Due Diligence Report (DDR), Project Year 2 (PY2) Batch 2 of Pumping Stations

Project Name:

Metro Manila Flood Management Project, Phase 1

Due Diligence Report Project Year 2 (PY2) Batch 2 of Pumping Station
Metro Manila Flood Management Project (MMFMP)

A. Overview

1. The Department of Public Works and the Metropolitan Development Authority with the support from the World Bank is implementing the Metro-Manila Flood Management Project to resolve recurring problems of flooding in Metro Manila through the improvement of urban drainage through strategic initiatives to further improve and provide adequate flood management infrastructure by modernizing existing pumping stations in flood-prone drainage areas, improving waterways and drainage channels, improving solid waste management in and along waterways served by the pumping stations.

2. The MMFMP has three components (1) Component 1 addresses the physical and technical improvement of the pumping stations and the drainage areas; (2) Component 2 addresses the structural and non-structural issues on solid waste management; and (3) Component 3 will be addressing the impact of the project among affected families and proposing measures to mitigate and improve physical and economic impact among the informal settler families (ISF's) residing within the technical footprint of pumping stations and drainage areas.

B. Year Two PS– Batch 2 Pumping Station and Drainage Areas

3. DPWH implemented the Year 1 of the project for the first five pumping stations out of the 36 pumping stations identified for rehabilitation and modernization. For the Year 2, six pumping stations and drainage areas have been selected. The city of Manila has (4PS) namely: Abucay, Balete, San Andres and Sta. Clara. Makati City has one PS, and Pasay City has one -Libertad PS.

4. The selected Batch 2 pumping station and drainage areas is the subject of this Due Diligence Report. The location and description of the 6 pumping stations and drainage areas is presented in Table 1.

Executive Summary

1. Sta. Clara Pumping Station

- Constructed in May 1976
- Drainage area (served) – 133 has
- Current Pump Capacity – 5.3 cms
- There were relocation activities in the past, in 1980's, but it was outside the technical footprint of the pumping station. ISFs were relocated to Tala Relocation Site in Caloocan City.

2. Libertad Pumping Station

- Constructed in December 1979
- Drainage area (served) – 779 has
- Current Pump Capacity – 48 cms
- The Engineer's staff disclosed that this is a reclaimed area and were previously occupied by some informal settlers but were resettled in the 1980's. Those relocated were not within the cut-off date of the project.

3. Makati Pumping Station

- Constructed in 1980
- Drainage area (served) – 151 has
- Current Pump Capacity – 7 cms
- Information from the plant staff indicated that there were no past relocation activities in this project. Barangay officials and some selected residents were interviewed and confirmed that this pumping station and the drainage areas did not have any relocation activities in the past as due to strict surveillance efforts of the local authorities.

4. San Andres Pumping Station

- Constructed in September 1994
- Drainage area (served) – 356 has
- Current Pump Capacity – 19 cms
- Information from the plant staff indicated that there were no past relocation activities within and around the pumping station and drainage area.

5. Abucay Pumping Station

- Constructed in March 2008
- Drainage area (served) – 312 has
- Current Pump Capacity – 6 cms
- Information from the plant staff indicated that there were no past relocation activities within and around the pumping station and drainage area. Residents and Barangay officials were interviewed to validate the information of the plant engineer and staff. Interview results confirmed that no relocation activities within and around the pumping station and drainage areas.

6. Balete Pumping Station

- Constructed in 1977
- Drainage area (served) – 52 has
- Current Pump Capacity – 5.3 cms from the original capacity of 2.58 cms. Additional pumps were installed in 2016.
- Information from the plant staff indicated that there was no history of ISFs occupancy and any relocation activities.

Table 1. Proposed Rehabilitation Activities in the Six (6) Pumping Stations

Drainage Site	Scope of Works
1.Sta. Clara	▪ Replacement of existing two (2) units submersible pumps (VAFP) with higher capacity. ▪ Replacement of column and discharge pipes, butterfly valves and flap valves complete with starting panel (VFD starting panel). ▪ Upgrading of Meralco power supply for the whole pumping station and installation of two (2) generator set. ▪ Provision of generator set for auxiliaries as back-up. ▪ Replacement of two (2) units automatic trash rakes, horizontal and inclined conveyor. ▪ Replacement of two (2) unit's secondary screens and supports. ▪ Total replacement of floodgate to include gate, cables, motors etc. ▪ Replacement of overhead crane for submersible pumps. ▪ Total rehabilitation of pumping station building and its appurtenant structures/facilities including roof deck, kitchen, windows, lightings etc. ▪ Provision of SCADA and ultrasonic water level sensor. ▪ Installation of one (1) unit 20,000 liters capacity storage tank. ▪ Provision of one (1) unit service tank with two (2) units fuel transfer pumps. ▪ Rehabilitation of perimeter lighting, fence and gate. ▪ Replacement of five (5) units stop logs and gantry crane.
2. Libertad	▪ Installation of new six (6) units of submersible pump with a capacity of $8m^3$/sec. ▪ Installation of complete trash rakes, conveyors and floodgates, etc. ▪ Installation of primary screen. ▪ Dredging of three (3) outfalls.
3. Makati	▪ Replacement of existing two (2) units submersible pumps (VAFP) with higher capacity. ▪ Replacement of column and discharge pipes, butterfly valves and flap valves complete with control/starting panel (VFD starting panel). ▪ Upgrading of Meralco power supply for the whole pumping station and provision of one (1) generator set as back-up. ▪ Provision of generator set for auxiliaries as back-up. ▪ Replacement of two (2) units automatic trash rakes, horizontal and inclined conveyor and garbage hopper with bigger capacity. ▪ Replacement of overhead crane for submersible pump. ▪ Replacement of two (2) unit's secondary screens and support.

	▪ Provision of five (5) units stop logs and gantry crane. ▪ Total replacement of one (1) unit floodgate to include gate, cables, motors, controls etc. ▪ Total rehabilitation of the pumping station building and its appurtenant structures/facilities such as roof deck, kitchen, personnel room, comfort room, operation room, lightings, windows, etc. ▪ Rehabilitation of perimeter fence including the two (2) gates and perimeter lightings. ▪ Provision of SCADA and ultrasonic water level sensor. ▪ Dredging of retarding pond.
4. San Andres	▪ Replacement of existing four (4) pumps (HAFP) with a higher capacity with the same brand/model or submersible pump. ▪ Replacement of column and discharge pipes, butterfly valves and flap valves complete with control/starting panel (VFD staring panel). ▪ Upgrading of Meralco power supply for the whole pumping station. Provision of two (2) generator sets as back-up power. ▪ Provision of one (1) generator set for auxiliaries as back up. ▪ Provision of sub-station to carry the requirement of the whole facility. ▪ Total replacement of four (4) units automatic trash rakes, two (2) unit's horizontal and inclined conveyors and two (2) unit's garbage hoppers with bigger capacity. ▪ Replacement of overhead crane for submersible pumps. ▪ Replacement of four (4) secondary screens and supports. ▪ Replacement of five (5) stop logs. ▪ Installation of stationary gantry crane. ▪ Installation of additional one (1) unit 20,000 liters capacity storage tank. ▪ Total rehabilitation of the pumping station building and its appurtenant structures/facilities such as roof deck, kitchen, personnel room, comfort room, operation room, lightings, windows, etc. ▪ Rehabilitation of perimeter fence including the four (4) gates and perimeter lightings. ▪ Provision of SCADA and ultrasonic water level sensor. ▪ Installation of 2,000 liters capacity service tank with two (2) unit fuel transfer pump.
5. Abucay	▪ Replacement of existing three (3) units pump-up gates with higher capacity. ▪ Replacement of column and discharge pipes, butterfly valves and flap valves complete with control/starting panel (VFD starting panel). ▪ Installation of submersible pump with 3 m^3/sec capacity.

	▪ Upgrading of Meralco power supply for the whole pumping station and provision of one (1) unit generator set as back-up power. ▪ Total replacement of two (2) units automatic trash rake and installation of additional trash rake, horizontal and inclined conveyors and garbage hopper with bigger capacity. ▪ Provision of overhead crane for the repair and maintenance of proposed submersible pumps. ▪ Provision of secondary screens and supports if necessary. ▪ Provision of five (5) units stop logs and gantry crane. ▪ Provision of office for pumping station personnel. ▪ Provision of SCADA and ultrasonic water level sensor.
6. Balete	▪ Replace three (3) units existing (old) submersible pumps with a capacity of 2 cms. Each, includes the column and discharge pipes, butterfly valves and flap valves complete with control panel. ▪ Provide Meralco Power as main power supply of the pumping station. ▪ Install additional generator set to supply power to three (3) Units submersible pumps. ▪ Install two (2) units automatic trash rakes, horizontal and inclined conveyors as well as garbage hopper. ▪ Total Replacement of two (2) unit's floodgates to include gates, cables, motors etc. ▪ Construction of two (2) story generator house where the second floor will be utilized as office. ▪ Install motorized overhead crane for the repair and maintenance of submersible pumps. ▪ Installation of One (1) Unit 10k cap. storage tank. ▪ Provision of SCADA and Ultrasonic water level sensors. ▪ Installation of 2k cap service tank with Two (2) Units fuel transfer pumps.

5. The **optimum pumping area (OPA)** is defined as the area corresponding to the volume of water stored in the waterway such that the pump station can operate at maximum capacity unimpeded to lower water level from just below street level (revetment elevation) until the stopping elevation (dictated by pump suction elevation) within the time of concentration (T_c). T_c is the time required for runoff to travel from the hydraulically farthest point of the catchment to reach the outlet (i.e. pump station). The optimum pumping area (OPA length calculation is presented in Table 2.

Table 2: Optimum Pumping Area (OPA) Length Calculation

Pump Station	Current Pump Capacity (cms)	T_c[1] (minutes)	T_c (sec)	Optimum Pumping Volume (m^3)[2]	Depth operating [3] (m)	Wave (m)	OPA length (~m)
Sta. Clara	5.3	36	2160	10,303	1.89	7	467
Libertad	48	53	3180	137,376	3.06	NA	--[4]
Makati	7	40	2400	15,120	2.7	NA	--[4]
San Andres	19	66	3960	67,716	2.07	NA	--[5]
Abucay	6	--	--	--	--	NA	--[4]
Balete	5.3*	30	1800	8586	2.16	13	183

[1] Design Tc provided from design specifications by MMDA
[2] Adjusted for pump efficiency and total additional catchment storage
[3] Adjusted with factor of safety β = 0.9
[4] No open waterways, entire catchment served by covered drainage system
[5] Served two waterways, OPA do not extend further into upstream waterways
* from original capacity of 2.58 cms, it was increased to 5.3 cms in 2016 by installing additional pumps

C. Due Diligence Objectives and Methodology

6. In accord with the World Bank policy, OP 4.12 on Involuntary Resettlement, MMFMP for its phase one of identified projects has taken a look retrospectively at past resettlement of people in the sub-project areas. It has been agreed that resettlement which took place after 8 December 2014 (the date of the Project Identification Mission) require due diligence to assess the outcomes for those resettled to ensure that their resettlement is in accordance with the provisions of OP 4.12. Where people were moved before 8 December 2014, MMFMP is also obliged to carry out due diligence on this earlier "legacy" issue to determine if resettlement outcomes are generally in line with national legislation and the general objectives of OP 4.12.

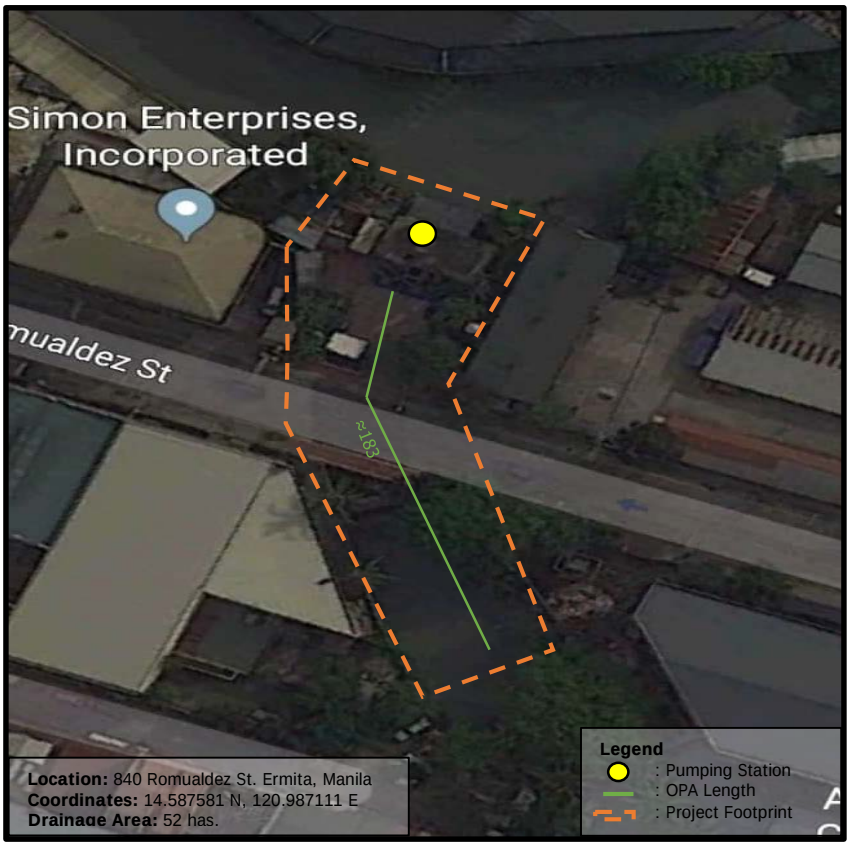
7. The objective of the due diligence carried out for the Abucay, Balete, San Andres, Sta. Clara all in the city of Manila, Makati PS in Makati City and Libertad Pumping Station in Pasay City pumping stations and drainage areas were verified, initial scoping findings conducted by DPWH and MMDA and the World Bank team which ascertained that the technical footprint areas of the three proposed sub-projects did not have land acquisition and resettlement issues. More specifically, on the basis of information from available government records and interviews with people in the area, to determine whether a government resettlement program, (entitled Oplan Likas, which is clearing informal settlement for entire lengths of the city's waterways) had resettled people from waterway sections within the technical footprints of these Batch 2 pumping stations and drainage areas for rehabilitation and modernization.

8. The due diligence included site visits supported by photo documentation. Site reconnaissance was carried out within the pumping stations and their facilities as well as along waterways within the technical footprints as provided in Annexes and the succeeding marked photos. Interviews were undertaken with plant engineers and selected personnel particularly those with the longest tenure in the pumping station. Validation interviews were also conducted with community leaders residing in the vicinity of the pumping stations. Site visits for the six identified pumping stations were conducted on February 5, 2020.

D. Due Diligence Findings

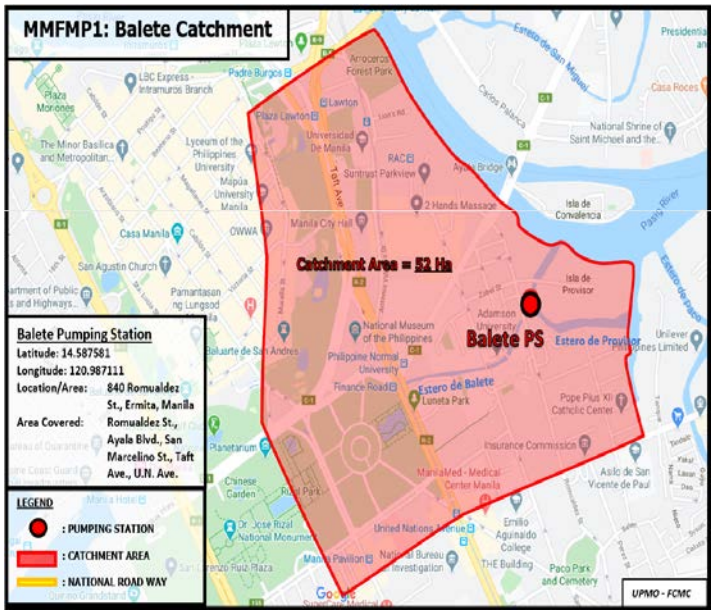
9. The Balete drainage area is located in Manila. The drainage area served by the pumping station is 52 ha. The original pump capacity is 2.58 m^3/sec but was increase to 5.3 m^3/sec in year 2016. The pumped water is drained into Pasig River that has open connection with Manila Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day rainstorm with a return time of 10 years, when about 20 percent the drainage area gets flooded. It is proposed during PY2 to increase the pumping capacity to 9 m^3/sec. The technical foot print of the proposed rehabilitation is described in the Figure 1.

Figure 1. Balete Technical Footprint



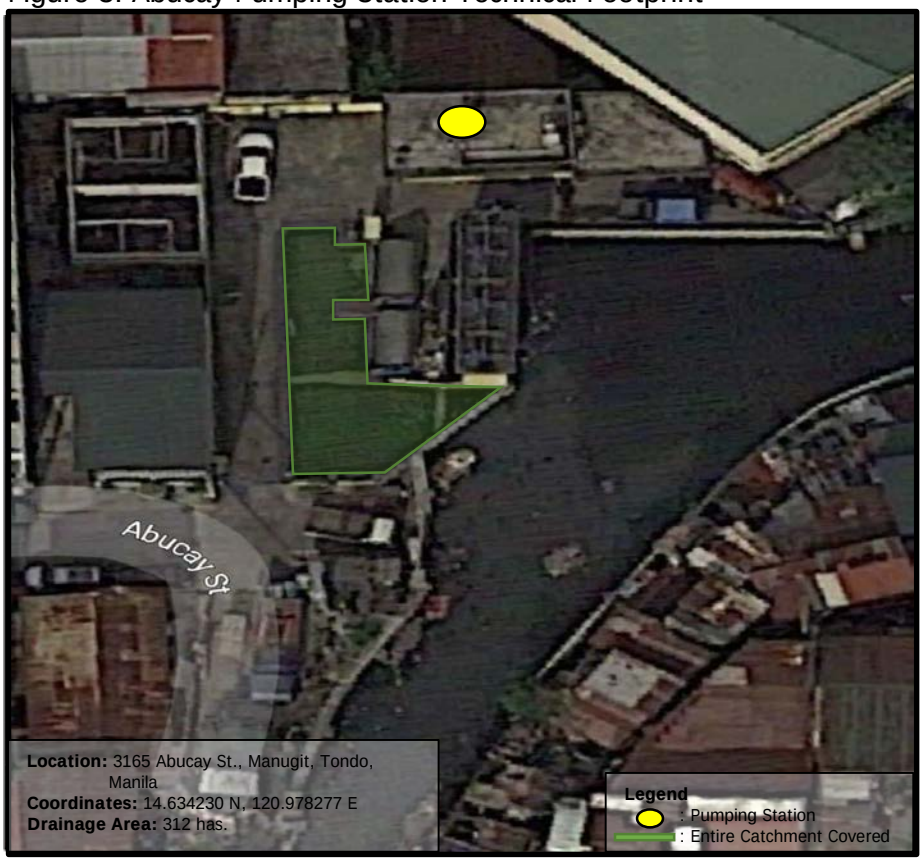
10. Key information interviews of the staff and head of the Balete Pumping Station and drainage areas revealed that the project site footprint is currently free of informal settlers. The PS is enclosed with perimeter fence and securely provided with the pumping station staff. The Plant Engineer In-charge Angeles G. Busmente informed the DDR team that this pumping station was constructed in 1977 and thus far have been kept it without any encroachment. Thus, it has been confirmed that this drainage area has not been and is not currently occupied by ISFs. Additionally, interviews with the Barangay officials and residents around the vicinity of the pumping stations also confirmed that the pumping station did not have families residing inside and or around it. Site inspection conducted in Balete Pumping station as shown in Figure 2. Further confirms that the location did not have any history of ISFs occupancy and any relocation activities. Also shown in figure 1 is the catchment area of the Balete PS for rehabilitation. Based on the reports gathered, the Balete pumping station's technical footprint is presently free and clear of structures and people and no previous occupants in this facility and in its drainage areas.

Figure 2. Balete Pumping Station



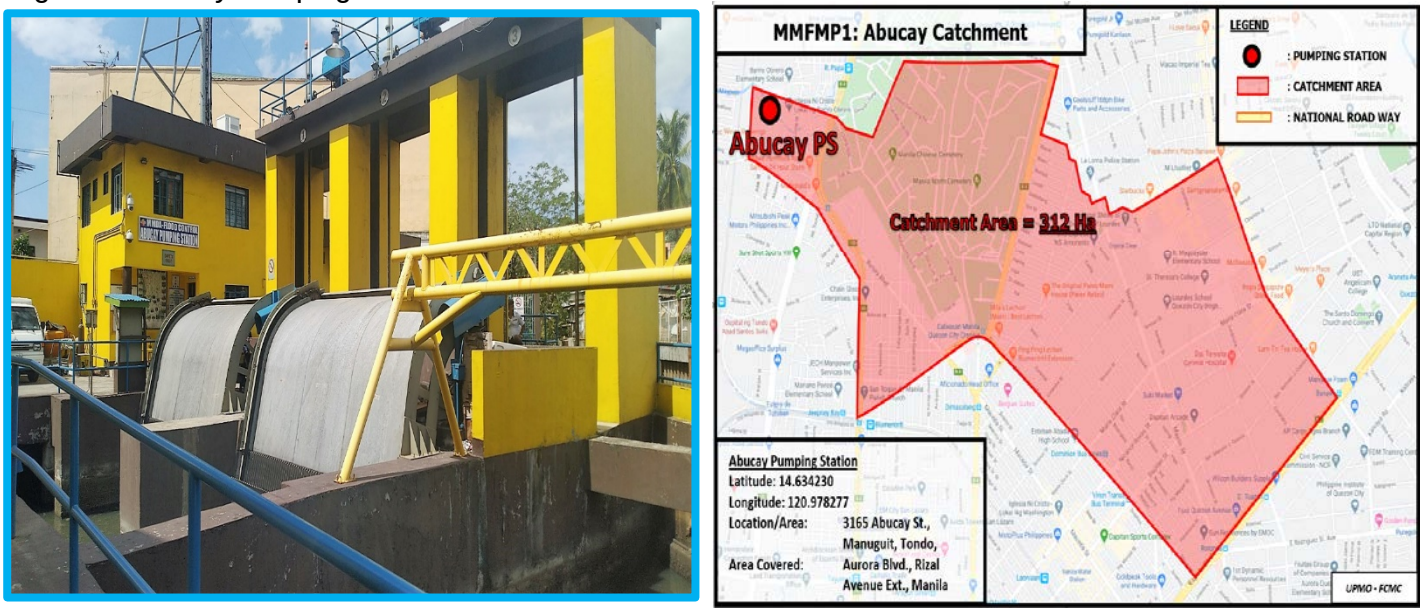
11. The Abucay Pumping Station and drainage area is located in the Aurora Blvd extension in city of Manila. The drainage area served by the pumping station is 312 hectares. The total existing pump capacity is 6 m^3/sec. The pumped water is drained into Estero de Maypajo that has open connection with Manila Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day rainstorm with a return time of 10 years, when about 30 percent the drainage area gets flooded. It is proposed during PY2 to increase the pumping capacity base on the actual site condition during rainy season. The technical footprint of the pumping station and drainage area is presented in Figure 3.

Figure 3. Abucay Pumping Station Technical Footprint



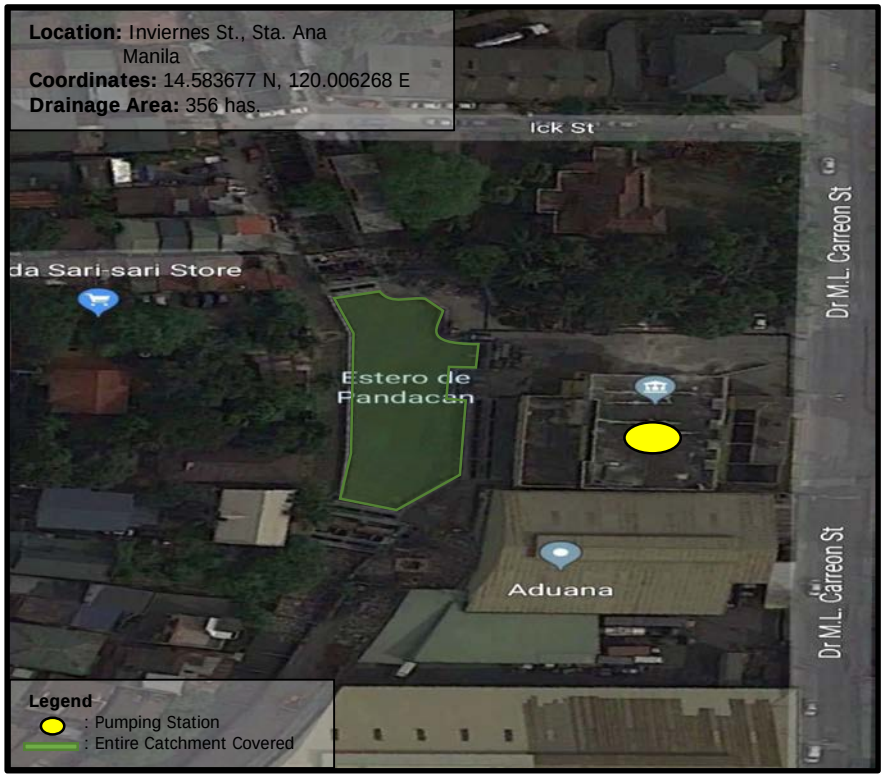
12. Site inspection and interview results found out that the pumping station was constructed in 2009. The Plant Engineer, Jose Greg N. Pilongco disclosed that the pumping station has no existing informal settler families because the facilities has been secured and fenced off. The location has around it some settlement that is divided by a fence separating the drainage area with the pocket or residents living within the vicinity. Interview results also revealed that there were no relocation activities that happened in the area within the cut-off date of the project. Residents and Barangay officials were interviewed to validate the information of the plant engineer and staff. Interview results confirmed that there were no relocation activities within and around the pumping station and drainage areas. There was an information gathered that the upstream of the pumping station had clearing operations and settlement activities in 2017, but the location is outside the pumping station and drainage areas. Location of the Abucay Pumping Station is presented in Figure. 4

Figure 4. Abucay Pumping Station



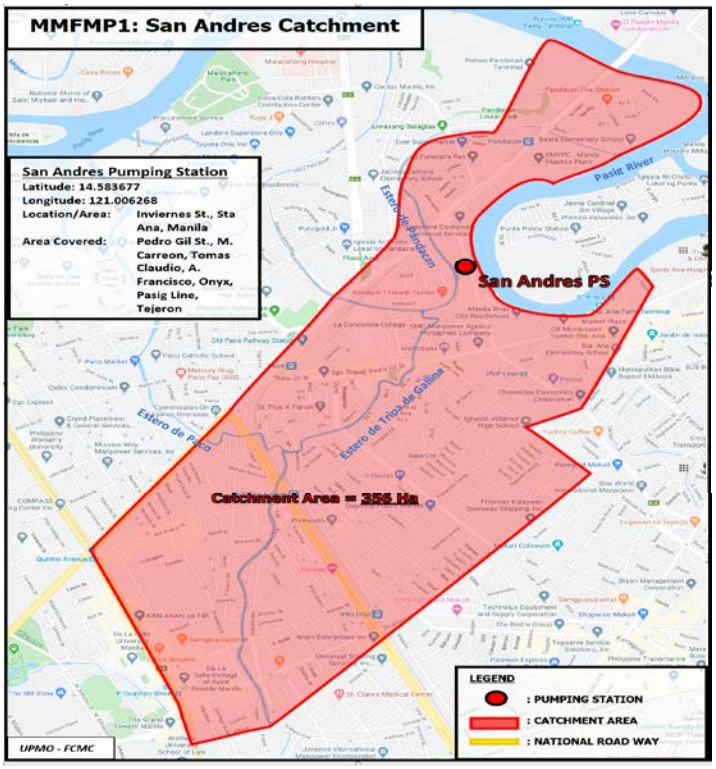
13. San Andres Pumping Station is located in Inviernes St. Sta. Ana Manila. The drainage area served by the pumping station is 356 hectares. The total existing pump capacity is 19 m^3/sec. The pumped water is drained into Pasig River that has open connection with Manila Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day rainstorm with a return time of 10 years, when about 50 percent the drainage area gets flooded. It is proposed during PY2 to increase the pumping capacity base on the actual site condition during rainy season. The technical foot print of the project is presented in Figure. 5.

Figure 5. San Andres Pumping Station Technical Footprint



14. San Andres Plant Engineer Benny Decolongon was the key informant of this pumping station. He disclosed that this was constructed in 1994. The pumping station site and the drainage has no existing ISFs. As regard past relocation activities, the plant staff disclosed that there were some waterways, clearing operations sometime in 2015 under the government's waterways cleaning activities upstream of the drainage areas and not in the same location of the project site. Interview results from the residents around the areas confirmed the information from the plant staff that there has not been any past relocation within and around the pumping station and drainage area. San Andres pumping station is presented in Figure 6.

Figure 6. San Andres Pumping Station

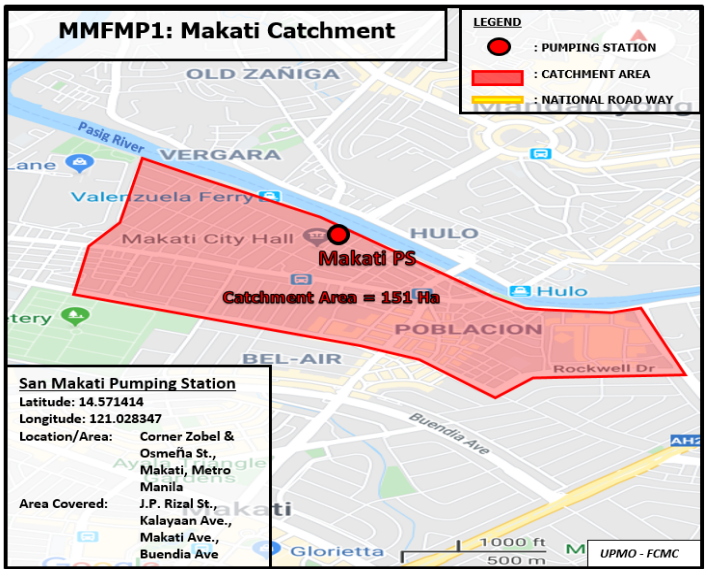


15. Makati Pumping Station drainage area is primarily located at Corner Zobel & Osmeña Streets in the City of Makati. The drainage area served by the pumping station is 151 ha. The total existing pump capacity is 7 m^3/sec. The pumped water is drained into Pasig River that has open connection with Manila Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day rainstorm with a return time of 10 years, when about 25 percent the drainage area gets flooded. It is proposed during PY2 to increase the pumping capacity base on the actual site condition during rainy season. Technical footprint of the project is presented in Figure 7.

Figure 7. Makati Pumping Station Technical Footprint

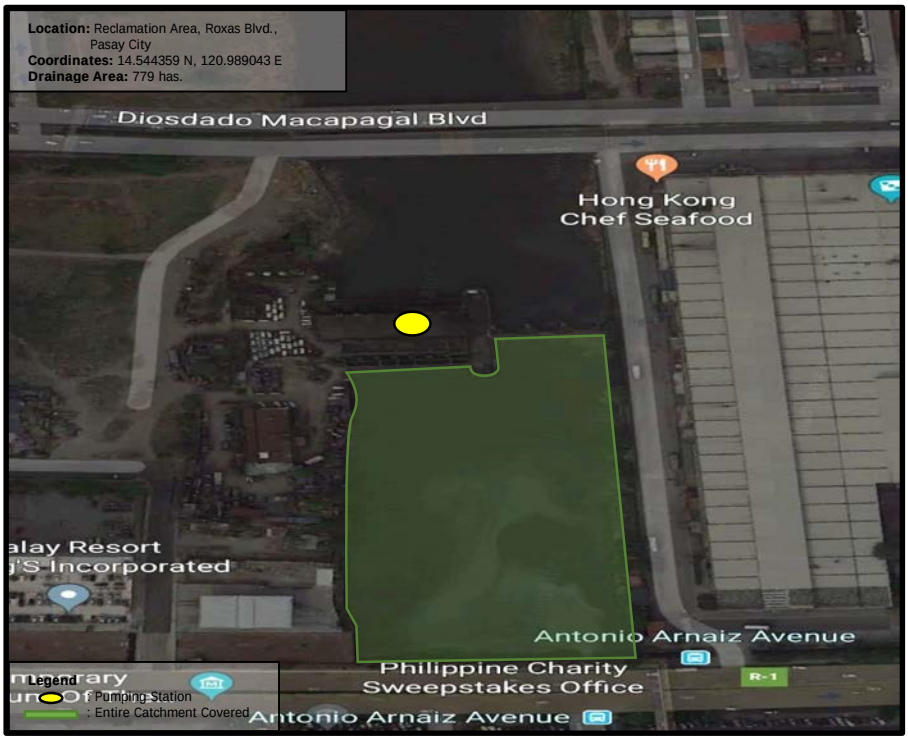
16. Key information interviews of the staff and head of Makati Pumping Station and drainage areas revealed that the project site free of informal settlers. The PS is enclosed with fence and is centrally located in Barangay Poblacion. The Plant Engineer In-charge Engr. Rizalino Padua informed the DDR Team that this pumping station was constructed in 1980 and thus far have been without informal settlers. Additionally, information from the plant staff indicated that there were no past relocation activities in this project. Thus, it has been confirmed that this drainage area has not been and is not currently occupied by ISFs. Barangay officials and some selected residents were interviewed and confirmed that this pumping station and the drainage areas did not have any relocation activities in the past as due to strict surveillance efforts of the local authorities. Figure 8 presents the location of the Makati Pumping Station.

Figure 8. Makati Pumping Station



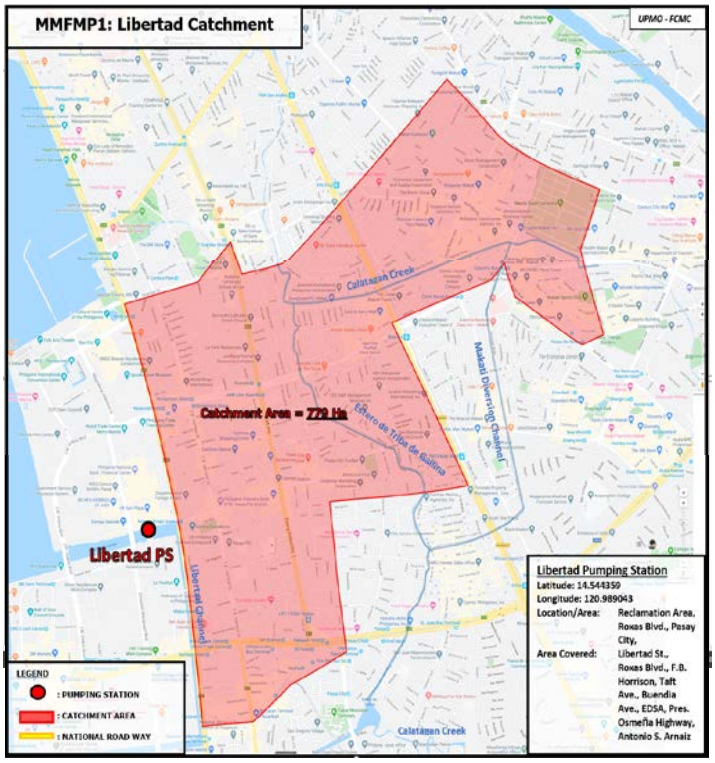
17. Libertad drainage area is located in Reclamation Area, Roxas Blvd., Pasay City The drainage area served by the pumping station is 779 ha. The total existing pump capacity is 48 m^3/sec. The pumped water is drained into Libertad Channel, Reclamation Area, Roxas Boulevard that has open connection with Manila Bay. The current pumping capacity is sufficient to prevent flooding during a two-day rainstorm. The Project will not increase the capacity further but it is proposed during PY2 to replace with new six (6) units of submersible pumps with a capacity of 8 m^3/sec. Technical footprint of the pumping station and drainage area is presented in Figure 9.

Figure 9. Libertad Technical Footprint



18. Libertad Pumping Station Engineer Dennis Gabriel Chavez was the key informant of this pumping station. He disclosed that this was constructed in 1979. The pumping station site and the drainage is located in a business district of the city and has no existing ISFs. As regard past relocation activities, the Engineer's staff disclosed that this is a reclaimed area and were previously occupied by some informal settlers but were resettled in the 1980's. This was within the vicinity but no information was confirmed that there were actual ISFs in this facility. The Barangay that covers this area is located outside the business district. Gathered information from the Barangays revealed that as far as they are concerned, this pumping station and drainage areas were not occupied and did not specifically did not have past relocation activities. The current location of the pumping station is presented in Figure 10.

Figure 10. Libertad Pumping Station

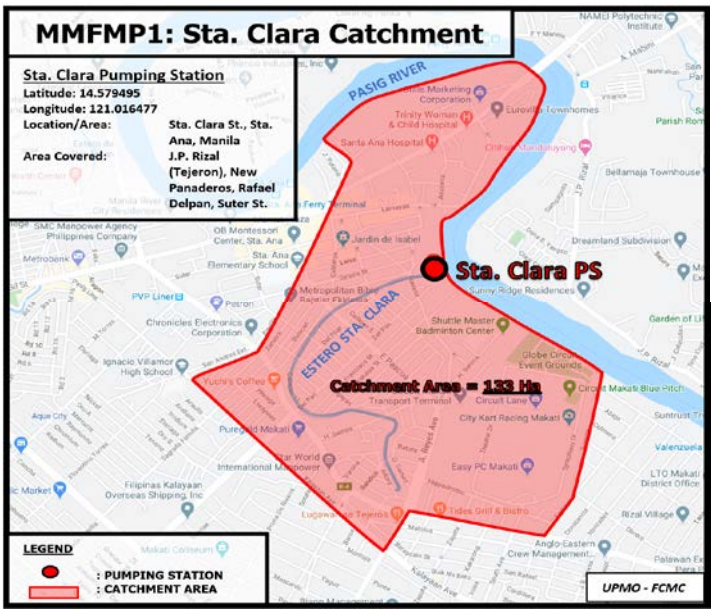


19. Sta. Clara drainage area is located within the vicinity of Estero de Sta. Clara, Sta. Ana, Manila The drainage area served by the pumping station is 133 hectares. The total existing pump capacity is 5.3 m^3/sec. The pumped water is drained into Pasig River that has open connection with Manila Bay. The current pumping capacity is not sufficient to prevent flooding during a two-day rainstorm with a return time of 10 years, when about 30 percent the drainage area gets flooded. It is proposed during PY2 to increase the pump capacity base on the actual site condition during rainy season. The technical footprint of the project is presented in Figure 11.

Figure 11. Sta. Clara Pumping Station Technical Footprint

20. Sta. Clara Pumping Station staff led by Engineer Edgardo C. Bustamante was the key informant. He disclosed that this was constructed in 1976. The pumping station site and the drainage has no existing ISFs. As regard past relocation activities, the plant staff disclosed that they are not aware of any relocation activities in this plant. Interviews with residents and community leaders in this community where the pumping station is located, revealed that there were relocation activities in the past but it was outside the technical footprint of the pumping station and this was done in the 1980's and the ISFs were relocated to Tala Relocation Site in Caloocan City. Current location of the pumping station is presented in Figure 12.

Figure 12 Sta. Clara Pumping Station



E. Conclusions

21. Due Diligence Team carried the process on investigating, and confirming that all sites identified in the Batch 2 of projects sites, do not have existing occupants within the pumping stations and in the drainage areas technical footprint. Information gathered using the methodology for this DDR, showed that some (3) out of 6 had previous relocation activities. These relocation activities are not in the identified project footprint, and mostly they happened upstream of the drainage areas. Two of the pumping sites identified had past relocation activities but it was earlier than the project cut- off and it is not within the technical footprint. In summary the identified project sites has no resettlement legacy issues to address and that none of the sites have existing occupants, also the increase in capacity of each pumping stations will be identified by the Consultants.

Annexes

Annex A. Description of Project Technical Footprint

Annex B. Project footprint and photos of Makati Pumping Station

Annex C. Project footprint and photos of Libertad Pumping Station

Annex D. Project footprint and photos of Sta. Clara Pumping Station

Annex E. Project footprint and photos of San Andres Pumping

Annex F. Project footprint and photos of Abucay Pumping Station

Annex G. Project footprint and photos of Balete Pumping Station

Annex H. Due Diligence Records of Consultations

Annex I. Certification of Clearances of ISFs

Annex J. Executive Summary

Annex A: Description of Project Technical Footprint

1. The Metro Manila Flood Management Project–Phase 1, in particular Component 1, is anchored upon the rehabilitation of existing pump stations or construction of new ones to enable effective and efficient drainage of flood waters and thereby address urban flooding.

2. Typically, excess rainwater will runoff from roofs, roads, and other surfaces before entering drainage pipes. Runoff inside drainage pipes eventually discharge into the waterways such as creeks, esteros, or tributary rivers before finally discharging into external water bodies such as Manila Bay or main rivers like Pasig River.

3. Without pumping, runoff discharge from catchments by gravity is dictated by slope of the terrain and the elevation of external water bodies. Flooding occurs when water cannot be discharged fast enough (i.e. higher runoff generation due to urbanization of the catchment; due to intense rainfall; elevated levels of the external water body; or a combination of these and other factors). Pump stations address flooding by discharging rainwater of a served waterway faster that what gravity would allow.

4. The directly flooded area can be further analyzed hydraulically to determine the critical segments of pipes and/or open waterways to ensure the optimum drainage of the area in cases of high rainfall. This critical portion of the directly flooded area is delimited as the “project footprint”. The project footprint is further composed of sub-areas as below. For purposes determining the project’s area of influence, the optimum pumping area (OPA) that runs along open channels will be the target for relocation of ISF’s. Other components will also survey drainage areas to determine whether additional areas should be included for resettlement, although this is unlikely.

   (i) Pump station area;

   (ii) Waterway maintenance access points;

   (iii) Optimum pumping area.

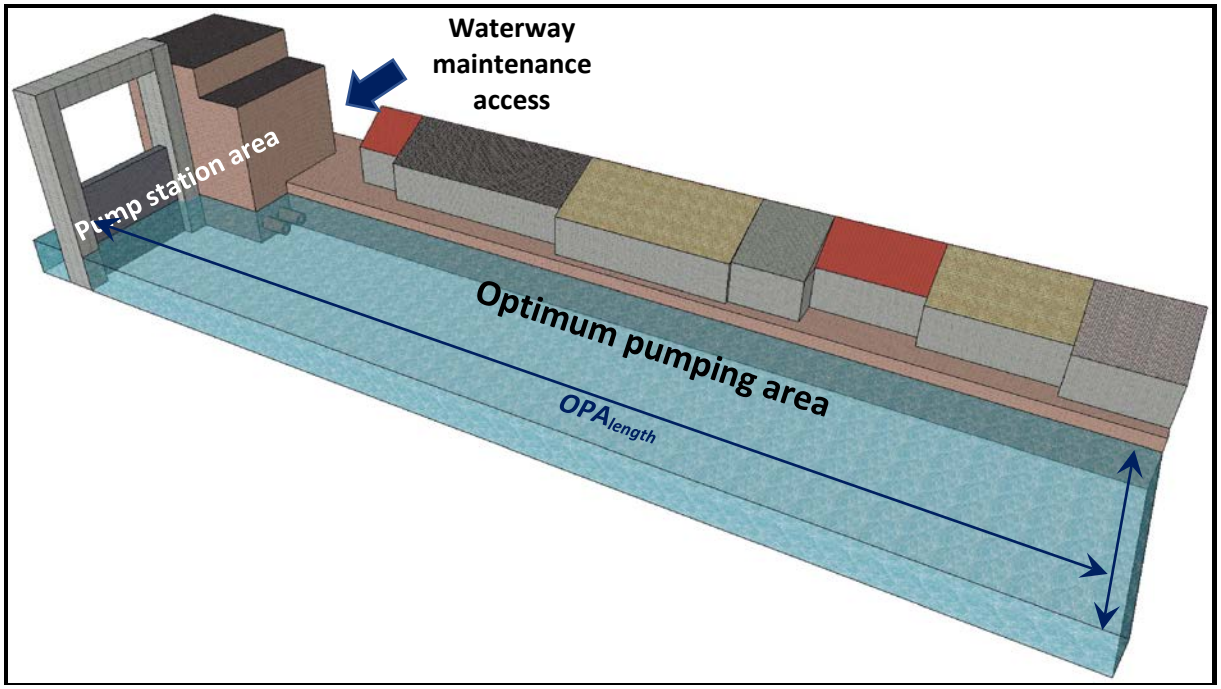


Figure 1: Project Footprint

5. The **pump station area** is the boundary of the physical structures of the facility which should have sufficient space of the electro-mechanical equipment, floodgates, trash collection and management system, and other ancillary functions. Based on the survey of existing pumping stations, this area is already well established, fenced-off, and have no resettlement issues.

6. The **waterway maintenance access** includes access roads and staging areas for mobilizing equipment in or over the waterway. Access requirements will vary depending on the characteristics of the waterway including maintenance strategy. In some cases, where the catchment is served entirely by a covered drainage system (ex. Abucay PS), there is no open waterway to be maintained. Instead, maintenance can be jetting and vacuuming of drainage pipes which can be carried-out from street-side manholes. For open waterways different maintenance strategies will be assessed, with a main focus on floating maintenance equipment.

7. The **optimum pumping area (OPA)** is defined as the area corresponding to the volume of water stored in the waterway such that the pump station can operate at maximum capacity unimpeded to lower water level from just below street level (revetment elevation) until the stopping elevation (dictated by pump suction elevation) within the time of concentration (T_c). T_c is the time required for runoff to travel from the hydraulically farthest point of the catchment to reach the outlet (i.e. pump station). OPA is given by:

$$\mathrm{OPA} = \frac{\alpha \mathrm{C} \times \gamma \mathrm{T_c}}{\beta \mathrm{D_{op}}}$$

Where:

C = maximum pump capacity, α= pump efficiency factor

T_c = Time of concentration, where:

$T_c = 0.0078\left(\frac{L^{0.77}}{S^{0.385}}\right)$, Kirpich equation; or

design T_c, if available

γ = peak flow factor

L = length from farthest part of the basin

S = channel slope

D_{op} = operating depth, β= factor of safety

8. For the purpose of planning, OPA is converted to the more tangible parameter, the corresponding length of OPA or OPA_{length}. This is derived by dividing OPA by the waterway's operating flood depth (i.e. elevation of street level minus suction stopping elevation).

9. The OPA (i.e. waterway along OPA_{length}) must be cleared of obstructions like sediments, solid waste, or informal structures to ensure unobstructed flow to the pump station and avoid pump problems such as vortices, uneven approach flow, uneven velocity profile in the pump, pre-rotation, vibrations, cavitation and increased energy `consumption—among others. Note that optimum maintenance is most critical in, but is not limited to, the OPA.

10. OPA_{length} is computed for identified priority pump stations as shown below. Unless stated otherwise, data are provided by MMDA.

OPA_{length} Calculation

Pump Station	Maximum Capacity (cms)	T_c[1] (minutes)	T_c (sec)	Optimum Pumping Volume (m^3)[2]	Depth operating [3] (m)	Wave (m)	OPAlength (~m)
Sta. Clara	5.3	36	2160	10,303	1.89	7	467
Libertad	48	53	3180	137,376	3.06	NA	--[4]
Makati	7	40	2400	15,120	2.7	NA	--[4]
San Andres	19	66	3960	67,716	2.07	NA	--[5]
Abucay	6	--	--	--	--	NA	--[4]
Balete	5.3*	30	1800	8586	2.16	13	183

[1] Design Tc provided from design specifications by MMDA

[2] Adjusted for pump efficiency and total additional catchment storage

[3] Adjusted with factor of safety β = 0.9

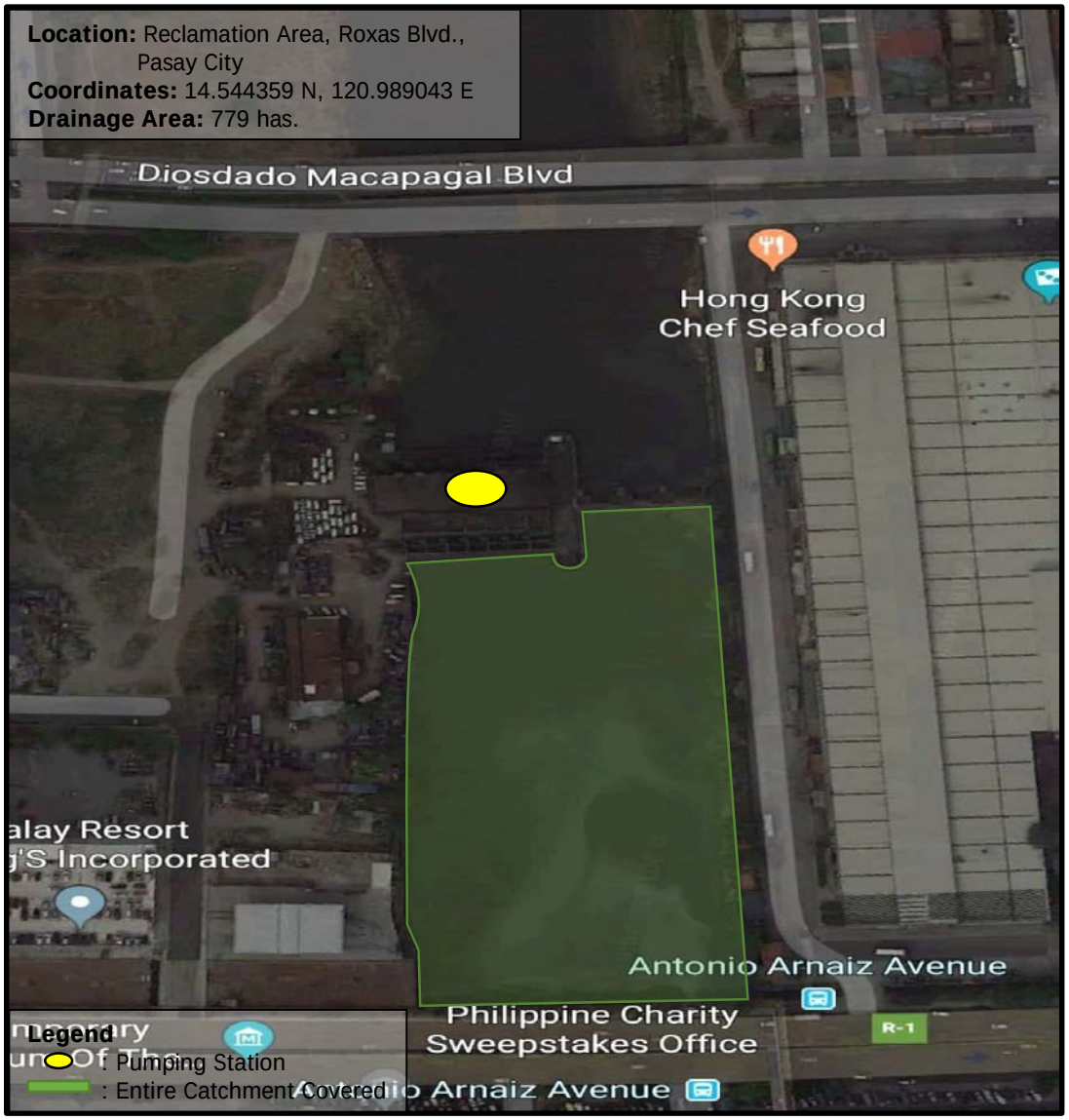
[4] No open waterways, entire catchment served by covered drainage system

[5] Served two waterways, OPA do not extend further into upstream waterway

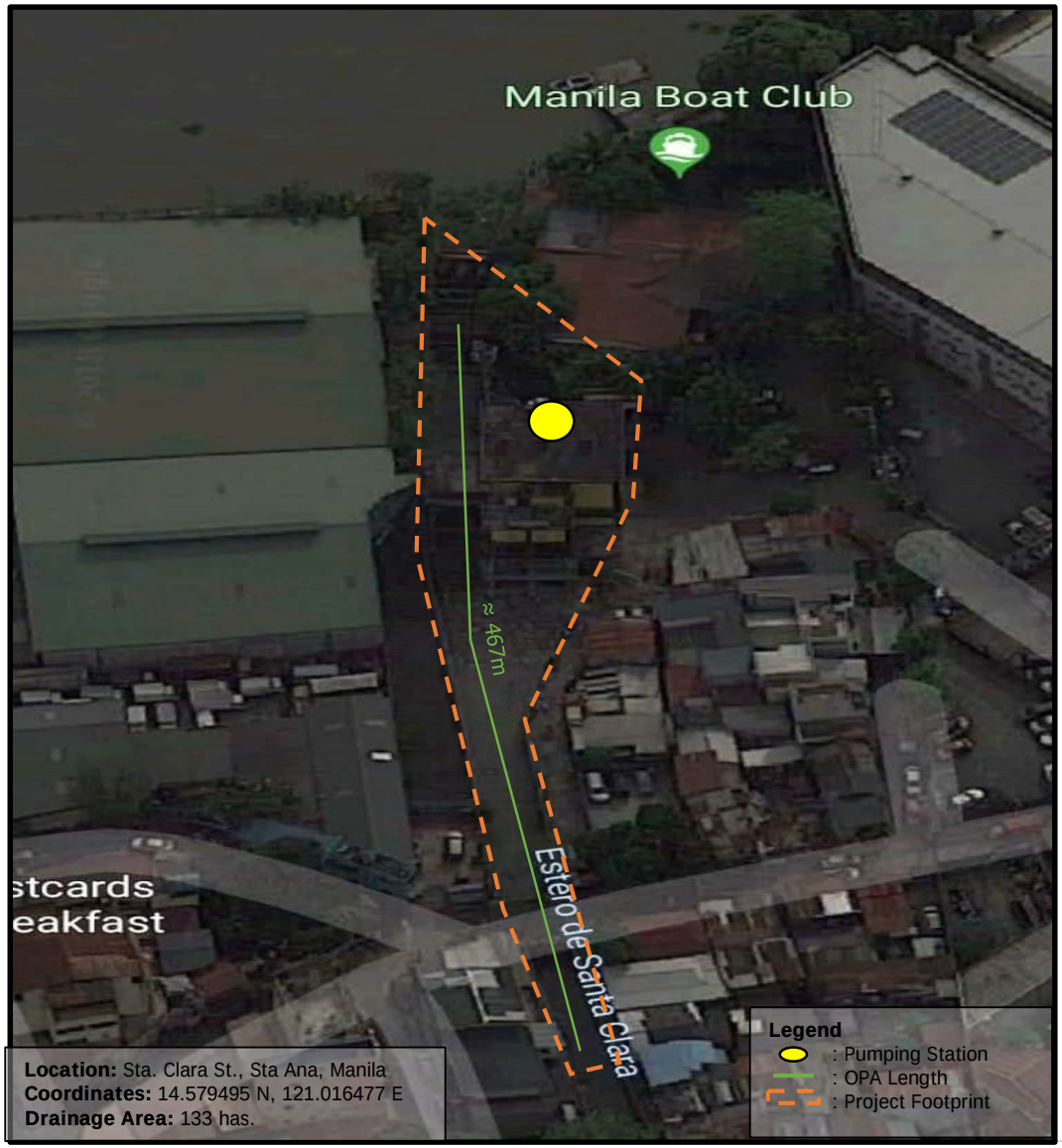
* from original capacity of 2.58 cms, it was increased to 5.3 cms in 2016 by installing additional pumps

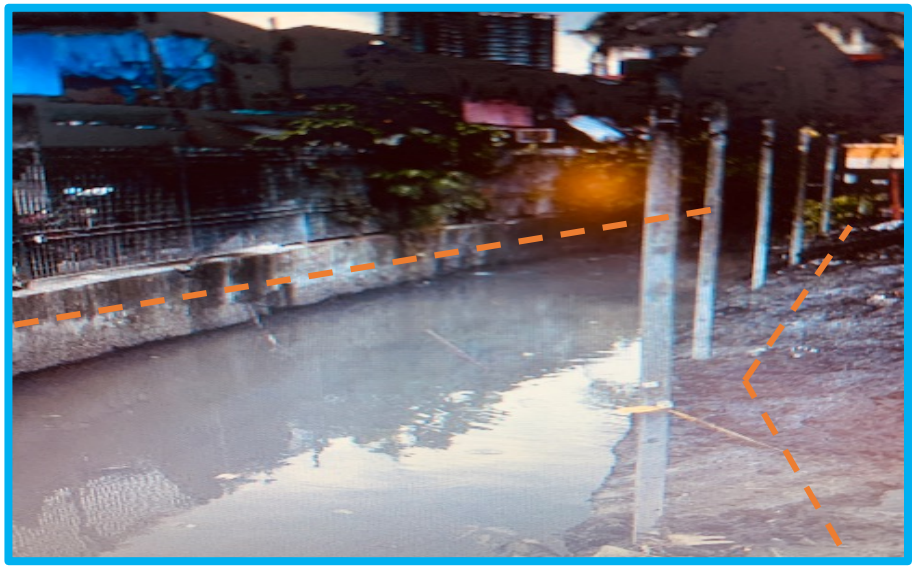
Annex B: Project Footprint and Photos of Makati Pumping Station

Annex C: Project Footprint and Photos of Libertad Pumping Station

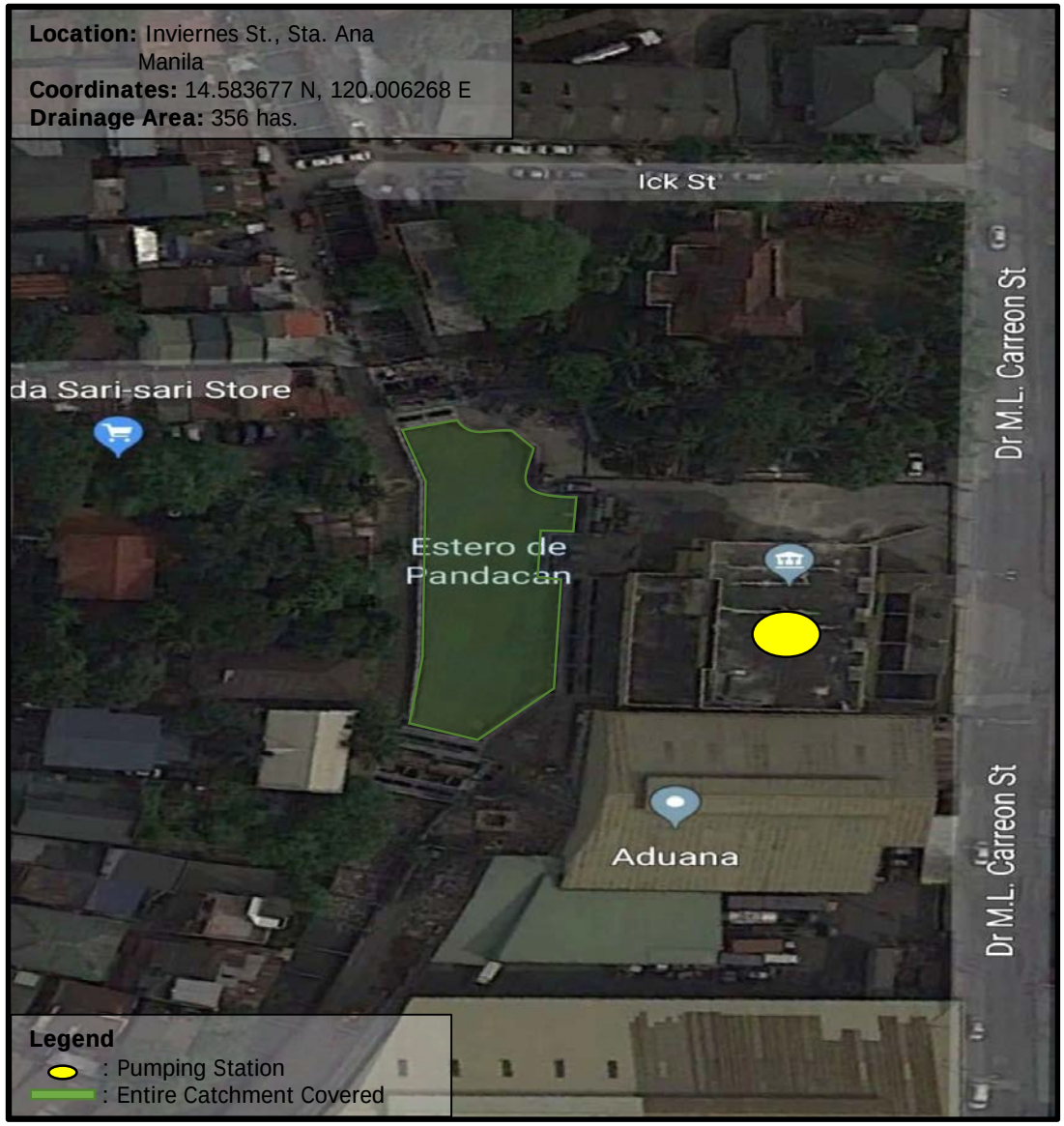


Annex D: Project Footprint and Photos of Sta. Clara Pumping Station

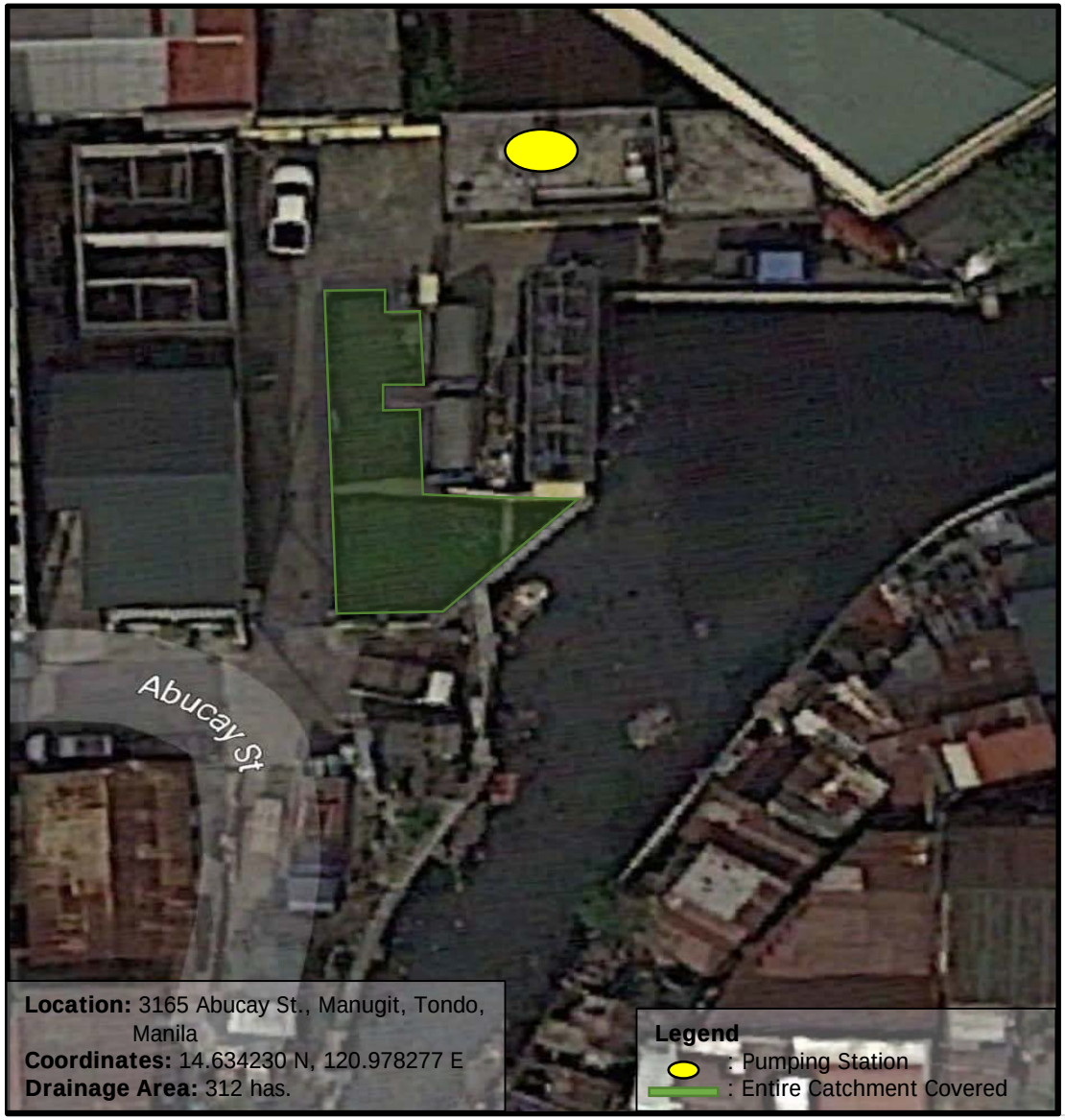




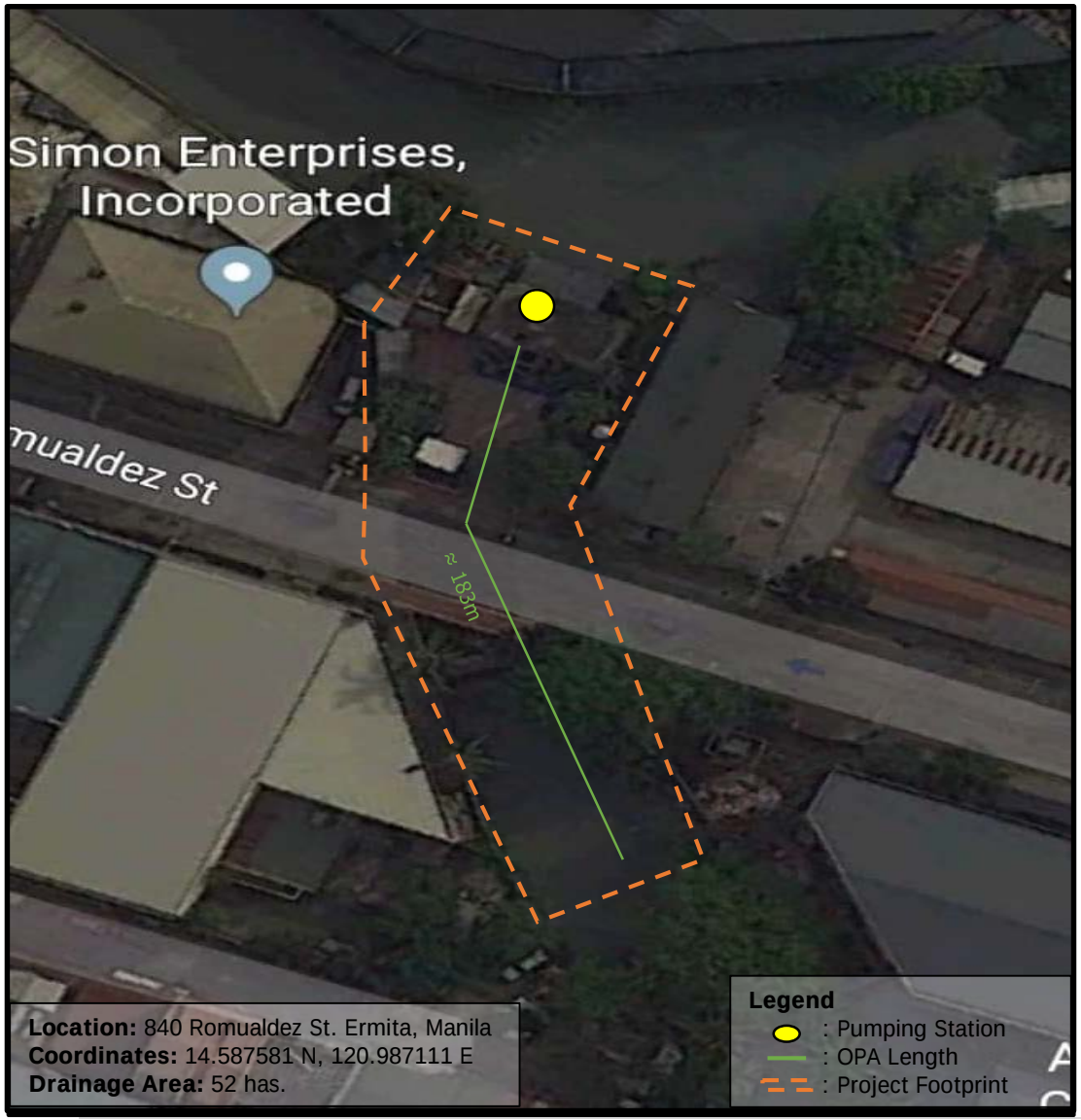
Annex E: Project Footprint and Photos of San Andres Pumping Station



Annex F: Project Footprint and Photos of Abucay Pumping Station



Annex G: Project Footprint and Photos of Balete Pumping Station



Annex H: Due Diligence Records of Consultation

Annex H. Due Diligence Records Consultations for the 6 Pumping Stations (Abucay, Balete, San Andres, Sta. Clara, Makati and Libertad)				
Date and Venue	Participants	Consultation Activities	Summary of Discussions / Issues and Concerns	Response of the Project
Date Feb 5, 2020 Abucay Pumping Station, Manila	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	-Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print Interviews with plant engineers and personnel and community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered such as amount of solid waste collected daily Community not discipline on garbage in the water ways	Rehabilitation and enhancement of the PS was explained Addressing solid waste is part of the MMFMP component 2 and will be part of the Batch program of activities.
Date Feb 5, 2020 Balete Pumping Station	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	-Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print -Interviews with plant engineers and personnel and community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered	Rehabilitation and enhancement of the PS was explained
Date Feb 5, 2020 San Andres Pumping Station, City of Manila	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	-Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print -Interviews with plant engineers and personnel -Interviews with community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered	Rehabilitation and enhancement of the PS was explained

Date Feb, 5,2020 Sta. Clara Pumping Station, City of Manila	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print -Interviews with plant engineers and personnel -Interviews with community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered	Rehabilitation and enhancement of the PS was explained
Date Feb 5, 2020 Makati Pumping Station, City of Makati	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print -Interviews with plant engineers and personnel -Interviews with community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered	Rehabilitation and enhancement of the PS was explained
Date Feb 5, 2020 Libertad Pumping Station, City Pasay	Engineers and Staff of the pumping station and DPWH/ MMDA DDR Team Community Informants	Briefing on the due diligence activity to be conducted -Site Visit and walk through on the project technical foot print -Interviews with plant engineers and personnel -Interviews with community	Information about PS construction dates was gathered Plant engineers reported that there are no existing ISFs in the PS and technical footprint of the drainage area Other relevant information about the current operations of the PS was gathered	Rehabilitation and enhancement of the PS was explained

Annex I: Certification of Clearances of ISFs

Republic of the Philippines
Barangay 76 Zone 10
Pasay City, Metro Manila
Philippines

CERTIFICATION

TO WHOM IT MAY CONCERN:

This is to certify that there are no affected/ relocated Informal Settler Families within the Technical Footprint of Libertad Pumping Station, for the Metro Manila Flood Management Project, Phase 1.

Given this **5th** day of **September 2020,** at **Barangay 76 – Zone 10, Pasay City**.

This certification is being issued upon the request of Mr. Ramon A. Arriola III, Project Director of UPMO-FCMC for any purpose it may best serve them.

ROSEMARIE B. SAN MIGUEL
Barangay Chairwoman
Barangay 76 – Zone 10

OFFICE OF THE BARANGAY CHAIRWOMAN
20 Russel Street, Pasay City, Metro Manila, Philippines
☎(+632) 8831 – 68 – 26 ☎(+632)8 834 – 08 – 12

REPUBLIC OF THE PHILIPPINES
CITY OF MANILA
Tanggapan ng Punong Barangay
Barangay 866 Zone 95 District VI
TEL. NO: 523-70-05

TERESITA M. SAÑGIL
Punong Barangay

K MA. LOURDES C. OBISPO
Family & Children Affairs
A VICTOR T. CLEMENTE
C ROBERT S. ACOSTA
Livelihood
A ROWENA D. VARONA
Appropriation
W ARTURO M. SAÑGIL
Clean and Green and
Maintenance Equipment
A ELDA F. PASAGUE
Religious Affairs
D MAY V. APOL
Health and Sanitation
GIORGINA CANLOBO
SK CHAIRMAN
Youth & Sports Committe
MA. SOCORRO A. ISLA
Secretary
FREDERICK C. CRUZ
Treasurer

DATE : Sept. 13, 2020

Department of Public Works and Highways
Central Office

Warm greetings from Barangay 866 Zone 95 District VI, City of Manila.

This is with regards to your letter sent, if there are Informal Settler Families within the Technical Footprint of San Andres Pumping Station.

This is to certify that there are no Informal Settler Families within the said area.

Thank you and God Bless!

TERESITA M. SAÑGIL
Barangay Chairwoman
Brgy. 866 Zone 95 Dist. VI

Republic of the Philippines
City of Manila
OFFICE OF THE BARANGAY CHAIRMAN
Barangay 883 Zone 97 District VI

CERTIFICATION

This is to certify that Sta. Clara Pumping Station is under the jurisdiction of this Barangay. There are no Informal Settlers in the said Barangay that will be affected by your planned improvements in the said Pumping Station.

This certification is issued upon request and may be used for whatever legal purpose it may serve.

Issued this 9th day of September 2020 in the City of Manila, Philippines.

Respectfully yours,

Eufrosinio C. Pecson
Punong Barangay

Not Valid Without Official Seal.

REPUBLIC of the PHILIPPINES
Department of Interior and Local Government
City of Manila
Office of the Sangguniang Barangay
Barangay 202,Zone 18,District II,Manila

CERTIFICATE OF CLEARANCE

This is to certify that as of this date September 4, 2020, there are no INFORMAL SETTLER FAMILIES within the Technical Footprint of the Abucay Pumping Station, Metro Manila Flood Management Project, Phase I, under AOR of Barangay 202, Zone 18, District II, Manila.

For your information and records.

Certified by:

SONNY L. SARMIENTO
PUNONG BARANGAY

NOT VALID WITHOUT OFFICIAL SEAL

DISIPLINA MUNA * Matino, Mahusay at Maasahan

Republic of the Philippines
CITY OF MAKATI
BARANGAY POBLACION
Tel. No. 899-7027 / 896-4559

CERTIFICATION

This is to certify that **MAKATI PUMPING STATION** located at F. Zobel cor. Osmeña Street has no affected / relocated Informal Settler Families (ISFs) inside the said area. As per verification from Plaant Engr. Rizalino Padua and S/G Jonathan Romano, inspected and verified by Ex-O Carlos Collantes.

Issued this **18th** day of **September** 2020, at the **Poblacion Barangay Hall, City of Makati.**

As per verification made by:

EX-O CARLOS COLLANTES
Ex-O Bantay Bayan

Noted by:

HON. BENHUR L. CRUZ
Punong Barangay
(Not valid without Barangay Poblacion dry seal)

/rrl

Republic of the Philippines
City of Manila
OFFICE OF THE BARANGAY CHAIRMAN
Barangay 664 Zone 71 District V
0977-3568826/0919-5012449/0939-7796921/0936-4675659

CERTIFICATION

TO WHOM IT MAY CONCERN

IN REGARDS TO THE LETTER WE RECEIVED FROM YOUR AGENCY REQUESTING FOR THE CLEARANCE OF THE INFORMAL SETTLER FAMILIES (ISFS). THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH) IS HEREBY GIVEN A CLEARANCE/CERTIFICATION INDICATE THAT THERE IS NO AFFECTED INFORMAL SETTLER FAMILIES (ISFS) LOCATED IN THE ESTERO DE BALETE PUMPING STATION WHICH IS WITHIN THE TERRITORIAL JURISDICTION OF THE BARANGAY.

ISSUED UPON THE REQUEST OF THE ***SAID ESTABLISHMENT*** OWNER, MANAGER FOR WHATEVER LEGAL PURPOSES IT MAY SERVE.

SUBJECT TO INSPECTION

MA. RUCHELIE A. RELLON
BARANGAY CHAIRMAN

BARANGAY 664

DATE ISSUED: SEPT. 17, 2020
NOT VALID WITHOUT OFFICIAL DRY SEAL

Ma. Ruchelie A. Rellon
Punong Barangay
KAGAWAD

Nathaniel Rellon	**Ritchan Acebo**	**Imelda Esquita**	**Annalyn Abella**
Appropriation / Peace & Order	LIvelihood	Women's & Family	Health & Sanitation
Rosana Calimutan	**Antonio Lumen**	**Delly Ybañez**	
Ways & Means	Public Information & Safety	Clean & Green/Beautification	
Gracielle Adamero	**Jose Levi Latoza**		
Secretary	Treaurer		