Initial Environmental Examination

January 2019

PHI: Angat Water Transmission Improvement Project (Additional Financing)

Prepared by the Metropolitan Waterworks and Sewerage System (MWSS) for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 22 January 2019)

Currency unit	–	Philippine peso (PHP)
PHP1.00	=	$0.019
$1.00	=	PHP52.80

ABBREVIATIONS

ADB	-	Asian Development Bank
AH	-	affected household
AP	-	affected person
AWTIP	-	Angat Water Transmission Improvement Project
BBWSP	-	Bulacan Bulk Water Supply Project
BOD	-	biochemical oxygen demand
CSC	-	construction supervision consultant
CNC	-	certificate of non-coverage
CPF	-	Common Purpose Facility
DAO	-	DENR Administrative Order
DENR	-	Department of Environment and Natural Resources
DMS	-	detailed measurement survey
EA	-	executing agency
ECA	-	environmentally critical area
ECC	-	environmental compliance certificate
ECP	-	environmentally critical project
EHS	-	environmental, health, and safety
EIA	-	environmental impact assessment
EIS	-	environmental impact statement
EMB	-	Environmental Management Bureau
EPRMP	-	environmental performance report and management plan
GHG	-	Greenhouse Gas
GOP	-	Government of the Philippines
GRC	-	grievance redress committee
GRM	-	Grievance Redress Mechanism
ICC	-	investment coordination committee
IEC	-	information, education and communication
IEE	-	initial environmental examination
LGU	-	local government unit
MC	-	memorandum circular
MGB	-	Mines and Geosciences Bureau
MWSS	-	Metropolitan Waterworks and Sewerage System
NCR	-	National Capitol Region
NEDA	-	National Economic and Development Authority
NGO	-	non-government organization
NHA	-	National Housing Authority
NIPAS	-	National Integrated Protected Areas System
NWRB	-	National Water Resources Board
OSPF	-	Office of the Special Project Facilitator
PAGASA	-	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCO	-	Pollution Control Officer
PD	-	presidential decree

PEISS	-	Philippine Environmental Impact Statement System
PM	-	Project manager
PMO	-	project management office
PPE	-	personal protective equipment
RA	-	republic act
REA	-	rapid environmental assessment
ROW	-	right of way
SERD	-	Urban and Water Division, Southeast Asia Department, ADB
SJDM	-	San Jose del Monte
SPS	-	Safeguards Policy Statement (ADB, 2009)
TA	-	technical assistance
UNFCC	-	United Nations Framework Convention on Climate Change
WB	-	World Bank

WEIGHTS AND MEASURES

m^3	-	cubic meters
dB(A)	-	decibel acoustic
oc	-	degree Celsius
ha	-	hectare
km	-	kilometer
m	-	meter
MAMSL	-	meters above mean sea level
ml	-	milliliters
mm	-	millimeter
MLD	-	million liters per day
km^2	-	square kilometers
m^2	-	square meter

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EXECUTIVE SUMMARY

Introduction

1. The Asian Development Bank (ADB) awarded a grant to Metro Manila Water and Sewerage System (MWSS) for a Project Preparatory Technical Assistance known as Metro Manila Water and Sanitation Development Project (ADB PPTA 8769-PHI). The Technical Assistance (TA) is intended to support a loan that will finance the transmission of 1,500 MLD of water from Bigte Basins to Novaliches Portal in La Mesa Dam.

2. The MWSS will be the executing agency (EA) responsible for overall planning, implementation and management of the Project to attain the Project's deliverables as defined under the loan agreement. The PMO will be established by MWSS in the Engineering and Project Management Department.

3. This Initial Environmental Examination (IEE) report relates to the proposed construction of the aqueduct known as BNQA7 and its related facilities from Norzagaray, through San Jose del Monte in Bulacan to North Caloocan City to Quezon City in Metro Manila.

4. The proposed project will increase the reliability of the transmission of water from Ipo Dam to the two concessionaries and correspondingly to the water users of Metro Manila. These will translate to improved accessibility to potable and reliable water supply. Improved access to safe water will contribute to reduced incidence of diarrhea, dysentery, skin rashes, and other water-borne diseases.

5. Local employment and short-term business opportunities could be generated during the construction period for residents and establishments along the MWSS ROW.

6. The IEE was prepared in accordance with ADB's SPS (2009) and contains the 10 basic chapters namely: (1) Introduction, (2) Policy, Legal and Administrative Framework, (3) Description of the Project, 4) Description of the Environment, (5) Anticipated Environmental Impacts and Mitigation Measures, (6) Analysis of Alternatives, (7) Information Disclosure, (8) Consultation and Participation, (9) Grievance Redress Mechanism and (10) Conclusion and Recommendation.

Policy, Legal and Administrative Framework

7. The IEE was prepared in accordance with the following:

a. ADB's Safeguards Policy Statement (SPS, 2009)
b. Philippine Environmental Impact Statement System
c. Presidential Proclamation No. 2146, series of 1981
d. EIA Coverage and Screening Checklist of DAO 2003-30
e. Project Thresholds for Coverage Screening and Categorization, Revised Guidelines for Coverage Screening and Standardized Requirements in the Philippine EIS System. EMB Memorandum Circular No. 2014-005
f. DENR Administrative Order (DAO) No. 2017-15
g. The Clean Water Act
h. Other laws relevant to water supply projects

Description of the Project

8. The Angat Reservoir in Norzagaray serves as the source of 93% of the water requirements of Metro Manila. Water from the reservoir is discharged through two sets of turbines that generate electricity. Water discharged through the main turbines (4 units) go straight to Bustos Dam and it is used to irrigate about 31,000 hectares of farm land within the Province of Bulacan. On the other hand, water discharged through the auxiliary turbines (5 units) is impounded by Ipo Dam which is located about 5 km downstream of Angat Dam. Water impounded by Ipo Dam is diverted to Bigte, Norzagaray, Bulacan through three tunnels. A fourth tunnel from Ipo Dam to Bigte currently being constructed. The total capacity of the four (4) tunnels is 6,150 MLD.

9. Water conveyed by the tunnels from Ipo Dam are discharged into six Bigte Basins identified as 1, 2, 3, 3A, A and B. The receiving basins at Bigte serve as transition structures where flow from the tunnels are passed on to the aqueducts. There are six aqueducts that are currently conveying water from Bigte Basins to Novaliches Junction located in Novaliches, Quezon City. These are aqueducts AQ1 (branching out to AQ2 at some locations), AQ3, AQ4, AQ5 and AQ6. The aqueducts were completed at various years: AQ1 in 1939, AQ2 in 1948, AQ3 in 1969, AQ4 in 1983, AQ5 in 1992, AQ6 Phase 1 in 2006 and AQ6 Phase 2 in 2012. The collective current capacity of the aqueducts is 6,460 MLD.

10. All six aqueducts have been constructed within a 15-km long and 60-m wide Right of Way (ROW) of the MWSS.

11. The aqueducts converge into a junction area containing five basins known as the Novaliches Junction. A few hundred meters downstream is the Novaliches Portal. From Novaliches Portal, water gets allocated to the treatment facilities of Manila Water (for distribution to the East Zone) and Maynilad (for distribution to the West zone).

12. AQ7, the subject of the PPTA Feasibility Study, will be constructed as a replacement of AQ1&2. It will have a capacity of 1,500 MLD.

13. AQ7 will pass through four Local Government Units namely; Norzagaray, San Jose del Monte, North Caloocan City and Quezon City.

14. The main component of AQ7 is the 3.6-meter diameter, 15-kilometer long aqueduct. The aqueduct will be composed of five alternating segments of tunnels (5 kms) and cut and cover portions (10.2 kms).

15. The project will also entail the dismantling of the oldest aqueduct of the system, AQ1.

16. The detailed engineering design and other preparatory works are estimated to be carried out in one year. Actual construction and related activities will span a period of about 2.5 to 3.0 years depending on the number of personnel to be deployed by the contractor.

17. The proposed project will be completed at an indicative cost of PhP 6.86 billion.

18. The manpower requirement during pre-construction and construction phases of the proposed AQ7 will range from 620 to 740 (skilled and non-skilled). It is estimated that the Common Purpose Facilities (CPF) office will deploy 10 employees during the operation and maintenance of the aqueduct and related facilities.

Description of the Environment

19. BNAQ7 will pass through four LGUs namely; Norzagaray, San Jose Del Monte City, North Caloocan City and Quezon City. These urbanized LGUs are linked to each other and the proposed aqueduct by the Quirino Highway which extends northward to San Jose Del Monte where it is referred to as the Del Monte-Norzagaray Road.

20. The climate in the aqueduct alignment falls under Type I of the Modified Coronas Classification. Mean annual temperature varies from 27.6°C to 28.5oC. Average annual rainfall varied from 2301.1 mm in 2016 to 4,538 mm in 2013.

21. The proposed BNAQ7 alignment however goes only through a gently sloping to undulating terrain from the Novaliches Junction up the Academia area in San Jose Del Monte City before traversing a rolling to moderately steep section until its terminus at the Bigte Basins area.

22. The northern segment of the BNAQ7 alignment will intersect the main channels and tributaries of the Sta. Maria River at four locations. The southern segment will intersect the main channels and tributaries of the Marilao River also at four locations.

23. Based on the Groundwater Availability Map of the Philippines, the BNAQ7 alignment is underlain by rock formations classified under Local and Fairly Extensive Aquifer.

24. The 60-meter wide ROW of MWSS for the BNAQ7 alignment will traverse an area consisting of built up sections developed through a combination of grasslands/shrub lands, forest lands and open areas.

25. The southernmost end of the BNAQ7 alignment in Quezon City with a length of about 160 meters occupies the northwestern edge of the La Mesa Watershed Reservation. The area has been declared a Reservation through a presidential proclamation No. 1336 signed on July 25, 2007. The primary species found include narra and mahogany with patches planted to gemelina and ipil-ipil. During the survey, wildlife species were not observed although these could potentially be present at the central section of the reservation.

26. The northernmost segment of the aqueduct will be founded on limestone. The remaining segment will be set on pyroclastics and tuffaceous sedimentary rocks.

27. The geohazard map prepared by the Mines and Geosciences Bureau show that most of the BNAQ7 alignment has a low susceptibility to landslides. The southern segment which corresponds to the La Mesa Dam area has a moderate susceptibility to landslide.

28. MGB classified the northern segment of BNAQ7 alignment under Low to Moderate Susceptibility to Flooding. The near surface segments of the aqueduct transected by the main channel and tributaries of the Sta. Maria River and Marilao River will be susceptible to flooding during periods of major rain events.

29. The aqueduct will be vulnerable to ground shaking due to the regional presence of major faults.

30. The major sources of air pollution within the 60-meter ROW are the vehicles which ply the roads traversing the area. These vehicles emit smoke and stir up sediments from the unpaved segments of the road.

31. The main sources of noise within the 60-meter ROW are the vehicles which ply the roads that the aqueduct alignment. Noise is also generated by the daily activities of the people

32. Baseline survey for air quality and noise was conducted at three (3) stations which represent the residential, institutional and commercial sectors.

33. All stations passed the DENR standard for PM10 and Total Suspended Particulates.

34. The table below summarizes the assessment of the results of the monitoring for noise at the three (3) stations.

Table 1. Assessment of Results

Station	Comparison with DEN Standard	Comparison with WB Guidelines
Academia (Institutional Area)	All time divisions Exceeded the DENR Standard	Exceeded in 2 hours (1228 to 1428); within guidelines for 22 hours
Gumaoc Terminal (Commercial Area)	Two (2) time divisions Passed; Ten (10) time divisions Exceeded the DENR Standard	Within guidelines for 24 hours
Pleasant Hill (Residential Area)	Two (2) time divisions Passed; Ten (10) time divisions Exceeded the DENR Standard	Exceeded in 4 hours (1810 20 2010; 2210 to 0010); within guidelines for 20 hours

35. Two (2) water samples were taken from the main channels of Sta. Maria River and Marilao River for laboratory analysis. For the tested parameters, the water samples passed the standards for both Class A and Class C waters except for Dissolved Oxygen (DO) and Fecal Coliform. DO values for both samples slightly exceeded the standards for Class A and Class C waters. Very high values of fecal coliform were obtained for both rivers which suggest that these waters receive discharges of human waste farther upstream.

36. There are no known sites of archaeological significance within and around the project area. The project components will therefore not affect any historical and archaeological sites.

Anticipated Environmental Impacts and Mitigation Measures

37. Most of the identified impacts will be generated during the construction stage particularly at the cut and cover segments of the aqueduct, the portals of the tunnels, dismantled segment of AQ1, the temporary and final spoil disposal areas, the construction work areas and haulage routes for equipment, construction materials, spoils and personnel which are generally coincident with the 60-meter wide Right of Way of MWSS.

38. The key planning issue corresponds to the location of the southernmost segment of BNAQ7 aqueduct within the La Mesa Watershed Reservation. The issue has been communicated with the La Mesa Watershed Multi-Sectoral Managements Council through National Ecology Center for advice on what guidelines will be observed during the construction period.

39. The proposed EMP will contain mitigating measures consistent with the guidelines to be provided by the La Mesa Watershed Multi-Sectoral Managements Council and the provision and requirement of the SPS 2009 on Legally Protected Areas and the National Integrated Protected Areas System Act of 1992 (NIPAS)

40. The other planning issue refers to the relocation of three (3) informal households and eight (8) business enterprises. An appropriate relocation and resettlement plan has been formulated to address this issue.

41. The construction impacts and proposed mitigation measures are presented in Table 2.

Table 2: Construction Impacts and Proposed Mitigation Measures

Impacts	Mitigation Measures
Loss of vegetation including endangered tree species as a result of clearing and grubbing	The trees that will be removed will be replaced through the planting of similar species in the La Mesa Watershed Reservation. As much as practicable, excavation shall be within the 10-m wide AQ7 footprint and the designated staging area to reduce the coverage of construction and number of trees to be cut
Demolition of three (3) houses of informal dwellers and nine (9) establishments	The affected families and establishments will be given ample time to relocate under the MWSS relocation and resettlement plan.
Generation of stockpiles of soil and rocks	As much as possible, earthworks should be confined within the actual 10-meter footprint of the aqueduct and the staging area for equipment and construction materials. This will significantly reduce the generated stockpiles of soils and rocks. A spoils management plan should be developed and strictly enforced by the Contractor.
Erosion and siltation of waterways	The contractor will be required to implement proper measures which would include the provision of silt traps, ditches, and sump pits to intercept the flow of silt laden runoff from the worksites into the nearby channels and watercourses. Activities, especially earthworks, will be scheduled during the dry season or be stopped during heavy rainfall.
Obstruction of access to houses, establishments and utilities	Safe temporary accesses to houses and other establishments affected by the works will be provided by the contractor. The contractor will restore and reinstate any damaged sections to properties immediately. The schedule of disruption of utilities should be made known to the affected residents and establishments so appropriate adjustments can be made. A traffic management plan which will include provision of temporary routes shall be provided for each construction area.
Increase in ambient noise, dust generation and emission of GHG	All vehicles and heavy equipment to be used during construction must be checked for compliance with emission standards, subjected to regular maintenance and fitted with mufflers to minimize noise and. Speed limit will be set and strictly observed for all vehicles. A fence shall be established around the work area which will serve as sound barrier. Noise levels shall be closely monitored throughout the construction period. Construction workers shall be required to wear Personnel Protection Equipment (PPE). Construction equipment will be properly maintained

	and operated according to manufacturer's specifications.
Increased site traffic	A traffic management plan shall be formulated and implemented in coordination with the local government officials.
Generation of wastes	Generated wastes will be collected by the contractor and properly disposed in the approved disposal facility used by the respective local government units
Spill of fuels and lubricants	Appropriate management of contaminants from equipment should be strictly enforced.
Risks to occupational health and safety	The contractor shall be required to develop an occupational health and safety plan which shall be a requisite part of the contract documents.
Hazards to occupational health and safety for construction of AQ7 but also for demolition of AQ1 aqueduct	The contractor should be required to provide perimeter fencing, restrict access to the construction sites and provide security personnel. Provision of health and safety orientation for construction workers shall be strictly enforced. These workers shall be required to use the proper personnel protection equipment. The sections for demolition will be cordoned off form unauthorized personnel
Potential social conflicts arising from construction activities	Passage of local ordinances for prevention of prostitution and regulation of alcohol intake

Analysis of Alternatives

42. Previous studies particularly the Angat Water Transmission Improvement Project (AWTIP 2014) and BNAQ 1-5 Assessment and Rehabilitation Works and Studies (2016) have established the need for an additional aqueduct to address the following issues:

a. Heavy losses incurred by the current aqueducts which means that the aqueducts are now likely under-capacity compared to the tunnels that bring in water from Ipo Dam to the Bigte Basins
b. Age of AQ1, AQ2, AQ3, AQ4, AQ5 which requires rehabilitation

43. Aside from increasing the capacity of the aqueducts, AQ7 would facilitate the rehabilitation of the ageing aqueducts and offer substantial factor of safety to the water supply security of Metro Manila.

44. The above conditions show that there would be no alternative to the development of AQ7.

45. For optimum transport and to avoid land acquisition and large-scale resettlement, the only logical route of AQ7 would be within the MWSS ROW.

46. Six technical options have been considered for the development of AQ7 within the MWSS ROW. Option 5 where AQ7 will connect to the supply from Tunnels 3 and 4 at Bigte was chosen after an evaluation in terms of system flexibility (40%), flow capacities (10%), ease in construction (10%), least disruption in service (10%) and cost (30%).

47. The No Project Alternative would correspond to the status quo of the current delivery of water from Bigte Basin to Novaliches Portal. This means that the conveyance of water from Bigte Basin to Novaliches Portal would be done through aging aqueducts with reported heavy losses.

Public Consultation and Information Disclosure

48. Stakeholders consultations were conducted in eight barangays within the period from April 10 to June 27, 2018. The consultations were conducted to discuss with the stakeholders the proposed project and to elicit the environmental concerns/issues of the community on the proposed project.

49. The issues raised focused on the safety of the local residents during construction, change in water source, possible increase in prostitution, increase in traffic, employment opportunities, relocation period, compensation for displacement and flooding, among others.

50. Prior to and during project implementation, information regarding the project will be disseminated to all key stakeholders. Consultations will be undertaken on a need basis with the date, time and venue to be agreed with the LGU official and concerned government agencies.

Grievance Redress Mechanism

51. A Grievance Redress Mechanism (GRM) will be established to address and facilitate complaints that may result from the implementation of the subproject. Should any project-affected person (AP) be identified during the detailed design stage, or arise at any point during project implementation, the project GRM will be applied. All costs involved in resolving complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the EA.

Environmental Management Plan

52. The environmental management plan (EMP) will serve as the framework for the mitigating the anticipated impacts of the project. Implementation will commence before the procurement process for construction contractor up to the operation. Details are presented in Table 2.

Table 3: Environmental Management Plan

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
Design Issues				
Location of southern segment of AQ7 at southern edge of La Mesa Watershed Reservation	Detailed inventory of trees, notably endangered species within the 25-meter footprint of excavation and 40m^2 footprint of tunnel portal Compliance with the guidelines of the National Ecology Center	During the design stage	MWSS/ Contractor	6,000
Construction Phase				

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
Removal of vegetation within a 25-meter strip along cut and fill segment of the aqueduct and portal of the tunnels	Limit removal within the 10-wide aqueduct footprint and the staging area; replanting of trees of the same species at the La Mesa Watershed Reservation	During civil works	MWSS/ Contractor	6,000
Demolition of three (3) houses of informal dwellers and nine (9) establishments	Sufficient time will be provided for the people who need to relocate or clear encroaching structures. Timely relocation of affected families and establishments	During civil works	MWSS/ Contractor	Part of MWSS relocation and resettlement plan
Generation of stockpiles of soil and rocks	Earthworks should be confined within the 10-meter wide footprint of the aqueduct and designated staging area Require contractor to develop and strictly enforce a spoils management plan	During civil works	MWSS/ Contractor	Part of construction cost
Erosion and siltation of waterways	Provision of silt traps, ditches, and sump pits to intercept the flow of silt laden runoff from the worksites into the nearby channels and watercourses. Earthworks will be scheduled during the dry season or stopped during heavy rainfall.	During civil works	MWSS/ Contractor	Part of construction cost
Obstruction of access to houses, establishments and utilities	Safe temporary accesses to houses and other establishments affected by the works will be provided by the contractor. Contractor to restore any damaged sections to properties immediately. Contactor to undertake a detailed survey of existing water pipes power poles and lines and schedule the earthworks in such manner as to minimize disruption; IEC regarding construction schedule.	During civil works	MWSS/ Contractor	Part of construction cost
Increase in ambient noise and dust generation	All vehicles and heavy equipment to be checked for compliance with emission standards; Speed limit should be set for all vehicles; Installation of mufflers for all construction vehicles and heavy equipment; Construction of perimeter fence around the work area;	During civil works	MWSS/ Contractor	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
	construction work be limited during daytime hours; monitoring of noise levels			
Increased site traffic	Implement traffic management plan with LGU officials	During civil works	MWSS/ Contractor	Part of construction cost
Generation of solid wastes, hazardous waste and domestic wastewater	Regular waste collection and disposal.	During civil works	MWSS/ Contractor	Part of construction cost
Spill of fuels and lubricants	Keeping storage areas for fuels and lubricants away drainage canals leading to water bodies; designating areas within construction sites for equipment and vehicle washing and maintenance; provision of oil and grease traps at construction sites	During civil works	MWSS/ Contractor	Part of construction cost
Risks to occupational health and safety	Contractor shall be required to develop and implement an occupational health and safety plan which shall be a requisite part of the contract documents	During civil works	MWSS/ Contractor	Part of construction cost
Hazards to occupational health and safety.	Limiting access to construction sites to authorized personnel including the area to be affected by the demolition of AQ1 aqueduct	During civil works	MWSS/ Contractor	Part of construction cost
Potential social conflicts arising from construction activities	Passage and enforcement of local ordinances regarding prostitution and alcohol intake	During project construction	LGU officials	Part of LGU governance
Operation and Maintenance				
Project impact during operation (water supply conveyance/transmission) is considered negligible.				

Conclusions and Recommendation

53. Results of the IEE show that the proposed project will increase the reliability of the transmission of water from Ipo Dam to the two concessionaries and correspondingly to the water users of Metro Manila. These will translate to improved accessibility to potable and reliable water supply and reduced incidence of water-borne diseases.

54. Most of the environmental impacts are expected to occur during the construction phase particularly during civil works which will entail the removal of trees and vegetation, modification of terrain, potential siltation of nearby waterways, relocation of selected households and establishments, obstruction of access to houses, establishments and utilities, increase in ambient noise and dust generation, increased site traffic, generation of waste, increased risks to

occupational health and safety and hazards to occupational health and safety. Most of the identified impacts will be limited within the designated 25-meter wide construction area footprint.

55. These impacts are not distinct in the area as AQ7 will be the seventh aqueduct to be constructed in the MWSS ROW. These will be mitigated through the strict implementation of the proposed environmental management plan.

56. The IEE concludes that the current assessment based on project design and available environmental information complies with the requirements of ADB SPS 2009. No further environmental assessment is therefore required.

INITIAL ENVIRONMENTAL EXAMINATION

1 Introduction

1.1 Project Overview and Rationale

1. The Asian Development Bank (ADB) awarded a grant to Metro Manila Water and Sewerage System (MWSS) for a Project Preparatory Technical Assistance (PPTA) known as Metro Manila Water and Sanitation Development Project (ADB PPTA 8769-PHI). The Technical Assistance (TA) is intended to support a loan that will finance the transmission of 1,500 million liters per day (MLD) of water from Bigte Basins to Novaliches Portal in La Mesa Dam.

2. The MWSS will be the executing agency (EA) responsible for overall planning, implementation and management of the Project to attain the Project's deliverables as defined under the loan agreement. The project management office (PMO) will be established by MWSS in the Engineering and Project Management Department.

3. This Initial Environmental Examination (IEE) report relates to the proposed construction of the aqueduct known as Bigte-Novaliches Aqueduct 7 (BNAQ7) and its related facilities from Norzagaray, through San Jose del Monte in Bulacan to North Caloocan City to Quezon City in Metro Manila.

4. Using ADB's Rapid Environment Assessment Checklist and ADB's Safeguard Policy Statement (SPS, 2009), BNAQ7 is classified as Category B for environment, and therefore requires the preparation of an Initial Environmental Examination (IEE) report.

5. The main objective of this IEE is to identify and evaluate the potential direct, indirect, cumulative, and induced environmental impacts of the proposed project to the existing environment. The IEE recommends mitigation and management measures including environmental monitoring plan to ensure sustainability of the project.

6. The information presented in this report is based on site assessment and field visits, consultations with stakeholders in the project area, and from related studies and available secondary information.

1.2 Organization of the Initial Environment Examination (IEE) Report

7. In accordance with ADB's safeguard policy statement (SPS) 2009, this IEE report contains the following:

(i) **Chapter 1: Introduction** – describes the purpose of the report, study objectives, approach and methodology.

(ii) **Chapter 2: Policy, Legal and Administrative Framework** – discusses the national environmental administrative and legal framework and ADB environmental policies and guidelines.

(iii) **Chapter 3: Description of the Project** – describes the proposed project: its components and expected outcomes, cost estimates, implementation schedule, project benefits and beneficiaries.

(iv) **Chapter 4: Description of the Environment** – describes the relevant physical, biological and socio-economic and cultural conditions within the affected local government units (LGUs) and study area.

(v) **Chapter 5: Anticipated Environmental Impacts and Mitigation Measures** – describes the potential impacts of the project and provides an assessment of its likely positive and negative direct and indirect impacts to the physical, biological, socio-economic aspects during the different stages of project implementation, i.e. pre-construction, construction, operation, and abandonment.

(vi) **Chapter 6: Analysis of Alternatives** – provides the summary of assessment on some of the alternatives to the project in terms of siting, technology, design and operation including the no-project option.

(vii) **Chapter 7: Information Disclosure, Consultation and Participation** – describes the summary of stakeholder engagements conducted for the project, the issues raised by the stakeholders, and the proposed communication work plan.

(viii) **Chapter 8: Grievance Redress Mechanism** – describes the grievance redress framework and sets out the mechanisms for resolving affected peoples' concerns, complaints and grievances about the project's environmental performance.

(ix) **Chapter 9: Environmental Management Plan** – presents the identified potential impacts of the project and their corresponding proposed mitigation and enhancement measures. This section also describes the implementation arrangements, institutional capacity development program, and environmental monitoring and reporting program.

(x) **Chapter 10: Conclusion and Recommendation** – presents the conclusions drawn from the assessment and provides the recommendations.

2 Policy, Legal and Administrative Framework

8. This chapter presents the policy, legal and administrative framework relevant to the environmental and social assessment of the project.

2.1 ADB's Environment Safeguard Policies

9. Projects that will be funded by the ADB are required to comply with ADB's Safeguards Policy Statement (SPS, 2009). The ADB's safeguards policy framework consists of three operational policies, i.e. on the environment, indigenous peoples and involuntary resettlement. The policies apply to all ADB-financed projects, including private sector operations and to all project components. The operational policies seek to avoid, minimize, or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process.

10. The environment safeguard of ADB is applied if a proposed project has the potential to pose adverse environmental impacts and/or risks. The requirements for ADB-supported projects depend on the project's category, the classification of which is presented as follows:

(i) **Category A:** Projects with potential for significant adverse environment impacts. An environmental impact assessment (EIA) is required to address significant impacts.

(ii) **Category B:** Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those of Category A projects. An IEE is required to determine if significant environmental impacts are likely to warrant an EIA. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

(iii) **Category C:** Projects unlikely to have adverse environmental impacts. Neither EIA nor IEE is required but environmental implications are still reviewed.

(iv) **Category FI:** Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all subprojects will result in insignificant impacts.

11. The category of a proposed project is determined through screening using the ADB's sector-specific Rapid Environmental Assessment (REA) checklist and in this case, the REA checklist for the water sector.

12. ADB's SPS (2009) requires that the environmental categorization should be based on the most sensitive environmental component. For instance, if one component of the project has potential for significant adverse impacts, the entire project should be classified as Category A, even if all other components have no significant environmental impacts. If the most sensitive component falls under Category B, the project should be classified as Category B even if the other components are unlikely to have adverse environmental impacts.

13. The environmental assessment process includes assessing impacts, managing impacts, preparing environmental assessment reports, disclosing information and undertaking consultation, establishing a grievance redress mechanism, and monitoring and reporting. Specific environmental safeguards requirements are also outlined for biodiversity conservation and sustainable management of natural resources, pollution prevention and abatement, occupational and community health and safety, and conservation of physical cultural resources.

14. ADB also requires public disclosure for Category A and B projects. For Category B, the draft IEE report should be available to interested stakeholders before project approval and posted on the ADB's website upon Board approval of a project in accordance with the Operations Manual and Public Communication Policy (2012).

2.2 Legal and Institutional Framework of Environmental Management in the Philippines

15. The Environmental Impact Statement (EIS) system was institutionalized in the Philippines with the passage of Presidential Decree (PD) 1586 in 1978. PD 1586 was conceived as a regulatory system that enjoins proponents to reconcile project development with the requirements of environmental quality. It stipulates that for undertakings or projects that have potential adverse effects on the environment, the proponents must obtain an environmental compliance certificate (ECC) or a certificate of non-coverage (CNC) as pre-requisite to implementation. The Philippine EIS System (PEISS) is implemented with guiding documents that include its implementing rules and regulations (IEE), the procedural manual, and the EIA review manual, among others. As the system is being implemented, guiding documents are modified as necessary to improve the procedures and the system itself. The revised procedural manual for DENR Administrative Order (DAO) No. 30, series of 2003 (DAO 2003-30) and amendments issued through Memorandum Circulars (MC) or Executive Orders (EO) are currently prevailing guides to the EIA process.

16. Presidential Proclamation No. 2146, series of 1981 defined the projects which are within the scope of the Philippine EIS as those which are classified as Environmental Critical Projects (ECPs) or those which are located in Environmentally Critical Areas (ECAs). Under the PEISS, the EIA Coverage and Screening Checklist of DAO 2003-30, further guidance was developed to determine the coverage and requirements for projects and undertakings. The guideline for coverage screening was recently amended/updated by virtue of Environmental Management Bureau (EMB) Memorandum Circular No. 2014-005, which was issued on 7 July 2014. Project thresholds for coverage screening and categorization are provided in the guidelines. Under the new circular, projects are classified into the following groups, namely:

(i) **Category A** – Projects or undertakings which are classified as Environmentally Critical Projects (ECPs). Proponents of these projects implemented from 1982 onwards are required to secure an ECC;

(ii) **Category 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 an Environmentally Critical Area (ECA). Proponents of these projects implemented from 1982 onwards are likewise required to secure an ECC;

(iii) **Category 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. Project proponents may be issued a CNC subject to evaluation of a submitted Project Description report.;

(iv) **Category 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 but may opt to secure a CNC from the DENR.

17. The documentary requirement for ECC application for Category A (ECPs) is an EIS while the documentary requirement for Category B (non-ECPs but located in ECA) could be an EIS or an IEE report or IEE checklist, depending on the project threshold defined under the screening checklist. Category C project are required to prepare a Project Description report (Parts 1 and 2) to confirm non-coverage, hence, may be issued a CNC by the DENR or to further classify as either Category A or B which requires an ECC. The Project Description report for Category C projects should include: (i) a description of how the project enhances the environment or address environmental issues; (ii) project components list; (iii) description of project phases; (iv) project emission/effluent/hazardous waste/solid waste/other wastes; (v) project cost and duration; and (vi) collage of photos or plates of proposed project site.

18. Projects that are unlikely to cause adverse environmental impacts and falls below the threshold levels established under the revised guidelines may secure a CNC from the DENR-EMB Regional Office by submitting a Project Description report (Part 1).

19. According to Annex A of the revised guidelines for coverage screening and standardized requirements of the Philippine EIS System under EMB Memorandum Circular No. 2014-005, water supply projects are classified as Category B projects. **Table 1-1** reproduces the section of Annex A for water supply projects without a dam.

Table 1-1: Project Thresholds for Coverage Screening and Categorization Requirements for Water Supply Projects

Project	Project Size Parameters	Category A: ECP	Category B: Non-ECP		Category D
		EIS	EIS	IEE Checklist	PD
Water Supply Projects (without dam)	15 kilometer (km) long pipeline	None	With water source (e.g. infiltration gallery, etc.) and water treatment facilities including desalination and reverse osmosis)	Levels III (Distribution system only)	Level II / Level I Water refilling station

Sources: Annex A Project Thresholds for Coverage Screening and Categorization, Revised Guidelines for Coverage Screening and Standardized Requirements in the Philippine EIS System. EMB Memorandum Circular No. 2014-005

20. For existing water projects for which an ECC has been earlier issued but are being proposed for modification either due to expansion of land area, increase in capacity or auxiliary component, and/or change in process flow or methodology, an Environmental Performance Report and Management Plan (EPRMP) is required for the issuance of an ECC amendment. For minor project modifications, updating of the Project Description or the EMP based on the proponent's historical performance or monitoring reports may suffice. The type of EIA report to be prepared has to be validated with the EMB Regional Office to ensure that DENR issuances such as declared protected areas are considered.

21. An ECC amendment shall go through the process of scoping, report preparation, and EIA report review and evaluation by the DENR review team prior to endorsement of recommendation and issuance of decision on the ECC application. Once the ECC is approved, a copy of the ECC is transmitted to concerned agencies and LGUs and with continuing public involvement and environment monitoring and evaluation during implementation.

2.3 Guidelines on Public Participation under the Philippine EIS System

22. DENR Administrative Order (DAO) No. 2017-15, which was promulgated on 2 May 2017, defined the framework and procedures for public participation under the Philippine EIS System. Public participation shall be required for the entire EIA process from social preparation (prior to scoping) to impact management and monitoring during project implementation/abandonment. It provides the necessary procedures for stakeholder identification and analysis, information education campaign (IEC) requirements prior to public scoping, the process of engaging public participation in the public scoping as well as the roles of publics during the review process. The DAO also provides the mechanisms for public disclosures as well as grievance redress mechanisms (GRM).

2.4 The Clean Water Act

23. The Clean Water Act of 2004 provides a comprehensive water pollution control policy and intends to apply water quality management in all water bodies in order to implement the abatement and control of pollution from land-based sources.

2.5 Other Environmental Laws and Regulations

24. Other environmental laws and regulations that are applicable to the water supply projects include the following:

(i) RA 7586: National Integrated Protected Areas System (NIPAS) Act of 1992
(ii) RA 9147: Wildlife Resources Conservation and Protection Act of 2001
(iii) RA 10121: Philippine Disaster Risk Reduction Management Act of 2010
(iv) RA 6969: Toxic Substances and Hazardous Nuclear Waste Control Act of 1990 which mandates the regulation, restriction or prohibition of the importation, manufacture, processing, sale, distribution, use and disposal of chemical substances and mixtures that present unreasonable risk and/or injury to health and the environment.
(v) PD 856: Code of Sanitation of the Philippines
(vi) PD 1144: Fertilizer and Pesticide Act
(vii) Occupational Safety and Health Standards
(viii) PD 1067: Water Code of the Philippines established the basic principles and framework relating to the appropriation, control and conservation of water resources and to achieve the optimum development and rational utilization of these resources. The agency responsible for the implementation of the Water Code is the National Water Resources Board.
(ix) RA 9512: Environmental Awareness and Education Act of 2008 which promotes environmental awareness through environmental education; integrates environmental education into the school curricula at all levels of public and private schools, barangay day care and pre-school, and non-formal, vocational, and indigenous learning.
(x) RA 9729: Climate Change Act of 2009 which declares as a Philippine policy the adoption of the ultimate objective of the United Nations Framework Convention for Climate Change (UNFCC), which is the stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
(xi) RA 10068: Organic Agriculture Act of 2010 which establishes a comprehensive organic farming program that includes incentives for farmers engaged in the production of agricultural crops free from harmful chemical pesticides and fertilizers.
(xii) DENR Administrative Order No. 35 series of 1990 (The Revised Effluent Regulations of 1990) which is based on the Philippine Pollution Control Decree of 1976 issued as PD 984.

2.6 International Conventions and Agreements

25. The Philippines is signatory to several international conventions which include, among others:

(i) Kyoto Protocol which sets binding obligations for industrialized countries to reduce greenhouse gas emissions.
(ii) Basel Convention which is designed to reduce movement of hazardous waste between nations specifically to prevent transfer of hazardous waste from developed countries to less developed countries.

(iii) Stockholm Convention on Persistent Organic Pollutants which aims to eliminate and restrict the production and use of persistent organic pollutants (POPs).

2.7 Milestones for Environmental Compliance of GOP Requirements

26. With respect to the GOP regulations, the following are the milestones which needs to be considered in the design, construction and implementation of the project (**Table 2-2**):

Table 2-2: Milestones for Environmental Compliance

Project Stage	Environmental Regulatory Requirement	Approving Entity	Purpose
Detailed Engineering and Design	Environmental Compliance Certificate (ECC) amendment	DENR	In compliance with PD1586. ECC is needed prior to ICC NEDA Board approval.
Bidding	ECC and EMP in bid documents		For reference for bidders
Notice to Proceed	Updated EMP prepared by contractor with budget (if necessary)		For reference of contractors and subcontractors
Construction	Permit to Cut/Ball Out trees	DENR-FMB	Applicable if the proposed project will cut/ball out trees
	Semi-annual Compliance Monitoring Report submitted to DENR-EMB Regional Office		In compliance with PD1586. To document implementation of EMP
Operation	Discharge Permit	DENR-EMB	In compliance with RA9275. Applicable for the treatment and discharge of wastewater effluent.
	Permit to Operate – Air Pollution Source Equipment	DENR-EMB	In compliance with RA8749. Applicable is the proposed project will utilize generator sets even if as standby units only.
	Water Rights Permit	NWRB	For the abstraction from surface water and/or groundwater.
	Hazardous Waste Registration	DENR-EMB	In compliance with RA6969. Applicable for management of hazardous wastes such as empty chemical containers, used oil, busted fluorescent lamps
	Semi-annual Compliance Monitoring Report submitted to DENR-EMB Regional Office		In compliance with PD1586. To document implementation of EMP
	Quarterly Self-Monitoring Report submitted to DENR-EMB Regional Office		To document monitoring of environmental parameters.

3 Description of the Project

3.1 Background

27. The Angat Reservoir in Norzagaray serves as the source of 98% of the water requirements of Metro Manila. Water from the reservoir is discharged through two sets of turbines that generate electricity. Water discharged through the main turbines (four units) go straight to Bustos Dam and it is used to irrigate about 31,000 hectares (has) of farm land within the Province of Bulacan. On the other hand, water discharged through the auxiliary turbines (five units) is impounded by Ipo Dam which is located about 5 km downstream of Angat Dam. Water impounded by Ipo Dam is diverted to Bigte, Norzagaray, Bulacan through three tunnels. A fourth tunnel from Ipo Dam to Bigte currently being constructed. **Table 3-1** presents the design capacities of the tunnels.

Table 3-1: Tunnel Design Capacities

Tunnel Designation	Design Capacity (MLD)
Tunnel 1	760
Tunnel 2	1,890
Tunnel 3	1,900
Tunnel 4	1,600
Total Capacity	6,150

28. Water conveyed by the tunnels from Ipo Dam are discharged into six Bigte Basins identified as 1, 2, 3, 3A, A and B. The receiving basins at Bigte serve as transition structures where flow from the tunnels are passed on to the aqueducts.

29. There are six aqueducts that are currently conveying water from Bigte Basins to Novaliches Junction located in Novaliches, Quezon City. These are aqueducts AQ1 (branching out to AQ2 at some locations), AQ3, AQ4, AQ5 and AQ6. **Table 3-2** presents the design capacities of the aqueducts. From Novaliches Junction, water gets allocated to the treatment facilities of Manila Water (for distribution to the East Zone) and Maynilad (for distribution to the West zone).

Table 3-2: Aqueduct Design Capacities

Aqueduct Designation	Design Capacity (MLD)
AQ1 & 2	380
AQ3	830
AQ4	1,250
AQ5	2,000
AQ6	2,000
Total Capacity	6.460

30. From the Bigte Basin, water is transferred to La Mesa Dam via six aqueducts (AQ 1-6) which extend approximately 15 km. The aqueducts were constructed within the MWSS Right-Of-Way (ROW) which is generally 60 meters (m) wide except at Bigte where the ROW widens considerably. Depending on the terrain, some portions were tunneled through elevated portions of the ROW while the rest were constructed using the conventional cut-and-cover. The aqueducts were completed at various years: AQ1 in 1939, AQ2 in 1948, AQ3 in 1969, AQ4 in 1983, AQ5 in 1992, AQ6 Phase 1 in 2006 and AQ6 Phase 2 in 2012.

31. The aqueducts converge into a junction area containing five basins known as the Novaliches Junction. A few hundred meters downstream is Novaliches Portal. From Novaliches Portal, water gets allocated to the treatment facilities of Manila Water (for distribution to the East zone) and Maynilad (for distribution to the West zone).

32. BNAQ7, the subject of the PPTA Feasibility Study, will be constructed as a replacement of BNAQ1&2. It will have a capacity of 1,500 MLD.

33. **Figure 3-1** shows the general alignment of the tunnels from Ipo Dam to Bigte Basins and the aqueducts from Bigte Basins to Novaliches Junction. **Figures 3-2** and **3-3** respectively show the general arrangement of the receiving basins at Bigte and Novaliches Junction.

Figure 3-1: General Alignment of the Tunnels and Aqueducts

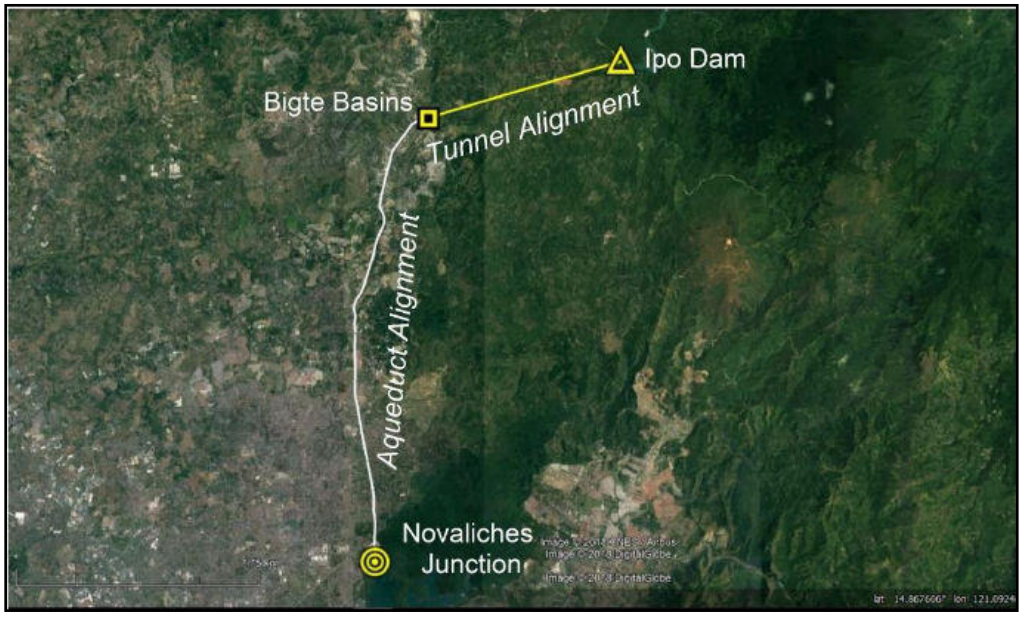
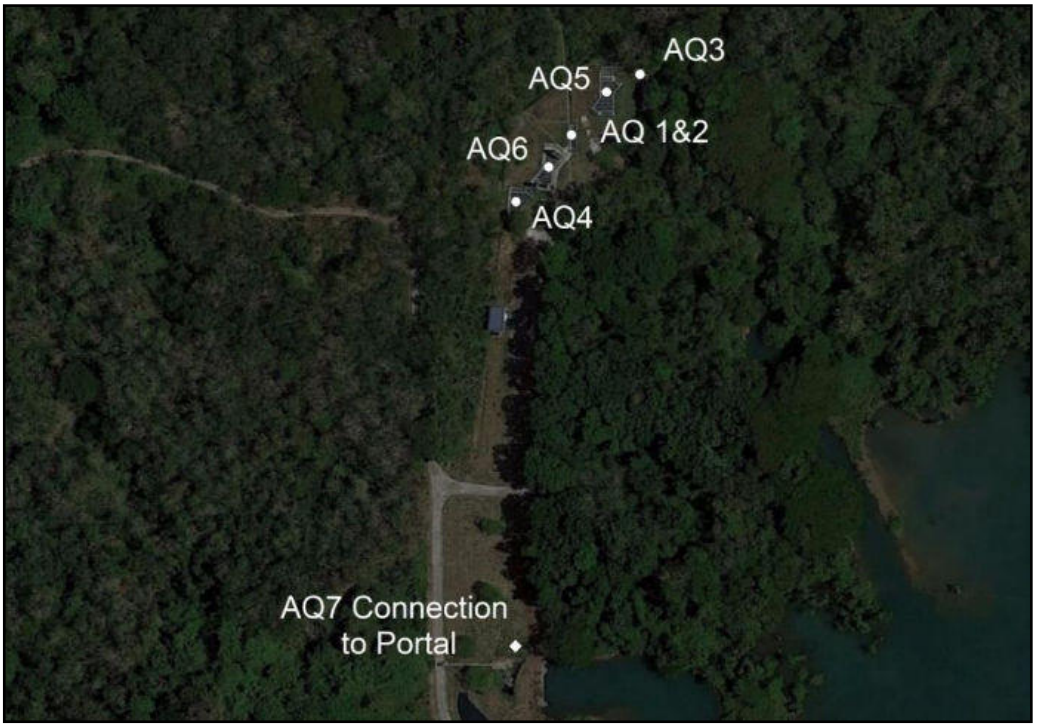


Figure 3-2: General Arrangement of the Receiving Basins at Bigte

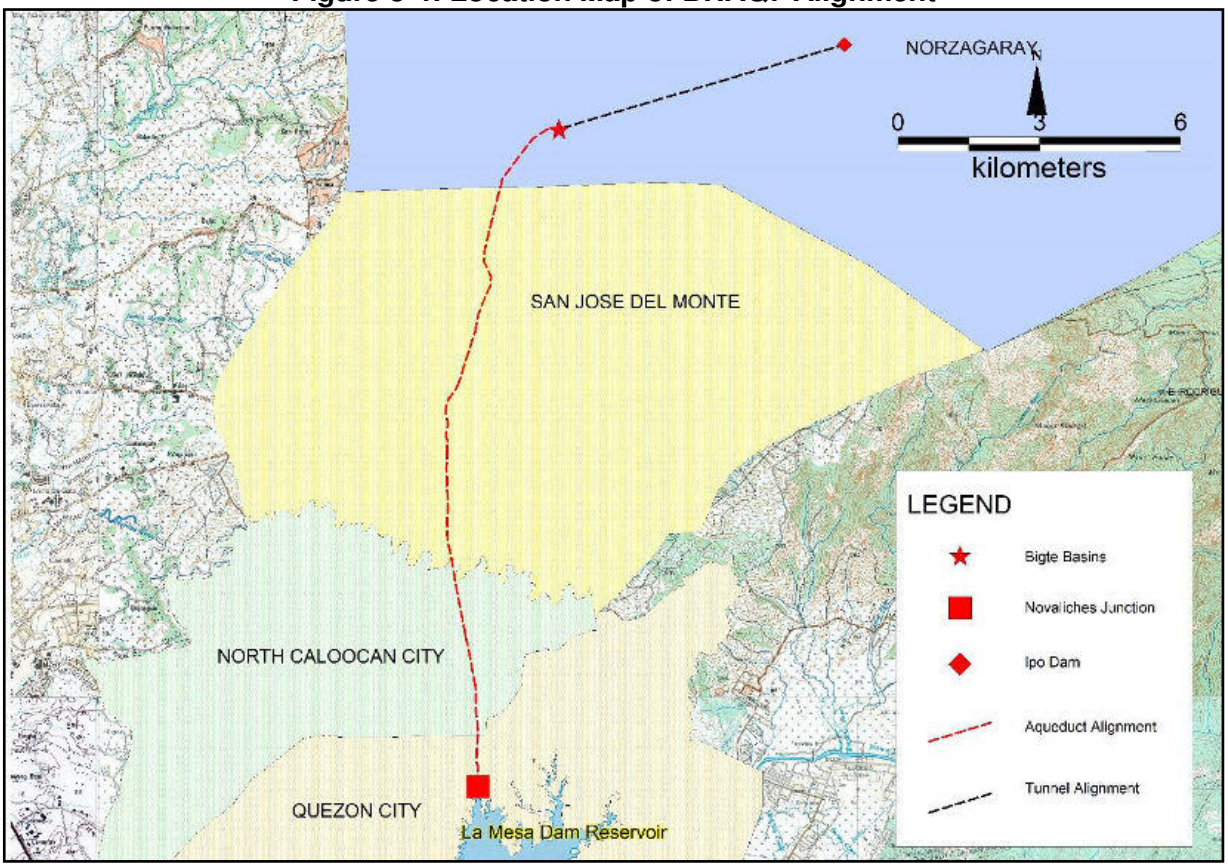
Figure 3-3: General Arrangement of the Receiving Basins at Novaliches Junction



3.2 Project Location

34. From north to south, BNAQ7 will pass through four LGUs namely; Norzagaray, San Jose del Monte, North Caloocan City and Quezon City. The Bigte Basins fall under the jurisdiction of Norzagaray. Novaliches Junction and Novaliches Portal fall within Quezon City (**Figure 3-4**).

Figure 3-4: Location Map of BNAQ7 Alignment



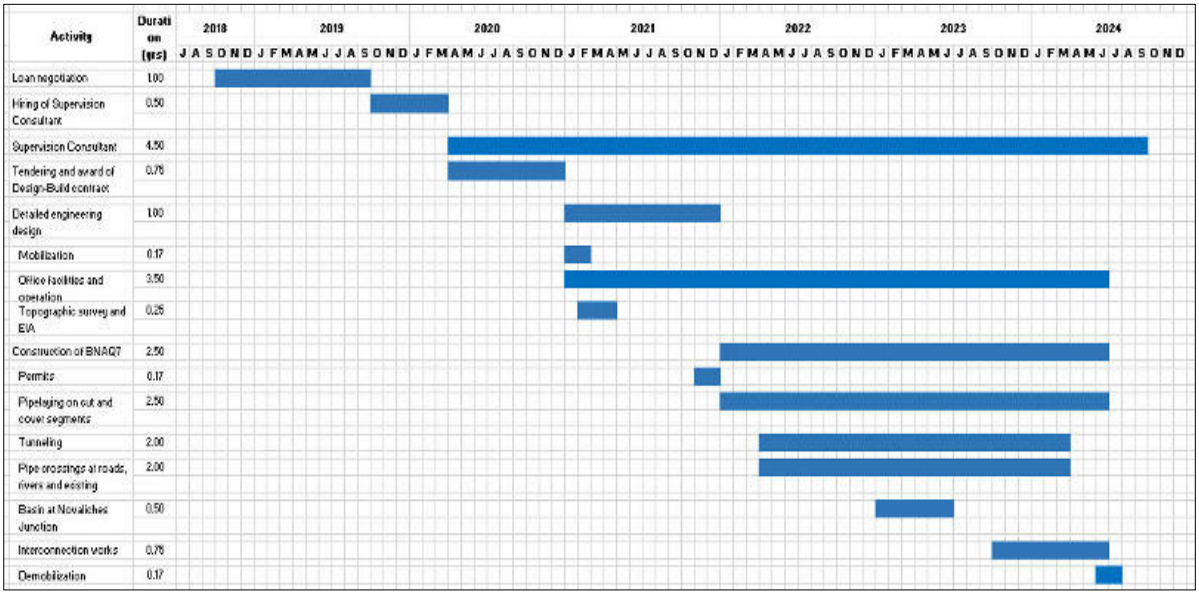
3.3 Project Components

35. The main component of BNAQ7 is the 3.6 m diameter, 15.141km long aqueduct. The aqueduct will include three (3) tunnel segments with rest to be installed through cut and cover.

3.4 Project Schedule

36. **Figure 3-5** shows the proposed implementation schedule of BNAQ7. The preparatory works for construction which include loan negotiation, hiring of supervision consultants, tendering and award of design-build contract and detailed engineering is estimated to last for 2.5 years. Actual construction and related activities will span a period of about 2.5 to 3.0 years depending on the number of personnel to be deployed by the contractor.

Figure 3-5: BNAQ7 Implementation Schedule



3.5 Indicative Project Cost

37. The proposed project will be completed at an indicative cost of PHP6.17 billion.

3.6 Manpower

38. The manpower requirement during pre-construction and construction phases of the proposed BNAQ7 will range from 620 to 740 (skilled and non-skilled). It is estimated that the MWSS will deploy 10 employees for the operations and maintenance viaduct and related facilities.

3.7 Project Benefits and Beneficiaries

39. The proposed project will increase the reliability of the transmission of water from Ipo Dam to the two concessionaires of MWSS and correspondingly to the water users of Metro Manila plus the Bulacan Bulk Water Supply Project (BBWSP). These will translate to improved accessibility to potable and reliable water supply. Improved access to safe water will contribute to reduced incidence of diarrhea, dysentery, skin rashes, and other water-borne diseases.

40. Local employment and short-term business opportunities could be generated for during the construction period for residents and establishments along the MWSS ROW.

4 Description of the Environment

4.1 Physical Sources

4.1.1 Geography

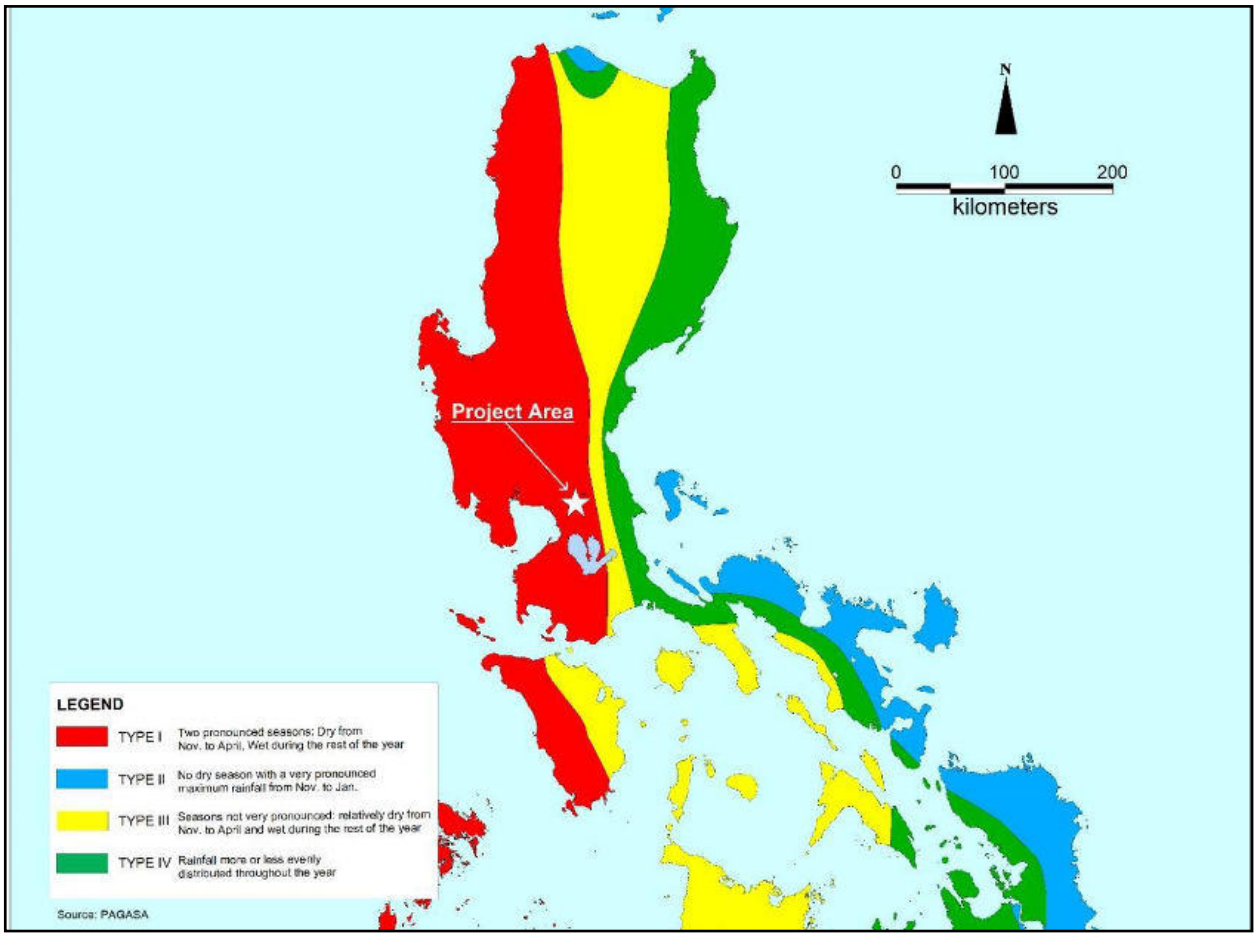
41. As shown in **Figure 3-4**, the BNAQ7 will pass through four LGUs namely; Norzagaray, San Jose Del Monte City, North Caloocan City and Quezon City. These four LGUs are linked to each other and the proposed aqueduct by the Quirino Highway which extends northward to San Jose Del Monte where it is referred to as the Del Monte-Norzagaray Road.

42. San Jose Del Monte City is a component city of the province of Bulacan. North Caloocan City and Quezon City both belong to the cluster of LGUs referred to as the National Capital Region.

4.1.2 Climate

43. The climate of the BNAQ7 alignment falls under Type I of the Modified Coronas Classification (**Figure 4-1**). This type is characterized by the wet season that usually starts in the month of May and lasts until October with heavy rains from July to October and the dry season the rest of the year with January and February as the driest.

Figure 4-1: Project Area as shown in the Climate Map of Luzon



44. The following meteorological conditions were inferred for the BNAQ7 alignment based on the 2007 to 2017 PAGASA data from its Science Garden Station in Quezon City.

4.1.3 Temperature

45. Mean annual temperature varies from 27.6°C to 28.5oC. The recorded coldest month is February and the hottest is May. Relatively cool temperature prevails from December to February. The warm months include April, May, June, July and August (**Table 4-1**).

Table 4-1: Monthly total and annual Mean Temperature (Cº)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
2007	26.6	26.2	27.8	29.7	29.7	29.7	28.9	27.6	28.2	27.5	26.9	26.7	28.0
2008	26.4	26.3	27.5	29.2	28.4	28.7	28.4	27.5	27.7	27.9	27.5	26.3	27.7
2009	25.5	27.2	28.3	29	29	28.1	28	28.5	27.6	27.6	27.4	26.1	27.7
2010	26.5	27.4	28.6	29.9	31.2	29.6	28.8	28.5	28.5	27.9	27.3	26.4	28.4
2011	25.9	26.6	27.6	27.8	29.3	28.3	27.7	27.7	27.9	27.7	27.8	26.8	27.6
2012	26.6	26.4	27.3	29.4	29.3	28.5	27.8	27.3	27.9	27.5	27.8	27.5	27.8
2013	25.9	27.1	25.9	29.7	29.8	29.1	28.5	27.5	27.6	27.3	27.4	27	27.7
2014	24.7	25.8	27.4	28.1	30.3	29.4	28.1	27.8	27.9	27.8	27.5	26.5	27.6
2015	23.7	25.6	27.2	29.4	29.9	29.7	27.6	28.5	28.6	28.2	28.4	27	27.8
2016	27.2	26.7	28.5	30.3	30.4	29.6	28.8	28.3	28.5	28.4	27.8	27.6	28.5
2017	26.3	26.2	27.6	29.4	30.1	29.7	28.6	28.9	28.8	28	28	26.9	28.2

46. Based on the 2011 PAGASA Publication “Climate Change in the Philippines”, the following changes in meteorological conditions are predicted to prevail:

47. Mean temperatures in all areas in the Philippines are expected to rise by 0.9 °C to 1.1 °C in 2020 and by 1.8 °C to 2.2 °C in 2050.

48. Generally, there is reduction in rainfall in most parts of the country during the summer (March April May) season. Rainfall increase is likely during the southwest monsoon (June July August) season until the transition (September October November) season in most areas of Luzon and Visayas, and also, during the northeast monsoon (DJF) season, particularly, in provinces/areas characterized as Type II climate in 2020 and 2050.

49. Hot temperatures will continue to become more frequent in the future.

50. Heavy daily rainfall will continue to become more frequent, extreme rainfall is projected to increase in Luzon and Visayas only, but number of dry days is expected to increase in all parts of the country in 2020 and 2050.

51. **Tables 4-2, 4-3** and **4-4** present the climate change projections in 2020 and 2050 Bulacan and the two northern LGUs of the National Capital Region (NCR) namely; North Caloocan City and Quezon City. These projections are based on the PRECIS Model that is used by the PAGASA for climate change scenarios and under the medium-range emission scenario.

Table 4-2: Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range scenario along the BNAQ7 alignment

Area	Observed Baseline (1971-2000)				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Bulacan	25.6	27.9	27.1	26.7	0.9	1.1	0.9	1.0	1.9	2.1	1.7	1.9
Metro Manila	26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9

Table 4-3: Seasonal rainfall change (in %) in 2020 and 2050 under medium-range scenario along the BNAQ7 alignment

Area	Observed Baseline (1971-2000)				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Bulacan	212.4	288.9	1041.4	842.1	4.2	-23	12.8	-2.9	-13.2	-36.4	23.6	-3.3
Metro Manila	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7

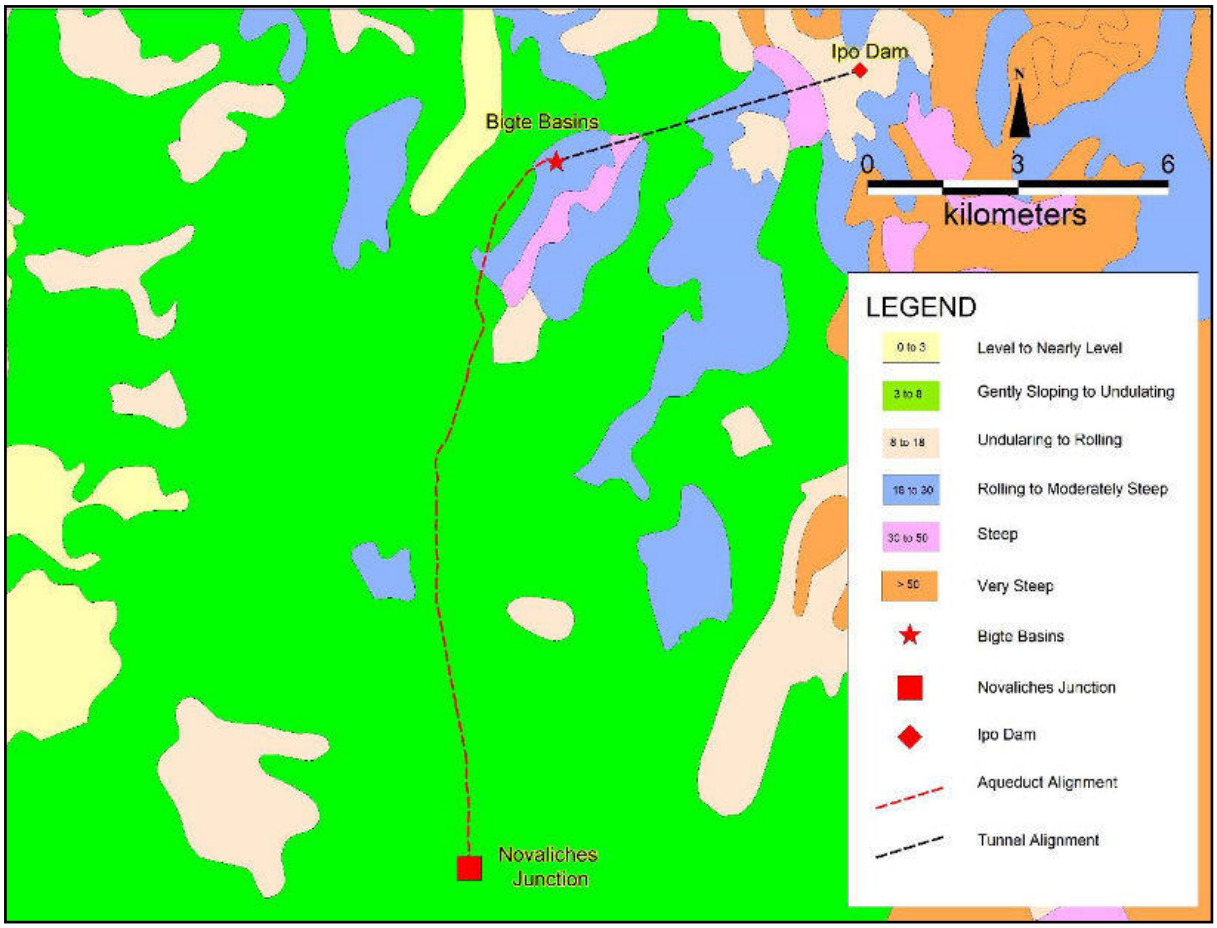
Table 4-4: Frequency of Extreme Events in 2020 and 2050 under the medium-range emission scenario along the BNAQ7 alignment

Area	Station	No. of Days w/ T Max > 35oC			No. of Dry Days			No. of Days w/ Rainfall > 200 mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Bulacan	Science Garden	1095	1984	3126	7476	6302	6220	9	13	17
Metro Manila	Science Garden	1095	1984	3126	7476	6302	6220	9	13	17

4.1.4 Topography

52. The LGUs which will be traversed by the proposed BNAQ7 are located on the western foothills of the Sierra Madre Range, a mountain chain that extends from the northeastern tip of Luzon to the province of Quezon in the south. This location accounts for the presence of the entire range of slope classes from nearly level to very steep within these LGUs. The proposed BNAQ7 alignment however goes only through a gently sloping to undulating terrain from the Novaliches Junction up the Academia area in San Jose Del Monte City before traversing a rolling to moderately steep section until its terminus at the Bigte Basins area (**Figure 4-2**). Elevation ranges from 45 to 130 meters above mean sea level (MAMSL).

Figure 4-2: Slope Map of the BNAQ7 Alignment



4.1.5 Surface Water and Drainage

53. The BNAQ7 alignment will traverse the upper sections of the watersheds of the west flowing Sta. Maria River and Marilao River. Both rivers originate from the western foothills of the Sierra Madre Range and eventually discharges into the South China Sea. The primary tributary of Sta. Maria River corresponds to the Bigte River.

54. The southern end of the BNAQ7 alignment corresponds to the northwestern edge of the La Mesa Reservoir. The reservoir has a watershed area of 27 km^2.

55. The northern segment of the BNAQ7 alignment will intersect the main channel of the Sta. Maria River. At the point of intersection, the main channel of Marilao River is locally referred to as the San Jose River. The southern segment of the BNAQ7 alignment will intersect the main channel of the Marilao River. At the point of intersection, the main channel of Marilao River is locally referred to as the Alat River. From north to south, AQ7 will intersect 19 waterways (**Table 4-5**).

Table 4-5: Locations Where AQ7 Will Cross Waterways

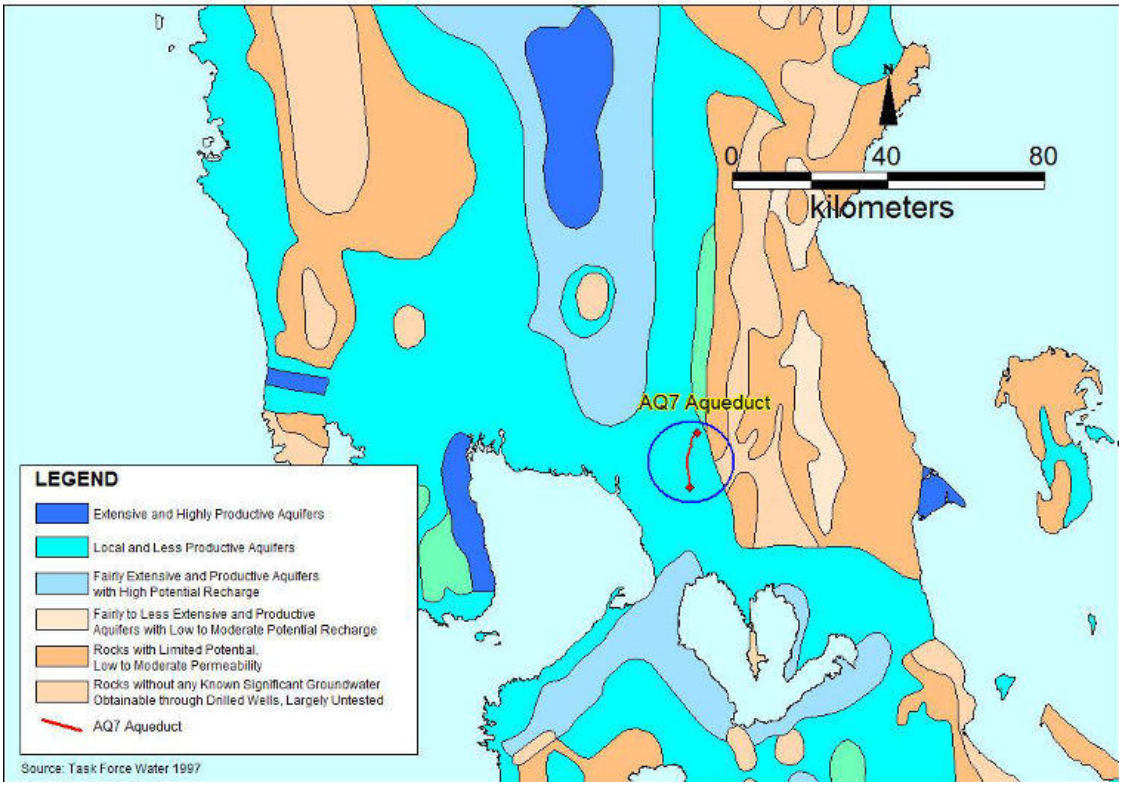
Road Crossing No.	Name of Road	Approximate Station		Approximate Length (m)
		Start	End	
1	Access road	0+860	0+870	10
2	Access road	0+990	1+005	10
3	Quirino Highway (slanting)	1+133	1+163	30
4	E. Roquero Sr. Avenue	1+610	1+630	20
5	Road 1 (to SJDMWD)	2+410	2+430	20
6	Del Monte Road	2+995	3+040	45
7	Road 3	3+235	3+245	10
8	Road to Sto. Cristo Gospel Church	3+818	3+828	10
9	Bayani Road	7+110	7+125	15
10	Quirino Highway (near Gumaok)	7+525	7+560	40
11	Gumaok Road	7+575	7+590	15
12	Narra Street Main Road	9+315	9+328	12
13	Pleasant Hills Gate 1 Road	9+840	9+855	15
14	Crusader Street	10+060	10+075	15
15	LWCP Road	10+328	10+340	12
16	Kaagapay Road	10+540	10+555	15
17	Victoria Wave Ecozone Road	10+685	10+700	15
18	Dirt road	10+860	10+875	15
19	Small (Y) road	10+955	10+965	10
20	St. Joseph	11+255	11+270	15
21	Crispulo Street	12+030	12+045	15
22	Anahaw Street	12+180	12+195	15
23	Santol Street	12+445	12+460	15

56. Drainage facilities within the ROW consist of canals which convey run-off from the adjoining built up areas towards the natural waterways which are intersected by the BNAQ7 alignment.

4.1.6 Groundwater

57. Based on the Groundwater Availability Map of the Philippines, the BNAQ7 alignment is underlain by rock formations classified under Local and Fairly Extensive Aquifer (**Figure 4-3**). The area traversed by the aqueduct is supplied by Level III systems of Norzagaray Water District, San Jose Del Monte Water District, and Maynilad for North Caloocan City and Quezon City. The wells of Norzagaray and San Jose Del Monte Water Districts tap the deep aquifer hosted by the Guadalupe Tuff.

Figure 4-3: Groundwater Availability Map showing the AQ7 alignment



4.1.7 Land Use

58. The 60 m wide ROW of MWSS for the BNAQ7 alignment will traverse an area consisting of built up sections developed through a combination of grasslands/shrub lands, forest lands and open areas.

59. The main categories of land use within the ROW include forested area, mixture of grass, shrubs and trees, open areas, roads and waterways. Google imageries combined with field verification were used in estimating the areas corresponding to these land uses.

60. **Table 4-6** presents the estimated linear areas of different land use along plotted trace of the BNAQ7 alignment. As shown the dominant land use corresponds to the mixture of grassland/shrublands/forests and forested areas which make up 51 and 34 %, respectively.

Table 4-5: Estimated linear areas of different land uses along the BNAQ7 alignment

Land Use	Length (km)	%
Road	0.47	3.1
Open Area	1.59	11
Forested Area	5.15	34
Built up	0.13	0.9
Waterway	0.07	0.5
Mixed Grass/Shrub land/Forest	7.76	51
Total	15.17	100

61. The tunnel and cut and fill segments of the aqueduct are intersected by a combination of national, local, barangay and subdivision roads at 34 locations. The Quirino Highway intersects the alignment four times. **Table 4-7** presents the list of the road and viaduct alignment intersections.

Table 4-6: Road and Viaduct Alignment Intersections

Designation	Latitude	Longitude	Road Name	Design
RC1	14.856103	121.085202	Barangay Road	Cut and Fill Segment
RC2	14.854071	121.083689	Barangay Road	Cut and Fill Segment
RC3	14.852924	121.082725	Quirino Highway	Cut and Fill Segment
RC4	14.849772	121.080012	Dr. Eduardo Roquero Avenue	Cut and Fill Segment
RC5	14.842816	121.078073	Road 1	Cut and Fill Segment
RC6	14.837507	121.076717	Del Monte Road	Cut and Fill Segment
RC7	14.835571	121.076466	Minor Road, unnamed	Cut and Fill Segment
RC8	14.830646	121.077463	Minor Road, unnamed	Cut and Fill Segment
RC9	14.814597	121.07246	Near Intersection with Quirino Highway	Tunnel Segment
RC10	14.812668	121.071997	Quirino Highway	Tunnel Segment
RC11	14.802878	121.06903	Bayani Road	Cut and Fill Segment
RC12	14.798869	121.068966	Quirino Highway	Cut and Fill Segment
RC13	14.792732	121.068807	Gov. Halili Road	Tunnel Segment
RC14	14.787382	121.068978	Minor Road, unnamed	Tunnel Segment
RC15	14.784114	121.069076	Mankor Street	Cut and Fill Segment
RC16	14.782945	121.069036	Corinth Street	Cut and Fill Segment
RC17	14.77827	121.069303	Altaraza Spine Road	Cut and Fill Segment
RC18	14.776267	121.069723	Crusader Street	Cut and Fill Segment
RC19	14.773916	121.070148	LWCP Road	Cut and Fill Segment
RC20	14.772018	121.070459	Kaagapay Road	Cut and Fill Segment
RC21	14.770822	121.071006	Malaria Road	Cut and Fill Segment
RC22	14.769961	121.070839	Minor Road, unnamed	Cut and Fill Segment
RC23	14.768338	121.07112	Minor Road, unnamed	Cut and Fill Segment
RC24	14.765722	121.071658	St. Joseph Road	Cut and Fill Segment
RC25	14.764331	121.071985	Minor Road, unnamed	Cut and Fill Segment
RC26	14.758796	121.073117	Crispulo Street	Cut and Fill Segment
RC27	14.757488	121.073398	Anahaw Street	Cut and Fill Segment
RC28	14.755075	121.074036	Santol Street	Cut and Fill Segment
RC29	14.749928	121.074444	Malanting Street	Tunnel Segment
RC30	14.746988	121.074509	H. de la Costa Avenue	Tunnel Segment
RC31	14.745708	121.074729	Corpus Christi	Tunnel Segment
RC32	14.745093	121.074725	St. George Street	Tunnel Segment
RC33	14.744534	121.074754	Visitation Street	Tunnel Segment
RC34	14.739778	121.074684	Quirino Highway	Tunnel Segment

4.1.8 Geology

62. The island of Luzon, where the proposed BNAQ7 alignment is located, is influenced by the presence of major earthquake generators which can potentially affect the proposed water transmission facility. **(Figure 4-4)**. These include the Philippine Fault Zone, the Manila Trench and the West Marikina Valley Fault.

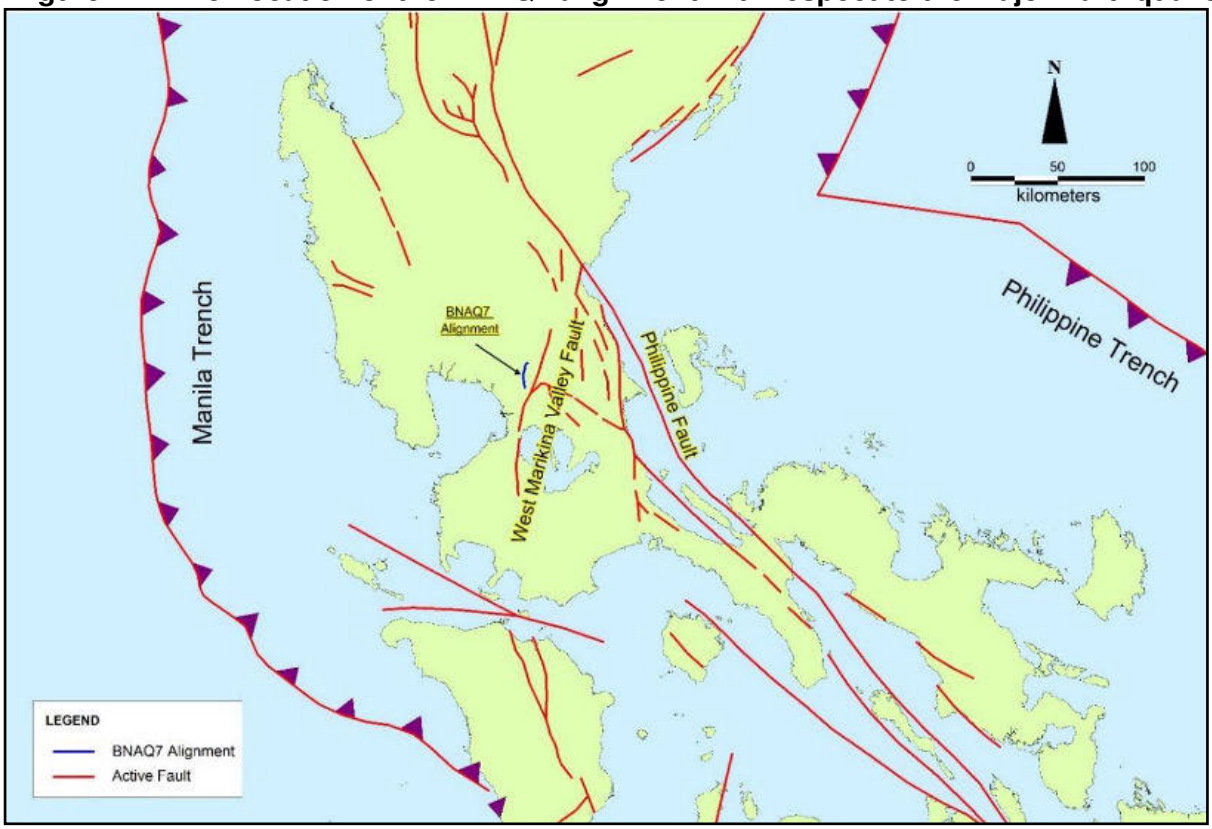
63. The Philippine Fault is a left lateral fault which cuts through Luzon, the Visayas and Mindanao over a length of more than 1,200 km. Its segment at Baler Area is approximately 57 km east of the alignment.

64. The Philippine Fault and its splays that pass through the Central Cordillera, together with the Manila Trench Subduction Zone on the west and the East Luzon Trough-Philippine Trench, are known to be active earthquake generators. Earthquake generated in these sites can cause strong ground shaking movements in seismically active areas like Baguio City, La Trinidad, and vicinities where several local faults and lineaments traverse.

65. The Manila Trench is a broad arcuate geological structure located west of the island of Luzon and spans the length from 13° north to 22° north latitude. This earthquake generator is located approximately 214 km west of the alignment.

66. The southern end of the alignment at the La Mesa Dam area is approximately 5 km west of the West Marikina Valley Fault.

Figure 4-4: The Location of the BNAQ7 alignment with respect to the Major Earthquake Generators of Central Luzon

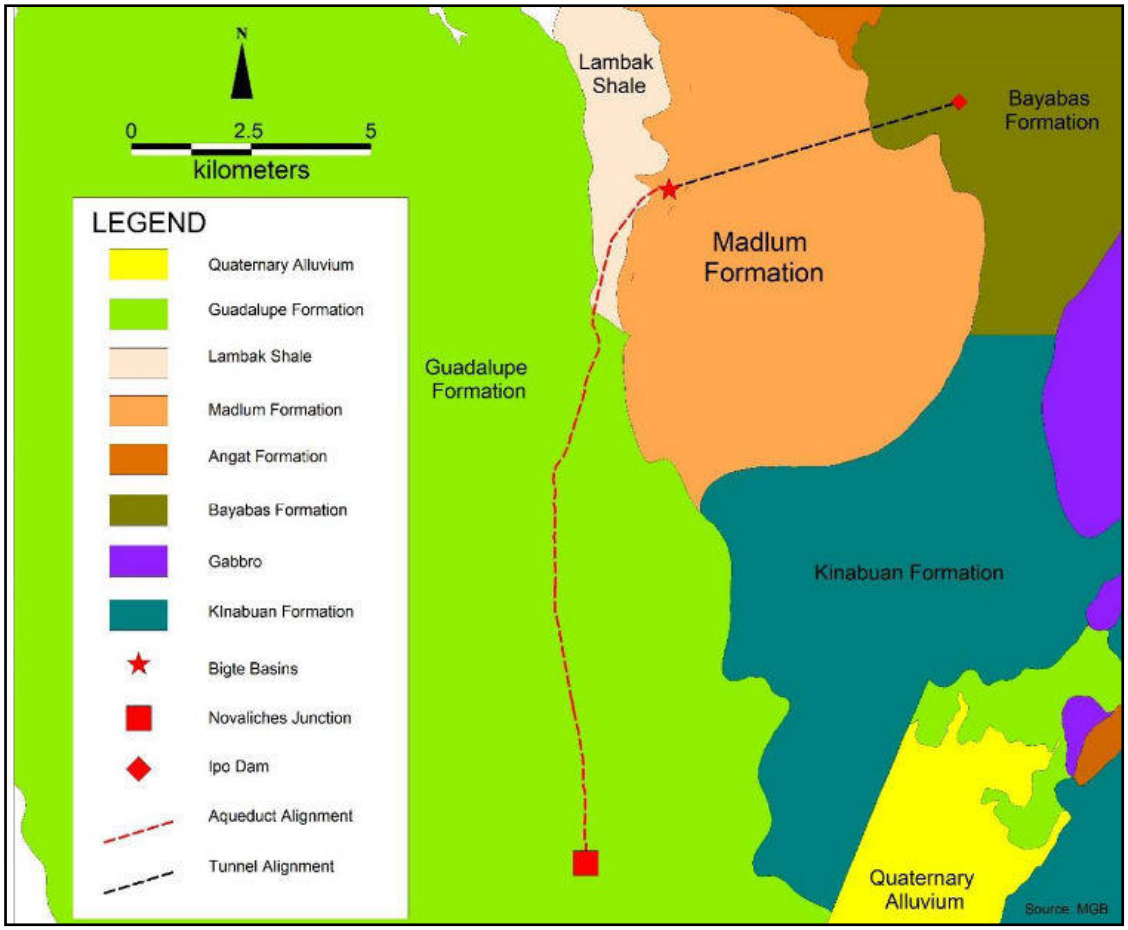


67. The geologic formations within a 15 km corridor of the BNAQ7 alignment were identified and delineated using available geologic maps in combination with field validation (**Figure 4-5**). Within this corridor, three geologic formations were identified namely the Guadalupe Formation, Lambak Shale and Madlum Formation. **Table 1-13** shows the stratigraphic and distribution succession along the route traversed by the BNAQ7 alignment including the general lithologic identification.

Table 4-7: Stratigraphy of the BNAQ7 Alignment

Epoch	Geologic Formation	Lithology1	Distribution
Pleistocene	Guadalupe Formation	Conglomerate, sandstone, mudstone, tuffs, pyroclastic breccias, tuffaceous sandstones	80% of the alignment
Late Miocene	Lambak Shale	Tuffaceuous shale, sandstone, conglomerate	Immediately south of the limestone segment
Middle Miocene	Madlum Formation	Sequence of limestone, sedimentary rocks, volcanic rocks	Limestone at the northern segment of the alignment

Figure 4-5: Regional Geologic Map of Project Area



68. The geohazard map prepared by the Mines and Geosciences Bureau (Figure 1-12) show that most of the BNAQ7 alignment has a low susceptibility to landslides, a condition that can be attributed to the essentially gentle terrain and the comparatively good quality of the geologic formations within the corridor. The southern segment which corresponds to the La Mesa Dam area has a moderate susceptibility to landslide.

[1] Source: Geology and Mineral Resources of the Philippines, 2004.

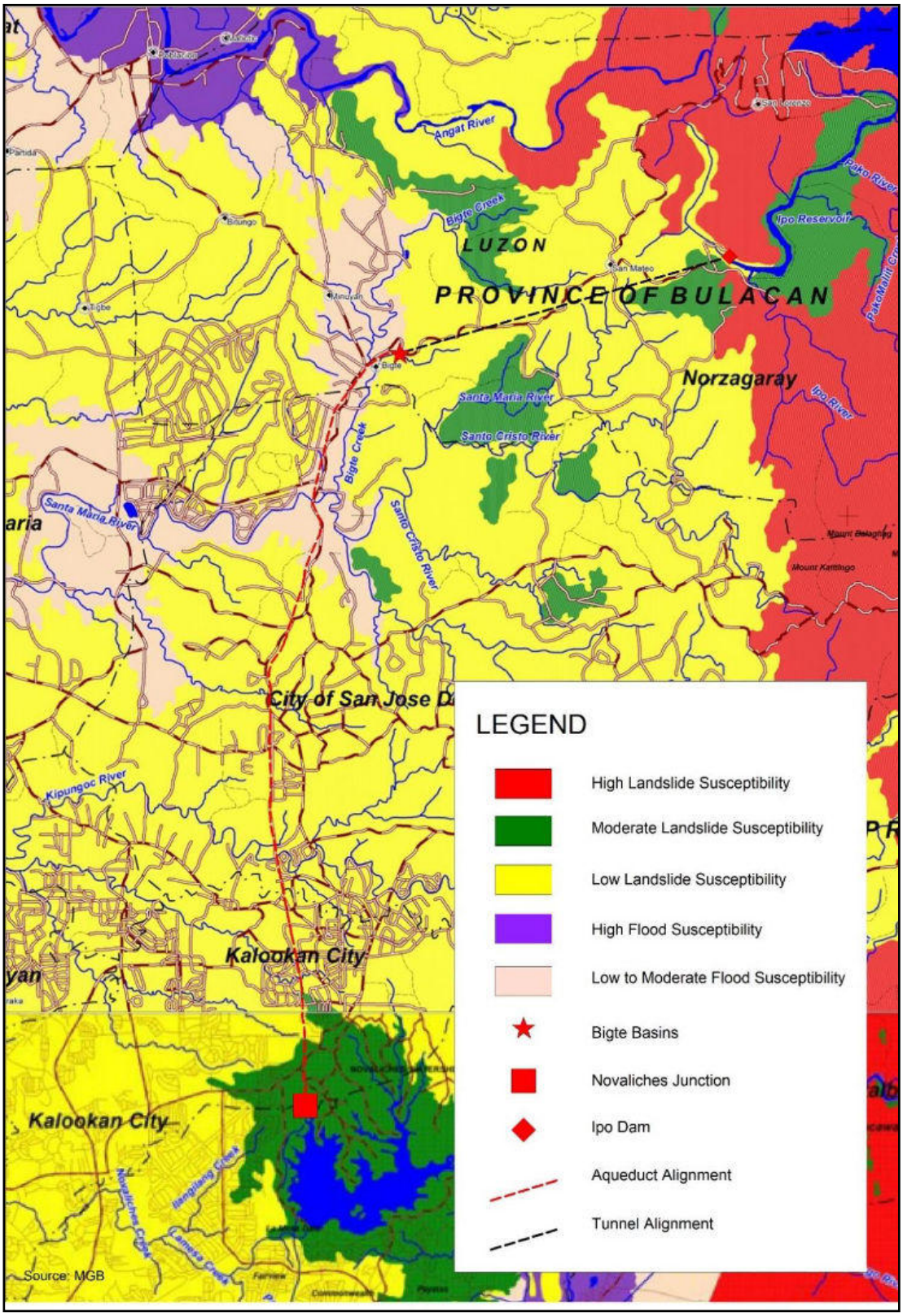
69. MGB classified the northern segment of BNAQ7 alignment under Low to Moderate Susceptibility to Flooding. The near surface segments of the aqueduct transected by the main channel and tributaries of the Sta. Maria River and Marilao River will be susceptible to flooding during periods of major rain event

70. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking that could potentially instability of the embankments and foundation of the aqueduct. Based on the regional studies conducted by Thenhaus et al (1995), the ground acceleration that can be experienced by structures on soft soil, medium soil and rock foundation correspond to 0.7 g, 0.4 g and 0.2 g, respectively. The recommended design ground acceleration for structures as recommended in the 2011 National Structural Code of the Philippines is 0.4 g.

71. In the feasibility study, it was recommended that the aqueduct system be designed for full post-earthquake functionality under the maximum credible earthquake (MCE). The MCE to be used has yet to be confirmed by the design team with PHIVOLCS. Once confirmed, the design g value of the MCE for each section of the aqueduct and appurtenances shall be determined using the appropriate attenuation relation, distance, and correction factor for soil/rock type.

72. The BNAQ7 is not be susceptible to ground rupture due to its significant distance from the West Marikina Valley Fault and the segment of the Philippine Fault.

Figure 4-6: The BNAQ7 Alignment as Situated in the Geohazard Map of Bulacan and Northern Metro Manila

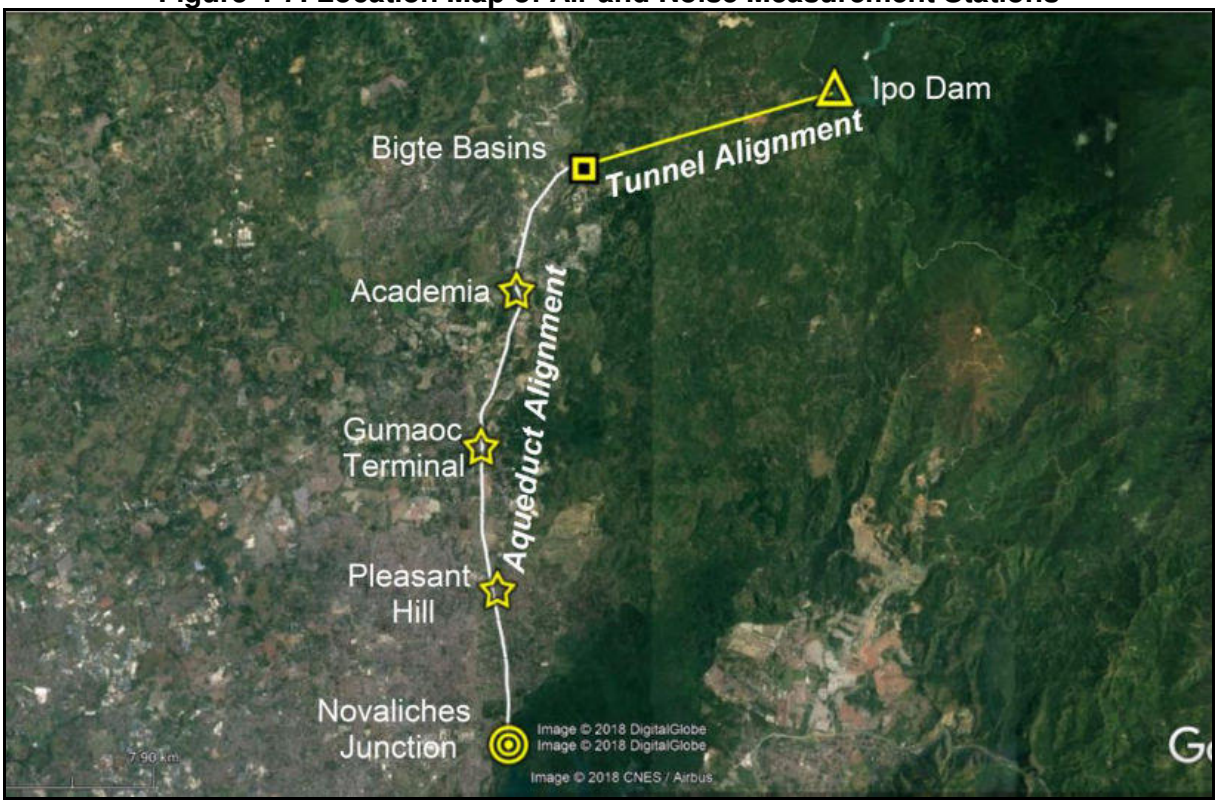


4.1.9 Air Quality

73. The major sources of air pollution within the 60 m ROW are the vehicles which ply the roads traversing the area. These vehicles emit smoke and stir up sediments from the unpaved segments of the road.

74. Air quality measurements for TSP and PM10 were made at typical residential, institutional and commercial areas within or immediately beside the 60 m MWSS ROW which will be affected by the proposed project (**Figure 4-7**). The residential area was represented by Pleasant Hill Subdivision. The institution was represented by Academia in San Jose del Monte City. The commercial area was represented by the Gumaoc Terminal area which is surrounded by commercial establishments.

Figure 4-7: Location Map of Air and Noise Measurement Stations



75. **Table 4.9** presents the results of the 24-hour ambient air measurements in comparison with the NAAQGV prescribed limit under Republic Act 8749 (Clean Air Act) Implementing Rules and Regulations. All stations passed the DENR standard.

Table 4.9: Results of the 24-hour ambient air measurements, 2018

Station No.	Location	Date and Time of Sampling	TSP (ug/Ncm)	PM10 (ug/Ncm)
A1	Academia (Institutional Area)	August 29 to 30, 2018 1228H - 1228H	123.9	67.2
A2	Gumaoc Terminal (Commercial Area)	August 30 to 31, 2018 1320H - 1320H	73.7	44.8
A3	Pleasant Hill (Residential Area)	August 31 to September 1, 2018 1410H - 1410H	105.7	42.9
DENR Standard (NAAQGV)		23-hour Sampling	230	150

4.1.10 Noise

76. The main sources of noise within the 60 m ROW are the vehicles which ply the roads that the aqueduct alignment. Noise is also generated by the daily activities of the people who occupy the residential, commercial and institutional establishments close to the ROW.

77. Noise measurements were made at typical residential, institutional and commercial areas within or immediately beside the 60 m MWSS ROW. The residential area was represented by Pleasant Hill Subdivision. The institution was represented by Academia in San Jose del Monte City. The commercial area was represented by the Gumaoc Terminal area which is surrounded by commercial establishments.

78. **Tables 4.10, 4.11** and **4.12** present the results of noise level monitoring recorded in decibels dB(A) at the three (3) stations.

Table 4.10: Observed 24-hour Noise Level Propagation in Decibels dB(A) at Academia de San Lorenzo Area, 2018

Sampling time / Date	Average dB (A)	DENR Standard Maximum Allowable Noise Level, dB(A)***	IFC WB EHS Noise Guidelines	Comparison with DENR Standard	Comparison with WB Guidelines	Observations
Aug. 29 to 30, 2018 1228H - 1428H	58.80	59	55	Exceeded	Exceeded	Noise came from occasional passing vehicles, residential area and from ongoing class at nearby school
1428H - 1628H	58.30	50		Exceeded	Within	
1628H - 1828H	59.60	50		Exceeded	Within	
1828H - 2028H	59.70	45		Exceeded	Within	Noise came from occasional passing vehicles, animals and residential area
2028H - 2228H	57.40	45		Exceeded	Within	
2228H - 0028H	57.40	40	45	Exceeded	Within	
0028H - 0228H	58.80	40		Exceeded	Within	
0228H - 0428H	53.30	40		Exceeded	Within	Noise came from occasional passing vehicles and animals
0428H - 0628H	57.00	40		Exceeded	Within	
0628H - 0828H	57.90	45	55	Exceeded	Within	Noise came from occasional passing vehicles, animals and residential area
0828H - 1028H	57.90	45		Exceeded	Within	Noise came from occasional passing vehicles and animals
1028H - 1228H	59.10	50		Exceeded	Within	Noise came from occasional passing vehicles, animals and residential area

Table 4.11: Observed 24-hour Noise Level Propagation in Decibels dB(A) in Gumaok Terminal Area, 2018

Sampling time / Date	Average dB (A)	DENR Standard Maximum Allowable Noise Level, dB(A)	IFC WB EHS Noise Guidelines	Comparison with DENR Standard	Comparison with WB Guidelines	Observations
Aug. 30 to 31, 2018 1320H - 1520H	67.50	65	70	Exceeded	Within	Noise came from constant vehicles traffic along the road
1520H - 1720H	67.00	65	70	Exceeded	Within	
1720H - 1920H	63.20	65	70	Within	Within	Noise came from occasional passing vehicle
1920H - 2120H	67.10	60	70	Exceeded	Within	
2120H - 2320H	63.70	60	70	Exceeded	Within	
2320H - 0120H	65.10	55	70	Exceeded	Within	Noise came from sound system of nearby tricycle
0120H - 0320H	62.30	55	70	Exceeded	Within	
0320H - 0520H	63.30	55	70	Exceeded	Within	Noise came from occasional passing vehicles
0520H - 0720H	65.10	60	70	Exceeded	Within	
0720H - 0920H	69.20	60	70	Exceeded	Within	
0920H - 1120H	64.20	65	70	Within	Within	
1120H - 1320H	67.10	65	70	Exceeded	Within	

Table 4.12: Observed 24-hour Noise Level Propagation in Decibels dB(A) in Pleasant Hill Subdivision, 2018

Sampling time / Date	Average dB (A)	DENR Standard Maximum Allowable Noise Level, dB(A)	IFC WB EHS Noise Guidelines	Comparison with DENR Standard	Comparison with WB Guidelines	Observations
Aug. 31 to Sept. 1, 2018 1410H - 1610H	50.40	55	55	Within	Within	Noise came from occasional passing vehicles, animals, residential area and from school activities
1610H - 1810H	52.20	55		Within	Within	
1810H - 2010H	56.70	50		Exceeded	Exceeded	Noise came from occasional passing vehicles and from animals
2010H - 2210H	54.00	50		Exceeded	Within	
2210H - 0010H	53.90	45	45	Exceeded	Exceeded	
0010H - 0210H	51.60	45		Exceeded	Exceeded	
0210H - 0410H	51.80	45		Exceeded	Exceeded	
0410H - 0610H	52.10	45		Exceeded	Exceeded	
0610H - 0810H	52.50	50		Exceeded	Exceeded	
0810H - 1010H	57.10	50	55	Exceeded	Exceeded	
1010H - 1210H	60.90	55		Exceeded	Exceeded	
1210H - 1410H	61.10	55		Exceeded	Exceeded	

79. **Table 4.13** summarizes the 24-hour noise monitoring measurements of the measurements vis-à-vis the DENR standards and the WB guidelines. The DENR standards were exceeded at the station near a school (Academia). 16% exceedances were recorded at the commercial and residential area.

80. The WB guidelines were complied with at the commercial area in Gumaoc. 8% and 16% exceedances were measured at the Academia and Pleasant Hill areas.

Table 4.13: Noise Monitoring Summary

Station	Comparison with DEN Standard	Comparison with WB Guidelines
Academia (Institutional Area)	All time divisions Exceeded the DENR Standard	Exceeded in 2 hours (1228 to 1428); within guidelines for 22 hours
Gumaoc Terminal (Commercial Area)	Two (2) time divisions Passed; Ten (10) time divisions Exceeded the DENR Standard	Within guidelines for 24 hours
Pleasant Hill (Residential Area)	Two (2) time divisions Passed; Ten (10) time divisions Exceeded the DENR Standard	Exceeded in 4 hours (1810 20 2010; 2210 to 0010); within guidelines for 20 hours

4.1.11 Water Quality

81. The BNAQ7 alignment will intersect the main channels of Sta. Maria and Marilao Rivers at their respective segments which are locally known as the San Jose River and Alat River.

According to the National Water Quality Status Report 2006 to 2013, the lower segment of Marilao River is rated under Class C while the upper section is classified under Class A.

82. During the preparation of the IEE for the Angat Water Transmission Improvement Project (AWTIP) in 2013, surface water samples were collected from segments of the Sta. Maria River at Bigte, creek near the MWSS property in Bigte Creek and at the main channel in the vicinity of the town of Sta. Maria. The results were evaluated against Class B surface water criteria. It was reported that elevated values of turbidity, color, and total coliforms were obtained at all sites. Slightly elevated values of phosphorus and BOD were reported for the main channel of Sta. Maria River (**Table 4-14**).

Table 4-14: Results of Water Quality Measurements for the AWTIP IEE, 2013

Parameter, mg/L (Unless Stated)	Class B (DAO 90-34)	SW2	SW03	SW Sta. Maria
		Bigte River	At Bigte	Sta. Maria River
Physical Characteristics				
Water Use				
Temperature (°C)		26.85	27	27.3
Salinity (%)		27.69	14.06	15.74
TSS		66	10	657
Electrical Conductivity (mS/cm)		432.7	219.7	246
Turbidity (NTU)	5	62	12.6	51.4
Color (Apparent, PCU)	5	100	20	500
TDS	500	285.95	141.1	158
Inorganic and Nonmetallic Constituents				
pH	6.5 - 8.5	7.65	8.33	8.2
ORP (mV)		201	211	187
Nitrogen as NO3-N	Nr	0.4	0.2	0.1
Phosphorus (as PO4-3)	0.2	0.2	0.08	0.7
Organic and Biological Constituents				
Dissolved Oxygen	5	13.4	22.5	Not measured
BOD5	5	3	2	14
COD		9.9	9.8	49
Fecal Coliform (MPN/100ml)	200	24	9200	920000
Total Coliform (MPN/100ml)	1000	240000	92000	920000
Oil and Grease	1	0.3	0.3	<0.3
Heavy Metals				
Antimony (Sb)	0.005	<0.001	<0.001	<0.001
Arsenic	0.01	<0.01	<0.01	<0.01
Cadmium (Cd)	0.003	<0.006	<0.006	<0.006
Chromium Hexavalent, Cr (VI)	0.03	<0.003	<0.003	<0.003
Copper (Cu)	1	<0.02	<0.02	<0.02
Lead (Pb)	0.01	<0.04	<0.04	<0.04
Manganese (Mn)	0.5	0.07	0.07	0.4
Mercury (Hg)	0.001	<0.001	<0.001	<0.001

Parameter, mg/L (Unless Stated)	Class B (DAO 90-34)	SW2 Bigte River	SW03 At Bigte	SW Sta. Maria Sta. Maria River
Nickel (Ni)	0.075	<0.01	<0.01	<0.01
Vanadium (V)	0.075	< 1.0	< 1.0	< 1.0
Zinc (Zn)	5	<0.02	<0.02	0.1

83. In this study, surface water samples were collected from the San Jose and Alat channels of the Sta. Maria River and Marilao River, respectively (**Figure 4-8**). These were tested for key parameters specified under DENR A.O. 2016-08: Water Quality Guidelines and General Effluent Standards (**Table 4-15**) and compared to Class A and Class C surface water.

Figure 4-8: Location Map of Surface Water Quality Sampling Stations at Alat River and San Jose River, 2018

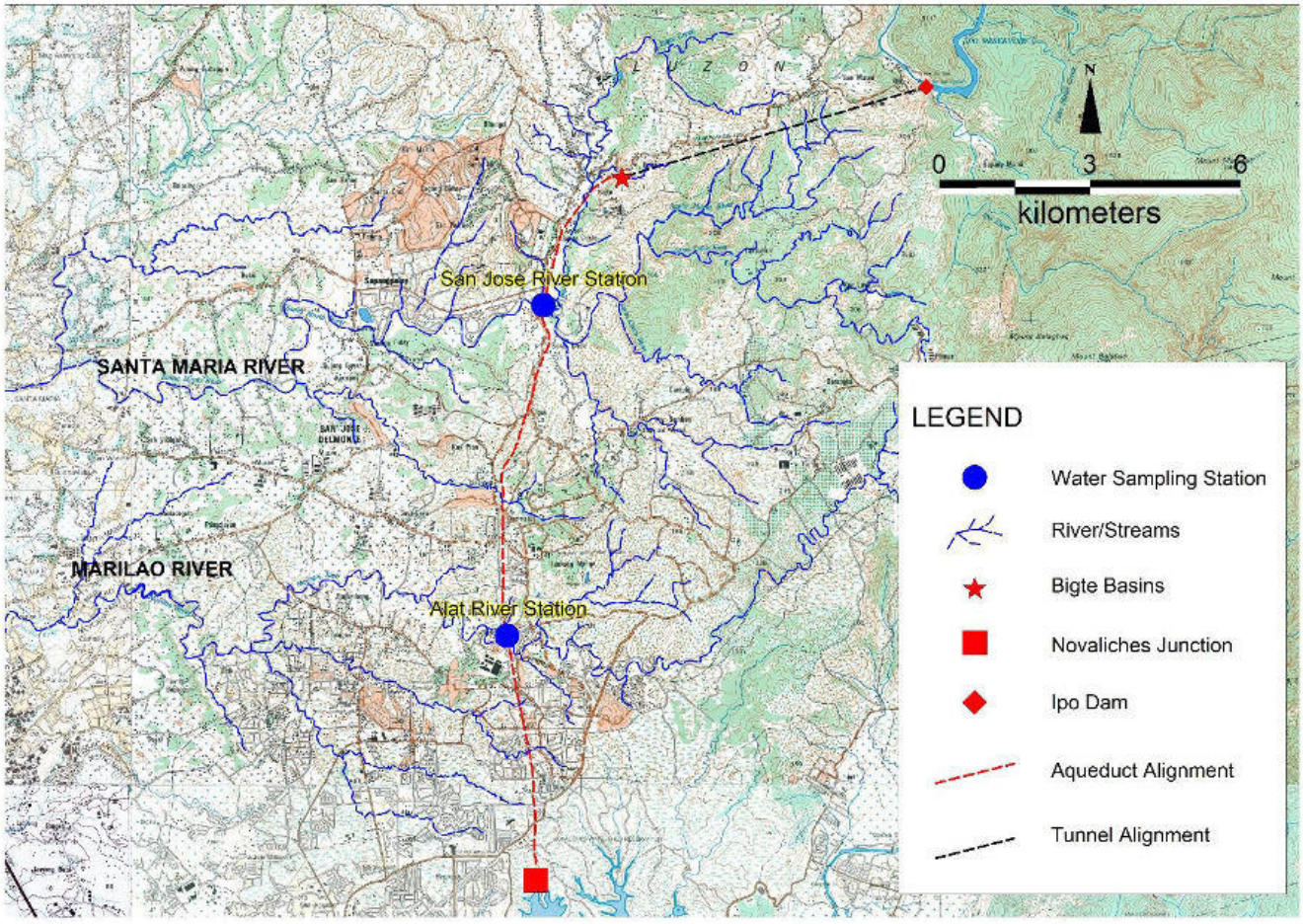


Table 4-15: Results of Analysis of Water Samples from Alat River and San Jose River, 2018

Parameters	Unit	Alat River	San Jose River	Class A	Class C
Fecal coliform	MPN/100 ml	46000	24000	<1.1	100
pH		7.7	8.1	6.5 - 8.5	6.5 - 8.5
Temperature	°C	29.4	28.6	26 - 30	25 - 31
Color	TCU	15	15	50	75
Biological Oxygen Demand	mg/l	3	2	3	7
Total Suspended Solids	mg/l	15	9.5	50	80
Oil and Grease	mg/l	0.7	0.8	< 1	2
Chloride	mg/l	13	7.9	250	350
Dissolved Oxygen	mg/l	8	8	5	5
Nitrogen as NO_3-N	mg/l	0.1	0.3	7	7
Phosphate	mg/l	0.3	0.1	0.5	0.5

84. For the tested parameters, the water samples passed the standards for both Class A and Class C waters except for Dissolved Oxygen (DO) and Fecal Coliform. DO values for both samples slightly exceeded the standards for Class A and Class C waters. Very high values of fecal coliform were obtained for both rivers which suggest that these waters receive discharges of human waste farther upstream.

4.1.12 Protected Areas

85. The northernmost end of the BNAQ7 alignment in Bigte lies about 6 kilometers southwest of the Angat Watershed Forest Reserve. The reserve was established on March 10, 1927 through Proclamation No. 71 signed by Governor-General Leonard Wood. It has an area of 62,309 hectares and covers the eastern portion of Bulacan and northern Rizal province between elevation 490 and 1,206 meters. It also extends to the provinces of Nueva Ecija and Quezon and is centered on an artificial lake created by the Angat Dam.

86. The La Mesa Dam Area has been declared a Reservation through a presidential proclamation No. 1336 signed on 25 July 2007. The portal of the tunnel segment and the southernmost cut and cover segment of the aqueduct will coincide with the northwestern edge of the Reservation.

4.1.13 Ecology

87. Ocular inspection aided by Google imagery was used to characterize the ecology of the 60 m, 15 km MWSS ROW. Reckoned from the Common Purpose Facility (CPF) in La Mesa Dam, the first 900 m will pass though the edge of a forested area which forms part of the La Mesa Watershed Reservation. The primary species found include narra and mahogany with patches occupied by acacia, gemelina and ipil-ipil. The aqueduct section from the Novaliches Junction to the Novaliches portal spans about 160 meters and will correspond to the cut and fill segment of the aqueduct within the La Mesa Watershed Reservation. The estimated construction area for the 160-meter segment will have a width of 25 meters or an area of 4000 m^2. It is estimated that within this area, there are about 50 and 40 fully grown narra and mahogany trees, respectively. Diameter

of the narra trees range from 30 to 80 centimeters near the base. The diameter of the mahogany trees varies from 20 to 40 centimeters. The space between the narra and mahogany trees are occupied by about 100 recently planted saplings of the same species. During the survey, wildlife species were not observed although these could potentially be present at the central section of the reservation.

88. The remaining 94% of the corridor will pass through segments and patches vegetated with a combination of ipil-ipil, gemelina, kapok, coconut, papaya, mango, star apple, bamboo, grass, shrubs, ornamental plants and other fruit trees with occasional narra and mahogany. This altered ecosystem is characterized by the presence of domesticated animals such as dogs, pigs, chicken and cats.

4.1.14 Historical and Archaeological Sites

89. There are no sites of archaeological significance within and around the project area. The project components will therefore not affect any historical and archaeological sites.

4.2 Socio-Economic Conditions of Affected Barangays

4.2.1 Norzagaray, Bulacan

90. Norzagaray is one of the first-class municipalities in Bulacan province consisting of 13 barangays including Bigte. In 2015, the municipality registered a total population of 111,348, with an annual growth rate of 1.60. Sex distribution is almost equal at 51% male and 49% female (**Table 4-16**).

Table 4-8: Norzagaray Population by Sex, 2015

Total	111,348
Male	56,309
Female	55,039

Source: Philippine *Statistics Authority.*

91. The municipality has a total number of 24,822 households, an average household size of 4.48, and 24,396 occupied housing units. Most houses are single detached, multi-unit residential and duplexes made of concrete, brick or stone, or with half wood, wood, bamboo, sawali, cogon or nipa, as well as roof made of galvanized iron or aluminum, and half galvanized iron and half concrete. Majority (63%) of the households own their housing units, while others either rent their houses or occupy the house and lot with or without the owner's consent.

92. The cement industry is a vital part of Norzagaray's economy, providing employment to more than thousand residents directly or indirectly. Industry-related sources of employment include trucking and hauling services, cement retailing, limestone crushing, marble trading, and direct employment (e.g., office administration, factory workers, engineers) in the cement companies.

93. The municipality has 23 public and eight private primary schools; six public and four private secondary schools; and one tertiary institution, Norzagaray College, which is owned and managed by the municipal government of Norzagaray. Primary health services are provided to residents through a municipal hospital, three rural health units, and health centers in all barangays.

94. Less than half of households use bottled water as source of water supply for drinking (47%), while others resort to owned and shared faucet (28%) and shared deep wells (10%). As

for source of water supply for cooking, majority of total households use their own faucets (65%), while others use shared deep wells (14%), and shared faucets (7%).

4.2.2 Barangay Bigte, Norzagaray, Bulacan

95. Barangay Bigte is one of the most populated barangays of the Municipality of Norzagaray, Bulacan. It registered a total population of 16,331 in 2015, with an annual growth rate of 2.13%. Male and female distribution is almost equal, with males accounting for 51% and females, 49%. Majority of the population are under the working age group 15-59 years old (64.0%), while senior citizens accounted for 6% of the total population. **Table 4-17** shows the breakdown by age and sex.

Table 4-9: Barangay Bigte Population by Sex and Age, 2015

Age Grouping	Male	Female	Total
0-5 months	69	84	153
6-11 months	81	73	154
1-5 years	802	831	1,633
6-14 years	1,512	1,440	2,952
15-21 years	1,260	1,130	2,390
22-40 years	2.612	2,512	5,124
41-59 years	1,500	1,436	2,936
60 & Above	458	531	989
Total	8,294	8,037	16,331

Source: Barangay Bigte, Norzagaray

96. There are 3,306 households, majority of which have average sizes of two to four members per family. The most common occupation is employment as skilled laborer, followed by professionals; the least common is agricultural production. Rice farming and piggery production are the usual agricultural activities.

97. Most residents live in concrete and semi-concrete dwelling units, while a few live-in nipa huts and shanties. Katuparan Village serves as a resettlement area. Educational facilities within the barangay include five-day care centers, and two public and one private pre-elementary/elementary school. The barangay is served by a barangay health center, a rural health unit, a general hospital, and two specialty clinics.

98. There are three existing piped water systems operated by the barangay and a non-governmental organization (NGO) which traps raw or untreated water from the air-release and blow-off valve assemblies of MWSS BNAQ4 and connects to about 600 households. These households do not drink the water but use it for cleaning, bathing, and other household purposes. Other households are connected to the Norzagaray Water District. Regarding access to basic sanitation, 90% of households have water-sealed toilets connected to septic tanks but the remainder utilize open pits (10%).

4.2.3 San Jose del Monte (SJDM) City, Bulacan

99. San Jose del Monte City is a component city in the province of Bulacan in Central Luzon (**Table 4-18**). In 2015, the city registered a total population of 574,089, with an annual growth rate of 3.08, and an almost equal male-female distribution (50.1% and 49.9% female).

Table 4-18: San Jose del Monte City Population by Sex, 2015

Total	574,089
Male	287,585
Female	286,504

Source: Philippine Statistics Authority

100. The city has the population in the province of Bulacan and the 18th most populated city in the Philippines. The city is home to resettlement areas in the Philippines like the Sapang Palay resettlement area spread over 36 barangays, Pabahay 2000 in Barangay Muzon, and Towerville in Barangay Minuyan. Most of the city's population came from former informal settlements along the creeks, esteros, riverbanks and railway tracks of Metro Manila.

101. The city has a total number of 126,553 households, with an average household size of 4.53. The city also registered total number of occupied housing units at 123,530. Most houses are single detached, multi-unit residential and duplexes made of concrete, brick or stone, or with half wood, as well as roof made of galvanized iron or aluminum. Majority of the households (66%) own their housing units, while others rent (15%) or occupy the house and lot with or without the owner's consent.

102. Major economic activities in the city are agriculture, commerce, and manufacturing. Major agricultural crops are palay, tropical vegetables, root crops such as cassava and ube, and seasonal fruits such as pineapple, mango, and papaya. Over 4,000 registered business establishments are situated in the city. Major industries include iron and steel works, furniture, handicrafts, and food processing. The city has one public hospital, seven private hospitals, and five city health centers.

103. Less than half of households use their own faucets as source of water supply for drinking (49%), while others resort to bottled water (28%) and shared faucets (18%). Few households get water from owned or shared deep wells, and peddlers. As for source of water supply for cooking, majority of total households use their own faucets (72%), while others use shared faucets (20%).

4.2.4 Barangay Minuyan, SJDM City, Bulacan

104. Barangay Minuyan is one of the most populous barangays in San Jose del Monte City. It registered a total population of 42,000, with annual growth rate of 22.85% in 2015. More than half of its population (50.2%) is composed of males and the remaining 49.8%, females (**Table 4-19**).

Table 4-109: Barangay Minuyan Population by Sex, 2015

Total	42,000
Male	21,095
Female	20,905

Source: Barangay Minuyan, San Jose del Monte City

105. There are 13,007 households and 13,407 families in Brgy. Minuyan Proper. The residents are mostly regularly employed or engaged in business; a few residents are engaged in farming. Most residents live in concrete and semi-concrete dwelling units. Phase 4B Towerville Project serves as a resettlement area.

106. The barangay is served by a barangay health center, three diagnostic clinics, and three birthing/maternity clinics. Educational facilities within the barangay premises include two day-care centers, three public and four private pre-elementary schools, two public secondary schools, and one private college.

107. All households have access to potable water supply, with San Jose Del Monte Water District as its main water service provider. Regarding access to basic sanitation, 96% of households have water-sealed toilets connected to septic tanks.

4.2.5 Barangay Sto.Cristo, SJDM City, Bulacan

108. Barangay Sto. Cristo registered a total population of 39,718 in 2016. More than half of the population are females (52%). Majority of the population are of working age group 15-59 years old (65.8%) while senior citizens accounted for 2,041 or 5% of the total population (**Table 4-20**).

Table 4-11: Brgy. Sto. Cristo Population by Sex and Age, 2015

Age Grouping	Male	Female	Total
0 years	175	186	361
1-5 years	1,760	1,709	3,469
6-14 years	3,944	3,767	7,711
15-21 years	2,773	3,469	6,242
22-40 years	6,007	6,638	12,645
41-59 years	3,469	3,780	7,249
60 & Above	1,008	1,033	2,041
TOTAL	19,136	20,582	39,718

Source: Barangay Sto. Cristo, San Jose del Monte City

109. The barangay has 7,284 households. Educational facilities in the barangays include 10 day-care centers, six private pre-elementary/elementary schools, and one private secondary/tertiary school, the Academia de San Lorenzo.

110. Around 80% of households have access to potable water supply, with San Jose del Monte Water District, Barangay Sto. Cristo Water System, and Prime Water as water service providers. About 80% also of households have water-sealed toilets connected to septic tank. The barangay is served by two health centers and a birthing clinic.

4.2.6 Barangay Kaypian, SJDM City, Bulacan

111. Barangay Kaypian registered a total population of 38,964 in 2018, with almost equal sex distribution of 50.5% male and 49.5% female (**Table 4-21**).

Table 4-12: Brgy. Kaypian Population by Sex, 2015

Total	38,407
Male	19,396
Female	19,011

Source: Barangay Kaypian, San Jose del Monte City

112. There are 8,837 households and 9,164 families in Brgy, Kaypian. The most common source of income is from employment, followed by business; least common source is fishing. Educational facilities within the barangay premises include 12 day-care centers, one public and 17 private pre-elementary/elementary schools, one public and seven private secondary schools,

and a public tertiary school, Bulacan State University. The barangay is served by a barangay health center and a clinic.

113. A large proportion of households (97%) have access to potable water supply and water-sealed toilets connected to septic tanks. San Jose del Monte Water District and Prime Water are the water service providers.

4.2.7 Barangay Graceville, SJDM City, Bulacan

114. Barangay Graceville is one of the most populous barangays in San Jose del Monte City, Bulacan. It registered a total population of 38,478, with a distribution of 49.5% male and 50.5% female (**Table 4-22**).

Table 4-13: Brgy. Graceville Population by Sex, 2015

Total	38,478
Male	19,029
Female	19,449

Source: Barangay Graceville, San Jose del Monte City

115. There are 8,865 households and 9,091 families in Brgy. Graceville. The barangay has 415 professionals, 446 overseas Filipino workers (OFWs), and more than 3,000 skilled workers. Others are business owners while a small proportion are fisher folks.

116. Most residents live in concrete and semi-concrete dwelling units. Government housing projects built in the barangay starting 2014 include Medium Rise Building Project of the National Housing Authority (NHA), the SRCC Garden Village, and the Towerville Phase 6 Housing Expansion Project.

117. Educational facilities include nine day-care centers, one public and nine private pre-elementary/elementary schools, one public and seven private secondary schools, and one private college.

118. All households have access to potable water supply, with San Jose Del Monte Water District as its main water service provider. With access to basic sanitation, 99.8% of households have water-sealed toilets connected to septic tanks. The barangay's health concerns are addressed by the barangay health center.

4.2.8 Barangay San Manuel, SJDM City, Bulacan

119. Barangay San Manuel registered a total population of 14,698, with 48.1% composed of males, and 51.9% females (**Table 4-23**).

Table 4-14: Barangay San Manuel Population by Sex, 2015

Total	11,452
Male	5,504
Female	5,948

Source: Barangay San Manuel, San Jose del Monte City

120. There are 2,836 households and 2,954 families in Brgy. San Manuel. Labor force numbered 5,319 and the unemployed, 1,058 in 2015. Most residents live in concrete and semi-concrete dwelling units. Educational facilities within the barangay include one day-care center,

one public and eight pre-elementary/elementary schools, one public and four private secondary schools, and one private tertiary institution. The barangay is served by one barangay health center, one barangay drugstore (*Botika ng Barangay*), and a dental and laboratory clinic.

121. All households have access to potable water supply via piped water supply system, with San Jose del Monte City Water District as the main water service provider and an existing barangay-owned potable water supply system. Regarding access to basic sanitation, all households also have water-sealed toilets connected to septic tanks.

4.2.9 Barangay Gumaok East, SJDM City, Bulacan

122. Barangay Gumaoc East in San Jose del Monte City, Bulacan registered a total population of 5,352 as of 2015, with 50.4% male and 49.6% female (**Table 4-24**).

Table 4-15: Brgy. Gumaoc East Population by Sex, 2015

Total	5,352
Male	2,698
Female	2,654

Source: Barangay Gumaoc East, San Jose del Monte City.

123. There are 2,217 households and 2,398 families in Brgy. Gumaoc East. The most common sources of income are employment and business. Most residents live in concrete and semi-concrete dwelling units. Government housing projects built in the barangay include the Gumaok Liberty Upgrading Project.

124. Educational facilities within the barangay premises include a day-care center. School children in the barangay attend schools in nearby barangays such as Gumaoc West and Gumaoc Central. For its health needs, the barangay is served by a barangay health center and a medical clinic.

125. Almost all households have access to potable water supply via piped water system, with San Jose Del Monte Water District as the main water service provider. Regarding access to basic sanitation, 99.8% of households have water-sealed toilets connected to septic tanks.

4.2.10 Caloocan City, Metro Manila

126. Caloocan City is situated in the northern part of Metro Manila and is divided into two non-contiguous areas, North and South Caloocan. It is the fourth most populous city in the country. In 2015, the city registered a total population of 1,583,978, with an annual growth rate of 1.18% and an almost equal male-female distribution of 50.1% male and 49.9% female (**Table 4-25**).

Table 4-16: Caloocan City Population by Sex, 2015

Total	1,583,978
Male	793,196
Female	790,782

Source: Philippine Statistics Authority

127. The city has a total number of 367,878 households, with an average household size of 4.30. The city also registered total number of occupied housing units at 353,357. Most houses are single detached and multi-unit residential made of concrete, brick or stone, or with half wood,

as well as roof made of galvanized iron or aluminum. Majority of the households (54%) own their housing units, 31% rent houses, and very few occupy the house and lot rent-free.

128. The city is well known for clusters of motorcycle dealers and motorcycle spare parts dealers. It has several shopping malls and stand-alone supermarkets and hypermarkets distributed throughout the city.

129. As of school year 2014-2015, the city has a total of 56 public elementary schools, 32 public and 74 private secondary schools, and 20 tertiary institutions composed of 16 private colleges, three private universities, and a government university, which are mostly located in South Caloocan. The city has 11 private and two government-owned hospitals.

130. More than half of the households use their own faucets as source of water supply for drinking (58%), while others resort to bottled water (23%) and shared faucets (16%). As for source of water supply for cooking, majority of total households use their own faucets (77%), while others use shared faucets (18%).

4.2.11 Barangay 186, Caloocan City, Metro Manila

131. Barangay 186 in Caloocan City registered a total population of 22,184, with an equal distribution of male and female. Majority of the population are of the working age group 15 to 59 years old (60.8%), while senior citizens accounted for 5% of the total population (**Table 4-26**).

Table 4-6: Barangay 186 Population by Sex and Age, 2017

Age Grouping	Male	Female	Total
0 years	281	245	526
1-5 years	1,288	1,216	2,504
6-14 years	2,349	2,143	4,492
15-21 years	1,458	1,525	2,983
22-40 years	3,386	3,463	6,849
41-59 years	1,799	1,854	3,652
60 & Above	531	646	1,177
Total	11,092	11,092	22,184

Source: Caloocan City Planning and Development Office

132. The barangay has 5,173 households, and majority of the residents works as employees and entrepreneurs. Most residents live in concrete and semi-concrete dwelling units, while. others live in shanties. Educational facilities within the barangay include two public pre-elementary/elementary schools, and two public secondary schools. Other students attend schools in other barangays in North Caloocan. For health needs, the residents go to other barangays.

133. About 70% of households have access to potable water supply and water-sealed toilets. Maynilad Water Services Inc. is the main water service provider as Caloocan City is part of the West concession area.

4.2.12 Barangay 179, Caloocan City

134. Barangay 179 in Caloocan City registered a total population of 38,224, with more than half female (51%). Majority of the population are of working age group, and senior citizens accounted for 5% of the total population (**Table 4-27**).

Table 4-27: Brgy. 179 Population by Sex and Age, 2017

Age Grouping	Male	Female	Total
0 years	410	419	829
1-5 years	1,965	1,823	3,788
6-14 years	3,585	3,435	7,020
15-21 years	2,741	2,879	5,620
22-40 years	5,677	5,873	11,551
41-59 years	3,663	3,822	7,485
60 & Above	858	1,074	1,931
Total	18,899	19,325	38,224

Source: Caloocan City Planning and Development Office

135. There are 8,879 households in the barangay. Common sources of income are regular employment and businesses. Most residents live in concrete and semi-concrete dwelling units, while others live in shanties. Educational facilities in the barangay include two pre-elementary/ elementary schools, and two public secondary schools. The barangay has a health center.

136. About 70% of households have access to potable water supply, with Maynilad Water Services Inc. as its main water service provider. The same proportion of households have water-sealed toilets connected to septic tanks.

4.3 Sources of Water Supply

137. All of the source communities are served by the water districts, specifically the Norzagaray Water District for Bigte; San Jose del Monte Water District for its barangays; and Maynilad Water Services, Inc (MWSI) for Caloocan barangays. Households in Bigte not connected to the local water have piped water system although the water is untreated, emanating from BNAQ4 air-release and blow-off valves. Connections to the local water district system are available, but some Bigte residents interviewed during consultations said that they find the connection fee to the Norzagaray Water District (around PHP 2,500) expensive compared to the PHP 500 fee they paid to be connected to the MWSS valves. These residents connected to the air-release and blow-off valves do not drink the untreated water and instead rely on water refilling stations for their drinking water. In other barangays where air-release and blow-off valves are located such as Sto. Cristo, San Manuel, Gumaok East, some residents use the water from the valves for cleaning and other household purposes except for drinking. The residents tap from the valves without paying any fees to the MWSS.

4.4 Waste Management

138. Waste collection and disposal in Norzagaray, San Jose Del Monte, North Caloocan and Quezon City are performed by the respective local government units. In North Caloocan and Quezon City, waste collection is done through a private company. The usual frequency is twice a week for biodegrable waste and once a week for dry, potentially recyclable waste. The collected waste from these (2) LGUs is disposed at the Rodriguez Disposal Facility in Rodriguez, Rizal.

139. Waste collection at San Jose del Monte and Norzagaray is done by the individual barangays. Biodegradable waste is collected twice a week while dry, potentially recyclable waste is collected once a week. The waste collected at San Jose Del Monte is disposed at the landfill in San Jose del Monte which is operated by VG Puyat. Norzagaray disposes its waste at the landfill in Barangay Matictic.

5 Anticipated Environmental Impacts and Mitigation Measures

140. The analysis of the potential impacts of the proposed project was guided by ADB's Rapid Environmental Assessment Checklist for urban and water infrastructure projects, results of site visits and stakeholder consultations. The mitigation measures for the identified impacts is presented in the environmental management plan.

141. Most of the identified impacts will be generated during the construction stage particularly at the cut and cover segments of the aqueduct, the portals of the tunnels, the temporary and final spoil disposal areas, the sections of AQ1 which will be dismantled, the construction work areas and haulage routes for equipment, construction materials, spoils and personnel which are generally coincident with the 60-meter wide Right of Way of MWSS.

5.1 Planning and Design Issues

142. Field verification and screening using the REA checklist showed that the southern end of the aqueduct segment will pass through the La Mesa Watershed Reservation.

143. The portal of the tunnel and a cut and fill segment of 160 meters in length will be constructed through the forest section of the reservation. The construction zone for the tunnel portal will cover 1,000 m^2 (25 m x 40 m) while construction zone for the cut and fill segment will cover 4,000 m^2 (25 m x 160 m). These construction zones are occupied 100 fully grown narra and mahogany trees and about 100 newly planted saplings of the same species. This issue has been communicated with the La Mesa Watershed Multi-Sectoral Managements Council through National Ecology Center for advice on what guidelines will be observed during the construction period.

144. The actual footprint of the cut and fill segment and the portal is about 10 meters. This will include the excavation for the aqueduct and portal and provisions for potential slope extension. The 25-meter construction width has been delineated to provide space for the staging area for storage of construction related equipment and materials such as vehicles and stockpiles of construction materials. During actual construction, removal of vegetation shall be limited to the actual aqueduct footprint and the designated staging area. This will significantly reduce the number of trees which will be removed.

145. The proposed EMP will contain mitigating measures consistent with the guidelines to be provided by the La Mesa Watershed Multi-Sectoral Managements Council and the provision and requirement of the SPS 2009 on Legally Protected Areas and the NIPAS Act of 1992.

146. Since AQ7 will be constructed within the MWSS ROW, there will be no need for land acquisition.

147. The socio-economic and resettlement studies showed that the following project will affect three (3) informal households (one (1) shanty occupied by a family while two are old barracks structures which belong to MWSS), eight (8) small business enterprises and one (1) academic

institution (Academia School). The households and the business enterprises are all located within the 25-meter construction zone and will be demolished. The occupants will be provided with financial assistance for two months of the actual wage or corresponding to the prevailing regional wage subject to the approval of the Local Inter-Agency Committee (LIAC) that will be organized before the start of the project. Crop loss of the informal families will be compensated. The affected families and establishments will be given enough time to relocate in accordance with the MWSS relocation and resettlement plan. Only the portion of the Academia School within the 25-meter construction zone will be demolished. This will include the covered pathway structures and the concrete basketball and volleyball courts.

148. The proposed subproject will not affect nor impact any historical, archaeological or culturally important sites.

149. Potential impacts to be brought about by natural hazards such as localized flooding and ground shaking due to major earthquake events shall be addressed. Local flooding within the immediate vicinity of stream and aqueduct intersections shall be addressed through a combination of the following: regular removal of construction debris and waste at points of intersection and provision temporary canals for water diversion during construction period only.

5.2 Impacts During Construction

150. Construction activities that may be undertaken for the proposed subproject would include land clearing, excavation and grading, filling, disposal of excavated soil, road construction/rehabilitation, dismantling of segments of AQ1, tunnel construction, and movement of construction vehicles, operation of heavy equipment, and operation of worker camps.

151. The works for the proposed project are expected to generate the following adverse impacts:

(i) Loss of vegetation including endangered tree species as a result of clearing and grubbing
(ii) Loss of homes and establishments within the MWSS ROW
(iii) Generation of stockpiles of soil and rocks
(iv) Erosion and siltation of waterways
(v) Local flooding at drainage and river intersections
(vi) Obstruction of access to houses, establishments and utilities
(vii) Increase in ambient noise and dust generation
(viii) Increased site traffic
(ix) Generation of wastes, i.e. solid wastes, hazardous waste and domestic wastewater
(x) Spill of fuels and lubricants
(xi) Risks to occupational health and safety
(xii) Hazards to occupational health and safety

5.3 Removal of Vegetation

152. Trees and other vegetation within the designated 25 m wide strip of the cut and fill segments and tunnel portals will be removed. The area to be affected will include the 160 m long segment at the northernmost end of the aqueduct and the tunnel portal which lies within the northern edge of the La Mesa Watershed Reservation.

153. This is a permanent impact within the MWSS ROW. The trees that will be removed will be replaced through the planting of similar species in the La Mesa Watershed Reservation. As much as practicable, excavation shall be within the designated 25 m foot print for earthmoving. The replacement of trees will be consistent with the Memorandum from the Executive Secretary dated 20 October 2011, or a replacement ratio of 1:100 or as otherwise specified by the guidelines to be provided by La Mesa Watershed Multi-Sectoral Management Council.

5.4 Loss of homes and establishments within the MWSS ROW

154. The socio-economic survey showed that three (3) informal households and eight (8) business enterprises will be removed. The affected families and establishments will be given ample time to relocate under the MWSS relocation and resettlement plan.

5.5 Generation of stockpiles of soil and rocks

155. The construction along the cut and fill segments of the BNAQ7 aqueduct will permanently remove the soil and rock materials which will be occupied by the aqueduct.. The portals of the tunnel segments will also be permanently altered. Voids which will be occupied by pipelines will be generated at the tunnel segments. In the process, stockpiles of loosened soils and weathered rock fragments will be generated.

156. **Table 5-1** presents the estimated volume of materials which will be generated during construction phase. It also includes the estimate for backfill and disposal.

Table 5-1: Estimated volume of Materials for Excavation, Backfill and Disposal[2]

Item	Length (m)	Total Excavation (m^3)	Total Backfill (m^3)	Total for Disposal (m^3)
Cut & Cover	8,753	310,067.74	211,709.37	98,358.37
Cut & Cover w/ Embankment	525	3,010.30	3,010.30	0.00
Tunnels	4,960	81,840.00	0.00	81,840.00
River Crossings	341	12,079.64	0.00	12,079.64
Road Crossings	406	14,382.21	9,819.95	4,562.26
Aqueduct Crossings	80	2,833.93	1,934.97	898.97
Total	15,065	424,213.82	226,474.58	197,739.24

157. Earthworks should be confined within the designated 25 m corridor. A spoils management plan should be developed and strictly enforced by the Contractor. The plan should include characterization of the materials, confirmation of the soil and rock volume estimates, measures to ensure proper transport, storage, reuse, and disposal, and activities for monitoring and recording. To the maximum extent possible, all earthworks must avoid the rainy periods of May to October. Stockyards for construction materials and spoils and storage areas for fuels and lubricants should not be located near the watercourses.

5.6 Local flooding at drainage and river intersections

158. Nineteen segments of the waterways to be intersected by the cut and fill segments of the aqueduct will be affected during the construction stage. Among these waterways, only Alat River and San Jose River have flows large enough to move or transport the excavated and construction

[2] Source: Project Design Team

materials which are accidentally deposited into their respective channels. The remaining 17 small waterways could potentially be blocked or temporarily dammed by the improperly placed soil and rock materials.

159. The same blockage could affect the drainage canals of the roadways intersected by the cut and fill segments of the aqueduct.

160. The blockage of the waterways and drainage canals could be mitigated by requiring the contractor to formulate and strictly implement materials management program. The handling of materials at construction sites should be regularly monitored by the environmental officer of the PMO. The immediate area near the intersection of the aqueduct cur and fill segments with natural waterways and drainage canals can potentially be flooded during major rain events if the construction debris and materials are not properly managed. This potential impact will be short term and will take place during the rainy season

161. As a precaution, all waterways and canals near these aqueduct segments shall be regularly cleared of debris and waste.

5.7 Erosion and siltation of waterways

162. The areas that will be exposed during excavation and the stockpile of excavated and construction materials will be vulnerable to erosion unless properly managed. The eroded materials will contribute to the siltation of the waterways intersected by the cut and fill segments of the aqueduct. This potential impact will be short term and will take place during the rainy season.

163. The contractor will be required to implement proper measures which would include the provision of silt traps, ditches, and sump pits to intercept the flow of silt laden runoff from the worksites into the nearby channels and watercourses. Activities, especially earthworks, will be scheduled during the dry season or be stopped during heavy rainfall.

164. Areas which have been exposed but will not be built on shall be immediately revegetated.

5.8 Obstruction of access to houses, establishments and utilities

165. In general, pipe laying for the proposed aqueduct will be undertaken along the existing road right-of-way. During trench excavation and pipe laying works, access to residential and commercial establishments, schools, and community facilities will be affected. The areas likely to be affected correspond to 34 sections where the aqueduct will intersect roadways in the project area (**Table 4-7**).

166. As mitigation for this impact, safe temporary accesses to houses and other establishments affected by the works will be provided. Particular attention will be given to ensuring safety along roads and paths normally traversed by pedestrians. The contractor will restore and reinstate any damaged sections to properties immediately. The contractor will prepare and implement a traffic management plan in coordination with the corresponding LGU. During construction, the contractor will be required to install appropriate signages and barricades to the work areas to avoid untoward incidents and accidents.

167. Existing water mains could be disrupted while power could be temporarily cut off. The Contactor should undertake a detailed survey of existing water pipes power poles and lines and schedule the earthworks in such manner as to minimize disruption. Where this cannot be avoided,

the schedule of disruption should be made known to the affected residents and establishments so appropriate adjustments can be made.

5.9 Increase in ambient noise, dust generation and GHG emission

168. Earthworks and other construction activities will generate dust or particulate matter while increased movement of vehicles will emit air pollutants. Significant noise will be generated by the movement of vehicles and equipment, grading and excavation activities. These impacts will affect the construction workers and residents within the immediate vicinity of the MWSS ROW. At the La Mesa Dam area, these could potentially affect the wildlife at the inner sections of the forested area.

169. The typical noise levels attributed to the use of equipment range from 71–106 decibel (dB), 59-94 dB and 53 to 88 dB at a distance of 15 m, 60 m and 120 m, respectively. **Table 5-2** shows the level of noise the typical construction equipment.

Table 5-2: Noise Range of Construction Equipment

Construction Equipment	Noise Level (dBA) at 15 m	Predicted Noise Level (dBA) at 60 m	Predicted Noise Level (dBA) at 120 m
Compactors (rollers)	71-73	59-61	53-55
Front Loaders	71-84	59-72	53-66
Backhoes	71-92	59-80	53-74
Tractors	77-95	65-83	59-77
Graders, Scrapers	80-92	68-80	63-74
Trucks	82-94	70-82	64-76
Concrete Mixers	71-88	59-76	53-70
Generators	71-82	59-70	53-64
Compressors	74-88	62-76	56-70
Impact Pile Drivers (peaks)	95-106	83-94	77-88

Source: US Environmental Protection Agency, 1972, p. 2-108

170. Assuming all the equipment are used in a construction site along the AQ7, then the calculated noise generated would range from 95.5 to 107dB, 83.5 to 95 dB and 77.4 to 89 dB at distances of 15 m, 60 me and 120m, respectively. The permissible noise level of 85 dB[3] can still be generated 120 meters from the construction area.

171. All vehicles and heavy equipment to be used during construction must be checked for compliance with emission standards. Speed limit should be set and strictly observed for all vehicles. All construction vehicles and heavy equipment should also be fitted with mufflers to minimize noise and subjected to regular maintenance. A fence shall be established around the work area which will serve as sound barrier. As far as practicable, construction work may be limited during daytime hours.

172. Noise levels shall be closely monitored throughout the construction period. Construction workers shall be required to wear Personnel Protection Equipment (PPE) and undergo thorough briefing on health and safety. Operators of equipment and those working near equipment must always wear hearing protection devices. Where possible, construction equipment should not be used simultaneously.

[3] 49 CFR 227.

173. Drivers of construction vehicles shall be required to minimize blowing of horns except in emergencies. use of acoustically insulated mechanical equipment, and proper tuning and maintenance of construction equipment and vehicles shall be strictly observed.

174. Operation of construction equipment generates greenhouse gases which include hydrocarbons (HC), Carbon Monoxide (CO), Nitrogen Oxide (NOx), Particulate Matter (PM) and Carbon Dioxide (CO2). The typical equipment which will be used for earthworks of AQ7 will include the bulldozer, off-road truck, grader and excavator. Each equipment has its own emission factor depending on the use or duty cycle. **Table 5-3** presents the emission factors of the various heavy equipment which can be used for earthmoving based on the 2010 study of Ahn, C., Pan, W., Lee, S. and Peña-Mora, F., 2010.

Table 5-3. Emission Factors for Various Duty Cycle Equipment[4]

Equipment	**Duty Cycle**	**Emission Factors**				
		HC (g/hr)	CO (g/hr)	NO_x (g/hr)	PM (g/hr)	CO_2 (g/hr)
Bulldozer	Rough grade	130.09	270.01	806.53	5.56	55.13
	Stockpile	100.53	272.45	962.29	8.78	83.44
Off-road truck	Hauling	56.78	128.26	385.64	2.94	28.84
Excavator	Soil Excavation	126.94	341.57	1122.52	10.22	98.05
Grader	Resurfacing	75.52	200.45	655.43	5.86	56.48
All Equipment	Idling	18.34	36.00	105.96	0.67	6.72

175. The table shows that the highest emission NO_x is generated by all the equipment. The excavator emits the highest amount of NO_x. The next GHG emitter is the bulldozer followed closely by grader and off-road truck. All the equipment emits GHG even while idling.

176. The following are recommended to reduce GHG emission of construction equipment:

(i) Reduction of idling time
(ii) Regular maintenance
(iii) Equipment operation based on manufacturer's specifications
(iv) Training of operators in the proper use of equipment
(v) Use of properly sized equipment for the required job
(vi) Regular air quality monitoring

5.10 Increased Site Traffic

177. Construction will bring about a significant increase in the number of vehicles coming in and out of the aqueduct area for the delivery of equipment, construction materials, excavated materials and workers. The increase will be focused at the in intersection of the AQ7 and the road segments. The frequent movement of vehicles to and from the site will disrupt normal traffic patterns and expose the local community to risk of injury or accidents.

[4] Source: Enhanced estimation of air emissions from construction operations based on discrete-event simulation.

5.11 Generation of wastes, i.e. solid wastes, hazardous waste and domestic wastewater

178. Solid waste will be generated at the work sites and the worker's camp. It is projected that the temporary camps will generate an estimated 0.4 to 0.5 kilogram (kg) per person per day and would consist mainly of plastic and glass bottles, paper, cardboard, food wastes, and packaging wastes. This will be collected and properly disposed in the approved disposal facility of the local government.

179. Hazardous wastes such as containers of paint and solvents and spent batteries are projected to be generated during the construction phase. Although small in volume, this type of waste is highly detrimental to the environment and public health. As mitigation, these materials will be segregated from the general solid waste, collected and disposed appropriately by government approved collector.

180. The contractor and workers' camps will also generate domestic wastewater. If not properly managed, this could contaminate surface water and shallow groundwater sources and surrounding land. Potential adverse impacts are minimal and temporal in duration and can be readily mitigated through measures established in the EMP. Proper management of the domestic wastewater from the contractor's facilities and workers' camps should be undertaken at all times. Appropriate latrines shall be installed in the camps and facilities of the Contractor.

5.12 Spill of Fuels and Lubricants

181. Spill of fuels and lubricants and washing of construction equipment at work areas could contaminate nearby waterways and soils within the MWSS ROW.

182. Appropriate management of contaminants from equipment should be strictly enforced. Storage areas for fuels and lubricants shall be kept away from any drainage canal leading to water bodies. In addition, an area within the site shall be designated for equipment and vehicle washing and maintenance. This area should be provided with oil and grease traps to prevent oil from being washed into canals.

5.13 Risks to occupational health and safety

183. Construction activities may cause harm and danger to the lives and welfare of workers. Dust generated by civil works particularly from excavations and access roads could affect vision while working. Air emissions from operation of equipment may pose some levels of health hazards to workers on site. Noise generated on site could prevent effective communication among workers which could affect efficiency and safety. Operation of heavy equipment and proximity to operating machineries pose safety hazards to workers. Working underground in the tunnel segments poses danger to the construction staff.

184. The contractor shall be required to develop an occupational health and safety plan which shall be a requisite part of the contract documents. The occupational health and safety plan shall include: (1) provision of personal protective equipment (PPE) like hard hats, safety gloves, boots, and ear mufflers to workers; (ii) provision of training on basic occupational health and safety to all workers including emergency response and first aid, HIV/AIDs prevention, sanitation and hygiene; (iii) provision of safety signages and reminders at the construction site; and (iv) accident and incident monitoring. The contractor will also prepare an emergency response plan, the outline of which is as follows:

(i) Possible causes of construction-related emergency situations due to man-made and natural hazards.
(ii) Procedures for addressing each emergency category specifying necessary actions to be performed by appropriate personnel within a time or event sequence.
(iii) The plan will establish what constitutes an emergency and the procedure will be developed for the following:
  a) Emergency Reporting
  b) Notification of Emergency Response Personnel
  c) Dispatching of Emergency Response Personnel and Equipment to the Site
  d) Coordination of all Emergency Response activities
  e) Evacuation of personnel and the public
  f) Communication to project employees/workers and the public
  g) Restoration of normal operations
(iv) Training provisions for employees/workers and emergency response team.

185. The contractor shall be required to provide emergency first aid kits at the site.

186. Sanitary facilities such as temporary toilets should be provided by the contractor at the construction camps. This will prevent workers from disposing of wastes in canals, water bodies, and on land. Sufficient and safe drinking water and washing facilities at the site should be provided.

5.14 Risks to community health and safety

187. The construction activities may also pose risks to the local communities arising from unauthorized entry at the construction site by the residents. This may result to exposure of unauthorized persons to operating equipment, open excavations, falling structures and other related hazards.

188. The contractor should be required to provide fencing around the entire perimeter of the work sites. Access to the construction sites should be restricted by assigning security personnel that will man the construction area. Open excavations should be provided with barricades and warning signs. Excavations and other hazardous areas should have sufficient lighting at night time.

189. Provision of health and safety orientation for construction workers shall be strictly enforced. These workers shall be required to use the proper personnel protection equipment. The sections for demolition will be cordoned off form unauthorized personnel.

5.14 Social conflicts arising from construction activities (prostitution, drunkenness)

190. During public consultations, issues concerning possible increase in prostitution and intoxication related to construction activities. In order to address these anticipated social conflicts, it is recommended that ordinances be passed by the respective LGUs prohibiting prostitution and intoxication from liquor. The contractor on the hand must implement strict house rules at the construction quarters

5.15 Impacts During Operation

191. Potential impacts during operation are deemed insignificant and include minor and short-term changes in water quality and minor risks to community health and safety during maintenance and repair.

192. The aqueduct will be properly fenced off and secured to restrict access and intrusion of unauthorized personnel. Watchmen/security personnel will be hired to secure the facilities on a 24-hour basis. This would minimize the safety risks to the community.

6 Analysis of Alternatives

6.1 Alternatives to the Project

193. Currently, transport of water from Bigte Basins to the Common Purpose Facility in La Mesa Dam is done through six aqueducts, namely: AQ1, AQ2, AQ3, AQ4, AQ5 and AQ6. All six aqueducts were constructed within the 60 m wide ROW of the MWSS.

194. Previous studies particularly the Angat Water Transmission Improvement Project (AWTIP 2014) and BNAQ 1-5 Assessment and Rehabilitation Works and Studies (2016) have established the need for an additional aqueduct to address the following issues:

(i) Heavy water losses incurred by the current aqueducts which means that the aqueducts are now likely under-capacity compared to the tunnels that bring in water from Ipo Dam to the Bigte Basins
(ii) Age of AQ1, AQ2, AQ3, AQ4, AQ5 which requires repair and rehabilitation

195. Aside from increasing the capacity of the aqueducts, AQ7 would facilitate the repair and rehabilitation of the ageing aqueduct and offer substantial factor of safety to the water supply security of Metro Manila.

196. The above conditions show that there would be no alternative to the development of AQ7.

197. For optimum transport and to avoid land acquisition and large-scale resettlement, the only logical route of AQ7 would be within the MWSS ROW.

6.2 Alternatives within the Project

198. Six technical options have been considered for the development of AQ7 within the MWSS ROW.

6.2.1 Option 1

199. Option 1 will have a Common Basin for all tunnels and aqueducts. A Common Basin is proposed to be built for all the tunnel inflows and the aqueducts for maximum flexibility. The most logical location of the proposed Common Basin will still be at Bigte. At Igay, the interconnection between Igay Basins 5 and 6 will be closed. This will also be common to all options. At Novaliches Junction, the current receiving basin of AQ1&2 will be replaced with a new receiving basin for AQ7. At Novaliches Portal, the common basin of AQ3 and AQ5 will be modified to accommodate flow from AQ7.

200. **Figure 6-1** shows the layout of the Common Basin overlaid on Google Earth map. The inflows from Tunnels 1 and 2 will be directly captured and that from Tunnel 3 will be through the existing Basin B. Tunnel 4 will require a new connection from the Transition Basin to the Common Basin plus a bypass line directly to AQ7. The outlets to AQ3 and AQ4 will also be automatically contained in the Common Basin but AQ5, AQ6 and AQ7 will be new outlets. The lengths of the

new lines to the existing AQ5 and AQ6 will be such that the hydraulic grade line requirements are met and that there will be no reduction in capacity. In this case, the interconnection point was determined to be at about 380 m downstream of Bigte.

201. The Common Basin shall have an overflow level of 93 m to achieve optimum flows coming from the tunnels and delivered by the aqueducts.

Figure 6-1: Preliminary Layout of Option 1

202. Because of the lowering of the head from Basin 3 to the Common Basin, the capacities of AQ5 and AQ6 will be considerably reduced but the option will still satisfy the water allocated to MWSS in all scenarios.

203. The normal operating set-up of Option 1 will be when all tunnels flows go to the Common Basin and all discharges shall emanate from the Common Basin through the aqueducts. However, the operation of the option can be modified using higher heads coming from Tunnels 3 and 4 using the direct lines.

204. Option 1 will potential entail relatively massive civil works and disruption to operation.

6.2.2 Option 2

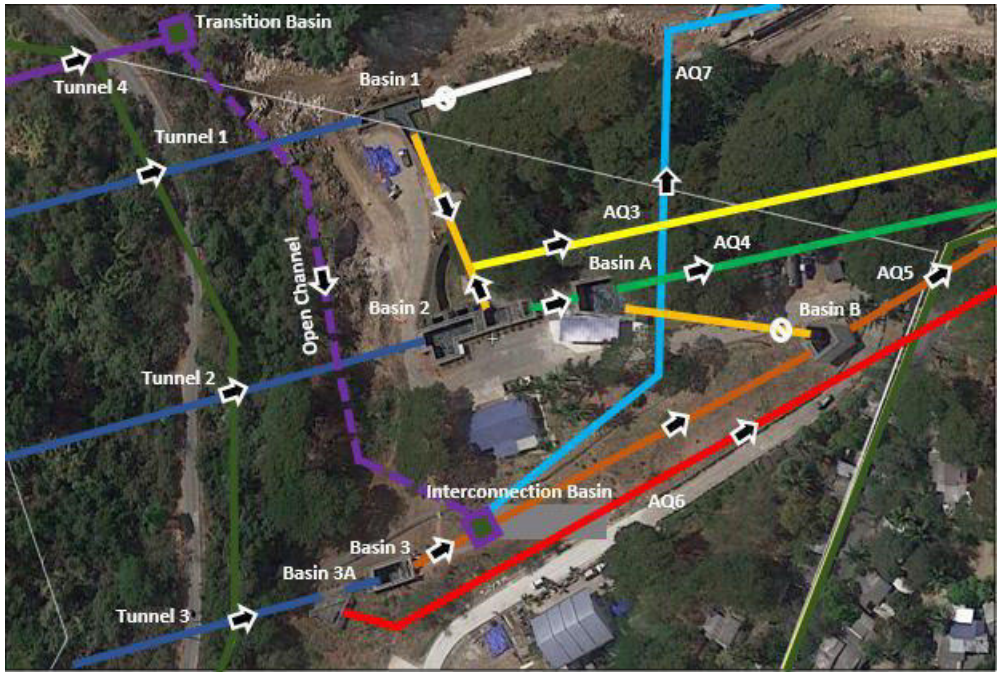
205. Option 2 will have AQ7 connected to the Interconnection Basin of Tunnels 3 and 4. At Bigte, Basin 1 will be as it is but the sluice gate to AQ1&2 will be shut off (**Figure 6-2**).

206. Without a common basin and with the connection of Basins A and B closed, the water transmission system will be split into two separate sub-systems. The first sub-system will consist of Tunnels 1 and 2 supplying AQ3 and AQ4 while the second one will have Tunnels 3 and 4 supplying AQ5, AQ6 and AQ7.

207. For Sub-System 1, if any of AQ3 or AQ4 is closed, Tunnel 2 can easily supply the flows to either AQ3 or AQ4. On the other hand, Tunnel 1 flow will just be enough for AQ3 but not for AQ4. For Sub-System 2, Tunnels 3 and 4 are capable of supplying the water requirement for any combination of two aqueducts among AQ5, AQ6 and AQ7.

208. The system will be able to convey the water allocation of MWSS with a minimum surplus of 113 MLD when AQ4 is closed.

Figure 6-2: Preliminary Layout of Option 2



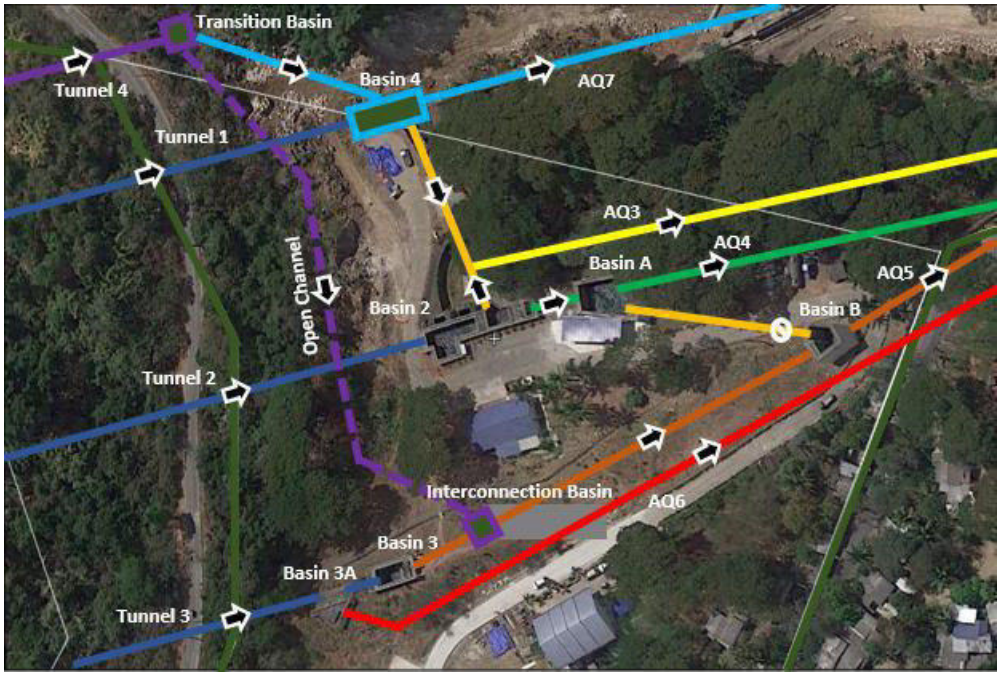
6.2.3 Option 3

209. Basin 1 in Option 3 will be upgraded to accommodate AQ7 and will be renamed Basin 4. Tunnel 4's Transition Basin will feed directly to Basin 4. The big change in elevation from the Transition Basin to Basin 4 will be handled by flow restrictors or by energy dissipators. The scheme practically integrates the two sub-systems.

210. Though this option appears to be an integrated system, AQ7 practically gets all the water from Tunnel 4 leaving the channel from the Transition Basin to the Interconnection Basin with minimal flow. The only time the channel will have large flow is when AQ7 is the one on stand-by. The system will be able to convey the water allocation of MWSS when any of the aqueducts is closed one at a time. However, the excessive energy of water from Tunnel 4 to Basin 4 needs to be dissipated.

211. The preliminary layout of Option 3 at Bigte is shown in **Figure 6-3**.

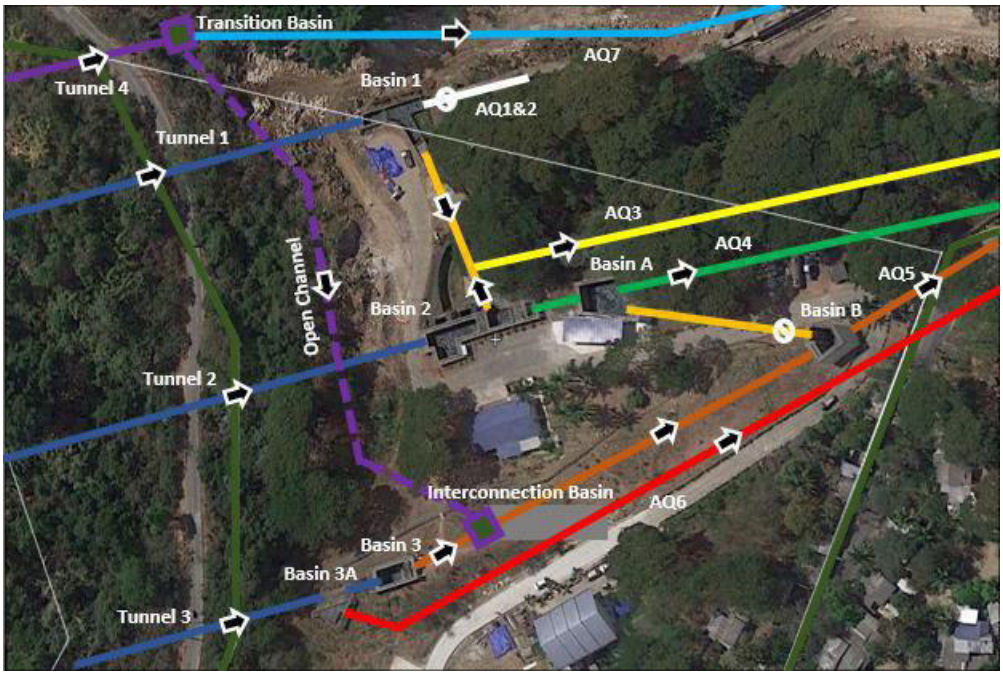
Figure 6-3: Preliminary Layout of Option 3



6.2.4 Option 4

212. Option 4 will have AQ7 directly connected to the Transition Basin of Tunnel 4. The outlet to AQ1&2 at Basin 1 will be closed. AQ7 in this option will emanate at higher elevation at the Transition Basin of Tunnel 4. The preliminary layout of Option 3 at Bigte is shown in **Figure 6-4**.

Figure 6-4: Preliminary Layout of Option 4

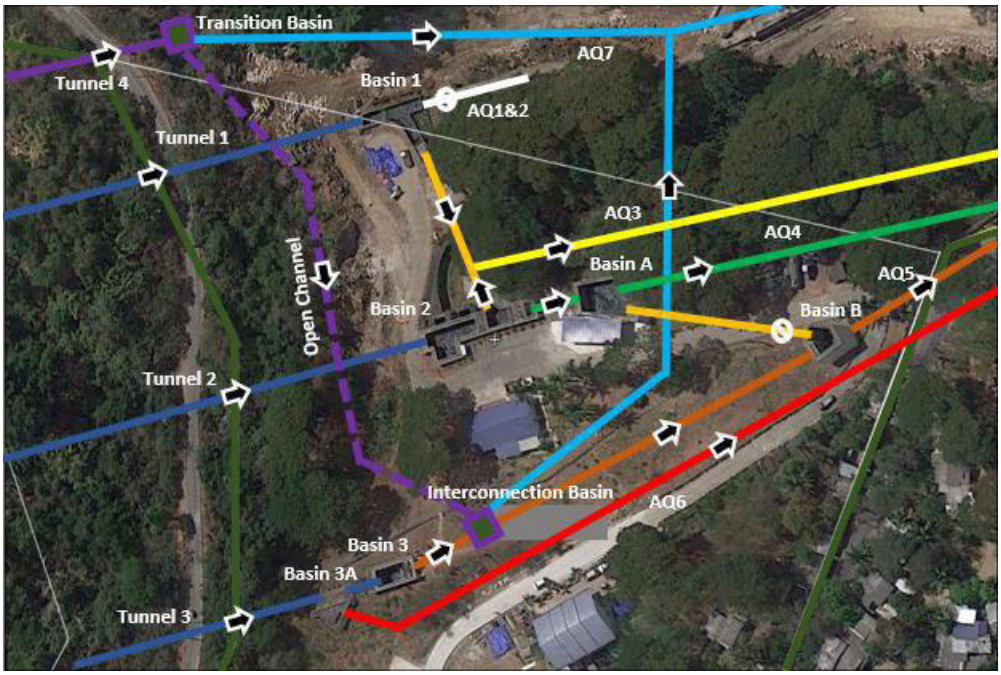


213. This option will again have two sub-systems. Like Option 3, AQ7 will practically get all the flow from Tunnel 4 and will leave the channel empty. The channel will only have flows when AQ7 is on stand-by. Flow from the channel will go to Sub-System 2 where AQ5 and AQ6 are connected. The system will be able to convey the water allocation of MWSS.

6.2.5 Option 5

214. Option 5 is a combination of Options 2 and 4. AQ7 will be supplied by two sources. It will be getting water from the Transition Basin of Tunnel 4 and from the Interconnection Basin which is basically supplied by Tunnel 3. **Figure 6-5** shows the preliminary layout of Option 5 at Bigte.

Figure 6-5: Preliminary Layout of Option 5



215. Option 5 still has two separate systems. Even with two sources, AQ7 is only hooked to Sub-System 2 where supply comes from Tunnels 3 and 4 and discharge is through AQ5, AQ6 and AQ7. The channel from the Transition Basin to Interconnection Basin will only have flow when AQ7 is on stand-by. Otherwise, Tunnel 4 is practically exclusive for AQ7. In case of problem in Tunnel 4, AQ7 can also get supply from Tunnel 3 through the additional line from the Interconnection Basin. This is an extreme possibility similar to a “double flat tire” with Tunnel 4 and one of AQ5 and AQ6 not working.

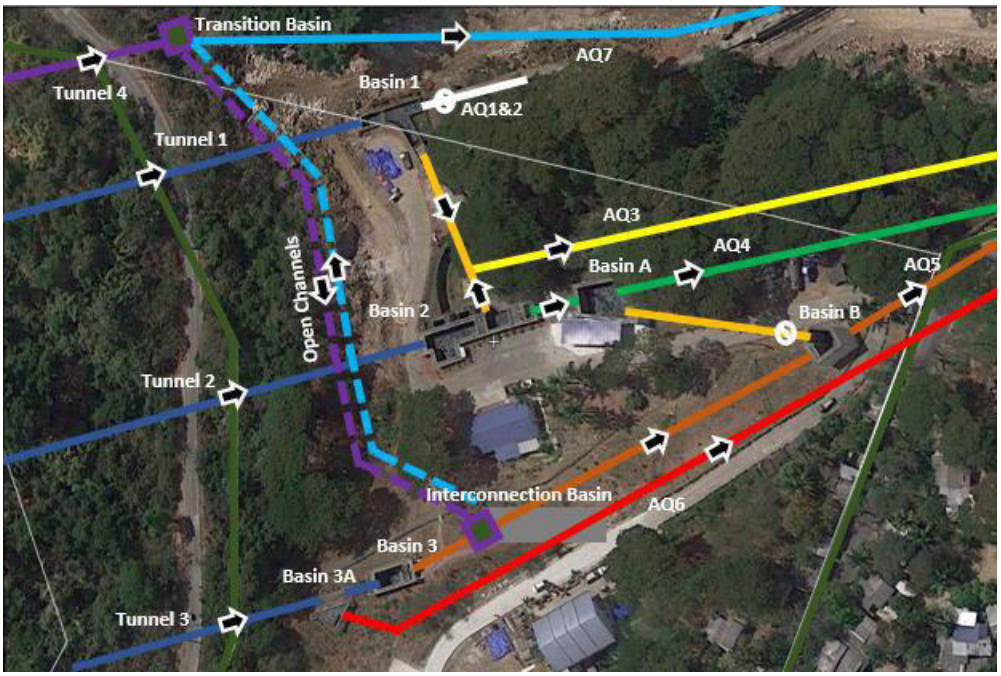
6.2.6 Option 6

216. Option 6 is a further modification of Option 5 where the open channel from the Transition Basin to the Interconnection Basin shall be a two-way channel. Instead of the line feeding AQ7 from the Interconnection Basin, there will be an “opposite lane” at the channel section between the Transition Basin and the Interconnection Basin. As the elevation of the Transition Basin is higher than the Interconnection Basin, the original channel will have a slope from the Transition Basin to the Interconnection Basin. A second barrel will be provided which will have an opposite slope. The receiving basin will again be the Transition Basin which will have two chambers. The

second chamber will be deeper. The system in Option 6 will be able to convey the water allocation of MWSS.

217. **Figure 6-6** shows the preliminary layout for Option 6.

Figure 6-6: Preliminary Layout of Option 6



218. Option 5 was chosen after an evaluation in terms of system flexibility (40%), flow capacities (10%), ease in construction (10%), least disruption in service (10%) and cost (30%).

6.2.7 No Project Alternative

219. The No Project Alternative would correspond to the status quo of the current delivery of water from Bigte Basin to Novaliches Portal. This means that the capacity of the four tunnels from Ipo Dam and the six current aqueducts. AQ1, AQ2, AQ3, AQ4, AQ5 and AQ6 will almost be equal. The conveyance of water from Bigte Basin to Novaliches Portal would be done through aging aqueducts with reported heavy losses.[5]

7 Public Consultation and Information Disclosure

7.1 Public Consultation

220. Stakeholders Consultations were conducted at eight barangays within the period from 10 April to 27 June 2018 (**Table 7-1**). The consultations were conducted to discuss with the stakeholders the proposed project and to elicit the environmental concerns/issues of the community on the proposed project.

[5] As reported in the AWTIP study pf Halcrow (2014) and Arcadis (BNAQ 1-5 Assessment and Rehabilitation Works 2016

221. The issues raised focused on the safety of the local residents during construction, change in water source, possible increase in prostitution, increase in traffic, employment opportunities, relocation period, compensation for displacement and flooding, among others.

222. **Tables 7-2 to 7-7** present the key issues which were raised during the consultations.

Table 7-1: Summary of Public/Stakeholders Consultations

Date	Location	Barangay	Participants		
			Male	Female	Total
10 April 2018	Bigte Bgy. Hall	Bigte, Norzagaray	9	21	30
24 April 2018	179 Bgy. Hall	179, Caloocan City	18	26	44
25 April 2018	Gumaok East Bgy. Hall	Gumaok East, SJDM	15	19	34
20 June 2018	Minuyan Bgy. Hall	Sto. Cristo and Minuyan, SJDM	7	14	21
25 June 2018	Kaypian Bgy. Hall	Kaypian, SJDM	8	13	21
27 June 2018	Graceville Bgy. Hall	San Manuel and Graceville, SJDM	12	14	26

Table 7-2: Issues Raised at Barangay Bigte, Norzagaray

Key issues/Concerns	Response/Comment
Women	
Safety of mothers and children walking or crossing the streets.	Residents suggested that signs be placed where vehicles should slow down.
Open holes pose a danger to curious children.	Residents suggested that others should closely supervise their children especially along the streets and that barriers around the hole be set up.
The barangay is where the main lines originate but the residents do not enjoy potable water from the system. Instead they will have to connect to Norzagaray Water District for potable water and where they will have to pay connection fee.	It was explained that there are no treatment facilities in Bigte so the residents do not get drinking water from the system. It was also mentioned that treatment facilities are currently being constructed in SJDM under the Bulacan Bulk Water Supply project which aims to provide potable water to the whole province.
Accidents may happen especially during rainy season when the roads become slippery.	The contractors should help maintain the roads to ensure safety of residents.
Accidents may happen to workers performing their job in the aqueduct similar to what happened when water entered Aqueduct 6 due to torrential rains.	The safety officers of the contractors should do their job to ensure safety.
The influx of truckers may cause the increase of young commercial sex workers (as young as 14 years old) who currently climb the trucks and offer services for cash. These young workers oftentimes maintain a front of selling commodities along the road.	It was suggested that the practice of women/girls climbing up trucks and/or trucks picking up girls/women be prohibited through an ordinance in order to set penalties and be a deterrent for such practice.
Men	
During the construction of Aqueduct 6, some drivers of trucks used in construction drove fast and did not slow down even in populated areas. This caused hazard to residents, commuters, and other drivers.	Speed limit be regulated when entering the barangay and signages on the speed limit be put up.
One tricycle operator-driver leader noted that the current general contractor for Aqueduct 6 conducted consultations at the start of the project, but consultations have noticeably stopped when	It was suggested that the residents get more involved in monitoring the project and that the barangay should closely coordinate with the general contractor.

Key issues/Concerns	Response/Comment
construction began. Some community organizations were also identified as counterparts to assist the technical team in monitoring the progress. But he added that they have not yet been called upon to perform such task.	

Table 7-3: Issues Raised at Bgy. 179, Caloocan City

Key issues/Concerns	Response/Comment
Women	
The women residents expressed concern over the safety of children where the aqueduct will be constructed near school facilities.	It was suggested that the barangay officials closely coordinate with the contractor to help in traffic management.
The women remarked that all of the residents should be made aware of the project.	The various homeowners' associations committed to inform their members and assist in information, education, and communication efforts when project implementation is near.
Men	
Concerns about increased traffic were articulated with the increased presence of trucks during construction.	It was suggested that the contractor assist in traffic management.
Residents who use the tennis court in the subdivision (located within the 60-meter ROW) requested that the tennis court be further developed.	It was explained that the MWSS has ownership of the ROW and that the tennis court is considered an encroaching structure even if former MWSS employees are the ones who use the facility. As the MWSS policy on encroaching structures was yet unclear, it was suggested that the facility users formally write a request letter to MWSS management.

Table 7-4: Issues Raised at Bgy Gumaok East, SJDM

Key issues/Concerns	Response/Comment
Women	
The women expressed worry that construction-related workers might get drunk and cause trouble to residents.	The barangay officials said that there are no beerhouses in their barangay, drinking is prohibited in public places, and that videoke sessions are limited until 10 pm only.
Women residents expressed concern on the safety of children and senior citizens during construction.	The barangay officials committed to deploy personnel to assist in traffic management.
Men	
Male residents would like to be given priority for employment during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory of skills and manpower updated regularly for this purpose.

Table 7-5: Issues Raised at Sto. Cristo and Minuyan, SJDM

Key issues/Concerns	Response/Comment
General	
One resident asked if the existing septage treatment plant of the San Jose del Monte Water District in Bgy. Minuyan will be affected by the project.	If it is outside the identified 60 meters ROW and will not be affected.
Another asked if there will be earth-moving at the tunnel portion.	No. The surface will not move at the tunnel portion.

Key issues/Concerns	Response/Comment
Residents with structures that encroach on the 60 m ROW inquired on who will address issues regarding resettlement or displacement of people.	The MWSS will address resettlement issues with ROW and will announce their policy as soon as it becomes available. Some residents have expressed willingness to voluntarily clear their encroaching structures rather than be demolished.
Male	
Some men asked about the project schedule and whether they will be given time to prepare in the event they need to relocate.	As project implementation will probably start after two years, there is sufficient time for the residents to plan accordingly. Moreover, the MWSS policy on resettlement will be announced as soon as it becomes available.
Increased traffic especially along the main roads may become a problem in the barangay.	Barangay officials committed to help in traffic management.
One school owner asked about the possibility of paying rental fee to MWSS to secure his location.	MWSS will decide on this matter.
Male residents asked whether barangay residents will be employed during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory of skills and manpower updated regularly for this purpose.
Female	
Female residents were concerned that sex workers might appear during construction.	It was suggested by the barangay residents themselves that strict regulation of entertainment hubs such as beerhouses be done by the barangay officials. Barangay officials admitted that there was no such ordinance and would consider the suggestion.
Women residents were concerned about the safety of children, elderly, pregnant women and PWDs on the main roads which become muddy especially during the rainy season.	It was requested that barangay officials release rerouting advisories to children, elderly, etc. to avoid muddy roads prone to accident. A representative from a school located within the 25 m ROW committed to assist in information campaign especially for their students and their families.
Information dissemination needs to be conducted among the residents to inform them about the project.	The senior citizens group and solo parents group committed to help by giving out flyers or information materials.

Table 7-6: Issues Raised at Kaypian, SJDM

Key issues/Concerns	Response/Comment
Women	
Women residents were concerned about the safety of children in high traffic areas.	
One resident, who had experienced being evicted from her house after just two weeks' notice, asked whether they will be given enough time to relocate and whether they will be compensated.	The MWSS will announce its relocation and entitlement policy as soon as it becomes available. Sufficient time will be provided for the people who need to relocate or clear encroaching structures.
Men	
Male residents would like to be given priority for employment during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory

Key issues/Concerns	Response/Comment
	of skills and manpower updated regularly for this purpose.
Some asked about the project schedule and whether they will be given time to prepare in the event they need to relocate.	As project implementation will probably start after two years, there is sufficient time for the residents to plan accordingly. The MWSS policy on resettlement will be announced as soon as it becomes available.

Table 7-7: Issues Raised at Bgys. Graceville and San Manuel, SJDM

Key issues/Concerns	Response/Comment
General	
In case the families that will be displaced will be compensated, it was suggested that payments be made directly to them rather than be coursed through channels.	Participants requested that payments must be made directly to affected families without coursing through various channels.
Some worried that unpleasant odor might emanate from paint or other chemicals.	It was suggested that in case there will be some painting jobs, the contractor must find a way to minimize the unpleasant smell of paint or chemicals.
Some residents expressed worry that the project might cause flooding in their subdivisions like what they experienced with the ongoing construction of the Bulacan Bulk Water Supply Project.	It was suggested that homeowners' associations be consulted by the contractor since the former are knowledgeable on the sizes of drainages in their subdivisions.
All of the subdivision residents need to be made aware of the project and its possible impact.	Officers of homeowners' associations and senior citizens associations committed to help in information dissemination.
Male	
Some male participants suggested that skilled workers come from their barangays and that their selection be based on skills and qualifications rather than their personal relationship to the barangay officials.	It was explained that as a policy, the general contractor is required to hire local resident and that the barangay's inventory of skills and manpower is usually the basis for selecting the local manpower.
Female	
The female participants were concerned that the roads might become dusty during the dry season and muddy during the rainy season and might pollution and accidents to the residents, especially the elderly, women, and children.	It was suggested by the residents that barangay coordinate with contractor and demand that the latter assign personnel to clear and maintain the roads.

7.2 Information Disclosure

223. Prior to project implementation, a copy of the approved IEE and EMP will be submitted to the DENR and local government units concerned. The IEE will also be posted on the ADB website. During construction and operation, communities within the impact area of the project area will be kept informed of construction activities through billboards or information boards about the construction activities and schedules. Consultations will be undertaken on a need basis with the date, time and venue to be agreed with the LGU official and concerned government agencies. The contact details of the grievance redress mechanism (GRM) focal contact persons and construction managers will be prominently displayed in the respective construction areas for the reference of the affected communities/persons. All suggestions, opinions and responses from the community on the project should be taken into account and feedback provided on how concerns and recommendations have been addressed.

8 Grievance Redress Mechanism

224. A grievance redress mechanism (GRM) is a systematic process for receiving, validating and addressing affected people's project-related complaints. The objective of the GRM is to resolve complaints as quickly as possible at the local level through a process of conciliation, and if that is not possible, to provide clear and transparent procedures for appeal. All affected persons will be made fully aware of their rights, and the detailed grievance redress procedures will be publicized through an effective public information campaign. An aggrieved affected person (AP) or affected household (AH) will be free from any fees in connection with the lodging and resolution of complaints, as the costs will be borne by the MWSS and the appointed contractors.

225. As a general policy, the MWSS will work proactively toward preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Nonetheless, during construction and operation it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented, or unforeseen issues occur.

226. Eligible grievances or complaints include:

(i) Negative impacts such as from loss of water, loss of roadside trees, health and safety issues, nuisances, etc.).
(ii) Hazard to health and safety due to pollution of the environment.
(iii) Hazards due to construction activities (e.g. noise, dust, disruption of access, etc.)
(iv) Impacts on social infrastructure.
(v) Failure to comply with standards or legal obligations.
(vi) Improper conduct of contractor (s) leading to nuisance of affected person(s).
(vii) Misuse of funds and other irregularities.
(viii) Grievances due to land acquisition, resettlement, compensation, relocation and unaddressed losses.
(ix) Complaints on gender issues.

227. A grievance redress committee (GRC) composed of representatives from the host LGU project management (PM): two municipal/city council representatives, a barangay council representative from each affected barangay, and 1 female and male AP from each barangay will be formed at the LGU level to address AP complaints for the project.

228. Complaints can be made verbally or in written form. In cases where AHs do not have the writing skills or are unable to express their grievances verbally, AHs are allowed to seek assistance from any recognized local group, NGO, family member, village heads or community chiefs to have their complaints or grievances written for them. In the case of verbal complaints, a written record of the complaint will be made during the first meeting with the complainant. Complainants who present their complaints within the prescribed procedures will be exempt from all administrative fees incurred. In addition, complainants who lodge complaints and appeals to courts will be provided with free legal representation.

229. AHs will be allowed to have access to the detailed measurement survey (DMS) or contract document to ensure that where disputes do occur, all the details have been recorded accurately enabling all parties to be treated fairly. Throughout the grievance redress process, the responsible committee will ensure that the concerned AHs are provided with copies of complaints and decisions or resolutions reached.

230. **Table 8-1** presents a matrix of functions and procedures for the implementation of the GRM.

Table 8-1: Grievance Redress Stages, Procedures and Functions

Stage	Procedure	Responsible Entity	Timeframe of Action
Stage 1	Filing of complaint to GRC	Complainant/GRC Secretary	Complainant-driven
	Reproduction and distribution of complaint (Original with GRC, 1 copy complainant, 2 LGU PM)	GRC Secretary	Upon receipt of complaint
	Meeting to resolve issue	Complainant GRC LGU representative	Within 15 days upon receipt of complaint. If not resolved, proceed to Stage 2
Stage 2	Filing of Complaint to PMO Safeguards Focal Person	Complainant/ GRC Secretary	Complainant-driven
	Reproduction and distribution of complaint (Original PMO, 2 LGU, 1 Complainant)	PMO	Upon receipt of complaint
	Resolution of issue	PMO	Within 15 days upon receipt of complaint. If not resolved, proceed to Stage 3
Stage 3	Filing of complaint to Municipal Trial Court or Regional Trial Court	Complainant/GRC	Complainant-driven
	Reproduction and distribution of complaint (Original Court, 1 PMU, 1 GRC, 1 LGU, 1 Complainant)	Complainant with assistance from pro-bono lawyer	Complainant-driven
	Hearing	MTC6 or RTC7	Dependent on MTC or RTC schedule
	Decision	MTC or RTC	Dependent on MTC or RTC schedule
	Appeal to Supreme Court	Complainant	Complainant-driven
	Decision (Final & executory)	Supreme Court	Dependent on Supreme Court schedule. If complainant is not satisfied with SC decision, next step
Stage 4	Discussion with ADB's Urban and Water Division at ADB Headquarters	Complainant ADB Country Office	Complainant-driven. If complainant not satisfied, proceed to last step
	Contact ADB Office of Special Facilitator	Complainant	Complainant-driven
	Decision	ADB Office of Special Facilitator	

[6] Municipal Trial Court
[7] Regional Trial Court

231. If efforts to resolve complaints or disputes are still unresolved and unsatisfactory following the grievance redress mechanism, the affected persons/households have the right to send their concerns or problems directly to ADB's Operations Department, i.e. Urban and Water Division, Southeast Asia Department (SERD). If the AP is still not satisfied with the responses of SERD, he/she can directly contact the ADB's Office of the Special Project Facilitator (OSPF) as outlined in the "Information Guide to the Consultation Phase of the ADB Accountability Mechanism". The Information Guide can be downloaded through this link: **https://www.adb.org/documents/information-guide-consultation-phase-adb-accountability-mechanism**. Those who want to make a complaint with the ADB can refer to the sample letter of complaint adapted from the Information Guide as shown in **Figure 20.**

Figure 8-1: Sample Complaint Letter

Date:

Office of the Special Project Facilitator
Asian Development Bank
6 ADB Avenue, 1550 Mandaluyong City
Metro Manila, Philippines
Tel: (+632) 632-4825
Fax: (+632) 636-2490
Email: spf@adb.org

Dear Special Project Facilitator,

We, _____ *[(name of your group) or name of representative authorized by your group]*, whose names and addresses are attached, live in _____ *[location and country]*.

We hereby present this complaint to the Special Project Facilitator. *[If the complaint is filed through a representative, please provide the names of the project-affected people with their addresses and evidence of authority to represent them.]*

1. We are currently experiencing problems due to an ADB-assisted project *[specify name and description of project, and specify the site and country where it is located].*
2. The direct harm we experience is/are the following: *[describe the problem].*
3. We seek the following outcomes and remedies through the help of the Special Project Facilitator: *[describe what you would like to happen, how the harm or problem can be resolved].*
4. We have previously made efforts to address our problem with the EA/IA and ADB Operations Department concerned in the following manner: *[list and attach correspondence, details of meetings, emails, and other communications].*
5. We do not request that our identities be kept confidential
   [or]
   We request that our identities be kept confidential for the following reason: *[state reason].*
6. You can contact us at: *[specify directions how to set a meeting with you and/or your authorized representative].*

_____

Signatures:
Names:
Addresses:
Other contact information:
Tel:
Fax:
Email:
Attachments: *[complete list of complainants and addresses; representative's letter of authorization, if any]*

Some matters not eligible for complaints/requests

- Allegations of fraud and corruption
- Procurement of goods, services, and consulting services
- Projects with a project completion report
- ADB personnel matters

9 Environmental Management Plan

9.1 Institutional Responsibilities

232. The following are the key players for the environmental management of the Project:

Table 9-1. Institutional Responsibilities on Implementation of the EMP

Agency	Responsibilities
MWSS	• Executing agency with overall responsibility for project construction and operation; • Ensure that sufficient funds are available to properly implement the EMP; • Ensure that Project implementation complies with Government environmental policies and regulations; • Ensure that the Project, regardless of financing source, complies with the provisions of the EMP and ADB Safeguard Policy Statement 2009 (SPS); • Obtain necessary environmental approval(s) from the Environmental Management Bureau and/or other concerned government agencies prior to commencement of civil works; • Ensure that tender and contract documents for design, supervision and civil works include the relevant EMP requirements; • Establish information on an environmental grievance redress mechanism, as described in the IEE, to receive and facilitate resolution of affected peoples' concerns; and •
MWSS-Project Management Office (PMO)	• Project management office with direct responsibility for the implementation of civil works, engineering designs and project coordination; • Ensure that EMP provisions are strictly implemented and monitored during various project phases (design/pre-construction, construction and operation) to mitigate environmental impacts to acceptable levels; • Ensure compliance with environmental permits; and • Include relevant provisions of the EMP in the bid and contract documents for design, civil works and supervision. • Submit semi-annual monitoring reports (**Appendix B**) on EMP implementation to ADB. • The PMO will also monitor and report to DENR-EMB on the implementation of conditions prescribed in the Environmental Compliance Certificate (ECC) issued by DENR-EMB. • Coordinate with DENR-EMB, Local Government Units (LGU), and other concerned agencies related to environmental aspects for maintaining project`s compliance with environmental permits.

Agency	Responsibilities
Detailed Engineering Design (DED) Consultant	• Incorporate into the project design the environmental protection and mitigation measures identified in the EMP for the design/pre-construction stage; and • Assist PMO to ensure that all relevant mitigation and monitoring measures from the EMP are incorporated in the bidding and contract documents for project supervision and civil works.
Construction Supervision Consultant (CSC)	• Engage environment specialists who will undertake supervision and monitoring of EMP implementation and contractor's environmental performance; • As part of day-to-day project supervision, closely supervise the contractor's implementation of mitigation measures specified in the EMP; • Undertake monthly monitoring of contractor's environmental performance and over-all implementation of the EMP; • Prepare semi-annual environmental monitoring reports on status of EMP implementation for submission to ADB; • Based on the results of EMP monitoring, prepare time-bound environmental corrective action plans to address adverse environmental impacts and other non-compliance issues, as necessary, for submission to ADB
Contractors	• Recruit qualified environmental and safety officer to ensure compliance with environmental statutory requirements, contractual obligations and EMP provisions; • Provide sufficient funding and human resources for proper and timely implementation of required mitigation and monitoring measures in the EMP; and • Implement additional environmental mitigation measures, as necessary, to avoid, minimize and/or compensate for adverse impacts due to construction works and related activities performed by the contractor.
Asian Development Bank (ADB)	• Conduct periodic site visits to assess status of EMP implementation and over-all environmental performance of the Project; • Review environmental monitoring reports submitted by the executing agency to ensure that adverse impacts and risks are properly addressed; and • Publicly disclose through posting on ADB's website environmental monitoring reports, corrective action plans, prepared by the executing agency during project implementation.

9.2 Mitigation Plan

233. The environmental management plan (EMP) will serve as the framework for the mitigating the anticipated impacts of the project. Implementation will commence before the procurement process for construction contractor up to the operation. As shown in **Table 9-2**, it presents all the required measures and monitoring responsibilities corresponding to the impacts as assessed that are considered necessary through the environmental assessment process. The mitigation measures required cover all stages of the contract and are separated into pre-construction, construction and operation phases. This EMP is based on the type, extent and duration of the

environmental impacts identified at the design stage. In the event that unexpected impacts occur during implementation, the EMP will be amended to take into account of unexpected impacts and mitigation measures will be amended as necessary.

234. A copy of the EMP must be kept at the site at all times. The EMP will be included in the bid documents and will be further reviewed and updated during implementation, as necessary. The EMP will made binding on all contractors operating on site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set-out in the document constitutes a failure in compliance.

9.3 Institutional Assessment and Capacity

235. The new organizational structure of MWSS-Corporate Office (CO) consists of three (3) major functional groups namely; the Innovation and Technology Group, Engineering and Technical and the Management Services Group. As currently structured, MWSS does not have an in-house environmental department that can oversee compliance with the proposed environmental management plan. Potentially, this department can be created within the Engineering and Technical and the Management Services Group.

236. Within the existing MWSS organization, the Project Management Office for the Bigte-Novaliches AQ7 Project (PMO-BNAQ7P) is proposed to be created. During project implementation, and for purposes of compliance to safeguard monitoring, it is proposed that a Safeguards Group (SG) be set up within the PMO of BNAQ7P. The SG will have its own safeguard officer (IR/social development/gender officer) and environmental officer in which the MWSS shall provide for the project. The above-mentioned positions shall be co-terminus to the project.

237. The project based position of the environmental officer is proposed to be reinforced on the technical aspects of environmental monitoring through short term engagement of consultants on water and air quality. The actual sampling or water for laboratory tests and short term measurements of noise and emissions shall be contracted to accredited laboratories. All reports and results though would be integrated by the environmental officer.

Table 9-2: Environmental Management Plan

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
Design Issues				
Presence of endangered tree species along the cut and fill section will be made within the La Mesa Watershed Reservation.	Detailed inventory of trees, notably endangered species within the 25 m footprint of excavation and 40 m^2 footprint of tunnel portal Compliance with the guidelines of the National Ecology Center	During the design stage	MWSS/ Contractor	6,000
Impact of ground shaking due to earthquake events	Adoption of the appropriate g factors for the AQ7 segments using maximum credible earthquake	During the design stage	MWSS/ Contractor	Part of design cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
	recommended by PHIVOLCS			
Construction Phase				
Demolition of three houses of informal dwellers and nine establishments	Sufficient time will be provided for the people who need to relocate or clear encroaching structures. Timely relocation of affected families and establishments	During civil works	MWSS/ Contractor	Part of MWSS relocation and resettlement plan
Removal of vegetation within a 25 m construction strip along cut and fill segment of the aqueduct and portal of the tunnels	Limit earthworks within the 10-m wide footprint of the aqueduct and the designated staging areas; Replanting of trees of the same species at the La Mesa Watershed Reservation	During civil works	MWSS/ Contractor	6,000
Generation of stockpiles of soil and rocks	Earthworks should be confined within the 10-m wide footprint of the aqueduct and the designated staging areas. Require contractor to develop and strictly enforce a spoils management plan	During civil works	MWSS/ Contractor	Part of construction cost
Erosion and siltation of waterways	Provision of silt traps, ditches, and sump pits to intercept the flow of silt laden runoff from the worksites into the nearby channels and watercourses. Earthworks will be scheduled during the dry season or stopped during heavy rainfall.	During civil works	MWSS/ Contractor	Part of construction cost
Local flooding at aqueduct/stream intersections	Regular cleaning of intersection of the aqueduct and streams and canals	During civil works	MWSS/ Contractor	Part of construction cost
Loss of access to houses, establishments and utilities.	Contractor to provide safe temporary access to structures along the construction site and to restore any damaged sections to properties immediately; Contractor to undertake a detailed survey of existing water pipes power poles and lines and schedule the earthworks in such manner as to minimize	During civil works	MWSS/ Contractor	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
	disruption; IEC regarding construction schedule.			
Increase in ambient noise and dust generation	All vehicles and heavy equipment to be checked for compliance with emission standards; Speed limit should be set for all vehicles; Installation of mufflers for all construction vehicles and heavy equipment; Construction of perimeter fence around the work area; construction work be limited during daytime hours; use of PPE for construction personnel; monitoring of noise levels; air quality monitoring;	During civil works	MWSS/ Contractor	Part of construction cost
Increased site traffic	Implement traffic management plan (TMP) with LGU officials. The outline of the TMP to be prepared by the contractor is as follows: 1. Details of coordination activities with local government units and other relevant agencies on preparation and implementation of the TMP 2. Identification of traffic diversion and management 3. Details of traffic schedules 4.Transport schedule of project vehicles and equipment 5.Traffic arrangements showing all detours 6.Details of necessary barricades, warning/ advisory signs, road signs, lighting, and other provisions to be installed to ensure that adequate and safe access is provided to motorists in the affected areas.	During civil works	MWSS/ Contractor	Part of construction cost
Generation of solid wastes, hazardous waste and domestic wastewater	Regular waste collection and disposal.	During civil works	MWSS/ Contractor	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
Spill of fuels and lubricants	Keeping storage areas for fuels and lubricants away drainage canals leading to water bodies; designating areas within construction sites for equipment and vehicle washing and maintenance; provision of oil and grease traps at construction sites	During civil works	MWSS/ Contractor	Part of construction cost
Public safety	The following mitigation measures to ensure public safety will be implemented by the contractor: i) ii) Fencing of construction sites and regular patrols to restrict public access. iii) Prior to excavation work, provide fencing on all sides of areas to be excavated. iv) Provide warning signs at the periphery of the construction site. v) Strictly impose speed limits along residential areas and where other sensitive receptors are located. vi) Educate drivers on safe driving practices to minimize accidents and to prevent spills of construction materials during transport. vii) Excavations and other hazardous areas should have sufficient lighting at night time.	During civil works	MWSS/ Contractor	Part of construction cost
Risks to occupational health and safety during construction of AQ7 and dismantling of AQ7	Contractor shall be required to develop and implement an occupational health and safety plan which shall be a requisite part of the contract documents. The occupational health and safety plan shall include: (1) provision of personal protective equipment (PPE) like hard hats, safety gloves, boots, and ear mufflers to workers; (ii) provision of training on	During civil works	MWSS/ Contractor	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
	basic occupational health and safety to all workers including emergency response and first aid, HIV/AIDs prevention, sanitation and hygiene; (iii) provision of safety signages and reminders at the construction site; and (iv) accident and incident monitoring.			
Hazards to occupational health and safety during construction of AQ7 and dismantling of AQ7	Limiting access to construction sites to authorized personnel. The contractor will also prepare an emergency response plan, the outline of which is as follows: a. Possible causes of construction-related emergency situations due to man-made and natural hazards. b. Procedures for addressing each emergency category specifying necessary actions to be performed by appropriate personnel within a time or event sequence. c. The plan will establish what constitutes an emergency and the procedure will be developed for the following: i. Emergency Reporting ii. Notification of Emergency Response Personnel iii. Dispatching of Emergency Response Personnel and Equipment to the Site iv. Coordination of all Emergency Response activities	During civil works	MWSS/ Contractor	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
	v. Evacuation of personnel and the public vi. Communication to project employees/workers and the public vii. Restoration of normal operations d. Training provisions for employees/workers and emergency response team.			
Damage to relics and artifacts during the conduct of the works.	In the event of unanticipated discoveries of cultural or historic artefacts (movable or immovable) in the course of the work, the contractor will take all necessary measures to protect the findings. Procedures to be followed in case of discovery of artefacts are: a) Contractor to immediately cease operations at the site of discovery b) Contractor to inform the CSC and MWSS c) MWSS to notify the National Historical Commission of the Philippines (NHCP) and/or other concerned government agencies for the next steps d) Recommence work only after NHCP has provided official notification accordingly The Contractor will ensure that the workforce is briefed that in the event of accidental finds relics they should immediately cease any works in the area and promptly report the find to their supervisor.	During construction	Contractors, MWSS	Part of construction cost

Potential Environment Impact	Mitigation Measures	Schedule	Institutional Responsibility	Estimated Cost ($)
Social conflicts arising from construction activities (prostitution, drunkenness)	Passage and strict implementation of ordinances regarding prostitution and intoxication from liquor; strict house rules at the construction quarters;	During construction	LGUs/Contractors	Part of LGU budget and construction cost
Unanticipated environmental impacts	If any unanticipated impacts become apparent during project implementation, the DPWH will update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts. The updated or newly prepared documents will be submitted to ADB for review, clearance and public disclosure.	During construction	MWSS	Part of project cost
Need for additional environmental mitigation measures	Implement additional environmental mitigation measures, as necessary, to avoid, minimize and/or compensate for adverse impacts due to construction works and related activities performed by the contractor.	During construction	Contractor	Part of bid cost
Operation and Maintenance				
Project impact during operation (water supply conveyance/transmission) is considered negligible or minor)				

9.4 Monitoring Plan

238. **Table 9-3** outlines the Environmental Monitoring Plan of BNAQ7 Project. MWSS shall designate a Pollution Control Officer (PCO) or contract an Environmental Specialist who shall be in-charge of monitoring the environmental compliance of the project and in preparing reports for the DENR-EMB/PMO. The plan focuses on the 10 km long AQ7 segment which will be constructed through the cut and fill method. Monitoring shall be done over the estimated construction period of 30 months. Given the duration and length, the earthworks per kilometer would last about 10 to 13 weeks depending on the weather and actual site condition. Accordingly, the monitoring period per kilometer of the AQ7 will be about 3 months. This will translate to 3 measurements per station per kilometer or a total of at least 9 measurements per kilometer. The number of stations per kilometer for air and noise would be at least three (3) which will be sited within the 25-m construction zone, edge of the MWSS 60-m ROW and 120 meters from the construction site.

Table 9-3: Environmental Monitoring Plan

Parameters/Activity	Schedule/Frequency	Location	Cost (US$)	Responsible Person/Unit
Construction Phase				
Extent of earthworks and number of trees cut at La Mesa Watershed Reservation	Weekly	La Mesa Watershed Reservation	10,000	Environmental Specialist/ MWSS/Contractor
Ambient air quality	Monthly	Active construction sites	Site observation and interviews with affected people and other stakeholders as part of monthly environmental compliance monitoring*	Environmental Specialist/ MWSS
Noise	Monthly	Active construction sites	Site observation and interviews with affected people and other stakeholders as part of monthly environmental compliance monitoring	Environmental Specialist/ MWSS
Surface water quality	Quarterly	Waterways near active construction sites	18,000 Field sampling as well as site observation and interviews with affected people and other stakeholders as part of monthly environmental compliance monitoring*	Environmental Specialist/ MWSS
Monitoring and reporting of compliance on implementation of mitigation measures in the EMP	Monthly		120,000	Environmental Specialist/ MWSS
Operation and Maintenance Phase				
Impacts during operation phase are not significant and will not be monitored.				

**Should there be complaints, field sampling/measurements will be undertaken by MWSS.*

239. For the MWSS Watershed Reservation, earthworks are estimated to last about 3 months due to the care that must be observed in moving the equipment through the forested area. The suggested frequency is every week for 3 months to ensure proper tree count and adequate monitoring of the extent of excavation.

240. The cut and fill segment at the southernmost segment of AQ7 at the La Mesa Watershed Reservation should be monitored in terms of the following:

1. Extent of excavation in relation to the 10m wide AQ7 footprint
2. Extent and location of staging area
3. Number of trees cut

241. For surface water quality monitoring, the monitoring duration would be also 3 months per kilometer. The number of stations would depend on the number of waterways to be intersected by the 1-kilometer segment of the AQ7. The station will be located immediately downstream of the affected intersection.

242. Surface water quality monitoring entails the sampling and testing of the waterway which receives the materials from the construction sites. These materials could potentially include soil and rock, oil and grease, domestic waste from workers, septage from toilet facilities.

243. The basic parameters to be measured should at least include the following:

a. pH
b. Temperature
c. Conductivity
d. Total Dissolved Solids
e. Total Suspended Solids
f. Dissolved Oxygen
g. BOD5
h. Fecal Coliform (MPN/100ml)
i. Total Coliform (MPN/100ml)
j. Oil and Grease

244. Monitoring of surface water should include an estimate of the amount of soil or rock which has been dumped into the waterway.

245. The monitoring report will include, but will not be limited to, the following:

i. Location of sampling station (Barangay, latitude, longitude)
ii. AQ7 segment designation
iii. Location map showing station with respect to the AQ7 segment
iv. Estimate of excavated area within the La Mesa Watershed Reservation
v. Results of laboratory tests/in-situ tests, tree count
vi. Site photos or videos which highlight the activities, potential receptor, actual sampling and measurement
vii. Evaluation results vis-à-vis standards
viii. Recommendations
ix. Name and Signature of Environmental Specialist

246. The monitoring report should be submitted to the PMO two weeks from completion of monitoring activities. Where exceedance has been detected, Immediate implementation of the mitigation measures indicated in the EMP shall be initiated. Monitoring should be done more frequently from monthly to weekly until the environmental standards have been satisfied.

10 Conclusions and Recommendations

247. This IEE for the Metro Manila Water and Sanitation Development Project - Phase 2 was undertaken to determine the environmental issues and concerns associated with the proposed Bigte-Novaliches Aqueduct 7 (AQ7) Project. The assessment confirms that the project remains classified as Category B for environment based on ADB Safeguards Policy Statement (SPS, 2009).

248. Aside from more water AQ7 will transmit when it replaces AQ1&2, AQ7 will facilitate the rehabilitation of the existing aqueducts from Bigte Basin to Novaliches Portal in La Mesa Dam. Without AQ7, repair and rehabilitation of the existing pipelines notably AQ4, AQ3 and a major portion of AQ5 cannot be undertaken. AQ7 will therefore increase the reliability and security of the transmission of water from Ipo Dam to the two concessionaries and correspondingly to the water users of Metro Manila. This will translate to improved accessibility to potable and reliable water supply. Improved access to safe water will contribute to reduced incidence of diarrhea, dysentery, skin rashes, and other water-borne diseases.

249. Most of the environmental impacts are expected to occur during the construction phase within the designated 25 m wide construction area footprint. These include the following:

(i) Loss of vegetation including endangered tree species as a result of clearing and grubbing
(ii) Generation of stockpiles of soil and rocks
(iii) Erosion and siltation of waterways
(iv) Restiction of access to houses, establishments and utilities
(v) Increase in ambient noise and dust generation
(vi) Increased site traffic
(vii) Generation of wastes, i.e. solid wastes, hazardous waste and domestic wastewater
(viii) Spill of fuels and lubricants
(ix) Risks to occupational health and safety
(x) Hazards to occupational health and safety

250. The environmental impacts are not expected to cause irreversible and significant adverse environmental impacts and can be managed by appropriate mitigation measures. No significant adverse impacts have been identified during operation phase. Low to moderate impacts will come from maintenance and repair.

251. These impacts are not distinct in the area as AQ7 will be the seventh aqueduct to be constructed in the MWSS ROW.

252. Strict implementation of the mitigation measures formulated in the EMP, its inclusion in the contractual framework, and an effective monitoring of construction sites will reduce these impacts to an acceptable level. The EMP also includes the institutional responsibilities for implementing the mitigation measures. All project activities prior to construction, during construction and during operation will be managed as provided in the EMP and the Contractor's compliance and implementation of the mitigation measures shall be monitored. An environmental monitoring plan has been provided to ensure that air and water quality are maintained according to the prevailing standards.

253. The IEE concludes that the current assessment based on project design and available information on the sector of the environment which will be affected, complies with the requirements of ADB SPS 2009. No further environmental assessment is therefore required.

IEE APPENDIX A

PROCEEDINGS OF PUBLIC CONSULTATIONS

Stakeholders Consultations were conducted at eight (8) barangays within the period from April 10 to June 27, 2018**.** The issues raised focused on the safety of the local residents during construction, change in water source, possible increase in prostitution, increase in traffic, employment opportunities, relocation period, compensation for displacement and flooding, among others.

Details are presented in the following tables.

Table 1: Summary of Stakeholders Participation

No.	Date	Location	Barangay	Participants		
				Male	Female	Total
1	10 April 2018	Bigte Bgy. Hall	Bigte, Norzagaray	9	21	30
2	24 April 2018	179 Bgy. Hall	179, Caloocan City	18	26	44
3	25 April 2018	Gumaok East Bgy. Hall	Gumaok East, SJDM	15	19	34
4, 5	20 June 2018	Minuyan Bgy. Hall	Sto. Cristo and Minuyan, SJDM	7	14	21
6	25 June 2018	Kaypian Bgy. Hall	Kaypian, SJDM	8	13	21
7, 8	27 June 2018	Graceville Bgy. Hall	San Manuel and Graceville, SJDM	12	14	26

1.1 Summary of Issues Raised during Stakeholders' Consultations

Table 2: Barangay Bigte, Norzagaray

Key issues/Concerns	Response/Comment
Women	
Safety of mothers and children walking or crossing the streets.	Residents suggested that signs be placed where vehicles should slow down.
Open holes pose a danger to curious children.	Residents suggested that others should closely supervise their children especially along the streets and that barriers around the hole be set up.
The barangay is where the main lines originate but the residents do not enjoy potable water from the system. Instead they will have to connect to Norzagaray water district for potable water and where they will have to pay connection fee.	It was explained that there are no treatment facilities in Bigte so the residents do not get drinking water from the system. It was also mentioned that treatment facilities are currently being constructed in SJDM under the Bulacan Bulk Water Supply project which aims to provide potable water to the whole province.
Accidents may happen especially during rainy season when the roads become slippery.	The contractors should help maintain the roads to ensure safety of residents.
Accidents may happen to workers performing their job in the aqueduct similar to what happened when water entered Tunnel 6 due to torrential rains.	The safety officers of the contractors should do their job to ensure safety.
The influx of truckers may cause the increase of young commercial sex workers (as young as 14 years old) who currently climb the trucks and offer services for cash. These young workers oftentimes maintain a front of selling commodities along the road.	It was suggested that the practice of women/girls climbing up trucks and/or trucks picking up girls/women be prohibited through an ordinance in order to set penalties and be a deterrent for such practice.
Men	
During the construction of Aqueduct 6, some drivers of trucks used in construction drove fast and did not slow	Speed limit be regulated when entering the barangay and signages on the speed limit be put up.

Key issues/Concerns	Response/Comment
down even in populated areas. This caused hazard to residents, commuters, and other drivers.	
One tricycle operator-driver leader noted that the current general contractor for Aqueduct 6 conducted consultations at the start of the project but consultations have noticeably stopped when construction began. Some community organizations were also identified as counterparts to assist the technical team in monitoring the progress. But he added that they have not yet been called upon to perform such task.	It was suggested that the residents get more involved in monitoring the project and that the barangay should closely coordinate with the general contractor.

Table 3: Bgy. 179, Caloocan City

Key issues/Concerns	Response/Comment
Women	
The women residents expressed concern over the safety of children where the aqueduct will be constructed near school facilities.	It was suggested that the barangay officials closely coordinate with the contractor to help in traffic management.
The women remarked that all of the residents should be made aware of the project.	The various homeowners' associations committed to inform their members and assist in information, education, and communication efforts when project implementation is near.
Men	
Concerns about increased traffic were articulated with the increased presence of trucks during construction.	It was suggested that the contractor assist in traffic management.
Residents who use the tennis court in the subdivision (located within the 60-meter ROW) requested that the tennis court be further developed.	It was explained that the MWSS has ownership of the ROW and that the tennis court is considered an encroaching structure even if former MWSS employees are the ones who use the facility. As the MWSS policy on encroaching structures was yet unclear, it was suggested that the facility users formally write a request letter to MWSS management.

Table 4: Bgy Gumaok East, SJDM

Key issues/Concerns	Response/Comment
Women	
The women expressed worry that construction-related workers might get drunk and cause trouble to residents.	The barangay officials said that there are no beerhouses in their barangay, drinking is prohibited in public places, and that videoke sessions are limited until 10 pm only.
Women residents expressed concern on the safety of children and senior citizens during construction.	The barangay officials committed to deploy personnel to assist in traffic management.
Men	
Male residents would like to be given priority for employment during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory of skills and manpower updated regularly for this purpose.

Table 5: Sto. Cristo and Minuyan, SJDM

Key issues/Concerns	Response/Comment
General	

Key issues/Concerns	Response/Comment
One resident asked if the existing septage treatment plant of the San Jose del Monte Water District in Bgy. Minuyan will be affected by the project.	If it is outside the identified 60 meters ROW and will not be affected.
Another asked if there will be earth-moving at the tunnel portion.	No. The surface will not move at the tunnel portion.
Residents with structures that encroach on the 60-meter ROW inquired on who will address issues regarding resettlement or displacement of people.	The MWSS will address resettlement issues with ROW and will announce their policy as soon as it becomes available. Some residents have expressed willingness to voluntarily clear their encroaching structures rather than be demolished.
Male	
Some men asked about the project schedule and whether they will be given time to prepare in the event they need to relocate.	As project implementation will probably start after two years, there is sufficient time for the residents to plan accordingly. Moreover, the MWSS policy on resettlement will be announced as soon as it becomes available.
Increased traffic especially along the main roads may become a problem in the barangay.	Barangay officials committed to help in traffic management.
One school owner asked about the possibility of paying rental fee to MWSS to secure his location.	MWSS will decide on this matter.
Male residents asked whether barangay residents will be employed during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory of skills and manpower updated regularly for this purpose.
Female	
Female residents were concerned that sex workers might appear during construction.	It was suggested by the barangay residents themselves that strict regulation of entertainment hubs such as beerhouses be done by the barangay officials. Barangay officials admitted that there was no such ordinance and would consider the suggestion.
Women residents were concerned about the safety of children, elderly, pregnant women and PWDs on the main roads which become muddy especially during the rainy season.	It was requested that barangay officials release rerouting advisories to children, elderly, etc. to avoid muddy roads prone to accident. A representative from a school located within the 25-meter ROW committed to assist in information campaign especially for their students and their families.
Information dissemination needs to be conducted among the residents to inform them about the project.	The senior citizens group and solo parents group committed to help by giving out flyers or information materials.

Table 6: Kaypian, SJDM

Key issues/Concerns	Response/Comment
Women	
Women residents were concerned about the safety of children in high traffic areas.	
One resident, who had experienced being evicted from her house after just two weeks of notice, asked whether	The MWSS will announce its relocation and entitlement policy as soon as it becomes

Key issues/Concerns	Response/Comment
they will be given enough time to relocate and whether they will be compensated.	available. Sufficient time will be provided for the people who need to relocate or clear encroaching structures.
Men	
Male residents would like to be given priority for employment during construction.	It was explained that as a policy, the general contractor is required to hire local residents. It was emphasized that the barangay's inventory of skills and manpower updated regularly for this purpose.
Some asked about the project schedule and whether they will be given time to prepare in the event they need to relocate.	As project implementation will probably start after two years, there is sufficient time for the residents to plan accordingly. The MWSS policy on resettlement will be announced as soon as it becomes available.

Table 2.6: Bgys. Graceville and San Manuel, SJDM

Key issues/Concerns	Response/Comment
General	
In case the families that will be displaced will be compensated, it was suggested that payments be made directly to them rather than be coursed through channels.	Participants requested that payments must be made directly to affected families without coursing through various channels.
Some worried that unpleasant odor might emanate from paint or other chemicals.	It was suggested that in case there will be some painting jobs, the contractor must find a way to minimize the unpleasant smell of paint or chemicals.
Some residents expressed worry that the project might cause flooding in their subdivisions like what they experienced with the ongoing construction of the Bulacan Bulk Water Supply Project.	It was suggested that homeowners' associations be consulted by the contractor since the former are knowledgeable on the sizes of drainages in their subdivisions.
All of the subdivision residents need to be made aware of the project and its possible impact.	Officers of homeowners' associations and senior citizens associations committed to help in information dissemination.
Male	
Some male participants suggested that skilled workers come from their barangays and that their selection be based on skills and qualifications rather than their personal relationship to the barangay officials.	It was explained that as a policy, the general contractor is required to hire local resident and that the barangay's inventory of skills and manpower is usually the basis for selecting the local manpower.
Female	
The female participants were concerned that the roads might become dusty during the dry season and muddy during the rainy season and might pollution and accidents to the residents, especially the elderly, women, and children.	It was suggested by the residents that barangay coordinate with contractor and demand that the latter assign personnel to clear and maintain the roads.

1.2 Signed Attendance Sheets of Participants

Stakeholders' Consultations
Barangay Bigte, Norzagaray, Bulacan
Attendance Sheet
10 April 2018

Name	Organization / Agency	Signature
Amelia M CHA	BMPA	[signature]
Ritchie Rose A. dela Cruz	BMPA	[signature]
Minerva Sajalamunte	BMPA	[signature]
Perlita L. Santos	MOTHER LEADER	[signature]
Fedelina D. Vegara	" "	[signature]
Patria G. Antoni	" "	[signature]
Bema U. Abanes	Mother leader	[signature]
Jelly T. Balsana	" "	[signature]
Diana B. de Jesus	Mother leader	[signature]
Te Francia A. Ledesma	BHW	[signature]
Francia Pitallano	BHW	[signature]
MARITE B. SARGENTO	ML	[signature]
MARTINA SAN ANDRES	ML	[signature]
Soledad E. Urbano	M.L.	[signature]
Myrna E. Ibanez	M.L.	[signature]
Anabel S. Trinidad	ML	[signature]
AGNES ROMAN	[illegible]	[signature]
Rosalie M. Alosia	LLN	[signature]
[illegible]	MW	[signature]
Sofia R Jose	BNS	[signature]
Ana Josie T. Dungog	Buidal Aviva	[signature]

Stakeholders' Consultations
Barangay Bigte, Norzagaray, Bulacan
Attendance Sheet
10 April 2018

Name	Organization / Agency	Signature
Benjamin Amora	CPF Security	
JAIME N. LIMANDO	MDC1-CPF	
Chung Amadeo	CPF - Security	
Pascual, Romy	" "	
Sebastian, Richie	" "	
TEODORO SACONGA	BIGTE, NORZAGARAY, BUL.	
ERNESTO L. ORALDO JR	BLG. SANTODA (PRESIDENT)	
DIOSCORO M. MADRID	MAGSASAKA NG UPPER COC INC.	
ANGELITO G. ALCAZAR	(V-PRES) BMSM TODA	

Stakeholders' Consultations
Barangay 179, Caloocan City, Metro Manila
Attendance Sheet
24 April 2018

Name	Organization / Agency	Signature
Hilda Malabuyo	Blk 32 b lot 7 dela costa 2	[signature]
Florence Salvador	Blk 27 L 37 dela Costa 2	[signature]
Carmelita Salvador	Blk 27 L 37 dela Costa 2	C Salvador
Macedonia Hora	B-14E lot-17 Dela Costa 2	[signature]
MRS LADINIA R. MIRANDA	BLK 48 PH2 DLC 2	[signature]
Mr. Jestony Panopio	BLK 7B L45 DLC 2	[signature]
Hermito San Buenaventura	Blk 1-A L21 6 DLC 2	[signature]
Shun Ganhinhin	Dela Costa Tennis Club	[signature]
Bernard Bello	Dela Costa Tennis Club	[signature]
RAYMUNDO TORRES	DELA COSTA TENNIS CLUB	[signature]
Juanito Maybanua	Delacosta II	[signature]
Tomas Panal	Dela Costa	[signature]
NERIO BEJER	do	[signature]
Victor Salamanque	//	[signature]
MARITES ATIENZA	//	[signature]
RHEAAN N. ANDEO	//	[signature]
ANTONIO T. SERRANO	//	[signature]
ROSITO A. SINGAYAN	//	[signature]
VENANCIO MACMO	DELA COSTA II	[signature]
RENATO SALAS	BLK 5B LOT 1 DELA COSTA 2	[signature]
Aldrin Eulogco	BLK 5 B Lot-10 Freedom park	[signature]
MARICHU B. DIVAGA	DLCH2 HOA / B1A L9 DLCH 2	[signature]
Aida Estopido	DLC II Ph2	[signature]
Joy V. Manuel	DLC II Blk L13	[signature]
Elizabeth D. Anjuro	Amparo Subd C.C	[signature]

Stakeholders' Consultations
Barangay 179, Caloocan City, Metro Manila
Attendance Sheet
24 April 2018

Name	Organization / Agency	Signature
Karen Vergara	Brgy 179	
ANALYN ELIAS	BRGY. 179	
Catherine Castro	Brgy 179	
[illegible] [illegible]	Brgy 179	
Gilberto [illegible] V.	BRGY 179	
RENATO P. MONTENEGRO	AVAHA (Pres)	
Danilo S. Balhan	AVAHA BOD	
JESSIE [illegible]	HDLC II (HOA) Pres.	
JULIUS CESAR D. BALLO	HDLC II (HOA) Sec.	

Stakeholders' Consultations
Barangay 179, Caloocan City, Metro Manila
Attendance Sheet
24 April 2018

Name	Organization / Agency	Signature
Jezel Refer	Brgy 179 - EMS	
Elizabeth D. Aujero	Association of Single Parent 179	
	Lakas Katabataan	
Judith P. Pimentel	Brgy 179 Clerk	
Cheryl Anne Montopat	Brgy 179 Livelihood	
Alicia M. Espinoli	B179	
Violeta H. delin	Lupon	
ROBECCA ENRIQUEZ	Lupon	
ROSSELYN MARIQUEZ	BRGY 179	
Jonic Gaitano	Brgy 179	
Leonida A. Baruela	Lupon	

Stakeholders' Consultations
Barangay Gumaoc East, San Jose del Monte City, Bulacan
Attendance Sheet
25 April 2018

Name	Organization / Agency	Signature
Silvestre Ramos Jr.	Lay minister	
RAMON E. PARAS	United Senior Citizen Assn.	
Benigno Macapinlac	" " "	
Christopher Valdevieso	Brgy. TANOD, GUMAOC EAST	
Rosario N. SAMOY	P. LEADER	
RUBEN SY JR.	DEPUTY TANOD G. EAST	
[illegible] Bautista	RESIDENT G. EAST	
Celso B. dela Torre	BLAK III	
GIBERY Bautista		
OSCAR M. Nogoy	BLAK-III - TANod	
DITHAN P. CLARITO	BRGY. TANOD	
LEVI D DUGAY		
Ruperto P. Dagay		
Edwin S.A Montilla	BLK 2	
JOSE ALLAN SERDEÑA	BLK 3	
SERVANDO GALIZA	BK 3	

Stakeholders' Consultations
Barangay Gumaoc East, San Jose del Monte City, Bulacan
Attendance Sheet
25 April 2018

Name	Organization / Agency	Signature
Marites O. Sy	Lingkod Lingap sa Nayon	[signature]
Rosario Victoria	ML (Mother Leader)	[signature]
Leticia Santos	Resident G. East	Leticia Santos
Julieta Emberga	Resident G. - East	L. Emberga
Catalina Maningas	Resident G. East	C Maningas
Remia S. Calusay	Kagawad	rcalusay
Levita V. Estrada	P. Leader	[signature]
Lorie Caceres	Arangkada	[signature]
Jocylin P. Rosales	Resident.	[signature]
Luzviminda G. Pomer	Senior BLK 2 G-East	[signature]
Merlyn C. Lenezam	President Gumaoc BLK 3	[signature]
Nieves Quilonyen	Lupon	[signature]
Miranda P. Dimalanta	Kagawad	[signature]
Ma. Beatriz Ducay	Residence G. East	[signature]
Antonia Dayson	Kagawad	[signature]
Roselyn Benakemo	Brgy. Secretary	[signature]
Jennilyn Dela Cruz	Brgy Record Keeper	[signature]
Marvin B. Visto	Brgy. Treasurer	[signature]
Rante Arcadia	BRGY Tanod	[signature]

ADB-TA 8769 PHI

Metro Manila Water and Sanitation Development Project

Stakeholders' Consultation

Barangay Sto. Cristo and Barangay Minuyan San Jose Del Monte City, Bulacan

Attendance Sheet

20 June 2018 , Sto. Cristo Brgy. Hall

Name	Organization / Agency	Barangay	Signature
MARILOU S. FRIAS	ROSARIOVILLE	STO. CRISTO	[signature]
VICTORIA C. RODRIGUEZ			[signature]
MYRA A. ARRIBAS		Sto Cristo	[signature]
Alegria M. Diaroga	Senior Citizens	Sto. Cristo	[signature]
Rolia S. Redableda	Senior Citizens	Sto. Cristo main	[signature]
Jovita Gallardo	Senior Citizens	Sto Cristo main	[signature]
SALVADOR CORTEZ	Academia	STO CRISTO	[signature]
Eda S. Pablo	VAWC	Minuyan Proper	[signature]
JERRY POLICARPIO	BRGY OFFICIAL	MINUYAN PROPER	[signature]
ABETH DE Jesus	Lupon (Brgy. Minuyan)	Towerville	[signature]
LEMUEL DELACRUZ	Academia	Sto. CRISTO	[signature]
Remedios I. Tan	minuyan Proper →	Sub Ronald Org.	[signature]
RODCEY D. CONSUMO	MINUYAN PROPER	BRGY WORKER	[signature]
CHRIS C. GERTES	TOTAL ASSURANCE TRACTEBEL INC	ORTIGAS	[signature]
Zenaida B. Encabo	ML	Towerville Min. propr	[signature]
Rowena Postrero	LLN	Sto. Cristo	[signature]
Velma S. Perez	ML	St. Crist	[signature]
Josephine B. Tiquelo	ML/SOLO PARENT PTMC	Sto. Cristo	[signature]
EUFRONIO B. AVENA	KAGAWAD	STO CRISTO	[signature]
PEDRO, ALEXDO C. / JOSEPHINE A. PERFECTO		STO. CRISTO	[signature]
DANILO FLORES	PARAGUA, PALIPAPAN	STO CRISTO	[signature]
FLORENTINO FLORES			[signature]
Rachel V. Ramos	Survey Asst / Tractebel Inc.		[signature]
Thea Yabula F. Gabbuey	Social Asst Gender Specialist/Tractebel		[signature]

ADB TA8769-PHI:
Metro Manila Water and Sanitation Development Project (MMWSDP)

STAKEHOLDERS' CONSULTATION
Kaypian Barangay Hall, Kaypian, San Jose del Monte, Bulacan
June 25, 2018

ATTENDANCE SHEET

NAME	MALE / FEMALE	ORGANIZATION / AGENCY	BARANGAY	SIGNATURE
Juliana M. Edora			Kaypian	
Lina Gallego	F		Kaypian	
Hermidas	F		Kaypian	
CHONA HERRERA	F		KAYPIAN	
Conrado M. Jacinto	M		Kaypian	
Clarissa M. Edora			Kaypian	
Pampita S Binting			KAYPIAN	
Consuelo [illegible]			Kaypian	
MONICA [illegible]			KAYPIAN	
Marilou A. [illegible]	Female	P.W.D.	Kaypian	
Sylvia C. [illegible]	F	Senior	Kaypian	
Bernadette Galasino	F	BESO DEPT.	Kaypian	
IMELDA M. LACAP	F	BHW DEPT.	KAYPIAN	
Ma. Teresa C. Robos	F	Desk officer	Kaypian	
JOE-JOIE R. [illegible]	F	HOA FED	KAYPIAN	
Juanito L. Barinata	M	Lupon	Kaypian	
[illegible]	M	TASK FORCE K	KAYPIAN	
Ricardo A. [illegible]	M	Kapwad	Kaypian	
JHONLIE BERGANTIN 20			KAYPIAN	
Rowena P. [illegible]	F	KAGAWAD	Kaypian	
VICENTE V. ROBES	M	KAGAWAD	KAYPIAN	
Rachel V. Romo	F	Survey Asst / Tractebel Inc.		
Maria Isabela F. [illegible]	F	Social Dev't / Gender Specialist / Tractebel	-	
CHRISTOPHER C. CARTER	M	TECHNICAL ASSOCIATE TRACTEBEL INC.	-	

ADB TA8769-PHI:
Metro Manila Water and Sanitation Development Project (MMWSDP)

STAKEHOLDERS' CONSULTATION
Barangays San Manuel and Graceville, San Jose del Monte, Bulacan
June 27, 2018, Graceville City Hall

ATTENDANCE SHEET

NAME	MALE / FEMALE	ORGANIZATION / AGENCY	BARANGAY	SIGNATURE
RICARDO A. GRACILLA	Male	HOA Phase I-A Pleasant Hill	San Manuel	[signature]
DOLLY PASAUK	FEMALE	HOA PAG	Sn Manuel	[signature]
REYELINA VENZON	FEMALE	HOA PAG	Sn Manuel	[signature]
Nelson N. Aglayan	Male	AMD President	Sn. Manuel	[signature]
FRANKY CESAR	MALE		GRACEVILLE	[signature]
Virgilita B. Monte	FEMALE	AGENCY	Graceville	[signature]
Mercedes P. Escoro	Female	Celo ...[illegible] / NCW	Grace Ville	[signature]
Violeta Magnaua	Female		Grace Ville	[signature]
Ma. Theresa Ferrer	Female		Grace Ville	[signature]
Fernanda Acosta	Female		Grace Ville	[signature]
Jerry Buree	Male		Grace Ville	[signature]
ROBERTO F. SANTOS	MALE		Grace Ville	[signature]
Janice D. Mabini	Female		Graceville	[signature]
RUJA A. VIVAS	FEMALE		Graceville	P. VIVAS
Cicil Mendoza	Female		Graceville	[signature]
[illegible]	Male		GRACEVILLE	[signature]
FLOE CASIS	Male		Graceville	[signature]
Anicia Laxamana	Female	Senior Citizen Pres.	Graceville	[signature]
Nanette J. Sara	Female	DCV HOA President	San Manuel	[signature]
WILSON B. PACHU	MALE	BRGY GRACEVILLE	GRACEVILLE	[signature]
Roman Christopher Guilda	Male	Brgy. Graceville Sec	Graceville	[signature]
Jenifer Alamo	Female	Brgy Graceville	Graceville	[signature]
ROMEO A. VILLANUEVA	MALE	SAN MANUEL DILG TODA CBO	SAN MANUEL	[signature]
Rogo Resurreccion	Male	San Manuel PRS [illegible]	San Manuel	[signature]
INOCENCIO PLANADO, SR	MALE	GAD-[illegible]	GRACEVILLE	[signature]
GLORIA C. MANUEL	Female	[illegible]	San Manuel	[signature]

1.3 Photos of Consultation

Barangay Bigte Consultations

Barangay Gumaok Consultation

Barangays Sto. Cristo and Minuyan Consultation

Barangay Kaypian Consultation

Barangays San Graceville and San Manuel Consultation

IEE APPENDIX B

TEMPLATE OF PROJECT SEMI-ANNUAL ENVIRONMENTAL MONITORING REPORT

1.1 Introduction and Project Overview

Project Number and Title:	
Progress of Project Implementation	• On-going Site Works (description of current site works, location and target completion) • Previous Activities (description of construction activities during the previous months: provide details of specific activities such as earthworks, vegetation clearing, spoils disposal, establishment of construction camp and other construction related facilities (e.g., concrete mixing plant, asphalt batching plant, crushing plant, etc.), establishment and operation of quarry/borrow areas, etc., including locations, schedules, dates, etc. • Schedule of construction activities for the subsequent months (provide details similar to above)
Monitoring period covered	Specific dates (day/month/year) site visits/inspections were conducted to monitor compliance of the contractors(and subcontractors) with the mitigation measures specified in the EMP.
Key sub-project activities implemented since last report:	
Status of compliance with ADB environmental loan covenants	
Status of compliance with government environmental requirements: provide a list of government environmental requirements (permits, etc.) for the project as well as construction-related facilities/ activities and specify level of compliance, indicate any required environmental permit/license/consent obtained to date and to be obtained (including schedule) for the project and construction related facilities/activities	
Changes in project scope	Such as change in alignment or footprint in case of horizontal infrastructure, implementation of additional Project component/s, etc. (with reference to the Project scope identified in the ADB-cleared environmental assessment report , i.e., IEE) and corresponding safeguard measures undertaken, if applicable.
Report prepared by:	

1.2 Environmental Performance Monitoring

Table 1: Status of Compliance with EMP Requirements (Environmental Performance) – *Ensure that the following table is updated to reflect all the required mitigation measures specified in the EMP*

Environmental Impact	**Mitigation Measures**	**Level of Compliance** *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	**Required Action and Target Dates to Achieve Compliance** *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
I. Pre-Construction Phase			
Impact to Natural resources and protected areas Impact on natural resources and protected areas from cutting/clearing of trees and other vegetation.	Cutting of trees will be undertaken as per approved design and only upon approval. Avoid cutting of trees as much as possible and minimize damage to native vegetation. Trees that need to be cut in private land will be compensated in cash in accordance with the approved Land Acquisition and Compensation Plan		
Impact on Historical and Archaeological Sites Damage to relics and artifacts during the conduct of the works.	The Contractor will ensure that the workforce is briefed that in the event of accidental finds relics they should immediately cease any works in the area and promptly report the find to their supervisor.		
II. Construction Phase			
Temporary disruption of existing community roads, pathways, and accesses Pipe laying will cause temporary disruption of community services and access to properties. Particularly at pipe road crossings, construction activities along narrow roads may lead to temporary blockage or closure of roads and hamper movement of vehicles and people in the community.	Walking access will be maintained to affected properties and access routes will be temporarily lined with timber or similar material. Particular attention will be given to ensuring safety along roads and paths used by school children. Side street parking of construction vehicles on prolonged basis will not be allowed. Install barriers and safety warning signs on road sections and if necessary deploy traffic aides / flag persons at affected locations. Information boards at blocked roads will provide information about the temporary closure of roads,	Contract documents to include the EMP with health and safety provisions monitoring through the Construction Supervisor's reports. Report any complaint received from the community to MWSS.	

Environmental Impact	Mitigation Measures	Level of Compliance *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	Required Action and Target Dates to Achieve Compliance *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
Community access will be affected.	schedule of works and the traffic-rerouting plan. Require the contractor to immediately rehabilitate the excavated areas and any damaged road and path sections.		
Air pollution Dust and air emissions from earthworks and movement of vehicles can pose nuisance to nearby communities	Require the contractor to cover materials with tarpaulin or other suitable materials while in transit to avoid spillage of materials. Moisten earthen roads during dry and dusty conditions, particularly roads near residences. Impose speed limits on construction vehicles. Conduct regular maintenance on construction equipment and vehicles to control air emissions during vehicle operation.	Contract documents to include the EMP with health and safety provisions monitoring through the Construction Supervisor's reports. Report any complaint received from the community to MWSS.	
Noise Operation of construction equipment such as jackhammer will cause excessive noise resulting in nuisance to communities.	Limit construction activities, particularly operation of noise generating equipment at night. Position any stationary equipment that produce high noise levels such as diesel generators as far as practical from sensitive receptors. Erect temporary barriers around construction sites especially near schools, hospitals, and houses. Install noise suppression devices to noise generating equipment. Require drivers to minimize blowing of horn and to comply with speed limits.	Include EMP in bid documents and contract. Report any complaint received from the community to MWSS.	

Environmental Impact	Mitigation Measures	Level of Compliance *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	Required Action and Target Dates to Achieve Compliance *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
	Provide information to community on schedule of construction activities through billboard/signs.		
Impact of borrow materials Quarrying of aggregates on nearby rivers will cause siltation and affect the ecological condition of the river.	The contractor will be prohibited from quarrying materials directly from nearby waterbodies. Construction materials will be procured from Government-permitted sources / suppliers only.	Include EMP in bid documents and contract. Report any complaint received from the community to MWSS.	
Impact on ecological resources Construction workers may undertake cutting of wood.	The contractors will prohibit activities such as cutting wood for cooking, hunting, or wildlife trade.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	
Clearing of vegetation Poor planning and execution of tree clearing/vegetation removal at project facilities and along pipeline alignments can result in loss of vegetation and general landscape	Cutting of trees will be undertaken as per approved design and only upon approval of relevant authorities. Avoid cutting of trees as much as possible and minimize damage to native vegetation. Trees that need to be cut in private land will be compensated in cash accordance with the approved Land Acquisition and Compensation Plan. Roads and paths will only be sufficiently wide to accommodate construction vehicles/equipment to minimize land take.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	
Water pollution - Siltation Sediment runoff undertaken during excavation, earthworks	Construct silt traps, deviation channels, mounting barriers or trenches around the stockpiles of materials.	Include EMP in bid documents and contract	

Environmental Impact	Mitigation Measures	Level of Compliance *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	Required Action and Target Dates to Achieve Compliance *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
and grading in the rainy season will cause siltation of rivers		Report any complaint received from the community PIU.	
Water Pollution - Worker's camp Domestic wastewater from worker's camp would result to the discharge of sewage into drainage canals. Unsanitary conditions at the worker's camp will occur without the provision of necessary sanitation arrangements.	Provide adequate water supply and temporary toilet facilities at the worker's camp.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	
Generation of construction waste - Generation of excavated soil Generation of excavated materials during pipe laying and foundation works for WTP tanks and reservoirs.	During pipe laying, excavated material will be utilized to backfill the trench. The contractor will be required to properly reinstate the excavated trench after completion of pipe laying. Surplus excavated material/cut soil from construction works will be used as backfill material for low-lying areas that have been identified by the barangay authority.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	
Generation of construction wastes – Solid, Inert and Hazardous Wastes Solid wastes, inert construction wastes, and hazardous wastes during construction will result to pollution of land and receiving water bodies.	Provide appropriate segregation bins or areas for construction wastes. Secure and control storage of all hazardous materials including fuels. Reuse recyclable construction wastes such as wood, steel, and scaffoldings or sell to junk shops.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	

Environmental Impact	Mitigation Measures	Level of Compliance *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	Required Action and Target Dates to Achieve Compliance *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
	Solid waste to be collected and disposed in approved disposal site of the LGU.		
Community health and safety Community may be exposed to dangers of open excavation	Install barricades/barriers and sturdy plate covers in open excavations during non-working time. Install warning signs in the area.	Include EMP in bid documents and contract Report any complaint received from the community to MWSS.	
Occupational health and safety Construction activities may pose hazards to workers because of the use of heavy equipment, lifting of heavy loads, and exposure to open excavations and chemicals. Potential conflict with local people will occur if migrant workers will be brought to the site.	Require the contractor to implement the construction health and safety plan in accordance with the World Bank EHS Guidelines (http://www.ifc.org/ehsguidelines) as a minimum standard. The contractor will appoint an environment, health and safety officer to ensure implementation of the plan. The plan will at minimum include: Provision of first-aid facilities readily accessible by workers. Provision of personal protective equipment (PPEs) such as hard hats, gloves, rubber boots, etc., Wearing of PPEs while working onsite will be a mandatory requirement for workers. Posting of safety signs/reminders in strategic areas within the construction area. Installation of sufficient lighting at night. Employ only trained personnel in handling chlorine during the line disinfection process. Ensure that vehicle and equipment operators are properly licensed and trained.	Contract documents to include the EMP with health and safety provisions monitoring through the Construction Supervisor's reports. Report any complaint received from the community to MWSS.	

Environmental Impact	Mitigation Measures	Level of Compliance *(NOTE: Answer should be either **Yes**, **No**, or **Partial** for each mitigation measure. State the reason why compliance is "No" or "Partial", indicate the specific dates – day/month/year, that partial or non-compliance was observed)*	Required Action and Target Dates to Achieve Compliance *(NOTE: Specify required action, responsible entity and target date to achieve compliance with each mitigation measure with compliance status of "No" or "Partial")*
	Provide staff with communicable disease and HIV-related awareness training. The contractor will be required to provide priority hiring of qualified construction workers from the villages and to consult with the local to avoid conflict if migrant workers will be brought to the site.		
III. Operation Phase			
Community health and safety Potential hazards to residents.	Facilities properly fenced and secured and watchmen/security personnel to be employed on a 24-hour basis.	Daily log of security personnel	

Summary of EMP Compliance Status: _____
_____
_____

1.3 Ambient Environmental Monitoring Program *(e.g., water quality)*

- Sampling locations and maps
- Results of laboratory analysis
- Assessment[1]
- River level
- Backwashing activities

1.4 Key Environmental Issues

Key Issues Identified (e.g., non-compliance to loan covenants, EMP and/or government environmental requirements, insufficient mitigation measures to address Project impacts, incidents, accidents, etc.)

1.5 Issues for Further Action

Issue	Required Action	Responsibility and Timing	Resolution
Old Issues from Previous Reports			
List of EMP measures or activities not completed (last column of previous table)			
New Issues from This Report			

1.6 Safety Issues

Details of safety issues, resolution, further necessary actions, etc.

1.7 Complaints

a. Details of Complaint/s (In a matrix form, provide details of any complaints that have been raised by the local population and other stakeholders regarding environmental performance and environmental impacts (complainant, nature of complaint, date complaint was filed, which office received the complaint, etc. The attached grievance intake form to document complaints may be used)

b. Action Taken (Document how the complaints were addressed or will be addressed by indicating the following):

i. names and designation of specific staff or officials within the Grievance Redress Committee, executing agency, project management

[1] Ambient environmental conditions should be compared to the relevant ambient standards and/or performance indicators noted in the EMP. Any exceedances and likely sources of such exceedances should be highlighted for attention and follow-up. In addition, ambient environmental conditions could be compared to the baseline conditions (if baseline data is available). Additional explanatory comments should be provided as necessary.

unit, local government, contractor and/or supervision consultant involved in receiving, documenting, and resolving the complaint (s).

ii. specific actions taken to be taken to resolve the complaint and corresponding timeframe

1.8 Training/Capacity Building Activities

1.9 Conclusion

- Overall Progress of Implementation of Environmental Management Measures
- Problems Identified and Actions Recommended
- Monitoring adjustment (recommended monitoring modifications based on monitoring experience/trends and stakeholder's response, as necessary)
- Recommendations to improve EMP management, implementation, and monitoring

1.10 Attachments

1. Ambient monitoring Results (Laboratory Analysis)
2. Photographs
3. Location Map of Sampling Stations
4. Copies of Environmental Permits/Approvals
5. Filled-out Grievance Intake Forms
6. Minutes of meetings (as applicable)
7. Other relevant information/documents