Coordinates								Findings/Observations											Other Remarks	Photo Reference No.
			UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
	LPR Tributary River-3 (Balot River)	LP-OF11	1601231.65	283143.75	14	28	30.64	120	59	17.02												0.70m dia pipe culvert located D/S of bridge, no water flowing, catchment area - open area	4110, 4111
	LPR Creek C	LP-OF12	1600857.39	281972.27	14	28	18.13	120	58	38.02			X					X		X		0.40m dia pipe culvert located D/S of box culvert, partly submerge, catchment area - residential & commercial	4115, 4116
	LPR Creek C	LP-OF13	1600819.17	281947.97	14	28	16.88	120	58	37.22			X					X		X		0.30m dia pipe culvert located U/S of box culvert, partly submerge, catchment area - residential & commercial	4117, 4118
Zapote River		LP-OF14/ZP-OF003	1599384.89	280997.39	14	27	29.95	120	58	5.91			X									0.30m dia pipe culvert along the concrete revetment, small amount of water flowing, catchment area - residential	4123
Zapote River		LP-OF15/ZP-OF004	1599401.54	280991.25	14	27	30.49	120	58	5.70												0.30m dia pipe culvert along the concrete revetment, no water flowing, catchment area - residential	4124
Zapote River		LP-OF16	1599333.31	281058.94	14	27	28.29	120	58	7.98												on-going construction of Zapote River bank protection and drainage outlet under DPWH, pipe culvert size range from 0.60m to 0.90m diameter (Contractor: EF Chua Construction)	4125, 4126, 4128, 4129, 4130, 4133, 4134, 4145, 4146, 4147, 4148
Zapote River		LP-OF17	1599311.65	281074.33	14	27	27.59	120	58	8.50													
Zapote River		LP-OF18	1599288.42	281094.19	14	27	26.84	120	58	9.17													
Zapote River		LP-OF19	1599262.39	281118.23	14	27	26.00	120	58	9.98													
Zapote River		LP-OF20	1599253.08	281127.43	14	27	25.70	120	58	10.29													
Zapote River		LP-OF21	1599195.53	281170.06	14	27	23.84	120	58	11.73													
Zapote River		LP-OF22	1599166.85	281179.99	14	27	22.91	120	58	12.07													
Zapote River		LP-OF23	1599139.12	281187.53	14	27	22.01	120	58	12.33													
Zapote River		LP-OF24	1599109.52	281197.16	14	27	21.05	120	58	12.66													
Zapote River		LP-OF25	1599082.99	281208.01	14	27	20.19	120	58	13.03													
Zapote River		LP-OF26	1599054.30	281218.84	14	27	19.26	120	58	13.40													
Zapote River		LP-OF27	1599025.32	281228.17	14	27	18.32	120	58	13.72													
Zapote River		LP-OF28	1598999.74	281235.13	14	27	17.49	120	58	13.96													
Zapote River		LP-OF29	1598970.21	281237.56	14	27	16.53	120	58	14.05													
Zapote River		LP-OF30	1598942.27	281233.42	14	27	15.62	120	58	13.92												on-going construction of Zapote	4125, 4126, 4128, 4129, 4130,

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

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N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
LP - Las Pinas
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Outfall Identification

LP-OF000

outfall number

City/Municipality

OUTFALL INFORMATION																								
Main River	Tributary River/Waterway	ID	Coordinates								Findings/Observations											Other Remarks	Photo Reference No.
			UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Zapote River		LP-OF31	1598911.61	281224.46	14	27	14.62	120	58	13.63												River bank protection and drainage outlet under DPWH, pipe culvert size range from 0.60m to 0.90m diameter (Contractor: EF Chua Construction)	4133, 4134, 4145, 4146, 4147, 4148
Zapote River		LP-OF32	1598884.27	281221.83	14	27	13.73	120	58	13.55													
Zapote River		LP-OF33	1598858.23	281211.71	14	27	12.88	120	58	13.22													
Zapote River		LP-OF34	1598835.32	281195.63	14	27	12.13	120	58	12.69													
Zapote River		LP-OF35	1598812.75	281174.76	14	27	11.39	120	58	12.00													
Zapote River		LP-OF36	1598782.10	281165.50	14	27	10.39	120	58	11.70													
Zapote River		LP-OF37	1598754.14	281162.86	14	27	9.48	120	58	11.62													
Zapote River		LP-OF38	1598721.19	281169.46	14	27	8.41	120	58	11.85													
Zapote River		LP-OF39	1598694.65	281180.91	14	27	7.55	120	58	12.24													
Zapote River		LP-OF40	1598668.48	281185.47	14	27	6.70	120	58	12.40													
Zapote River		LP-OF41	1598600.39	281168.39	14	27	4.48	120	58	11.85													
Zapote River		LP-OF42	1598572.80	281159.16	14	27	3.58	120	58	11.55													
Zapote River		LP-OF43	1598543.95	281153.81	14	27	2.64	120	58	11.38													
Zapote River		LP-OF44	1598514.42	281155.95	14	27	1.68	120	58	11.46													
Zapote River		LP-OF45/ZP-OF006	1598484.58	281158.08	14	27	0.71	120	58	11.54													
Zapote River		LP-OF46	1598456.85	281165.62	14	26	59.81	120	58	11.80													
Zapote River		LP-OF47	1598431.81	281180.98	14	26	59.00	120	58	12.32													
Zapote River		LP-OF48	1598405.31	281188.23	14	26	58.14	120	58	12.57													
Zapote River		LP-OF49	1598370.62	281183.43	14	26	57.01	120	58	12.42													
Zapote River		LP-OF50	1598347.59	281180.53	14	26	56.26	120	58	12.33													
Zapote River		LP-OF51	1598300.66	281168.13	14	26	54.73	120	58	11.93													
Zapote River		LP-OF52	1598269.95	281164.87	14	26	53.73	120	58	11.83													
Zapote River		LP-OF53	1598237.39	281161.28	14	26	52.67	120	58	11.72													
Zapote River		LP-OF54	1598219.55	281162.92	14	26	52.09	120	58	11.78													
Zapote River		LP-OF55/ZP-OF007	1598185.98	281169.82	14	26	51.00	120	58	12.02													
Zapote River		LP-OF56/ZP-OF008	1598154.00	281171.33	14	26	49.96	120	58	12.08												on-going construction of Zapote River bank protection and drainage outlet under DPWH, pipe culvert size range from 0.60m to 0.90m diameter (Contractor: EF Chua	4125, 4126, 4128, 4129, 4130, 4133, 4134, 4145, 4146, 4147, 4148
Zapote River		LP-OF57	1598049.84	281234.82	14	26	46.59	120	58	14.23													

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

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N6 - Water Color (Clear)
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N10 - Water Odor (Foul)
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U/S - upstream
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Outfall Identification

LP-OF000

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City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Zapote River		LP-OF58	1597993.58	281269.67	14	26	44.77	120	58	15.41												diameter (Contractor: EP Chua Construction)	
Zapote River		LP-OF59	1597971.96	281280.56	14	26	44.07	120	58	15.78													
Zapote River		LP-OF60	1597931.43	281310.76	14	26	42.76	120	58	16.80													
Zapote River		LP-OF61	1597916.87	281322.62	14	26	42.29	120	58	17.20													
Zapote River		LP-OF62	1597889.96	281342.15	14	26	41.42	120	58	17.86													
Zapote River		LP-OF63	1597824.35	281391.60	14	26	39.30	120	58	19.53													
Zapote River		LP-OF64	1597797.22	281399.75	14	26	38.42	120	58	19.81													
Zapote River		LP-OF65	1597769.22	281403.10	14	26	37.51	120	58	19.93													
Zapote River		LP-OF66	1597741.53	281405.25	14	26	36.61	120	58	20.01													
Zapote River		LP-OF67/ZP-OF009	1597708.32	281406.75	14	26	35.53	120	58	20.07													
Zapote River		LP-OF68	1597673.02	281435.20	14	26	34.39	120	58	21.03													
Zapote River		LP-OF69	1597633.76	281460.62	14	26	33.12	120	58	21.89													
Zapote River		LP-OF70	1597598.84	281481.28	14	26	31.99	120	58	22.59													
Zapote River		LP-OF71	1597567.37	281494.19	14	26	30.97	120	58	23.03													
Zapote River		LP-OF72	1597527.63	281502.82	14	26	29.68	120	58	23.33													
Zapote River		LP-OF73	1597491.07	281501.00	14	26	28.49	120	58	23.28													
Zapote River		LP-OF74/ZP-OF010	1597446.81	281500.01	14	26	27.05	120	58	23.26													
Zapote River		LP-OF75	1597419.22	281525.53	14	26	26.16	120	58	24.12													
Zapote River		LP-OF76	1597387.70	281544.43	14	26	25.14	120	58	24.76													
Zapote River		LP-OF77	1597349.71	281565.06	14	26	23.91	120	58	25.46													
Zapote River		LP-OF78	1597314.57	281575.84	14	26	22.77	120	58	25.83													
	ZR Creek B (Sin Nombre Creek)	LP-OF79/ZP-OF005	1598636.32	281206.75	14	27	5.66	120	58	13.12												2.0m wide x 2.0m high concrete box conduit outlet draining at ZR Creek B located U/S of bridge, no water flowing, outlet of Alabang-Zapote Septage Treatment Plant	4131, 4132
	ZR Creek B (Sin Nombre Creek)	LP-OF80	1598633.23	281209.42	14	27	5.56	120	58	13.21												0.90m dia pipe culvert located U/S of bridge, no water flowing, catchment area - factory	4131, 4132

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			UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Zapote River		LP-OF81	1597214.53	281729.54	14	26	19.56	120	58	30.99												cannot confirm outfall size located at the D/S of Molino Dam, only saw flowing water, covered with trees and vegetation, no access, catchement area - residential	4140, 4143
Zapote River		LP-OF82/ZP-OF026	1594870.69	283392.41	14	25	3.79	120	59	27.18			X					X		X		0.60m wide x 1.00m high concrete box conduit located D/S of bridge, small amount of water flowing, trash piled up at the outlet portion	4151
Zapote River		LP-OF83/ZP-OF027	1594872.76	283401.42	14	25	3.86	120	59	27.48												cannot confirm outfall size covered with roots of trees, located D/S of bridge, only saw flowing water, catchement area - residential & commercial	4152, 4153
Zapote River		LP-OF84/ZP-OF028	1594855.24	283401.26	14	25	3.29	120	59	27.48												0.60m dia pipe culvert located U/S of bridge, no water flowing, catchment area - residential & commercial	4154, 4155
	IC Creek C/Pasong Baka Creek	LP-OF85	1594857.94	283408.48	14	25	3.38	120	59	27.72												0.70m dia pipe culvert located U/S of bridge, no water flowing, catchment area - residential & commercial	4156, 4157
	IC Creek C/Pasong Baka Creek	LP-OF86	1594857.61	283410.87	14	25	3.37	120	59	27.80			X					X		X		0.60m dia pipe culvert located U/S of bridge, small amount of water flowing, catchment area - residential & commercial	4158, 4159, 4161
	LPR Tributary River-1 (Kay Kanti Creek)	LP-OF95	1601043.63	281560.25	14	28	24.07	120	58	24.21		X						X		X		0.60m dia pipe culvert located U/S of bridge, outlet half sumerge, catchment area - residential	4183, 4184
	LPR Tributary River-1 (Kay Kanti Creek)	LP-OF96	1601042.18	281550.35	14	28	24.02	120	58	23.88			X					X		X		0.40m wide x 0.40m high concrete box conduit, partly submerge outlet, catchment area - residential	4185, 4186

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		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
	LPR Creek E (Tartar Creek)	LP-OF97/TR-OF010	1598060.34	283220.48	14	26	47.50	120	59	20.51			X					X				0.70m dia pipe culvert located U/S of box culvert, small amount of water flowing, catchment area - residential, commercial, & open areas	4190, 4191
	LPR Creek E (Tartar Creek)	LP-OF98/TR-OF011	1598081.56	283219.77	14	26	48.19	120	59	20.48												0.70m dia pipe culvert located D/S of box culvert, no water flowing, catchment area - residential & commercial	4193, 4194
	LPR Creek E (Tartar Creek)	LP-OF99/TR-OF012	1598086.78	283219.82	14	26	48.36	120	59	20.48												0.60m dia pipe culvert located D/S of box culvert, no water flowing, catchment area - residential & commercial	4195
	LPR Creek E (Tartar Creek)	LP-OF100/TR-OF013	1598090.47	283220.15	14	26	48.48	120	59	20.49												1.20m dia pipe culvert located D/S of box culvert, no water flowing, catchment area - residential & commercial	4196, 4197
	LPR Creek E (Tartar Creek)	LP-OF101/TR-OF014	1598061.02	283212.70	14	26	47.52	120	59	20.25			X		X			X				0.70m dia pipe culvert located U/S of box culvert, small amount of water flowing, catchment area - residential & commercial	4198
Las Piñas River	(Kay Almirante Creek)	LP-OF102/KA-OF002	1598743.06	283680.60	14	27	9.84	120	59	35.67			X		X							0.70m dia pipe culvert located U/S of CAA Bridge, small amount of water flowing, catchment area - residential & commercial	4199, 4200
Las Piñas River	(Kay Almirante Creek)	LP-OF103/KA-OF003	1598755.04	283681.61	14	27	10.23	120	59	35.70			X		X							0.70m dia pipe culvert located U/S of CAA Bridge, small amount of water flowing, catchment area - residential & commercial	4199, 4200
Las Piñas River	(Kay Almirante Creek)	LP-OF104/KA-OF004	1598754.91	283662.13	14	27	10.22	120	59	35.05			X		X	X						1.00m wide x 1.00m high concrete box conduit, small amount of water flowing, catchment area - residential & comercial	4204, 4205

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

Date Surveyed: 13 & 17 May 2016 City/Town: **Las Pinas** Weather: Fair - Cloudy - Rainy

Notes:

N1 - Water Depth (Full / PartlyFull)
N2 - Water Depth (Half)
N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
LP - Las Pinas
LPR - Las Pinas River
IC - Ilet Creek

Outfall Identification

LP-OF000

outfall number

City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Las Piñas River	(Kay Almirante Creek)	LP-OF105/KA-OF005	1598742.63	283660.53	14	27	9.82	120	59	35.00			X		X							0.76m dia pipe culvert located D/S of CAA Bridge, small amount of water flowing, catchment area - residential & commercial	4206, 4207
Las Piñas River	(Manarigo Creek)	LP-OF106/MN-OF002	1599434.66	283022.24	14	27	32.15	120	59	13.49												0.10m dia pipe culvert located U/S of bridge, no water flowing, catchment area - residential	4210
Las Piñas River	(Manarigo Creek)	LP-OF107/MN-OF003	1599440.93	283008.82	14	27	32.35	120	59	13.04			X					X				0.60m dia pipe culvert located D/S of bridge, small amount of water flowing water flowing, catchment area - residential	4212, 4213
Las Piñas River	(Manarigo Creek)	LP-OF108/MN-OF004	1599433.58	283005.76	14	27	32.11	120	59	12.94												0.60m dia pipe culvert located D/S of bridge, no water flowing, catchment area - residential, school	4214, 4213
Las Piñas River	(Manarigo Creek)	LP-OF109/MN-OF005	1599441.29	283002.83	14	27	32.36	120	59	12.84			X									cannot confirm size of outfall, covered with vegetation/grass, small amount of water flowing, catchment area - residential	4217
Las Piñas River	(Naga Creek)	LP-OF110/NG-OF008	1600128.87	282699.73	14	27	54.64	120	59	2.52												0.90m dia pipe culvert located U/S of bridge, no water flowing, bridge and drainage under construction, catchment area - residential	4221, 4222
Las Piñas River	(Naga Creek)	LP-OF111/NG-OF009	1600140.82	282703.43	14	27	55.03	120	59	2.64												0.90m dia pipe culvert located D/S of bridge, outlet under water, bridge and drainage under construction, catchment area - residential	4220
Las Piñas River	(Naga Creek)	LP-OF112/NG-OF010	1600119.46	282720.62	14	27	54.34	120	59	3.22												0.90m dia pipe culvert located U/S of bridge, outlet partly submerge, bridge and drainage under construction, catchment area - residential	4224

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

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N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
LP - Las Pinas
LPR - Las Pinas River
IC - Ilet Creek

Outfall Identification

LP-OF000

outfall number

City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Las Piñas River	(Naga Creek)	LP-OF113/NG-OF011	1600131.43	282722.22	14	27	54.73	120	59	3.27												0.90m dia pipe culvert located D/S of bridge, outlet under water, bridge and drainage under construction, catchment area - residential, Note: Photo 4232 show manhole of OF186	4232
Las Piñas River	(Naga Creek)	LP-OF114/NG-OF012	1600071.69	282734.87	14	27	52.79	120	59	3.71												0.70m dia pipe culvert located U/S of bridge, small amount of water flowing, bridge and drainage under construction, catchment area - residential	4228, 4229
Las Piñas River	(Naga Creek)	LP-OF115/NG-OF013	1600068.77	282751.92	14	27	52.70	120	59	4.28												0.90m dia pipe culvert located U/S of bridge, no water flowing, Naga bridge and drainage under construction, catchment area - residential	4230, 4231
	LPR Creek B (Marulas Creek)	LP-OF116/ML-OF001	1601097.91	283215.67	14	28	26.31	120	59	19.46												cannot confirm size of outlet, covered with vegetation/grass, catchment area - residential	4236, 4237
	LPR Creek B (Marulas Creek)	LP-OF117/ML-OF002	1601106.47	283220.24	14	28	26.59	120	59	19.61												cannot confirm size of outlet, partly covered by stone masonry wall, catchment area - residential	4238, 4239
	LPR Creek B (Marulas Creek)	LP-OF118/ML-OF003	1601118.63	283235.62	14	28	26.99	120	59	20.12												cannot confirm size of outlet, covered with vegetation/grass, catchment area - residential	4242, 4243

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall-Las Pinas (FS)

Summary

Almanza Creek	15	AL	- Almanza Creek
Balot River	4	BL	- Balot River
Kay Almirante Creek	50	KA	- Kay Almirante Creek
Kay Kanti Creek	2	KK	- Kay Kanti Creek
Las Pinas River	12	TL	- Talon Creek
Manarigo Creek	12	TR	- TartarCreek
Marulas Creek	15	TT	- Tungtong Creek
Naga Creek	30	ZP	- Zapote River
Pasong Baka Creek	23	LSP	- Las Pinas River
Sin Nombre Creek	1	MN	- Manarigo Creek
Talon	40	PB	- Pasong Baka Creek
Tartar	14	SN	- Sin Nombre Creek
Tungtong Creek	8	CF	- Creek F
Zapote River	31		
Creek F	5		
Total	262		

OUTFALL INFORMATION		
River/Creek	ID	Total
Almanza Creek	AL-OF001	15
	AL-OF002	
	AL-OF003	
	AL-OF004	
	AL-OF005	
	AL-OF006	
	AL-OF007	
	AL-OF008	
	AL-OF009	
	AL-OF010	
	AL-OF011	
	AL-OF012	
	AL-OF013	
	AL-OF014	
	AL-OF015	
Balot River	BL-OF001	4
	BL-OF002	
	BL-OF003	
	BL-OF004	
Kay Almirante Creek	KA-OF001	50
	KA-OF002/LP-OF102	
	KA-OF003/LP-OF103	
	KA-OF004/LP-OF104	
	KA-OF005/LP-OF105	
	KA-OF006	
	KA-OF007	
	KA-OF008	
	KA-OF009	
	KA-OF010	
	KA-OF011	
	KA-OF012	
	KA-OF013	
	KA-OF014	
	KA-OF015	
	KA-OF016	
	KA-OF017	
	KA-OF018	
	KA-OF019	
	KA-OF020	
	KA-OF021	
	KA-OF022	
	KA-OF023	

OUTFALL INFORMATION		
River/Creek	ID	Total
	KA-OF024	
	KA-OF025	
	KA-OF026	
	KA-OF027	
	KA-OF028	
	KA-OF029	
	KA-OF030	
	KA-OF031	
	KA-OF032	
	KA-OF033	
	KA-OF034	
	KA-OF035	
	KA-OF036	
	KA-OF037	
	KA-OF038	
	KA-OF039	
	KA-OF040	
	KA-OF041	
	KA-OF042	
	KA-OF043	
	KA-OF044	
	KA-OF045	
	KA-OF046	
	KA-OF047	
	KA-OF048	
	KA-OF049	
	KA-OF050	
Kay Kanti Creek	KK-OF001	2
	KK-OF002	
Las Pinas River	LSP-OF001	12
	LSP-OF002	
	LSP-OF003/LP-OF2	
	LSP-OF004/LP-OF3	
	LSP-OF005	
	LSP-OF006	
	LSP-OF007/LP-OF4	
	LSP-OF008/LP-OF5	
	LSP-OF009/LP-OF6	
	LSP-OF010	
	LSP-OF011	
	LSP-OF012	
Manarigo Creek	MN-OF001	12
	MN-OF002/LP-OF106	
	MN-OF003/LP-OF107	
	MN-OF004/LP-OF108	
	MN-OF005/LP-OF109	
	MN-OF006	
	MN-OF007	
	MN-OF008	
	MN-OF009	
	MN-OF010	
	MN-OF011	
	MN-OF012	
Marulas Creek	ML-OF001/LP-OF116	15
	ML-OF002/LP-OF117	
	ML-OF003/LP-OF118	
	ML-OF004	
	ML-OF005	
	ML-OF006	
	ML-OF007	
	ML-OF008	
	ML-OF009	

OUTFALL INFORMATION		
River/Creek	ID	Total
	ML-OF010	
	ML-OF011	
	ML-OF012	
	ML-OF013	
	ML-OF014	
	ML-OF015	
Naga Creek	NG-OF001	30
	NG-OF002	
	NG-OF003	
	NG-OF004	
	NG-OF005	
	NG-OF006	
	NG-OF007	
	NG-OF008/LP-OF110	
	NG-OF009/LP-OF111	
	NG-OF010/LP-OF112	
	NG-OF011/LP-OF113	
	NG-OF012/LP-OF114	
	NG-OF013/LP-OF115	
	NG-OF014	
	NG-OF015	
	NG-OF016	
	NG-OF017	
	NG-OF018	
	NG-OF019	
	NG-OF020	
	NG-OF021	
	NG-OF022	
	NG-OF023	
	NG-OF024	
	NG-OF025	
	NG-OF026	
	NG-OF027	
	NG-OF028	
	NG-OF029	
	NG-OF030	
Pasong Baka Creek	PB-OF001	23
	PB-OF002	
	PB-OF003	
	PB-OF004	
	PB-OF005	
	PB-OF006	
	PB-OF007	
	PB-OF008	
	PB-OF009	
	PB-OF010	
	PB-OF011	
	PB-OF012	
	PB-OF013	
	PB-OF014	
	PB-OF015	
	PB-OF016	
	PB-OF017	
	PB-OF018	
	PB-OF019	
	PB-OF020	
	PB-OF021	
	PB-OF022	
	PB-OF023	
Sin Nombre Creek	SN-OF001	1
Talon	TL-OF001	40
	TL-OF002	

OUTFALL INFORMATION		
River/Creek	ID	Total
	TL-OF003	
	TL-OF004	
	TL-OF005	
	TL-OF006	
	TL-OF007	
	TL-OF008	
	TL-OF009	
	TL-OF010	
	TL-OF011	
	TL-OF012	
	TL-OF013	
	TL-OF014	
	TL-OF015	
	TL-OF016	
	TL-OF017	
	TL-OF018	
	TL-OF019	
	TL-OF020	
	TL-OF021	
	TL-OF022	
	TL-OF023	
	TL-OF024	
	TL-OF025	
	TL-OF026	
	TL-OF027	
	TL-OF028	
	TL-OF029	
	TL-OF030	
	TL-OF031	
	TL-OF032	
	TL-OF033	
	TL-OF034	
	TL-OF035	
	TL-OF036	
	TL-OF037	
	TL-OF038	
	TL-OF039	
	TL-OF040	
Tartar	TR-OF001	14
	TR-OF002	
	TR-OF003	
	TR-OF004	
	TR-OF005	
	TR-OF006	
	TR-OF007	
	TR-OF008	
	TR-OF009	
	TR-OF010/LP-OF97	
	TR-OF011//LP-OF98	
	TR-OF012/LP-OF99	
	TR-OF013/LP-OF100	
	TR-OF014/LP-OF101	
Tungtong Creek	TT-OF001	8
	TT-OF002	
	TT-OF003	
	TT-OF004	
	TT-OF005	
	TT-OF006	
	TT-OF007	
	TT-OF008	
Zapote River	ZP-OF001	31
	ZP-OF002	

OUTFALL INFORMATION		
River/Creek	ID	Total
	ZP-OF003/LP-OF14	
	ZP-OF004/LP-OF15	
	ZP-OF005//LP-OF79	
	ZP-OF006/LP-OF45	
	ZP-OF007/LP-OF55	
	ZP-OF008/LP-OF56	
	ZP-OF009/LP-OF67	
	ZP-OF010/LP-OF74	
	ZP-OF011	
	ZP-OF012	
	ZP-OF013	
	ZP-OF014	
	ZP-OF015	
	ZP-OF016	
	ZP-OF017	
	ZP-OF018	
	ZP-OF019	
	ZP-OF020	
	ZP-OF021	
	ZP-OF022	
	ZP-OF023	
	ZP-OF024	
	ZP-OF025	
	ZP-OF026/LP-OF82	
	ZP-OF027/LP-OF83	
	ZP-OF028/LP-OF84	
	ZP-OF029	
	ZP-OF030	
	ZP-OF031	
Creek F	CF-OF001	5
	CF-OF002	
	CF-OF003	
	CF-OF004	
	CF-OF005	

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

Date Surveyed: 11-May-16 City/Town: **Imus** Weather: Fair - Cloudy - Rainy

Notes:

N1 - Water Depth (Full / PartlyFull)
N2 - Water Depth (Half)
N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
IM - Imus
IR - Imus River
BCR - Bacoor River
BR - Baluctot River

Outfall Identification
IM-OF000
outfall number
City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	ID	Coordinates								Findings/Observations											Other Remarks	Photo Reference No.
			UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
	IR Tributary River 1	IM-OF10	1597594.48	277005.45	14	26	30.55	120	55	53.19												0.80m x 0.80m concrete box located along the new concrete revetment, D/S of river confluence, no water	3903
	IR Tributary River 1	IM-OF11	1597580.43	277064.04	14	26	30.11	120	55	55.15												1.20m dia. concrete pipe, located beside the cemetery area, no water	3904
	IR Tributary River 1	IM-OF12	1597662.75	276934.46	14	26	32.75	120	55	50.80												2-1.20m dia. concrete pipe, located along the new concrete revetment D/S of river confluence, no water	3906, 3907
Imus River		IM-OF13	1596491.59	277845.79	14	25	54.92	120	56	21.57												0.70m dia. concrete pipe, located along the concrete revetment, no water flowing, partly covered by	3908, 3909
Imus River		IM-OF14	1596326.42	277958.15	14	25	49.58	120	56	25.37			X		X	X						0.60m dia. concrete pipe, U/S of Bridge of Isabel II, small amount of water flowing	3911
Imus River		IM-OF15	1596322.28	277940.14	14	25	49.44	120	56	24.77												0.30m dia. concrete pipe, D/S of Bridge of Isabel II, no water flowing	3914
Imus River		IM-OF16	1596322.92	277869.14	14	25	49.98	120	56	22.40			X		X	X						0.90m dia. concrete pipe, D/S of Bridge of Isabel II, small amount of water flowing	3913
	IR Tributary River 1	IM-OF17/C-E-404	1596441.06	277139.17	14	25	53.07	120	55	58.00			X		X	X						0.50m x 0.50m concrete box U/S of the bridge, located in Brgy. Medicion 1-A	3917
	IR Tributary River 1	IM-OF18/C-E-401	1597275.16	276960.93	14	26	20.15	120	55	51.80			X		X	X						0.60m dia. concrete pipe, D/S of bridge	3918, 3919
	IR Tributary River 1	IM-OF19/C-E-402	1597277.84	276971.14	14	26	20.24	120	55	52.14												0.30m dia. concrete pipe, D/S of bridge, no water flowing	3920
	IR Creek B	IM-OF20	1596029.06	277180.41	14	25	39.68	120	55	59.50			X		X			X				1.20m dia. concrete pipe, located near the bridge	3923
	IR Creek B	IM-OF21/C-E-407	1596028.77	277178.31	14	25	39.67	120	55	59.43												0.40m dia. concrete pipe, no water flowing	3923
Imus River		IM-OF22	1595600.96	278227.00	14	25	26.06	120	56	34.56			X		X			X				0.60m dia. concrete pipe, U/S of Imus bridge, small amount of water flowing	3925, 3926

Data Collection Survey for Sewerage Systems in West Metro Manila

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U/S - upstream
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OF - outfall
IM - Imus
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Outfall Identification
IM-OF000
outfall number
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OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
Imus River		IM-OF23	1595631.86	278244.05	14	25	27.07	120	56	35.12			X		X			X				0.90m dia. concrete pipe U/S of Imus bridge, small amount of water	3929, 3930, 3931
Imus River		IM-OF24	15995631.86	278244.05	14	25	27.07	120	56	35.12												1.20m dia. concrete pipe U/S of Imus bridge, no water flowing	3929, 3930, 3931
Imus River		IM-OF25	1595645.87	278225.00	14	25	27.52	120	56	34.48												0.50m x 0.50m concrete box D/S of Imus bridge, no flowing water	3932
Imus River		IM-OF26	1595633.65	278181.15	14	25	27.11	120	56	33.02												0.30m dia. CP D/S of Imus bridge, no flowing water	3933
Imus River		IM-OF27	1595640.50	278171.92	14	25	27.33	120	56	32.71												0.60m dia. concrete pipe D/S of Imus bridge, no flowing water	3933, 3934
Imus River		IM-OF28	1595651.99	278158.54	14	25	27.70	120	56	32.26												0.60m dia. concrete pipe D/S of Imus bridge, no flowing water	3933, 3934
Imus River		IM-OF29	1594452.08	278543.61	14	24	48.78	120	56	45.47												0.40m x 0.40m concrete box located along the concrete revetment, no flowing water	3937
Imus River		IM-OF30	1593709.60	278344.62	14	24	24.57	120	56	39.05			X		X			X				1.20m dia. concrete pipe D/S of bridge	3938, 3939
Imus River		IM-OF31	1593693.06	278337.88	14	24	24.03	120	56	38.83			X		X	X						1.20m dia. concrete pipe U/S of bridge	3940, 3941
	Ylang-ylang River	IM-OF32	1593467.10	279443.01	14	24	17.00	120	57	15.78												0.80m x 0.80m concrete box (old irrigation check structure), no	3942
	Ylang-ylang River	IM-OF33	1593475.97	279447.89	14	24	17.29	120	57	15.94			X		X			X				0.40m dia. concrete pipe U/S of bridge, small amount of water	3943
	Ylang-ylang River	IM-OF34	1593480.83	279454.82	14	24	17.45	120	57	16.17			X		X			X				0.20m dia. concrete pipe U/S of bridge, small amount of water	3944
	Ylang-ylang River	IM-OF35	1593496.39	279467.54	14	24	17.96	120	57	16.59												0.40m dia. concrete pipe U/S of bridge, no water flowing	3945
	Ylang-ylang River	IM-OF36	1593498.42	279446.59	14	24	18.02	120	57	15.89			X		X			X				0.40m dia. concrete pipe D/S of bridge, small amount of water	3946
	Ylang-ylang River	IM-OF37	1591502.14	280306.26	14	23	13.33	120	57	45.17												1.0m x 1.0m concrete U/S of the bridge, no water flowing, near on-going housing development	3953, 3954
	Ylang-ylang River	IM-OF38	1591527.70	280300.79	14	23	14.16	120	57	44.89												1.0m x 1.0m concrete box D/S of the bridge, no water flowing, near on-going housing development	3957, 3958

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

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N1 - Water Depth (Full / PartlyFull)
N2 - Water Depth (Half)
N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
IM - Imus
IR - Imus River
BCR - Bacoor River
BR - Baluctot River

Outfall Identification
IM-OF000
outfall number
City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
	BR Creek A-3	IM-OF39	1590249.99	278612.83	14	22	32.11	120	56	49.03												0.90m dia. concrete U/S of bridge, no water flowing	3964
	BR Creek A-3	IM-OF40	1590275.54	278608.86	14	22	32.94	120	56	48.89												0.90m dia. concrete pipe D/S of bridge, no water flowing	3966
	IR Creek B	IM-OF41	1588697.85	276650.11	14	21	41.05	120	55	44.00			X					X				cannot confirm size of outfall covered by tree and grass	3974, 3975
	IR Creek B	IM-OF42	1588700.69	276676.20	14	21	41.15	120	55	44.87												concrete pipe, partly covered by grass, no water flowing	3976
	IR Creek B	IM-OF43/C-E-449	1588722.60	276667.11	14	21	41.86	120	55	44.56												concrete pipe, no water flowing, about 0.46m dia partly covered by some grasses	3978, 3979
	IR Creek B	IM-OF44	1590320.45	276989.22	14	22	33.93	120	55	54.83			X		X		X					1.20m dia concrete pipe located U/S of the bridge, small amount of water flowing	3980
	IR Creek B	IM-OF45	1590323.11	276966.77	14	22	34.01	120	55	54.08												cannot confirm size of outfall covered house, no flowing water	3982
	IR Creek B	IM-OF46	1590337.26	276965.39	14	22	34.47	120	55	54.03												0.61m dia concrete pipe located D/S of the bridge, no water flowing	3983
	IR Creek B	IM-OF47	1590338.55	276993.28	14	22	34.52	120	55	54.96												1.20m dia concrete pipe located D/S of the bridge, no water flowing	3984, 3985

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall-Imus (FS)

Summary

Imus River	13	IM	- Imus
IR Tributary River 1	5	IR	- Imus River
IR Creek B	19	OF	- Outfall
Along Alapan Street	1		
Along Advincula Road	4		
Along Patndig Araw Road	1		
Along Malagasang II Road	6		
Total	49		

OUTFALL INFORMATION		
River/Creek	ID	Total
Imus River	C-E-321	13
	C-E-322	
	C-E-323	
	C-E-324	
	C-E-325	
	C-E-326	
	C-E-328	
	C-E-360	
	C-E-371	
	C-E-372	
	C-E-373	
	C-E-374	
	C-E-381	
IR Tributary River 1	C-E-401	5
	C-E-402	
	C-E-403	
	C-E-404	
	C-E-405	
IR Creek B	C-E-407	19
	C-E-408	
	C-E-411	
	C-E-413	
	C-E-414	
	C-E-417	
	C-E-442	
	C-E-443	
	C-E-444	
	C-E-445	
	C-E-453	
	C-E-454	
	C-E-455	
	C-E-446	
	C-E-447	
	C-E-448/IM-OF43	
	C-E-449	
	C-E-450	
	C-E-451	
Along Alapan Street	C-E-154	1
Along Advincula Road	C-D-112	4
	C-D-113	
	C-D-114	
	C-D-151	
Along Patndig Araw Road	C-E-470	1
Along Malagasang II Road	C-D-152	6
	C-D-153	
	C-E-471	
	C-E-472	
	C-E-473	
	C-E-474	

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

Date Surveyed: 11 & 13 May 2016 City/Town: Kawit Weather: Fair - Cloudy - Rainy

Notes:

N1 - Water Depth (Full / PartlyFull)
N2 - Water Depth (Half)
N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
KW - Kawit
SJR - San Juan River

Outfall Identification

KW-OF000

outfall number

City/Municipality

OUTFALL INFORMATION																							
Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
San Juan River	SJR Tributary River 3	KW-OF1	1598029.07	274438.62	14	26	43.93	120	54	27.38												0.40m x 1.00m channel D/S of bridge, no water flowing, catchment area - residential	3991, 3992
	SJR Tributary River 3	KW-OF2	1597980.59	274428.89	14	26	42.35	120	54	27.07	X			X				X				1.00m wide box culvert U/S of bridge, cannot verify depth of outfall, almost fully submerge, catchment area - residential	3993, 3994
	SJR Tributary River 3	KW-OF3	1598020.09	274412.17	14	26	43.63	120	54	26.50		X		X				X				0.30m dia pipe culvert D/S of bridge, half submerged, catchment area - park	3996, 3997
	SJR Tributary River 3	KW-OF4	1598169.09	274423.12	14	26	48.48	120	54	26.82			X		X			X				0.60m wide x 1.50m high open channel U/S of bridge, catchment area - residential	4005, 4006
	SJR Tributary River 3	KW-OF5	1598165.67	274394.03	14	26	48.36	120	54	25.85			X					X				0.30m dia pipe culvert U/S of bridge, partly submerged, catchment area - park	4007
	SJR Tributary River 3	KW-OF6	1597763.34	273945.46	14	26	35.14	120	54	11.00			X	X				X		X	X	0.60m wide x 1.00m high channel outlet with concrete gate U/S of Tabon bridge, catchment area -	4010
	SJR Tributary River 3	KW-OF7	1597755.59	273952.58	14	26	34.89	120	54	11.24			X	X				X		X	X	0.60m wide x 1.20m high channel U/S of Tabon bridge, partly submerge, catchment area -	4011, 4012
	SJR Tributary River 3	KW-OF8	1597746.50	273946.50	14	26	34.58	120	54	11.04			X	X				X		X		0.50m wide x 1.00m high channel D/S of Tabon bridge, partly submerge, catchment area -	4016
	SJR Tributary River 3	KW-OF9	1597755.73	273937.90	14	26	34.89	120	54	10.75			X	X				X		X		0.50m wide x 1.50m high channel D/S of Tabon bridge, partly submerge, catchment area -	4017
	SJR Tributary River 6	KW-OF10	1597199.15	273045.41	14	26	16.52	120	53	41.13			X	X				X				1.00m wide x 1.00m high open channel D/S of Panamitan bridge, catchment area - residential	4020, 4021, 4022
	SJR Tributary River 6	KW-OF11	1597181.83	273056.63	14	26	15.96	120	53	41.51			X	X				X		X	X	0.80m wide x 1.50m high open channel U/S of Panamitan bridge, catchment area - residential	4023

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall Location

Date Surveyed: 11 & 13 May 2016 City/Town: Kawit Weather: Fair - Cloudy - Rainy

Notes:

N1 - Water Depth (Full / PartlyFull)
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N3 - Water Depth (Low / Below Half)
N4 - Water Flow (Stagnant)
N5 - Water Flow (Flowing)
N6 - Water Color (Clear)
N7 - Water Color (Brown)
N8 - Water Color (Dark/Murky)
N9 - Water Odor (None)
N10 - Water Odor (Foul)
N11 - with floating trash/garbage
U/S - upstream
D/S - downstream
OF - outfall
KW - Kawit
SJR - San Juan River

Outfall Identification

KW-OF000

KW: City/Municipality
OF: outfall number

OUTFALL INFORMATION

Main River	Tributary River/Waterway	Coordinates									Findings/Observations											Other Remarks	Photo Reference No.
		ID	UTM		N (Latitude)			E (Longitude)			N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11		
			N	E	Deg.	Min.	Sec.	Deg.	Min.	Sec.													
	SJR Tributary River 6	KW-OF12	1597192.08	273078.90	14	26	16.30	120	53	42.25			X	X				X				0.80m wide bottom & 1.00m wide top x 2.00m high open channel U/S of Panamitan bridge, partly submerge, outlet under the house, catchment area - residential	4024, 4025
	SJR Creek B	KW-OF15	1597512.39	274394.36	14	26	27.11	120	54	26.06			X	X				X		X		1.0m wide x 1.50m high channel D/S of bridge, partly submerge, catchment area - residential	4046, 4047
	SJR Creek B	KW-OF16	1597484.39	274363.25	14	26	26.19	120	54	25.03		X		X				X		X		0.90m dia pipe culvert D/S of bridge, half submerge, catchment area - residential	4048, 4049
	SJR Creek B	KW-OF17	1597454.17	274372.56	14	26	25.21	120	54	25.35												0.90m dia pipe culvert U/S of bridge, no water flowing, partly clog with trash, catchment area - residential	4051, 4052
	SJR Creek D	KW-OF18/C-D-331	1596766.53	272549.49	14	26	2.30	120	53	24.71			X		X			X				2 - 0.60m dia pipe culvert D/S of bridge, small amount of water flowing, catchment area - residential	4060, 4062
San Juan River		KW-OF24	1597658.39	272515.44	14	26	31.30	120	53	23.30												0.60m wide x 1.50m high channel, no water flowing, catchment area - residential	4078, 4079
	SJR Creek F	KW-OF25	1596519.54	273334.89	14	25	54.50	120	53	51.00												0.90m dia pipe culvert D/S of Batong Dalig bridge, no water flowing, catchment area - residential, commercial & open area	4081
	SJR Creek F	KW-OF26	1596508.32	273318.31	14	25	54.13	120	53	50.45												0.90m dia pipe culvert D/S of Batong Dalig bridge, no water flowing, catchment area - residential, commercial & open area	4082

Data Collection Survey for Sewerage Systems in West Metro Manila

Outfall-Kawit (FS)

Summary

Imus River	5
San Juan River	1
SJR Creek A	1
SJR Creek D	6
SJR Creek F	2
SJR Tributary River 3	5
SJR Tributary River 6	2
Total	22

SJR - San Juan River
KW - Kawit
OF - outfall

OUTFALL INFORMATION		
River/Creek	ID	Total
Imus River	C-E-101	5
Imus River	C-E-301	
Imus River	C-E-302	
Imus River	C-E-303	
Imus River	C-E-801	
San Juan River	C-D-222	1
SJR Creek A	C-D-106	1
SJR Creek D	C-D-331/KW-OF18	6
SJR Creek D	C-D-332	
SJR Creek D	C-D-333	
SJR Creek D	C-D-334	
SJR Creek D	C-D-335	
SJR Creek D	C-D-336	
SJR Creek F	C-D-323	2
SJR Creek F	C-D-324	
SJR Tributary River 3	C-D-212	5
SJR Tributary River 3	C-D-221	
SJR Tributary River 3	C-D-223	
SJR Tributary River 3	C-D-224	
SJR Tributary River 3	C-D-225	
SJR Tributary River 6	C-D-321	2
SJR Tributary River 6	C-D-322	

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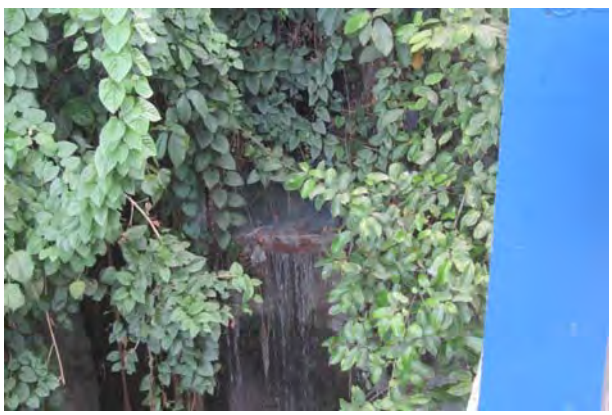

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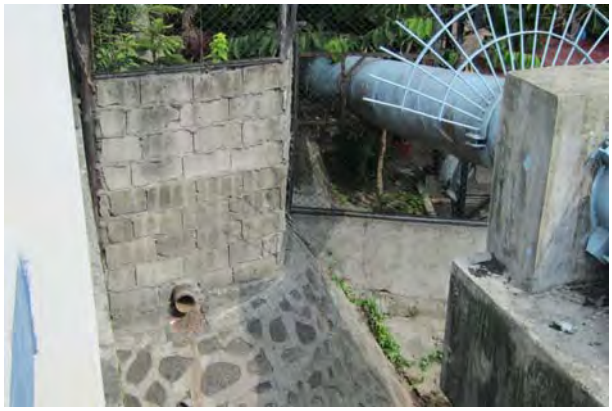

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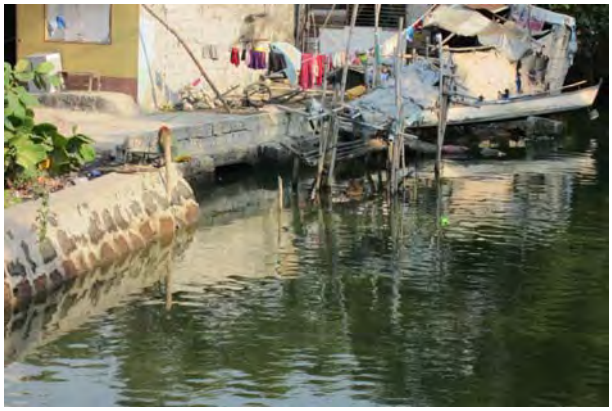

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