2022

La Consolacion
Seafront Development Corp.

ENVIRONMENTAL IMPACT STATEMENT

Proposed Seafront City Project

Barangay Tayud, Consolacion, Cebu

BAYAN NG CONSOLACION • CEBU 1920 PILIPINAS •

La Consolacion
Seafront Development Corp.

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EXECUTIVE SUMMARY

i. Project Fact Sheet

Project Proponent	Municipality of Consolacion
Office Address	Office of the Mayor, Consolacion Government Center, Consolacion, Cebu
Contact Person/Authorized Representative	Hon. Joannes P. Alegado, MD Municipal Mayor
Contact Number/Email Address	(032) 239 2908/ info@consolacion.gov.ph
Project Name	Seafront City Project
Project Location	Barangay Tayud, Municipality of Consolacion, Province of Cebu
Project Type	Reclamation and other Land Restoration
Project Area	235.8 hectares
Summary of Project Components	1. LOT 1 – 172.70 hectares (island type reclamation) 2. LOT 2 – 16.98 hectares (foreshore type reclamation) 3. LOT 3 – 46.12 hectares (foreshore type reclamation) Reclamation Parameters **Total fill volume:** 17,900,000cu.m. **Reclamation Elevation:** 4 meters above Mean Lower Low **Water (MLLW) Channel Width:** 50 meters wide
ECC Application	New application
Geographical Coordinates	Point 1 - 10°20'58.9"N 123°58'13.0"E Point 2 - 10°21'05.2"N 123°58'25.8"E Point 3 - 10°21'15.4"N 123°59'05.3"E Point 4 - 10°21'17.8"N 123°59'22.7"E Point 5 - 10°20'54.8"N 123°59'29.0"E Point 6 - 10°20'31.1"N 123°59'36.5"E Point 7 - 10°20'18.5"N 123°58'52.7"E Point 8 - 10°20'48.0"N 123°58'30.9"E

ii. Brief Project Description

The Seafront City Project covers a total area of 235.80 hectares. The Project is located in Barangay Tayud, Municipality of Consolacion, Province of Cebu.

The total development area of the Project will cover an approximate area of 2,358,000 square meters or 235.80 hectares, consisting of two (2) major lots, Lot-1 and Lot-2. Both lots will be separated by a 50-meter-wide channel. Lot-1 is an island-type reclamation with an area approximately 1,605,500 square meters or 160.55 hectares. On the other hand, Lot-2 has a total development area of approximately 752,500 square meters or 75.25 hectares which will cover the existing foreshore reclaimed areas fronting Barangay Tayud.

The project is a reclamation development classified into two: 1) Saleable Land, and 2) Non-Saleable Land. An approximate area of 62.10 hectares (26.34%) is classified as non-saleable to accommodate the road network with a maximum with of 32 meter wide and a minimu of 10 meter wide, bridges, coastal easement, drainage system with silt basins, rainwater harvesting ponds, and spaces for utilities. The remaining 173.69 hectares (73.66%) is classified as saleable land readily subdivided or zoned for future locators of industrial, mixed-use commercial, tourist and entrepreneur, mixed-use residential, and institutional development. The allocated Institutional area will include government buildings, auditoriums, assembly halls, schools, churches hospitals, civic centers, cultural facilities, and other related socio-cultural and institutional uses. Utility Areas are allocated areas for centralized wastewater treatment facility, material recovery facility, catchbasins, rainwater harvesting ponds, and for future development of power plant, desalination plant (and/or water reservoir areas). The project will have a component also for green space or open space that would include landscape areas and mangrove ecopark.

A bufferzone with a width of 50 meters is the minimun needed to set a proper working area that will accomodate the various equipments to be used during the construction phase of the project. This equipment includes barge mounted cranes and pile driving equipment that will be installing the containment structures, barges and dredgers delivering fill materials, and silt curtains. The bufferzone will ensure not just the safety of the workers and seafarers but also the protection of the project especially the structural integrity of the containment structures from the possible effects of future developments in the surrounding areas. The bufferzone also provides ample area for periodic maintenance of the containment structures as well as rehabilitation and replacement of structural components in the event of any damages would occur. Five bridges will be constructed to connect the two lots.

The project title for this ECC application reads as: SEAFRONT CITY PROJECT.

iii. Process Documentation of the Conduct of EIA

The terms of reference and procedures observed in the conduct of this Environmental Impact Assessment (EIA) are consistent with the provisions of Presidential Decree No. 1586 in observance with the guidelines under DAO 2003-30, and the Revised Procedural Manual under Environmental Management Bureau (EMB) Memorandum Circular 2007-002. Relevant DENR Administrative Orders were also followed namely, DENR DAO 2017-15, EMB MC 2014-005 and EMB MC 2020-30.

This EIS document follows the prescribed annotated outline for EIA Reports for New Single Project, Annex 1-A of DENR Memorandum Circular (DMC) 2010-14 Standardization of Requirements and Enhancement of Public Participation in the Streamlined

Implementation of the Philippine EIS System, and the Scoping and Procedural Screening Checklist for Environmental Impact Assessment (EIA), Annex 2-7a of DAO 2003-30 of the Revised Procedural Manual of the PD1586, otherwise known as the Philippine Environmental Impact Statement System.

Brief Summary of Regulatory Process in Reclamation Projects (PRA Process)

Reclamation projects are governed by several decrees and proclamations as described hereunder in chronological order:

- Presidential Decree No. 3-A mandates that all reclamation of foreshore, submerged and offshore areas shall be limited to the National Government or any person authorized by it under a proper contract;
- Executive Order No. 525, dated February 12, 1979, designated the Philippine Estates Authority-PEA (now known as the Philippine Reclamation Authority-PRA) as the agency primarily responsible for all reclaimed projects for and in behalf of the National Government and mandates that all reclamation projects be submitted to the President for his approval, upon recommendation by the PEA and the same to be undertaken by the PEA or through a proper contract executed by it with any person or entity;
- Executive Order No. 543, dated June 24, 2006, delegates to the PRA the authority of the President to approve reclamation projects;
- EO No. 146, dated November 13, 2013, transferred the power to approve reclamation projects from the PRA Board to the National Economic and Development Authority (NEDA) Board. Pursuant to Section 6 of this EO, the NEDA-PRA Joint Order was issued.
- EO 74, dated February 1, 2019, transferred the PRA to the control and supervision of the Office of the President (OP). EO No. 74 repeals the EOs designating power to the DENR and NEDA Board over the PRA. Furthermore, in this EO, the power of the President to approve all reclamation projects shall be delegated to the PRA Governing Board. Also, it mandates the PRA to seek advisory opinions from the NEDA, DENR, and Department of Finance on any proposed reclamation project. It states that no reclamation project shall be approved by the PRA without the required area clearance and environmental compliance certificate from the DENR.
- PRA Administrative Order No. 2019-4 embodies the Implementing Rules and Regulations (IRR) of EO 54. Under this IRR, “Area Clearance”, one of the mandatory documents for a reclamation project, is defined as:

Area Clearance refers to the document issued by the DENR declaring an area suitable for reclamation on the basis of:

a. Valid Geohazard Assessment of the Area duly prepared and signed by a licensed Geologist; and

b. Community Environment and Natural Resources Office (CENRO) Certification on the status of the area and land classification of adjacent land.

The capacity of the Municipality of Consolacion to reclaim is pursuant to Republic Act (RA) No. 7160 or the Local Government Code of 199. The Department of Interior and Local Government, under Memorandum Circular No. 120, s.2016, confirmed the authority of local government units to enter into Public-Private Partnerships and Joint Ventures for reclamation projects pursued consistent with the mandate and charter of the PRA. This project is under the EO 543 since this is already covered by the existing JV Agreement. Such application met the minimum requirements as stipulated in the IRR of EO 543.

As start of the EIA process, the proponent secured Letter of No Objection from different Government Agencies such as PRA, BFAR, DOE, CPA Philippine Coast Guard, and DPWH was secured. Then a DENR Area Clearance was also applied to DENR Region 7 in which they issued a Notice to Proceed for the ECC application. For the portion of the project area that are located within Timberland Area, the proponent also applied for the appropriate tenurial instrument that will serve as the proof of authority over the project area. The timberland areas will not be reclaimed but will be part of the project component for the mangrove ecopark, bufferzone, and other open spaces.

In connection with the Area Clearance application, a Notice to Proceed has been granted by the DENR-Region VII in favor of this proposed project. This enables the Project Proponent to proceed with the ECC Application process.

The recommendations of the DENR Region 7 in the issued Notice to Proceed were thoroughly considered that influenced the project design and layout of the Seafront City Project:

- Part of the applied area has existing expired tenurial instruments which are now included in the applied tenurial instrument for timberland areas and DENR Area clearance of the proponent;
- Mangrove areas will be retained as open space with open seawater access to ensure survival of the mangrove trees. The mangrove areas will serve as ecotourism mangrove park;
- The applied reclamation area was measured properly to ensure no disruption access of sea vessels in Mactan Channel as well as access from Cansaga Bay. The dredging activities will also help desilt the adjacent coastal areas such as Cansaga Bay which will in fact help mitigate the existing flooding issues during high tide;
- A thorough marine study with hydrologic and hydrodynamic modelling was conducted to address current and sediments flow, nutrient cycling, and other existing coastal profile that might be affected during project implementation;

- Engineering Geological and Geohazard Assessment was also conducted to ensure that the dredging and reclamation activities will not caused any geohazard impact on the coastal and inland areas near the applied project;
- A Letter of No Objection from LGU Lapu-lapu City was already secured while the No objection from the LGU Mandaue City is still under negotiations however assured no overlapping on the proposed reclamation project also of the LGU Mandaue City.

Figure 0-1 below shows the flow of the EIA study.

Figure 0-1: EIA Process Flow

EIA Team

Conduct of an Environmental Impact Assessment and preparation of an Environmental Impact Statement Report is a complex process that requires the inputs of experts and technical specialists of various disciplines. Hence, the proponent of the Project has contracted the services of a third-party environmental consultant in the preparation of the EIS. The EIA study team is composed of specialists who have extensive experiences in the conduct of baseline characterization and impact assessments for similar development projects. The team composition is presented below:

Table 0-1: List of EIA Team

Proponent LGU Team	
Hon. Joannes P. Alegado, MD	Mayor, Municipality of Consolacion – ECC Signatory
Atty. Paulo Crispino Sucalit	Municipal Legal Officer
Dr. Nerito A. Martinez	Consultant on Special Projects
Engr. Narciso H. Pilapil	Municipal Planning and Development Officer
Mark Edwin C. Saldua, DPA	Researcher
La Consolacion Seafront Dev. Corp (LCSDC) Technical Team Meadowlands Developers Inc.	
Engr. Michael Cañete	CEO / President – Lead Consultant
Engr. Aldren Gutang	Senior Engineer
Engr. Thadd Kholenn Cañete	Lead Project Engineer
Engr. Carl Bryan Ampit	Junior Engineer
Engr. Abrahan Lucero Jr.	Geologist / EGGAR Specialist
Engr. Eduardo Walag	Senior Water Resources Development Engineer / Hydrologist
Blue Nomads.Org Hydrography	

Diego E. Arechaga	Project Manager / Surveyor
Jose Andres Argote	Hydrography Surveyor / Sonar Engineer
Klaus M. Stiefel	Chief Marine Scientist
Ronald Olavides	Chief Marine Scientist
Jefrey Munar	Marine Geologist
Garry A Benico, Ph.D.	Marie Biology Scientist
Daniel Bueno	Ocean Simulations Specialist / Research Engineer
Maricris Legaspi Ocang	Logisitcs / Research Diver
Deep Earth Geotechnical and Environmental Consultancy (DE&GEC)	
John Paul E. Paa	Freshwater and Marine Ecologist
EIA Preparers	
Engr. Allan Plete	EIA Resource Person – General Ecology
Engr. Aldwin Camance	EIA Resource Person – Ecological Risk
Engr. Emerson Darroles	EIA Resource Person – Water Quality
Mr. Manuel Potrido	EIA Resource Person – Social Development

EIA Study Schedule and Study Area

The conduct of the EIA study as initiated by the project proponent already began through the conduct of support studies such as the primary baseline data gathering and secondary data compilations.

The acquisition and the procurement of the necessary supporting documents, as well as the conduct of technical and engineering studies in support to environmental studies to secure an Environmental Compliance Certificate for the project to proceed was initiated at the start of the previous year and are expected to be fully completed before project development starts. Specific to the requirements for the issuance of an Environmental Compliance Certificate from the EMB-DENR, the process of doing an Environmental Impact Assessment will be initiated through the conduct of a Public Scoping/Consultation, Technical Scoping and site visit in and around the project site with the proponent. The project development and construction are all set to proceed once the pre-construction requirements are such as securing of all permits and clearances from the concerned Government Agencies are all acquired.

Table 0-2: Schedule of EIA Phases and Activities

Activity	Date
EGS Philippines – Bathymetric and UAS Survey	October, 2019
Marine Assessment Study	August to September, 2020
Engineering, Geologic and Geohazard Assessment	December, 2020
Perception Survey at Barangay Tayud, Consolacion,Cebu	December 15-16, 2020
Combined Public Scoping and Focus Group Discussion at Consolacion Government Center	December 17, 2020
EMB - Facilitated Public Scoping at Consolacion Government Center	January 25, 2021
MDI Project Development Framework with SWOT	May, 2021

MDI Traffic Assessment Study	July, 2021
MDI Water Resource Study	July, 2021
MDI Institutional Study	July, 2021
MDI Proposed La Consolacion Estate Population Study Write-up Adjusted Land Use High, Medium, Low, Final	July, 2021
MDI Economic Valuation Study	July, 2021
EMB Technical Scoping	December, 17, 2021
Water Sampling	January 24, 2022
Air Sampling	January 24-26, 2022
EIS Draft Submission	February 9, 2022
Freshwater Study	March 12-13, 2022
2nd Perception Survey	March 25-30, 2022
1st Project Review with EIA Review Committee	TBA
EMB – Facilitated Public Hearing	TBA
Final Project Review	TBA

The study area covers the alignment of the proposed access road, bridge and the port area to be covered by the reclamation. Also included are the adjacent areas of the project site and other sensitive receptors that may be affected by the project. Figure 0-2 shows the impact area of the project. The primary impact area covers the project area itself, adjacent coastal waters, and adjacent inland areas in which primary baseline studies were conducted such as marine study, EGGAR, air sampling, water sampling, mangrove assessment and etc. The secondary impact areas cover the entire municipality, Cansaga River, and Butuanon River of Mandaue City. The primary baseline studies conducted in the secondary impact areas were ecological freshwater study from the 2 freshwater tributaries and traffic assessment.

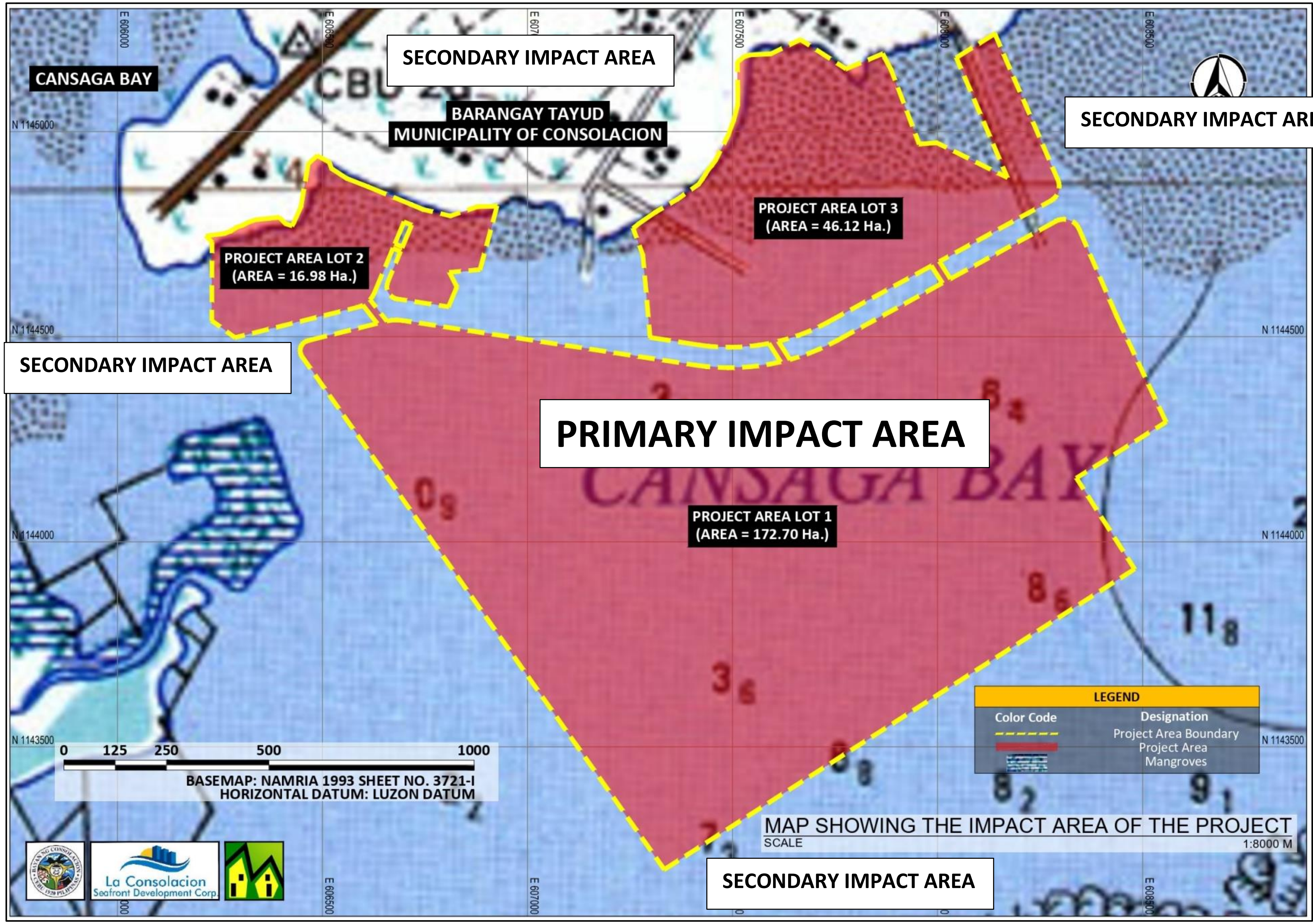


Figure 0-2: Map showing the Impact Area of the Project

Table 0-3 shows the description of the different impact areas of the project.

Table 0-3: List and Description of the Impact Areas of the Project

Area Classification	Area Coverage
Direct Impact Areas	In terms of biophysical impact: • The 235.8-hectare reclamation area; • Surrounding area, 100M from the peripheral boundaries of the proposed reclamation project and designated as the working area; • Mouth of the Cansaga Bay systems draining to the reclamation area, contributing to discharges from the community and the adjacent industrial establishments; • The 1-KM pheripheral area around the boundaries proposed project which will be the receptors of air and noise impacts during development. • The communities of Barangay Tayud, Consolacion Cebu, and Barangay Paknaan, Mandaue City, Cebu and who will be directly affected by environmental impacts of the project development;
	In terms of socio-cultural impact: • The barangay of Tayud as primary beneficiaries of the development of the project in terms of employment, infrastructure development, Social Development Programs (SDP) and whose lifestyle would be impacted by the project (e.g. increased traffic movement, safety and health risks, etc); and • Municipality of Consolacion as direct beneficiary of the revenue from the development.
Indirect Impact Areas	In terms of biophysical impact: The adjacent coastal waters of the reclamation project beyond the direct impact;
	In terms of socio-cultural impact: Adjacent communities / barangays other than the primary beneficiaries of the SDP that will benefit at a provincial and regional level from potential revenues and taxes of the project.

EIA Methodology

There were two approaches used in the EIA Process. First is the collection of primary data and information through the conduct of actual field studies, resources assessments and public consultation. The collection of primary data includes ecological profiling, onsite baseline studies such as Marine Study, Freshwater Study, EGGAR, Air Quality Sampling, and Water Quality Sampling. Further, a perception survey, IEC and public consultation were also conducted for social vulnerability and acceptability aspects.

Second is the collection of secondary data and information from reliable sources like the host local government, the provincial government, national government agencies like the DENR, DA, BFAR, DPWH, PAGASA, PhilVolcs, just among other scientific books and literature as reference.

Data and information generated out of the field studies, resource assessment, public consultation and secondary data gathering will be utilized in the preparation of an Environmental Impact Statement which will form part of this EIS report document.

The EIA process will be conducted in accordance with the PD 1586 or the PEISS. This process will both consider the environmental and socio-economic conditions. Hence, potential impacts due to the project will be also assessed.

The participative process will be through public consultations and IECs. The Proponent, LGUs and stakeholders will be allowed to provide their inputs on the project to ensure greater acceptance, commitment, and support.

All assessed information will be compiled in an EIS report that will be submitted to DENR-EMB Central Office for the application of an Environmental Compliance Certificate (ECC). The EIS will be referenced to the DAO 2003-30 (Revised Procedural Manual for the IRR of PD 1586) and MC 2014-005 (Revised Guidelines for Coverage Screening and Standardized Requirements under PEISS). This will later be used as a guide to implement the EMP for all the stressors that will be generated in the operation of the Project.

Figure 0-3 shows the EIA Process.

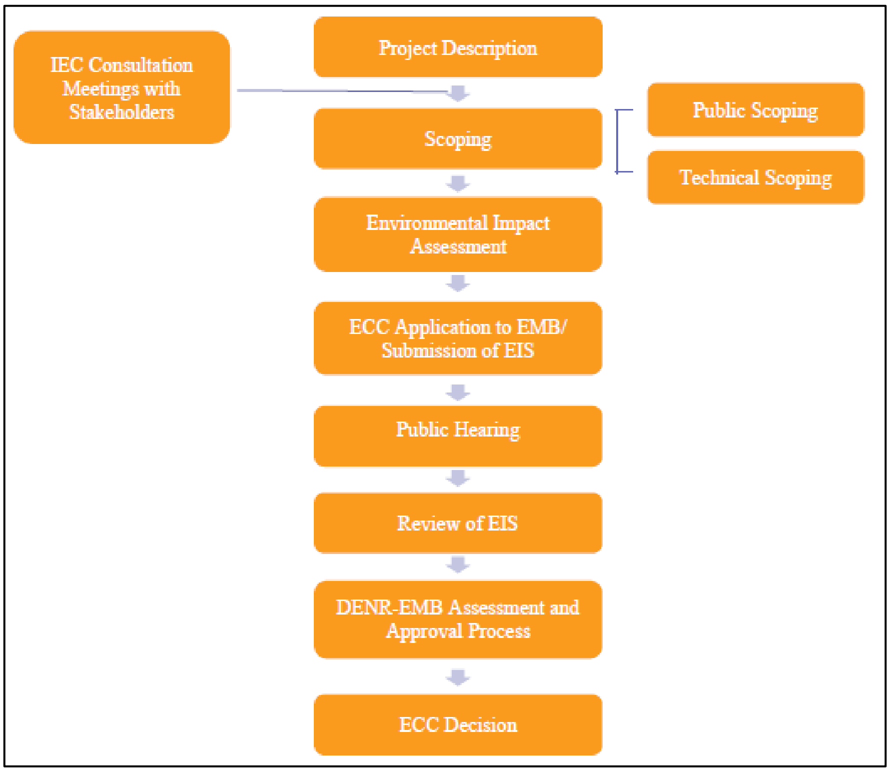


Figure 0-3: The EIA Process adopted from the Philippine EIS System

Public Participation

The Proponent's IEC activities centered on a Perception Survey conducted on December 15-16, 2020 in host community Barangay Tayud, and a combined Public Scoping and Focus Group Discussion conducted on December 17, 2020 at 9:00 AM at 6th floor of Consolacion Government Center, Municipality of Consolacion, and Province of Cebu. Due to the COVID-19 pandemic situation, and with reference to DENR Administrative Order 2017-15, Guidelines on Public Participation under the Philippine Environmental Impact Statement (EIS) System and EMB Memorandum Circular No. 2020-30, Interim Guidelines on Public Participation in the Implementation of the Philippines Environmental Impact Statement System (PD 1586) during the State of National Public Health Emergency, the Perception Survey was facilitated by the LGU with a maximum of 25 residents of Barangay Tayud, and a combined Proponent-driven Public Scoping and Focus Group Discussion served as the Project's Information, Education and Communication (IEC) campaign. Another perception survey conducted last March 26, 2022 for additional 3,508 households in Sitio East Binabag, Bagacay, Libo, Baha-baha, Bangkerohan, Libo, Looc, and Tawagan of Barangay Tayud, Consolacion, Cebu. Out of the 3,508 households, 85% were aware of the proposed reclamation project and 74% of the total households agreed on the proposed Seafront City. Most of the respondents who agreed or on favor of the project believed that the project will bring progress to the barangay or the host municipality. However, most negative comments for those who are not in favor of the project were due to possible huge loss of employment to the affected shipyard projects.

The EMB-facilitated Technical Scoping was held on December 17, 2021 at 9:00 AM virtually with EIA Review Committee (EIARC), EMB, Dr. Rey Martinez representing the Proponent Technical Team. It is noted that the Project Lead Consultant and EIA Preparer Consultant were unable to participate virtually in the activity due to the loss of power and cellphone signal as a result of the super typhoon Odette that ravaged Central Visayas in the evening of December 16, 2021.

The Information, Education and Communication Plan (IEC) calls for transparency on the part of the Proponent in dealing with the stakeholders on environmental issues which affect stakeholders. Central to the IEC campaign is an environmental awareness program. Topics covered include fire safety and protection, waste management, water and air quality management, stormwater management, and public health and safety.

The Proponent understands the importance of holding regular public consultations which provides a venue to inform the public on its environmental performance and at the same time solicit feedback and suggestions from community members on how to improve and enhance its environmental protection and enhancement activities.

The gathered issues and concerns from the conducted perception survey, public consultations, IEC, and public scoping were one of the references of the conducted baseline studies as well as the proposed social development program for the community, especially those who will be directly affected by the project.

iv. Summary of Baseline Characterization of Key Environmental Impacts

Module		Baseline Characterization
Land	Land Use	• Per approved CLUP of Consolacion, there are 10 land uses identified in the town's land use map namely: Built-Up Area, Commercial Area, Institutional Area, Industrial Area, Forest/Watershed Area, Agricultural Area, Grassland, Residential Area, Reclamation Area and Mangrove Area. • The proposed project including the proposed access road is consistent with the General Land Use Plan. Proposed Urban Core Land Use Plan, and General Zoning Plan/Map of the Municipality of Consolacion which is within the industrial zone of the Urban Core Zone, specifically for the Seafront City Project area.
	Geology	• The Visayas Sea Basin rest unconformably over a deformed volcaniclastic basement. The lower layers of the basin are dominated by the Middle to Upper Oligocene platform limestones and clastic sequences, while the Pliocene-Pleistocene layers are characterized by at least three major unconformities. • Cebu Island consists of two stratigraphic sub-groups: the Southern Cebu and the Northern/Central Cebu which is the area of interest. • The geomorphic features in the land management map of the Bureau of Soils and Water Management (BSWM) indicates that Barangay Tayud, where the proposed development is planned, consists of a low limestone hill surrounded by a coastal plain. • Based on the available geologic map; the surface geology at project area consists of Recent alluvium and Carcar Limestone. The alluvial deposit that occupies the coastal area and tidal flats is composed of unconsolidated clay, sand and gravels; whereas outcrops of porous (cavernous), coralline,

		fossiliferous limestone as observed as the land ascends.
	Geohazards	• **Earthquake:** The PHIVOLCS ground shaking hazard map modeled for Consolacion Municipality shows that the entire municipality is prone to earthquakes of Intensity VIII and higher under the Philippine Earthquake Intensity Scale (PEIS). The HazardHunterPH identified the Central Cebu Fault as the nearest active fault located approximately 9.9 km northwest of the project site. Although the Central Cebu Fault together with the South Cebu Fault is categorized as potentially active faults, PHIVOLCS does not discount the possibility that these faults would move and generate a strong earthquake. • **Liquefaction:** The PHIVOLCS liquefaction hazard map of Cebu Province shows that the area which is underlain by alluvial deposits is highly susceptible to liquefaction whereas the central area that is underlain by limestone is not susceptible to liquefaction. However, reclaimed lands in general are considered to be prone to liquefaction. • **Flooding:** With reference to the Mines and Geosciences Bureau (MGB) Landslide and Flood Susceptibility Map of Liloan Quadrangle at scale 1:50,000 and where the Project is located, the coastal areas of the Project area are classified as low to moderate susceptibility to flooding. However, coastal areas in the inner sections of Cansaga Bay and also areas near mouth of Butuanon River in Barangay Paknaan, Mandaue City are classified as high susceptibility to flooding. The lack of a drainage and sewage system in Barangay Tayud is a possible factor of flooding in some low areas to the north of Project area during period of heavy rains. Absence of drainage outlet results into perennial flooding in some areas • **Tsunami:** Generally, coastal areas in the Philippines experienced a tsunami or have a tsunami hazard

		potential. The PHIVOLCS' tsunami vulnerability mapping revealed the Municipality of Consolacion to prone from this hazard with an Inundation Depth of 2 to 2.99 meters. Further, tsunami threat to people's lives can be addressed by community preparedness and a tsunami evacuation plan. • **Storm Surges:** The reclaimed land will be in front of the existing coastline and therefore the reclaimed land will form the new sea front. This makes it most vulnerable to storm surge and flooding from the sea. • **Volcanic Eruption:** The nearest active volcano to the project site is Kanlaon Volcano which is located 94.5 km to the west. • **Sea Level Rise:** There is a slow rise of sea level based from the tide gauge data dating back to 1935. A general rate of 1.3 mm/year increase in sea level in the region is recorded since 1935. However, an increase to 5.9 mm/year from 1990 to Present is recorded. This is much higher than the global mean rate of sea level rise which was recorded at 3.3 mm/year per IPCC Report in 2015. A study by Kulp and Strauss (2019) estimated the vulnerability of communities to sea level rise utilizing Coastal Digital Eleveation Map (CoastalDEM) and Shuttle Radar Topography Mission (SRTM). Vulnerable areas around the bay are portions of barangays Paknaan, Basak, Tugbongan, Nangka, Opao, Guizo, Looc, Pajo, and Centro. Residential areas, commercial areas and industries within the coast have a high exposure for any coastal related hazards.
	Pedology	• One (1) soil type, a rocky phase and Hydrosol a Miscellaneous land type. The soil type is: the Faraon clay which was subdivided into three (3) soil mapping units based on slope range differences. • The Faraon rocky phase was also subdivided into three (3) mapping units based on slope range differences. The soil mapping units are: Faraon clay,

		0-3 % slopes; Faraon clay, 3-8 % slopes; Faraon clay, 18-30 % slopes; Faraon rocky phase, 3-8% slopes; Faraon rocky phase, 30-50% slopes and the Hydrosol with Mangrove. • Per geotechnical drilling, the project area has sand sediments which is found out generally consisting of brown to dark gray colored fine to coarse grained loose sand. The light colored sand consists mainly of limestone and corals fragments with minor silica fragments while the dark colored consist of mafic minerals and lithic fragments.
	Terrestrial Flora	• Meanwhile, there are 4 vegetation types which were identified in the Barangay Tayud, described and mapped in the approved CLUP namely: Coconut Associated with Corn, Grassland associated with Bamboo, Corn associated with coconut and mangrove swamp. • However, in the inland portion of the project area, the areas affected are mostly open space already or used to be shipyards/shipbuilding area dominated by grass and other shrubs, with fewer trees present such as fruit-bearing trees.
Water	Hydrology	• The Municipality of Consolacion has two (2) river systems. These are the Cansaga River and Pitogo River. Both river system drains towards the Cansaga Bay. Moreover, there are no creeks found in Barangay Tayud where the project will be constructed. • The watershed of Cansaga River and Butuanon River provides direct sediment supply to Cansaga Bay. Per JICA study in 2015, the catchment area of Cansaga River is measured at 26.9 sq. km with maximum creek length of 8.7 km. The catchment area of Butuanon River is measured at 50.8 sq. km with maximum creek length of 20.1 km. Illegal occupation of river zones are common within river channels. The construction of fill structures within the bay and river zones compromises the natural drainage of rivers. This increases the likelihood of inundation within coastal and floodplain areas during events of heavy rains and storm surges.

	Oceanography	• **Predicted Tides:** The mean sea level (MSL) at the NAMRIA-Cebu Tide Station is 0.72 m above the mean lower low water (MLLW) while the mean sea tide level at the NAMRIA-Carmen Tide Station is 0.76 m. The interpolated mean sea level at the project site is 0.73 m above MLLW. Mean tide level at the project site is only 0.01 m (or 1 cm) higher than the mean tide level at the NAMRIA-Cebu Tide Station. • **Current Speeds and Directions:** Comparison of simulated current patterns without and with the project development scenario shows apparent changes in currents with the reclaimed area. The project site (access road and reclamation area) blocks currents that generally moves in the NE and S-W quadrants and forms currents to the to the SSE and NNW directions. • **Accretion and Erosion:** Results show accretion and erosion of sediments north and northwest of the proposed reclamation area, respectively. The accretion or accumulation of sediments north of the project site is due to change in large formation which blocks the existing current patterns in the area. Erosion on the northeast section was due to increase current magnitudes over a narrower channel. • **Sediment Transport:** The two conditions correspond to an upheaval of sediment during the land reclamation, and possible erosion of the perimeters of the reclaimed area after the reclamation. Based on ADCIRC simulation, a total of 456,884 sediment particle packages are transported by the tidal currents.
	Marine Water	• In terms of water quality, the Project Area shows a copper concentration which is indicative of pollution stemming from ship anti-fouling paints, and nitrate concentrations, in some areas, which are indicative of eutrophication, likely due to untreated sewage. A significantly-sized oil spill comprising of a multitude of poly-cyclic hydrocarbons is further evidence of the

		detrimental effects of the shipyards in the project area. • It is generally known that variation in nutrients and some physico-chemical parameters in the marine environment affect the proliferation and survival of phytoplankton, which also has a cascading effect to higher trophic levels. In this survey though, there was no correlation on the abundance, diversity and richness of phytoplankton to the level of pH, DO, concentration of nitrate and heavy metals (mercury, zinc, copper and lead) ($r<0.5$). The stations sampled had relatively uniform pH values ranging from 6.88 to 7.51, which were well within the DENR water quality standard for pH of Class SC (6.5 to 8.5). The dissolve oxygen values ranged from 5.56–7.51 mg/L which were also within the 5.0 mg/L minimum set by DENR DAO 2016-08 for Class SC waters. Lastly, the levels of tested nutrients were also very low to significantly affect the plankton community in the area. Other physico-chemical parameters not tested in this study might have an influence of the phytoplankton community and should not be ruled out.
	Marine Ecology	• **Mangroves:** On the foreshore area, two mangrove zones were identified: a seaward zone dominated by either *Sonneratia alba* or *Avicennia marina* and a less pronounced midzone with *Rhizophora spp.* and *Avicennia spp.* The width of the mangrove forest cover, as measured from the shoreline to the sea, varied from 50 m in Inside the Project Site (MI) to 400 m in Outside Adjacent to Project Site (MO) and Control Site (MC) which is already located in Lapu-Lapu City. A total of 3 species were recorded within the sampling plots of the Project Area (MI), 3 species with the Adjacent Area (MO) and 4 species in the Control Area (MC). One species that is common in the estuary, Nypa fruticans, was not observed inside the plots.

		In all cases, the landward mangrove zone (where Xylocarpus, Excoecaria, Heritiera, and Nypa could be found; Wycott et al. 2007) have already been developed into residential (in MO and MC), fishponds (in MO), and industrial areas (in MI). The relative density of species per area showed that most of mangroves found in the Project Area (MI) are *Sonneratia alba* (62%), while most of the mangroves in both the Adjacent (MO) and Control Areas (MC) are *Avicennia marina*. The relative dominance of the basal area per species indicated that *S. alba* is again the dominant species in Project Area, contributing to about 88% of the biomass. A. marina was also again the dominant species in both the Adjacent and Control Areas in relative dominance of biomass. • **Associated Fauna in Mangroves:** Five (5) bird species were encountered during the survey of mangroves across sites. The birds observed in the Project Area were Little Egrets (*Egretta garzetta*), Mangrove Herons (*Butorides striata*), and Philippine Pied Fantails (*Rhipidura nigritorquis*), which is noteworthy given the small size of the mangrove patch. No birds were observed in the Adjacent Area at the time of the survey. Sandpipers (*Calidris sp.*) and Mangrove Kingfishers (*Todiramphus chloris*) were observed in the Control Area. None of these species recorded in the areas of interest are listed as threatened or endangered in the IUCN Red List. However, the vulnerable (threatened), migratory species Chinese Egret (*Egretta eulophotes*) has been previously reported in Casaga Bay, which itself harbors a rich avifauna (BirdLife International 2020). • **Seagrasses:** In the intertidal area within the immediate area of the proposed project are found small patches of mixed seagrass meadows composed of four (4) species, namely: Cymodocea rotundata, Halophila ovalis, Thalassia hemprichii and Enhalus acoroides under two families (Cymodoceaceae and

		Hydrocharitaceae). The four (4) species recorded represents 20% of all species recorded as found in the Philippines and indicates very poor representation in terms of species composition out of the sixteen (16) species recorded so far in the country. • **Soft Bottom and Infaunal Benthos:** A total of 266 benthic and infaunal organisms were recorded in the samples taken from the five (5) quadrat stations for infauna and benthos assessment. Collected organisms represented sixteen (16) taxa belonging to five (5) major groups, namely: Nematoda, Nemertea, Annelida, Mollusca and Arthropoda. Representatives of the Phylum Mollusca composed mainly of Tellinids and Mytellids were the most abundant organisms collected, comprising 39.97% of the total collection, followed by the arthropods with 29.7%. The percentage composition of the rest of the group only ranged from one to five (5) with the lowest at 2.26% composed of Nemertians. • **Corals:** There are no coral reefs in the project area. Substrate is mainly composed of Silt. In the Adjacent Area, the live coral cover was generally “poor” with a mean of 20.14%, although the farthest station (UO-3) had a “good” coral cover of 50% (mostly encrusting corals). At the Control Area, the mean live coral cover was significantly higher (39.1%) while the algal cover much less (22.5%) than in the Adjacent Area (20% coral and 44% algae) and Project Area (0% coral, 0% algae, and 100% silt). Like in the Adjacent Area, the coral cover is predominantly composed of the encrusting forms. However, unlike the Adjacent Area, the Control Area has more massive, corymbose, free-living forms, branching and tabulate Acropora, submassive, and foliose forms. • **Fish and Visual Census:** A total of 81 fish species belonging to 22 families were recorded during the underwater surveys in the Project, Adjacent, and Control Areas. However, only 3 fish species were

		found inside the Project Area and only at the northernmost station (UI-3). These species are: Acentrogobius sp. and Bathygobius sp. gobies, and the Large-toothed Cardinalfish (Cheilodipterus macrodon). Omnivore species comprise 71% while benthic carnivore species comprise 29% of the species abundance. All three fish species are categorized as “major” species (not “target” or “indicator”) and none are listed under IUCN. • **Phytoplankton**: A total density of 143,201 cells/m^3 belonging to 33 genera that were identified across all sampling stations. The phytoplankton community in the survey area is comprised of organisms from three major phytoplankton groups: Cyanophytes (blue-green algae) with two genera, Bacillariophytes (diatoms) with 21 genera, and Dinophytes (dinoflagellates) with 10 genera. • **Zooplankton:** A total of 11,125 individuals / mL distributed among 17 zooplankton groups (in adult and larval forms) were quantified from six sampling stations in locations along the marine waters from the coastline of Consolacion and Lapu-Lapu City, Cebu. Overall, recorded zooplankton consisted 62.8% (6,988 ind/m3) of adult forms, and 37.2% (4,137 ind/m3) of larval forms from the overall total zooplankton count. The adult zooplankton forms were composed of ten groups, while the larval zooplankton forms comprised of seven groups. A large portion of the adult forms was represented by cyclopoid copepods with 2,500 ind/m^3 at 22.5% composition. Larval forms were dominated by copepod nauplius and copepodites with a total of 3,475 ind/m^3 at 31.2% composition, which were also the most abundant group for the whole documented zooplankton community.
	Marine Sediment	• **Marine Sediment Characteristics:** Sediment sources are siliciclastic sediments coming from the erosion of the upstream areas and alluvium deposits along the coast. Other sources of sediment in the area come from longshore transport along the coast. This is

		enhanced by the construction of man-made structures in the coastline that trap sediments carried by the longshore currents that run along Cebu. Sidescan sonar imagery showed an overall uniform seafloor due to silt and mud-rich bottom. Relatively harder substrates were found on the western portion of Cansaga River which may be an accumulation formed due to its location near the river mouth. The acoustic character of the subsurface at ~2 m below the seafloor showed very similar soft mud sediment. This indicates that the subsurface is also rich in mud. Ground surveys show that the upper meter of the seafloor is composed of high amount of suspended mud and soft mud substrate. Given that the watershed opening to Cansaga Bay is relatively small, the first few meters already represent decades of natural accumulation from the river. Grab samples collected in the seafloor are found as mud with dark brown to black color. This is indicative of high amounts (> 5%) of organic matter mixed with siliciclastic mud and silt. The high amount of organic matter is attributed to human activities within the bay and accumulation of organic pollutants from the upstream urban areas which open to Cansaga Bay. • **Seabed Characteristics:** Results of the Geotechnical study revealed that there were alluvial deposits within the project site. At the mouth of Cansaga River, soft sediments of clay and silt extended down up to 45m in depth from seabed without encountering the limestone bedrock. Based from the results of the field Soil Penetration Test (SPT), there were different soil layers below seabed which were encountered. The upper layer (A) of the reclamation site is compost of very soft to medium stiff, gray silty clay, light to medium plastic, with traces of sand, with a SPT N value of 0 and an

		averagethickness of 25 meters. Other soil layers include: (B) loose to medium dense, gray, broken corals or sand/gravel-sized limestone fragments; (C) stiff to very stiff, gray, silty clay/clay (CL/CH), with traces of sand; (D) dense to very dense, gray/brown sand/gravel-sized coralline limestone fragments; (5) pockets of fine-grained sand and non-plastic sandy silt.
	Freshwater Ecology	• Two rivers were identified which drain at Cansaga Bay namely the Cansagar River and the Butuanon River. These rivers were subjected for ecological assessment. • **Benthos:** Both rivers host very low macro-invertebrate diversity with only 7 to 8 species recorded. Trends show that the farther the sampling site from the estuary, the higher the species composition is. The presence of litter and waste water discharges from heavy industries limit the population of these freshwater macro-invertebrates. Further, Butuanon River has long been declared as a “Biologically Dead River” by researchers. No Threatened Species were found in the area. • **Fish:** Only 3 species of freshwater fishes were recorded which were all found in Cansaga River. Since Butuanon is already biologically dead, it is expected that freshwater species are unable to thrive especially in the downstream area. • **Plankton:** A total of 34 species were observed in Cansaga River while 41 in Butuanon River composed of both Phytoplankton and Zooplankton. Highest densities of plankton were found at the Mid Downstream Sampling Site of Cansaga River and Lower Downstream Sampling Site of Butuanon River. Shannon-Weiner Diversity Index shows that both rivers host very low diversity of plankton community. • **Riparian Flora and Fauna:** A total of 49 vascular riparian floral species and 20 faunal species were recorded in all stations within the riparian zone. Only 1 was found to be listed under the Threatened Species Category of the IUCN which is the Narra Tree. Faunal species are expected to be very low because most of

		the riparian areas of the two rivers are surrounded by residential, commercial and industrial developments. • **Presence of Pollution Indicator Species:** A pollution indicator freshwater macro-invertebrate species *Chironomus sp.* was found in the two rivers. The fish *Poecilia reticulate* was also found in Cansaga River which is an indicator of a degrading river environment because of its opportunistic nature which colonizes poor quality habitats where other species cannot survive. Many pollution indicator plankton species were also recorded in both rivers. The phytoplankton species Dinophysis sp. is capable of producing okadic acid and pectenotoxins which causes diarrhea. The phytoplankton *Scenedesmus sp.,* is also a colonial green alga that is commonly used in experiments such as pollution studies and sewage purification process since it can provide oxygen to breakdown bacteria of organic matter that can destroy harmful substances. Around 42% of the plankton community in Butuanon River may contain toxins resulting in harmful blooms. A study conducted by Pearl (1998) states that the plankton starts to bloom when it reaches 10,000 to 1,000,000 (104 to >106) cells mL-1.
	Economically and Ecologically Important Species	• No economically important species of freshwater macro-invertebrates and fishes were found in both rivers. However, 77% of all recorded flora in the riparian area contains medicinal values.
Air	Meteorology	• The climate of the project site is within a zone classified as Type III Climate, as shown in the Climate Map of the Philippines (1951 to 2010). Type III climate has no very pronounced maximum rain period and dry period last only from one to three months. The dry months are either from December to February or from March to May. • July is the rainiest month with mean monthly rainfall of 329.6 mm, followed by August with 286.9 mm and September with 255 mm of rainfall. The driest month is February with mean monthly rainfall of 16 mm. Although August and September have high normal rainfall, the highest recorded rainfall was 276.1 mm on November 12, 1990. This occurred during the

		passage of Typhoon Ruping which crossed the Province of Cebu in November 1990.
	Air Quality	• Ambient twenty-hour concentrations of TSP and PM10 range has a maximum of 59 µg/Nm3 , along commercial area near the project site, while the corresponding one-hour has a maximum of 353 µg/Nm3. • One-hour average concentration of SO2 and NO2 range from <12 and 16 µg/Nm3 respectively, while the corresponding twenty-four averages are from <0.02 and 25 µg/Nm3, respectively. Reading all near residential houses. • Point sources observed were coming from the vehicles, smoke emission from residential houses, from nearby industries.
	Noise	• Median noise values range from 45 to 80 dBA. Background noise levels at the time of monitoring appear higher than ambient noise standards set for residential areas, but were within limits set for industrial areas. Sources of sound at the time of monitoring were mostly from the passing vehicles and noise from the nearby industries.
People	Demographic Characteristics	• Result of the 2020 Census of Population and Household shows that Barangay Tayud has continually been experiencing an increase of population from 2010 and 2015. The population of Barangay Tayud based on the 2020 CPH is at 23, 208 representing an increase of 14.94% from its 2015 population. However, this is lower than 28% increase in population recorded by the barangay for the 2010 to 2015 census periods. Average annual growth rate for the barangay is at 2.97. This is also lower than the average annual growth rate recorded by the barangay for the 2010 to 2015 period at 4.92. • There are more males than females in the municipality as reflected in the gender ration of 1.01. Dependency ratio, or the ratio of the noneconomically active segment of the population (below 15 and above

		65 years old) to the economically active segment of the population (15- 65 years old) is at 42.41%. • The highest recorded household size was determined in Sito Libo at 14 and Bagakay at 11. The average household size for the interviewed respondents is 4.9. Most of the respondents' primary source of household income comes from both contractual and regular employment 38.03% and 14.05%, respectively. Other identified sources include retail businesses at 9.30%, remittances and pension at 4.23%, farming at 3.38%, fishing at 2.82%, and other informal jobs with no fixed tenure or pay such as, tricycle drivers, construction worker, laborers, etc at 10.77%. • There also 115 private and 12 public primary educational facilities available in the municipality. For secondary education, there are 11 private and 11 public secondary education facility available in the municipality. Results from the perception survey showed that almost half of the respondents from were able to finish high school. Respondents who were recorded to have college and post graduate degrees are at 11.27% and 2.82%, respectively.
	Basic Services and Public Health Safety	• The municipality is served by one doctor, one RHU Nurse, nine midwives, one medical technologist, one dentist two sanitary inspectors, seven 'hilots' and 141 barangay health workers. The Barangay has one barangay health center, one private medical clinic and three drug stores available. Most of the household members purchase their medicines and vitamins from nearby pharmacies and whenever available, Barangay Health Centers are providing them for free. Furthermore, it was also noted that since 2016, a total of 15 deaths were recorded among the surveyed households. Common causes of mortality in this survey are hypertension, cancer, cardiac arrest, and pneumonia.

		• Available records show that 5,408 households have access to Level I water supply, 1,690 households have access to Level II water supply and 814 households have access to Level III water supply. • Around 5000 households have access to water sealed toilet while around 2,397 households do not have any access to any toiler facilities. Household with no toilet facilities usually shares with other households or practice open defecation in bodies of water. • The municipal collection of residuals is handled by the local government. The existing system collects daily for residuals while biodegradables are collected by the barangays. The health care waste coming from the Rural Health Unit (RHU) of the municipality is being handled by Pollution Abatement Systems Specialists Incorporated (PASSI Inc) in Cebu City. PASSI has been collecting an average of 90 kilos per month of healthcare/special waste from the Municipality of Consolacion. • The municipality hosts a municipal police station headquarters at the municipal building. The police force to population ratio is at 1:2135 which is way above the standard 1:500 ratio for urban municipalities. The municipality also hosts one fire station located in the municipal building manned by 6 firefighting personnel giving a force to population ratio of 1:9964. Records show that theft, violation of BP 22 (fraudulent check), and physical injuries are the most committed crimes during the period.
	Perception Survey	• **Sampling Size:** A second perception survey was conducted last March 25-30, 2022 by the LGU of Consolacion, Cebu. A total of 3,508 respondents were interviewed coming from selected residents in the 7 Sitios of Barangay Tayud. Out of the total respondents, Sitio East Binabag had the highest number of respondents with 867 followed by Sitio Tawagan with 575 and Sitio Bagacay with 523.

		• **Awareness of the Project:** Out of the initially processed data of 2,092 respondents, 1792 or 85.66% are aware of the proposed Seafront City Project of LGU Consolacion while 300 or 14.34% are not aware of the project. • **Approval of the Project:** Initial data processed revealed that 1,588 out of the 2,092 respondents or 76% agreed with the proposed reclamation project while 413 or 19.7% disagreed. 75 respondents did not care at all and 15 did not answer.

v. Summary of Impact Assessment, Monitoring and Mitigation

Project Activities	Potential Impacts	Proposed Mitigating Measures	Target Performance / Efficiency
I. Pre-Construction Phase			
Actual survey works and baseline data gathering such as Geotechnical Survey, Marine Study, Water and Air Sampling, and IEC. There are no residual impacts on the environment.			
II. Construction Phase			
Dredging Works Activity			
Removal of unwanted seabed and silt	Water pollution brought about by silt disturbance within the project area/sedimentation	-Installation of silt curtains and other silt management measures shall be placed in appropriate location depending on the waves and current -Establishing bufferzones where the silt curtains will be installed as protection for adjacent areas, important nearby corals outside the project site as preparation for the project implementation. - Location of the silt curtain must be placed based on the tidal current location which is areas facing to the Mactan Channel.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards outside the silt curtain area.

		- Oil spill in the sediments will be remediated, dredged, and removed from the area to avoid dispersing pollution into the water area. Contaminated sediments will be relocated first in a safe area then a 3rd party hauler and treater will be contracted for treatment prior disposal. - Careful removal, relocation, and disposal of heavy metal polluted sediment in the Project Area. Conduct water quality monitoring before, during and after the project. - Removed silt will be collected and will be use as part of the filling materials or will be use for other purposes such as compactment materials for construction purposes.	
	Potential loss of soft bottom fauna due to removal of sediment in the project area	-Documentation and regular monitoring of soft sediment fauna and other possible ecological coastal water resources.	
	Impact on the livelihood of fisherfolks	Affected fisherfolks will be assisted by the LGU for alternate job employment offer. However, for those who will remain as fisherfolks, they will still be assisted by the	100% Compliance to livelihood and Social Development Program

		LGU by provision of more appropriate fishing gears to organized fishers to enable them to fish further offshore where stocks of abundant fishes will be found. The LGU has also an existing Fisher's code wherein the fisherfolks in the municipality are supported with their livelihood. Though the project area is not a fishing ground, proponent will still allocate an area where there will still sufficiently access to the coastal area as docking area for the boats of the fisherfolks bound to their fishing grounds. There will be support for the establishment and maintenance of no-take Marine Protected Areas in the Adjacent or Control Area as consideration to help conserve the environment and increase fishery yields through spill over effects. A regular monitoring will be conducted to ensure that the project development will have no negative effects to the nearby fishing grounds.	

	Impact of closed down shipbuilding / shipyard operations. Displacement of 11 shipyard operators with expired tenurial instruments.	-Affected employees from the closed-down operations of the shipyards/shipbuilding operations will be assisted by the LGU for other alternative employment offers. The affected shipyards will ne be assisted by the LGU for possible relocation sites and there will be programs also offered by the LGU that help the affected shipyard covert their project that will jive into the development and operation of the Seafront City Project that would even give higher possible business opportunity to double their profit, will be much higher, if they proceed with business conversion or upgrade.	
	Disturbance of coastal water – Potential loss of soft bottom fauna due to removal of sediment in the project area	There will be no corals that will be affected within the project area. If there will be any corals that might be carried away from other location to the project site due to strong current, the affected corals/fishes within the project area will be transferred/relocated to a secured deeper location where it will not be disturbed by human activities and away from passing ships/ship anchorage	Documentation and monitoring of soft-sediment fauna is sufficient and recommended. 100% of contaminated

		area. To ensure no current-carried corals within the project area, there will be regular on-site monitoring of the benthic and fish community in the adjacent area in every phase of the project development in coordination with DENR and BFAR and formulation of a management and sustainability plan to conserve the area. Installation of a well-designed, science based artificial reef system that can increase rugosity on the newly created coastline. Meiobenthic fauna are short-lived and non-economically important animals. Their loss in the Project Area is imminent and permanent. The effect on the Adjacent Area is transient and recovery will be almost immediate after construction works due to quick recruitment and life cycles.	sediments with oil are disposed safely 100% of contaminated sediments with heavy metals are contained in compliance to R.A. 6969 100% Compliance to Aquatic Life Preservation / Protection
	Disturbance of oil-spill found in the sediment which could spread in adjacent areas and affect marine biodiversity	The significant oil spill in the sediment must first be remediated, dredged, and removed from the area to avoid dispersing pollution into a wider area. Contaminated	

		sediments should be disposed safely	
	Resuspension of toxic and heavy metals from the sediment to the water column	Careful removal and disposal / containment of heavy metal polluted sediment in the project area and conduct of regular water quality monitoring before, during and after the reclamation process	
	Alteration of benthic and fish community structures in the adjacent area caused by increased siltation	Installation of a silt curtain surrounding the area to be filled with reclamation materials and in the revetment structures area. Installation of a well-designed, sciencebased artificial reef system can help increase rugosity (attachment surfaces for corals) on the newly created coastline. This may help increase the speed of marine ecosystem recovery, initially of corals and benthic fauna, and later on of reef fishes when other management interventions are implemented.	
	Short term changes in density and diversity of plankton community in the project area due to	Prevention is unlikely but the plankton community is expected to recover quickly from advection, seeding or recruitment of	

	increase in load of suspended solids	plankton from nearby areas not affected by the construction and the connected seas	
Transport of dredged material to disposal site	Water pollution due to accidental spillage of dredged materials	The hauler shall ensure that vessels used for transporting are in good condition to prevent dredged materials from leaking or spilling	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards outside the silt curtain area.
Dumping of dredged material to disposal site (Inland)	Soil and water Pollution due to disposal of dredged materials	There will be temporary relocation sites for the unwanted seabed dredged materials from the project site. The perimeter of the relocation sites will be enclosed with fence and the stockpile area of the dredged materials will be installed with high density polyethylene (HDPE) liner and/or clay to prevent soil and water (ground and surface) contamination and zero discharge. A 3rd party contractor will be hired for the proper removal, relocation, treatment, and disposal of unwanted and hazardous materials from the seabed within the project area.	No soil contamination and Allowable Ambient Criteria due to disposal of dredged materials
Dredging of filling material for reclamation	Water pollution due to dredged filled materials that might affect the Mactan channel as well as the ajacent nearby freshwater body such as Cansaga Bay and other	Installation of silt curtains and other silt management measures shall be placed in appropriate location depending on the waves and current. Conduct regular ecological and water	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards

	freshwater tributaries. Additional turbidity and siltation in Adjacent Area. Accretion of sediments on mangrove roots in the Project Area and Adjacent Areas. Increased siltation and sediment loading in the Adjacent areas.	quality monitoring of adjacent and control areas as monitoring stations to ensure no exceedances of DENR water quality standards and destruction of the ecological coastal water resources.	
Barging of fill materials for reclamation	Water Pollution due to accidental spillage of dredged materials during barging Increase of suspended solids affecting the settlement of marine species in the dredging and reclamation areas Traffic congestion/disturbances on marine navigational area of Mactan Channel.	Provision of containment facility to prevent spillage such as oil spill booms, absorbent pads, etc. to contain and extract oil spill in the coastal water. Provision of control measures when transporting filling materials to avoid oil spill. Coordinate MARINA on the traffic regulations on coastal waters or navigational area. Implement traffic management plan in accordance to MARINA'a guidelines/protocols.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards 100% No proliferation of suspended solids
Reclamation Activity			
Construction of containment structures Installation of sand bags/containment wall system along	Water pollution/ Increase turbidity of adjacent areas due to infrastructure / construction activities of adjacent areas	Installation of a silt curtain/Silt management measures 50m away from the working area, surrounding the area to be filled with reclamation materials	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards

certain areas along the perimeter of the project area		and in the revetment structures area. Provision of geotextile membrane on the containment structures throughout the perimeters of the project area.	
	Water pollution/ Increase turbidity of adjacent areas due to Infrastructure /Construction Activities of adjacent areas that might affect the Mactan channel as well as the ajacent nearby freshwater body such as Cansaga Bay and other freshwater tributaries.	Installation of a silt curtain/Silt management measures 50m away from the working area, surrounding the area to be filled with reclamation materials and in the revetment structures area. - Location of the silt curtain must be placed based on the tidal current location which is areas facing to the Mactan Channel. Provision of geotextile membrane on the containment structures throughout the perimeters of the project area. Conduct of periodic monitoring of water quality and the occurrence of freshwater fish (i.e., abundance, species richness and biomass).	100% No freshwater quality degradation and loss of freshwater species particularly Ylang Ylang River
	Fish larvae and other marine species migrating to nearby mangrove areas	Sustainability of mangrove protection and conservation thru preparation of mangrove conservation plan	100% No cutting of mangroves

	Physical damage to mangrove trees and roots in the project area and adjacent area Obstruction of seawater flow in the mangrove patches in the project area Accretion of sediments on mangrove roots in the project area and adjacent area which could lead to oxygen shortage and death of mangroves	Establish a buffer zone around the mangroves to prevent root damage from operating heavy machineries. Creation of seawater channel to allow natural tidal inundation and flow of seawater in the mangrove patches around the project area Installation of silt traps and establishment of buffer zones around the mangrove areas	100% compliant to PD 705, as amended and R.A. 7161 No mangroves will be harmed or cut. No transfer / earth-balling of mangroves
	Tsunami/Storm surges	Strictly implement the recommendation of the EGGAR report	100% No flooding and permanent defense against tsunami/storm surge
	Decrease of fish catch production of affected fishermen	There will be no fishefolks that will be displaced within the project area, however, there might be fishing grounds nearby the project area that might be affected if project development will cause environmental impact. To ensure prevention of negative impacts to the fish catch production, religious implementation of mitigating measures	100% sustained the income of affected fishermen

		will be followed. However, proponent still prepared a supplementary livelihood program or social development program for fisherfolks that will be affected. Installation of a well designed, science based artificial reef system can help increase rugosity (attachment surfaces of corals) on the newly created coastline.	
	Health and Safety due to exposure to Construction Hazard	Implement wearing of PPE's at all times when inside the project site. Sufficient precautionary warning signs will be installed in every construction working stations and hazard prone areas to ensure safety of the workers. A readily available emergency health safety kits should be present with onsite medical personnel or physician in case of accidents or emergencies.	100% Compliant to PPEs and Zero accident
	Employment	Priority to qualified local hirees	100% Compliance to SDP in terms of local employment
Possible Vegetation Removal/Destruction (Mangrove)	Loss of important species/Loss of Habitat	Install buffer zone to ensure the that the mangrove trees will not be affected. Construction and reclamation activities should be restricted within a buffer area around the mangroves.	100% Compliance to SDP and to R.A. 7161

		A 50 meter bufferzone distance away from the construction and reclamation acitivities will be established to prevent damage to mangrove roots which is one of the main environmental protection measures prioritized by the project proponent. The mangrove area will serve as mangrove rehabilitation area to enhance the existing mangrove trees. The project will be designed to have a mangrove preservation/rehabilitation area with continuous open access of coastal water where it can still flow to the mangrove areas. The mangrove areas will also serve as rainwater harvesting area. Establish also a living shoreline. It is a natural way of approach for shoreline protection and is done by placing natural materials like plants, stone, and sand. This provides the first line of defense for incoming swells and wakes. By mimicking the physical properties of natural habitats, it increases biodiversity. This living shoreline will	

		be positioned in front of the sheet piles. There are no fishponds within the project area or adjacent to the mangrove areas but only existing shipyards structures. The abandonment and demolition of these structures will be carefully done to avoid destruction of mangroves and other adjacent areas. Hazardous wastes from the demolished structures will be carefully contained to be hauled by 3rd party hauler and treater.	
Filling the project area with reclamation materials '- Delivery of filling and other construction materials through barges	Water pollution /Increase turbidity due to filling materials near reclamation areas	Installation of a silt curtain/silt management measures 50m away from the working area, surrounding the area to be filled with reclamation materials and in the revetment structures area. Silt curtains shall be removed after all necessary components and materials are in place inside the revetment sections.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards"
	Increase in sedimentation outside the project area	Provision of permeable geotextile membrane to prevent sediments during high and low tide outside the project area.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards

		Several silt traps will be installed to ensure prevention of sedimentation.	
Hauling of filling materials	Noise generation	Use of efficient silencers on equipment and other noise dissipating device on all equipment to be used. Avoid use of heavy machinery during night hours. Observe allowable work hours to limit noise.	100% Compliant with Noise Standards
	Dust pollution due to vehicle movements: - Along the road leading to the reclamation area - Within the project area activities	Sprinkling of water using water tanker at least four times a day along all possible roads leading to the reclamation area (as shown in an indicative haul route map in the EIS), especially during dry season. Covering all loaded trucks properly/fully using tarpaulin throughout the hauling period. All trucks shall be road-worthy.	100% Compliant to RA 8749 in terms of air quality standards
Land Development			
Compaction/Soil stabilization of the project area	Liquefaction due to improper compaction Seabed/underwater ground vibrations/shaking due to intensive drilling for soil stabilization or foundation works	Geotechnical analysis of materials to determine the possible liquefaction and other geological hazards of the project area to ensure a proper design for mitigation measures such as strengthening the foundation structures, the type of filling	100 % No liquefaction

		materials appropriate to be used, and etc. based on the EGGAR report recommendations. Conduct thorough EGGAR to determine if there are no large voids or faults that might trigger intensive underground shaking that might cause tsunamis. The "g" values should be considered by the Structural Engineers in engineering design to determine potential hazard of an earthquake occurring during the life of a structure. The project area facing the coastal area will be built with high wave deflectors in case if storm surge or tsunamis.	
	Flooding due to insufficient drainage network and existing low-laying elevation of the project site as per geohazard assessment and PAGASA rainfall data.	Proper Engineering design for adequate drainage network with water catchment and rainwater tanks to address flooding problems. Implement bufferzones to areas of huge vulnerability to flooding. Critical facilities or equipment should be positioned away from the inundation prone areas. The projection of sea rise level based on climate change	100% No flooding

		projection was already considered by adding a freeboard in the reclamation elevation of 4 meters above mean low low water level as prescribed by the PRA.	
	Increase sedimentation fluxes	Stabilization or reclaimed areas through vegetation cover enrichment/enhancement Per EGGAR recommendation, since the project will require substantial backfilling activity to elevate the offshore areas, retaining walls are to be constructed around the perimeter of the project site. The sea walls or any other structures will protect the filling material so it will not be easily eroded by waves to the sea during strong winds and storms.	100% No further siltation/sedimentation will occur
	Noise pollution due to heavy equipment operation	Use of efficient silencers on equipment and other noise dissipating device on all equipment to be used. Install buffer zone surrounding the project area to minimize noise. Observe allowable work hours to limit noise.	100% Compliant to Noise Standards

	Dust pollution due to heavy equipment operation including transport vessels	Sprinkling of water using water tanker at least four times a day within the project area especially during dry season. Transport vessels/barges shall be fully and properly covered and load secured throughout the hauling period.	100% Compliant to RA 8749 in terms of air quality standards”
Construction of horizontal structures such as follows: A. Road networks B. Drainage system (sewage and sewerage system) C. Water distribution D. Centralized wastewater treatment facility E. Power and telecommunication lines	Land pollution due to indiscriminate /improper dumping of solid wastes and toxic substances	Ensure that its contractors shall practice onsite segregation and establish storage facility of the following: 1. Construction debris such as used drum, used tires, wood cuttings, iron bar cuttings, etc. 2. Hazardous wastes such as used oil, busted lamps, oily/contaminated rags, etc. will be contained in an enclosed facility intended for hazardous/special storage facility. The above waste materials shall be hauled and disposed of by a DENR accredited hauler and treater. The hazardous waste facility should be placed in a considerable distance away from the construction zone to prevent accidents and pollution in the Project and Adjacent Areas.	100% compliance with the following: • RA 9003 • DAO 1992-29 and DAO 2013-22 and its Revised Procedural Manual

		Rigid policies against disposal of oil waste and marine water bilge water should be implemented, as with all relevant marine pollution prevention protocols of DENR EMB and MARINA. Composting facility will be provided to process biodegradable waste. Compost materials shall be used for greening activities. 3. Installation of MRF for proper solid waste segregation In terms of foundation structures, it is therefore important for the project proponent to carefully consider the engineering properties of the fill materials to be used. Foundation of structures should be designed as not to exceed the bearing capacity of the soil. Static and dynamic loads must also be considered in the foundation design.	
	Generation of untreated/ improper disposal of domestic wastewater	Personnel stationed at the reclaimed land will be provided with on-site portable toilets and washrooms during project implementation. Collection and disposal will be done by a DENR accredited hazardous	Zero discharge of domestic waste to Bacoor Bay.

		waste hauler and treater. The proponent will install a centralized wastewater treatment facility with a capacity of 15,000 m3/day for treatment of domestic sewerage as preparation for project operation for small locators who cannot install their own STP. The capacity of the wastewater is based on projected water demand of the project during operation phase from year 1 of the project operation to year 20. Further, most locators who will invest in the project will be required to put up their own wastewater treatment facility. Treated wastewater will be recycled for watering the landscape area or greeneries. The proponent will also encourage the locators to implement dual piping system wherein treated wastewater from the STP will be recycled back to be used as water for toilet flusing purposes. Effluent from the wastewater treatment facility will have regular sampling or monitoring to ensure it passed the DENR	

		effluent water quality standards. Sludge from the wastewater treatment facility will be hauled and further treated by a 3rd party treater.	
	Water Pollution due Increase storm water run-offs surrounding the Areas	Adequate drainage system with settling ponds or settling basins to capture silts prior outfall as standard requirement by the DPWH. The settling basins will be permanently attached to the drainage system to served as permanent mitigating measures for silts in the run-off water even during operation phase wherein there will be several vertical construction activities of the future locators. Sewage and sewerage systems shall have dual piping (going to the wastewater treatment facility and for redistribution). Provision of storm water collection system. There will be also a secondary containment for fuel oil and chemical storage tanks in a considerable distance away from the construction area.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards"

	Dust pollution emanating from open areas	Sprinkling of water along all possible routes leading to the reclamation area, at least four times a day, especially during dry season. Open areas should be covered with greeneries such as grass, shrubs, etc.	100% compliance with RA 8749 in terms of air quality standards
	Health and Safety due to exposure to Construction Hazard	Implement wearing of PPE's at all times when inside the project site. Sufficient precautionary warning signs will be installed in every construction working stations and hazard prone areas to ensure safety of the workers. A readily available emergency health safety kits should be present with onsite medical personnel or physician in case of accidents or emergencies.	100% compliance to PPEs and Zero accident
	Employment	Priority to qualified local hirees	100% compliance to SDP in terms of local employment
	Socio Economic Benefit	Fifty one percent (51.00%) of the total land area reclaimed shall be the share of the GOVERNMENT. The agreed share of LGU CONSOLACION, the Province of Cebu and the Philippine Reclamation Authority shall be taken from the said share. All roads, open spaces for parks,	100% compliance to SDP in terms of local employment

		utilities, and facilities (i.e. Sewerage Treatment, Water Treatment, Waste Management, Power Plant, and the likes) shall be part of the GOVERNMENT share, provided, that all the costs of the construction of the road networks and all facilities and utilities shall be borne by the private partner. Forty-nine percent (49.00%) of the total reclaimed land area, which shall be saleable areas intended for commercial, institutional, and mixed residential use shall be the share of the private partner.	
III. Abandonment Phase			
Dismantling of equipment, clean-up, cessation of construction activities	Reduction and eventual termination of employment	Promote alternative livelihood at early stage of project operation. Pay employees termination pay and other payment mandated by laws.	100% compliance with SDP

vi. Summary of Risk and Uncertainties Relating to the Findings and Implication for Decision Making

The advance reclamation methodologies and the engagement of experienced reclamation contractor will significantly reduce project risks and uncertainties. The containment wall design and construction are a significant aspect in the reduction of risks and uncertainties that could otherwise challenge the integrity of the reclaimed land. The Detailed Engineering and Design (DED) requirements of the Philippine Reclamation Authority which are complied with post ECC and in the application for a Notice to Proceed (NTP) are another aspect of risk and uncertainty minimization. The dredging activities to be undertaken at the source of the fill materials must necessarily be backed up the expertise in dredging and by complete knowledge of the characteristics (particularly geologic) of the coastal seabed.

Table 0-4: Summary of Major Risk and Uncertainties

Risk and Uncertainties	Implications to the Proposed Project/Mitigating Measures
1. Leakage of storage tank and piping system of diesel fuel due to natural catastrophe	- Provision of secondary containment for storage of fuel oil at the reclamation site. Ensure that the containment facility will be located in a stable area that is considerably distance away from the construction works, bufferzone, and mangrove areas.
2. Damage to containment walls due to seismic activities	- Redesign and reconstruction of retaining walls that is above the ''g'' factor standard that can withstand maximum predicted ground shaking.
3. Flooding due to above normal heavy rains and super typhoon	- Flood control measures to be adopted such as adequate drainage system with freeboard design and sufficient catchbasins/rainwater harvesting ponds to ensure no everflowing of run-off water.
4. Storm Surge/Tsunamis	- Redesign and reconstruction of retaining walls with sufficient wave deflectors computed for possible heighest wave length.

vii. Summary of Environmental Guarantee and Monitoring Fund Scheme

The Environmental Monitoring Fund (EMF) will be created to support monitoring, evaluation and management activities that deal with environmental issues. The allocated maximum annual budget shall be Php 10,000,000.00 while the Environmental Guarantee Fund (EGF) Commitment is pegged at Php 50,000,000.00. Disbursement of this fund is subject to the terms and conditions set by the Environmental Monitoring Team. In order to finance the implementation on the Environmental Management and Monitoring Programs, a separate fund will be set aside and deposited in a bank for the intended purpose. The release of the funds will be subject to the approval of the proponent and shall be used only for the environmental enhancement and mitigation of any negative impacts. Part of the funds will also be used for monitoring purposes.

1. PROJECT DESCRIPTION

On June 28, 2019, the previous administration of the Municipality of Consolacion has passed Ordinance No. 6 series of 2019 otherwise known as "*An Ordinance Declaring the Foreshore, Offshore and Sea within the Municipal Territorial Limits from the Boundary of Liloan and Mandaue City Waters into an International Investment, Tourism, Commercial, Residential and Economic Hub of the Municipality of Consolacion*" in furtherance of the Municipal Development Council Resolution No. 2 series of 2019 entitled, "Resolution Favorably Endorsing the 200 Hectares Reclamation Project for Economic Zone at Tayud, Consolacion, Cebu. This most important piece of legislation paved the way for the realization of two (2) reclamation projects to be situated in Barangay Tayud, namely, the New Cebu International Container Port Project and the Seafront City Project.

It is the vision of the leaders of Consolacion to provide a space for possible unprecedented progress for its constituents that will hopefully entice international investment. The Seafront City Project is an undertaking between the Municipality of Consolacion and La Consolacion Seafront Development Corporation. The Project is consistent with the Build Build Build Program, a key element of the 10-Point Socioeconomic Agenda of the government, which aims among others to "accelerate annual infrastructure spending to account for 5% of GDP, with Public-Private Partnerships playing a key role." Executive Order 27 (s. 2017) directs all government agencies, including LGUs, to implement the Socioeconomic Agenda.

The Project is an infrastructure project necessary to address the problems of land scarcity and congestion in the Municipality of Consolacion. The Project is envisioned to create a new eco-friendly and economically vibrant community in the "expanded" Municipality of Consolacion, featuring modern business, commercial and residential spaces that can attract international investments and tourism. Seafront City is designed to have a net positive impact to the environment and its nearby communities. Moreover, land reclamation is an internationally proven safe, reliable and sustainable solution to urban development and renewal. It can generate additional revenues for the national and local government, which revenues can be devoted for social services. Moreover, due to the devastating economic impact of the Covid-19 pandemic, the Projects can help revitalize the economy and provide employment for thousands of Filipinos who lost their jobs due to the health crisis.

Consolacion has a role to play in the economic progress of Metro Cebu being the gateway to the north. It needs to be at par with its neighboring LGUs if only in terms of its appearance and infrastructure. All one has to do is spend a few minutes in the frontage of the Tayud shipyard and the waters in the area and realize where its leaders should bring the municipality to. Consolacion and the Consolacionanons need the Seafront City Project. The promise of a brighter economic future is one that's worth pursuing if only for the welfare of the majority of its constituents and not just for a few entities.

LCSDC was established to develop the Proponent's Seafront City Project at no expense to the Municipality of Consolacion. The project will be developed to be an ecologically friendly, environmentally conscious, clean and green metropolis, adopting latest innovations, advanced and state facilities. The Project is aimed to be a Smart City Estate.

Additional or future ancillary facilities such as high-end marinas, cruise ships and touring/fishing vessel port, and facilities such as restaurants, souvenir shops and boutiques will be established in the future. The ECC application is for horizontal land development only.

1.1. Project Location and Area

Consolacion lies within Metro Cebu. It is bordered on the north by the town of Liloan, to the west by Cebu City, on the east by the Camotes Sea, and on the south by the city of Mandaue. Based on income classification, Consolacion is a 1st class municipality in the province of Cebu, a population of 148,012 people (2020 census).

The Project is a 235.8-hectare reclamation project situated along the foreshore and offshore area of Barangay Tayud, Municipality of Consolacion, Province of Cebu as shown in Figure 1-1. It extends from the shore to the Mactan Channel and from the mouth of Cansaga Bay under the Cansaga Bay Bridge all the way to the edge of the Phoenix fuel docking pier.

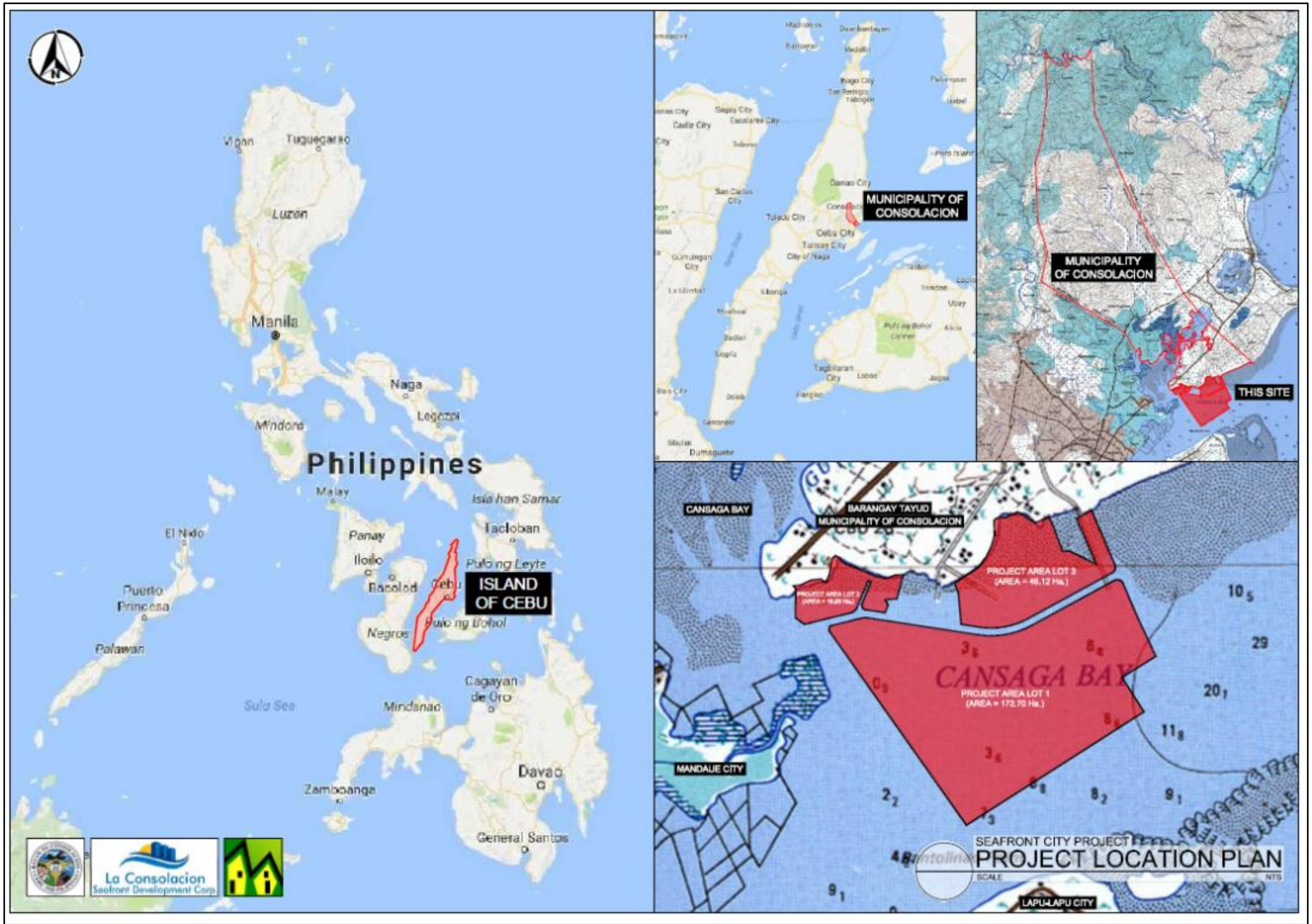


Figure 1-1.a: Location Map of the Project Site overlayed in NAMRIA Map

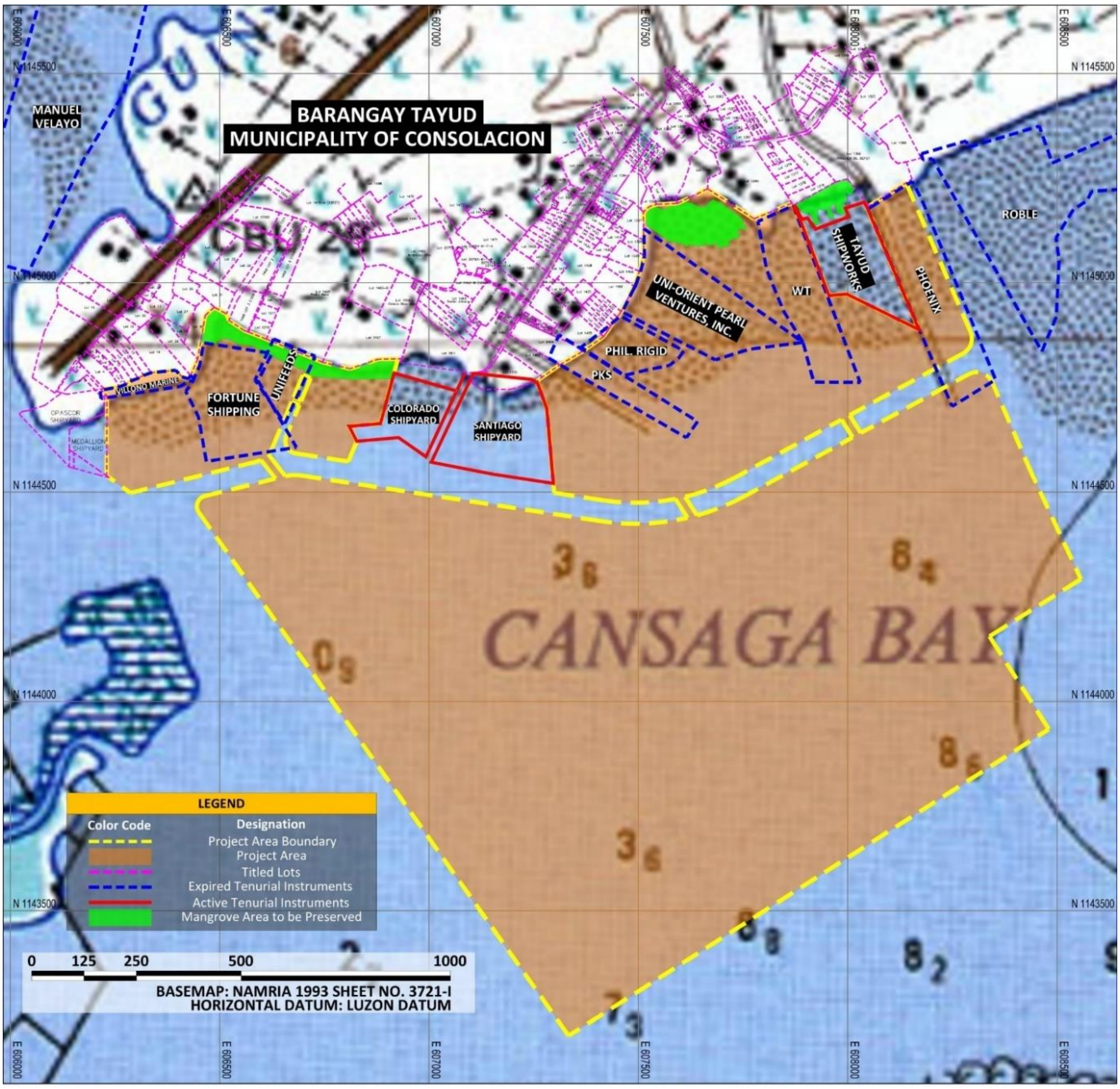


Figure 1-2.b: Location Map of the Project Site showing Magrove Areas and Affected Shipyards

Adjacent to the Project is a shipyard industrial area, with eleven (11) shipyards in total. Out of the eleven (11) shipyards, eight (8) have expired DENR tenurial instruments. The eight shipyards are, namely; 1) Nagasaka Shipyard, Inc. (formerly Villono Marine Services), 2) Fortune Shipworks, Inc., 3) Universal Feed Mill Corporation, 4) PKS Shipping Company, Incorporated, 5) Philippine Rigid Construction Corporation, 6) Uni-Orient Pearl Ventures, Inc, 7) WT Shipyard, 8) Phoenix Petroleum, Phils., Inc.. In contrast, three (3) shipyards, namely (1) Colorado Shipyard Corporation, (2) Santiago Shipyard & Shipbuilding Corporation, and (3) Tayud Shipworks, Inc., have active DENR tenurial instruments.

As part of the requirements in the ECC application, proponent already acquired Letter of No Objections (LONO) from the different Government Agencies such as DA-BFAR, Cebu Port Authority, Philippine Coast Guard, Department of Public Works and Highways, Department of Energy, Department of Tourism, and Philippine Reclamation Authority. This means that the project is free from any conflicts to any proposed government projects/activities within the applied project site.

The Bureau of Fisheries and Aquatic Resources (BFAR) issued a Letter of No Objection on June 28, 2021 for the project in view of their findings that the project will include the protection and rehabilitation of the mangroves in the project area. Another important consideration for their issuance is based on their findings that the project area has no history of fishpond operations or other fisheries development and that it has a low fishery production with minimal fishery activities due to the existence of the shipyards. However on March 2, 2022, BFAR-7 retracted the said Letter of No Objection in support to the application for Area Clearance citing that they have no authority to endorse any reclamation projects above 25 hectares. The new Letter of No Objection from BFAR is currently being processed at the National Director's Office in Metro Manila.

The Cebu Port Authority (CPA), on its part, anchored their Letter of No Objection to the project as it has not overlapped with the incoming New Cebu International Container Port Project. The Philippine Coast Guard (PCG) issued the same clearance because of the perceived impact to the economy of Cebu. The Department of Energy (DOE) based their clearance on the fact that the project area is not covered by any existing energy resource contract or application. The Department of Public Works and Highways (DPWH) grounded their letter of no objection on the willingness of the proponent to adjust the access of the project to the proposed Mandaue City-Consolacion-Liloan Bypass Road (MCLBR) project. The Philippine Reclamation Authority (PRA) recognized the importance of its none-objection in view of DOA No. 2018-14. And lastly, the Department of Tourism (DOT), in its letter of no objection, emphasized the importance of complying with all the legal requisites before the project can proceed.

Figure 1-2a to Figure 1-2b shows the vicinity map of the proposed reclamation project with its technical descriptions.

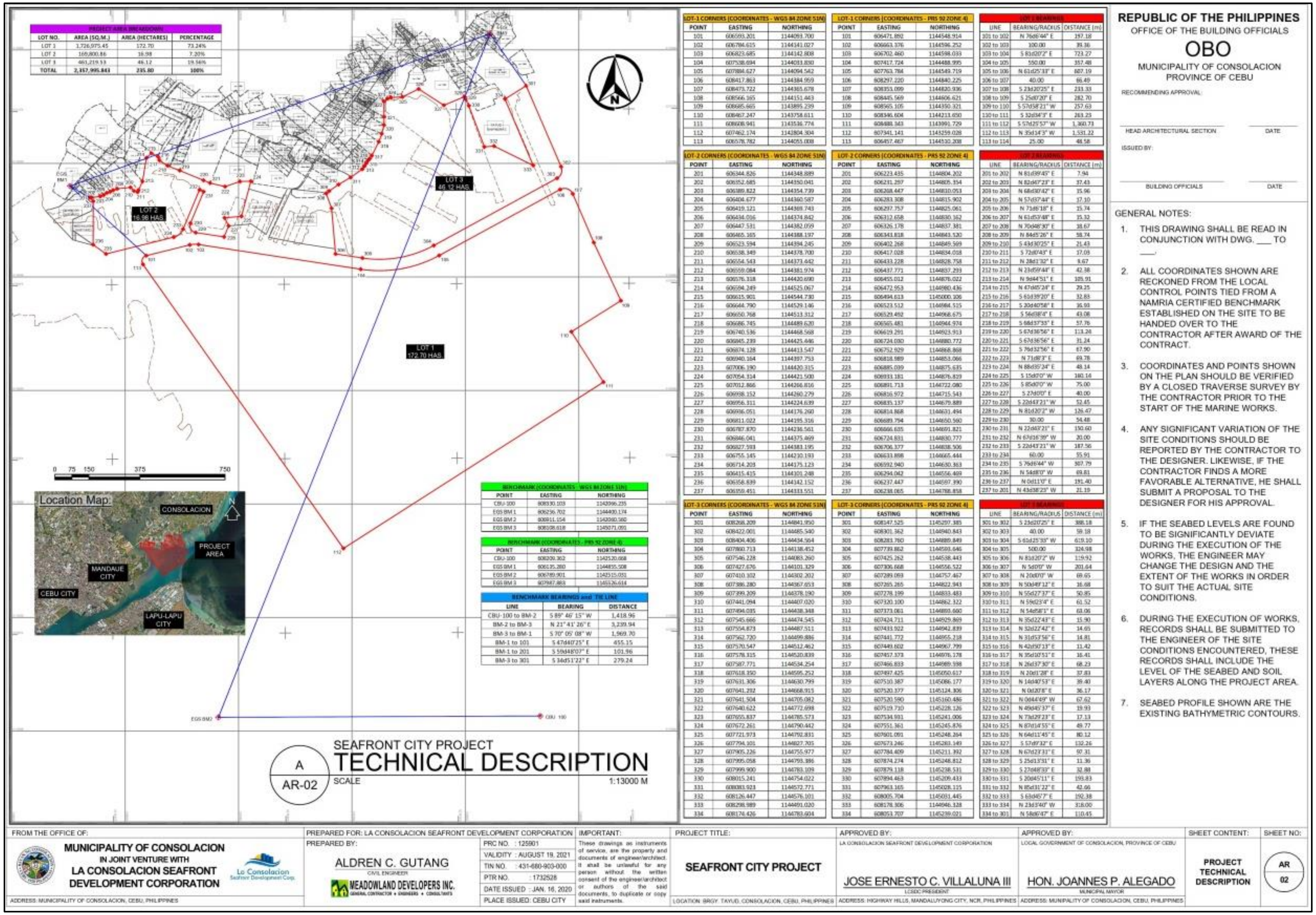


Figure 1-3a: Map of the Proposed Project with Technical Descriptions

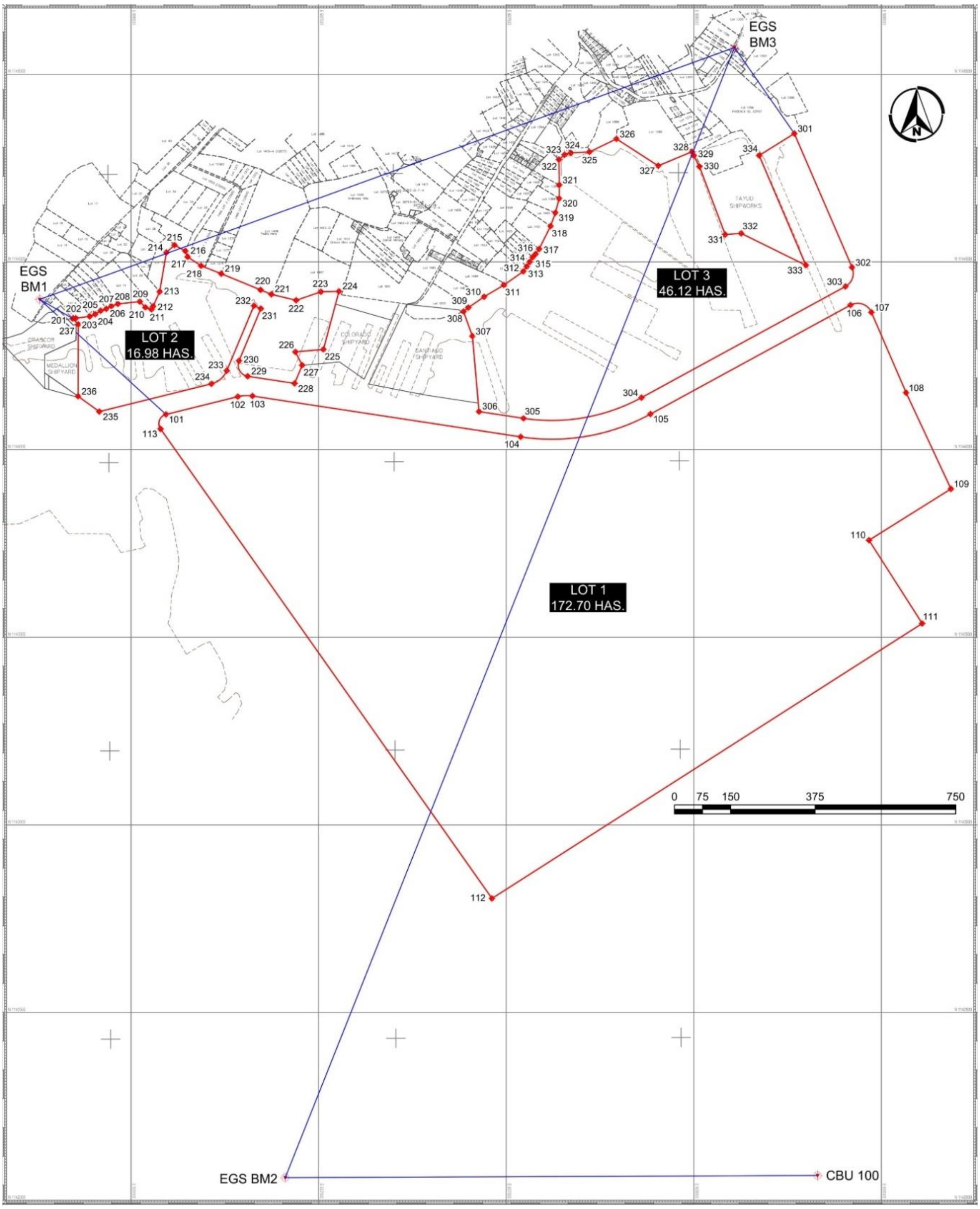


Figure 1-2b: Map of the Proposed Project blown up view

PROJECT AREA BREAKDOWN			
LOT NO.	**AREA (SQ.M.)**	**AREA (HECTARES)**	**PERCENTAGE**
LOT 1	1,726,975.45	172.70	73.24%
LOT 2	169,800.86	16.98	7.20%
LOT 3	461,219.53	46.12	19.56%
TOTAL	**2,357,995.843**	**235.80**	**100%**

LOT-1 CORNERS (COORDINATES - WGS 84 ZONE 51N)		
POINT	**EASTING**	**NORTHING**
101	606593.201	1144093.700
102	606784.615	1144141.027
103	606823.685	1144142.808
104	607538.694	1144033.830
105	607884.627	1144094.542
106	608417.863	1144384.959
107	608473.722	1144365.678
108	608566.165	1144151.443
109	608685.665	1143895.239
110	608467.247	1143758.611
111	608608.941	1143536.774
112	607462.174	1142804.304
113	606578.782	1144055.008

LOT-1 CORNERS (COORDINATES - PRS 92 ZONE 4)		
POINT	**EASTING**	**NORTHING**
101	606471.892	1144548.914
102	606663.376	1144596.252
103	606702.460	1144598.033
104	607417.724	1144488.995
105	607763.784	1144549.719
106	608297.220	1144840.225
107	608353.099	1144820.936
108	608445.569	1144606.621
109	608565.105	1144350.321
110	608346.604	1144213.650
111	608488.343	1143991.729
112	607341.141	1143259.028
113	606457.467	1144510.208

LOT 1 BEARINGS		
LINE	BEARING/RADIUS	DISTANCE (m)
101 to 102	N 76d6'44" E	197.18
102 to 103	100.00	39.36
103 to 104	S 81d20'2" E	723.27
104 to 105	550.00	357.48
105 to 106	N 61d25'33" E	607.19
106 to 107	40.00	66.49
107 to 108	S 23d20'25" E	233.33
108 to 109	S 25d0'20" E	282.70
109 to 110	S 57d58'21" W	257.63
110 to 111	S 32d34'3" E	263.23
111 to 112	S 57d25'57" W	1,360.73
112 to 113	N 35d14'3" W	1,531.22
113 to 114	25.00	48.58

LOT-2 CORNERS (COORDINATES - WGS 84 ZONE 51N)		
POINT	**EASTING**	**NORTHING**
201	606344.826	1144348.889
202	606352.685	1144350.041
203	606389.822	1144354.739
204	606404.677	1144360.587
205	606419.121	1144369.743
206	606434.016	1144374.842
207	606447.531	1144382.059
208	606465.165	1144388.197
209	606523.594	1144394.245
210	606538.349	1144378.700
211	606554.543	1144373.442
212	606559.084	1144381.974
213	606576.318	1144420.690
214	606594.249	1144525.067
215	606615.901	1144544.730
216	606644.790	1144529.146
217	606650.768	1144513.312
218	606686.745	1144489.620
219	606740.536	1144468.568
220	606845.239	1144425.446
221	606874.128	1144413.547
222	606940.164	1144397.753
223	607006.190	1144420.315
224	607054.314	1144421.500
225	607012.866	1144266.816
226	606938.152	1144260.279
227	606956.311	1144224.639
228	606936.051	1144176.260
229	606811.022	1144195.316
230	606787.870	1144236.561
231	606846.041	1144375.469
232	606827.593	1144383.195
233	606755.145	1144210.193
234	606714.203	1144175.123
235	606415.415	1144101.248
236	606358.839	1144142.152
237	606359.451	1144333.551

LOT-2 CORNERS (COORDINATES - PRS 92 ZONE 4)		
POINT	**EASTING**	**NORTHING**
201	606223.435	1144804.202
202	606231.297	1144805.354
203	606268.447	1144810.053
204	606283.308	1144815.902
205	606297.757	1144825.061
206	606312.658	1144830.162
207	606326.178	1144837.381
208	606343.818	1144843.520
209	606402.268	1144849.569
210	606417.028	1144834.018
211	606433.228	1144828.758
212	606437.771	1144837.293
213	606455.012	1144876.022
214	606472.953	1144980.436
215	606494.613	1145000.106
216	606523.512	1144984.515
217	606529.492	1144968.675
218	606565.481	1144944.974
219	606619.291	1144923.913
220	606724.030	1144880.772
221	606752.929	1144868.868
222	606818.989	1144853.066
223	606885.039	1144875.635
224	606933.181	1144876.819
225	606891.713	1144722.080
226	606816.972	1144715.543
227	606835.137	1144679.889
228	606814.868	1144631.494
229	606689.794	1144650.560
230	606666.635	1144691.821
231	606724.831	1144830.777
232	606706.377	1144838.506
233	606633.898	1144665.444
234	606592.940	1144630.363
235	606294.042	1144556.469
236	606237.447	1144597.390
237	606238.065	1144788.858

LOT 2 BEARINGS		
LINE	BEARING/RADIUS	DISTANCE (m)
201 to 202	N 81d39'45" E	7.94
202 to 203	N 82d47'23" E	37.43
203 to 204	N 68d30'42" E	15.96
204 to 205	N 57d37'44" E	17.10
205 to 206	N 71d6'18" E	15.74
206 to 207	N 61d53'48" E	15.32
207 to 208	N 70d48'30" E	18.67
208 to 209	N 84d5'26" E	58.74
209 to 210	S 43d30'25" E	21.43
210 to 211	S 72d0'43" E	17.03
211 to 212	N 28d1'32" E	9.67
212 to 213	N 23d59'44" E	42.38
213 to 214	N 9d44'51" E	105.91
214 to 215	N 47d45'24" E	29.25
215 to 216	S 61d39'20" E	32.83
216 to 217	S 20d40'58" E	16.93
217 to 218	S 56d38'4" E	43.08
218 to 219	S 68d37'33" E	57.76
219 to 220	S 67d36'56" E	113.24
220 to 221	S 67d36'56" E	31.24
221 to 222	S 76d32'56" E	67.90
222 to 223	N 71d8'3" E	69.78
223 to 224	N 88d35'24" E	48.14
224 to 225	S 15d0'0" W	160.14
225 to 226	S 85d0'0" W	75.00
226 to 227	S 27d0'0" E	40.00
227 to 228	S 22d43'21" W	52.45
228 to 229	N 81d20'2" W	126.47
229 to 230	30.00	54.48
230 to 231	N 22d43'21" E	150.60
231 to 232	N 67d16'39" W	20.00
232 to 233	S 22d43'21" W	187.56
233 to 234	60.00	55.91
234 to 235	S 76d6'44" W	307.79
235 to 236	N 54d8'0" W	69.81
236 to 237	N 0d11'0" E	191.40
237 to 201	N 43d38'23" W	21.19

LOT-3 CORNERS (COORDINATES - WGS 84 ZONE 51N)		
POINT	EASTING	NORTHING
301	608268.209	1144841.950
302	608422.001	1144485.540
303	608404.406	1144434.564
304	607860.713	1144138.452
305	607546.228	1144083.260
306	607427.676	1144101.329
307	607410.102	1144302.202
308	607386.280	1144367.653
309	607399.209	1144378.190
310	607441.094	1144407.020
311	607494.035	1144438.348
312	607545.666	1144474.545
313	607554.873	1144487.511
314	607562.720	1144499.886
315	607570.547	1144512.462
316	607578.315	1144520.839
317	607587.771	1144534.254
318	607618.350	1144595.252
319	607631.306	1144630.799
320	607641.292	1144668.915
321	607641.504	1144705.082
322	607640.622	1144772.698
323	607655.837	1144785.573
324	607672.261	1144790.442
325	607721.973	1144792.831
326	607794.101	1144827.705
327	607905.226	1144755.977
328	607995.058	1144793.386
329	607999.900	1144783.109
330	608015.241	1144754.022
331	608083.923	1144572.771
332	608126.447	1144576.101
333	608298.989	1144491.020
334	608174.426	1144783.604

LOT-3 CORNERS (COORDINATES - PRS 92 ZONE 4)		
POINT	EASTING	NORTHING
301	608147.525	1145297.385
302	608301.362	1144940.843
303	608283.760	1144889.849
304	607739.862	1144593.646
305	607425.262	1144538.443
306	607306.668	1144556.522
307	607289.093	1144757.467
308	607265.265	1144822.943
309	607278.199	1144833.483
310	607320.100	1144862.322
311	607373.061	1144893.660
312	607424.711	1144929.869
313	607433.922	1144942.839
314	607441.772	1144955.218
315	607449.602	1144967.799
316	607457.373	1144976.178
317	607466.833	1144989.598
318	607497.425	1145050.617
319	607510.387	1145086.177
320	607520.377	1145124.306
321	607520.590	1145160.486
322	607519.710	1145228.126
323	607534.931	1145241.006
324	607551.361	1145245.876
325	607601.091	1145248.264
326	607673.246	1145283.149
327	607784.409	1145211.392
328	607874.274	1145248.812
329	607879.118	1145238.531
330	607894.463	1145209.433
331	607963.165	1145028.115
332	608005.704	1145031.445
333	608178.306	1144946.328
334	608053.707	1145239.021

LOT 3 BEARINGS		
LINE	BEARING/RADIUS	DISTANCE (m)
301 to 302	S 23d20'25" E	388.18
302 to 303	40.00	59.18
303 to 304	S 61d25'33" W	619.10
304 to 305	500.00	324.98
305 to 306	N 81d20'2" W	119.92
306 to 307	N 5d0'0" W	201.64
307 to 308	N 20d0'0" W	69.65
308 to 309	N 50d49'12" E	16.68
309 to 310	N 55d27'37" E	50.85
310 to 311	N 59d23'4" E	61.52
311 to 312	N 54d58'1" E	63.06
312 to 313	N 35d22'43" E	15.90
313 to 314	N 32d22'42" E	14.65
314 to 315	N 31d53'56" E	14.81
315 to 316	N 42d50'13" E	11.42
316 to 317	N 35d10'51" E	16.41
317 to 318	N 26d37'30" E	68.23
318 to 319	N 20d1'28" E	37.83
319 to 320	N 14d40'53" E	39.40
320 to 321	N 0d20'8" E	36.17
321 to 322	N 0d44'49" W	67.62
322 to 323	N 49d45'37" E	19.93
323 to 324	N 73d29'23" E	17.13
324 to 325	N 87d14'55" E	49.77
325 to 326	N 64d11'45" E	80.12
326 to 327	S 57d9'32" E	132.26
327 to 328	N 67d23'31" E	97.31
328 to 329	S 25d13'31" E	11.36
329 to 330	S 27d48'33" E	32.88
330 to 331	S 20d45'11" E	193.83
331 to 332	N 85d31'22" E	42.66
332 to 333	S 63d45'7" E	192.38
333 to 334	N 23d3'40" W	318.00
334 to 301	N 58d6'47" E	110.45

BENCHMARK (COORDINATES - WGS 84 ZONE 51N)		
POINT	EASTING	NORTHING
CBU-100	608330.103	1142066.235
EGS BM 1	606256.702	1144400.174
EGS BM 2	606911.154	1142060.560
EGS BM 3	608108.618	1145071.091

BENCHMARK (COORDINATES - PRS 92 ZONE 4)		
POINT	EASTING	NORTHING
CBU-100	608209.362	1142520.668
EGS BM 1	606135.280	1144855.508
EGS BM 2	606789.901	1142515.031
EGS BM 3	607987.883	1145526.614

BENCHMARK BEARINGS and TIE LINE		
LINE	BEARING	DISTANCE
CBU-100 to BM-2	S 89° 46' 15" W	1,418.96
BM-2 to BM-3	N 21° 41' 26" E	3,239.94
BM-3 to BM-1	S 70° 05' 08" W	1,969.70
BM-1 to 101	S 47d40'25" E	455.15
BM-1 to 201	S 59d48'07" E	101.96
BM-3 to 301	S 34d51'22" E	279.24

1.1.1. Selection of Primary and Secondary Impact Areas

With reference to Annex 2-2 of the Revised Procedural Manual (RPM) of DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) Implementing Rules and Regulations of Presidential Decree 1586, Establishing the Philippine Impact Statement System, Sec. 3.a, a Direct Impact Area is defined as “the area where all project facilities are proposed to be constructed/situated and where all operations are proposed to be undertaken”. Indirect impact areas are areas located immediately outside the coverage of the project facilities and operations.

Table 1-1: Summary of Area Classification and Coverage

AREA CLASSIFICATION	AREA COVERAGE
Direct Area/Primary Area	**Biophysical Impact:** • The property where the proposed project components will be built • Direct adjacent areas both inland and coastal waters • Mangrove Areas • Cansaga Bay **Socio-cultural Impact:** • The Barangay Tayud being the host community
Indirect Area/Secondary Area	**Biophysical Impact:** • Immediate vicinity of the proposed project included within the 0.5-1.0 kilometer radial zone of the Municipality of Consolacion and Portion of the coastal area of Barangay Paknaan, Mandaue City and Butuanon River • Cansaga River • Nearest Fishing Grounds **Socio-cultural Impact:** • Areas other than the primary beneficiary of the Social Development Plan (SDP) that will benefit at the municipal, provincial, regional levels from potential revenues and taxes of the proposed project • Immediate vicinity of the proposed project included within the 0.5-1.0 kilometer radial zone

As part of the secondary impact areas, some existing anchorage and shelter areas of ship-owners will be covered by the proposed reclamation project. Those affected anchorages and shelters of shipyards will eventually be displaced, however, the anchorage and shelters that are outside the applied project will not to be affected and has still accessibility of passage going to the inland areas. The environmental setting of these existing anchorage and shelter area within the project site has most likely no presence of corals or any significant aquatic natural resources due to its activities. The impact of the reclamation on these areas is negligible due to its existing environmental setting.

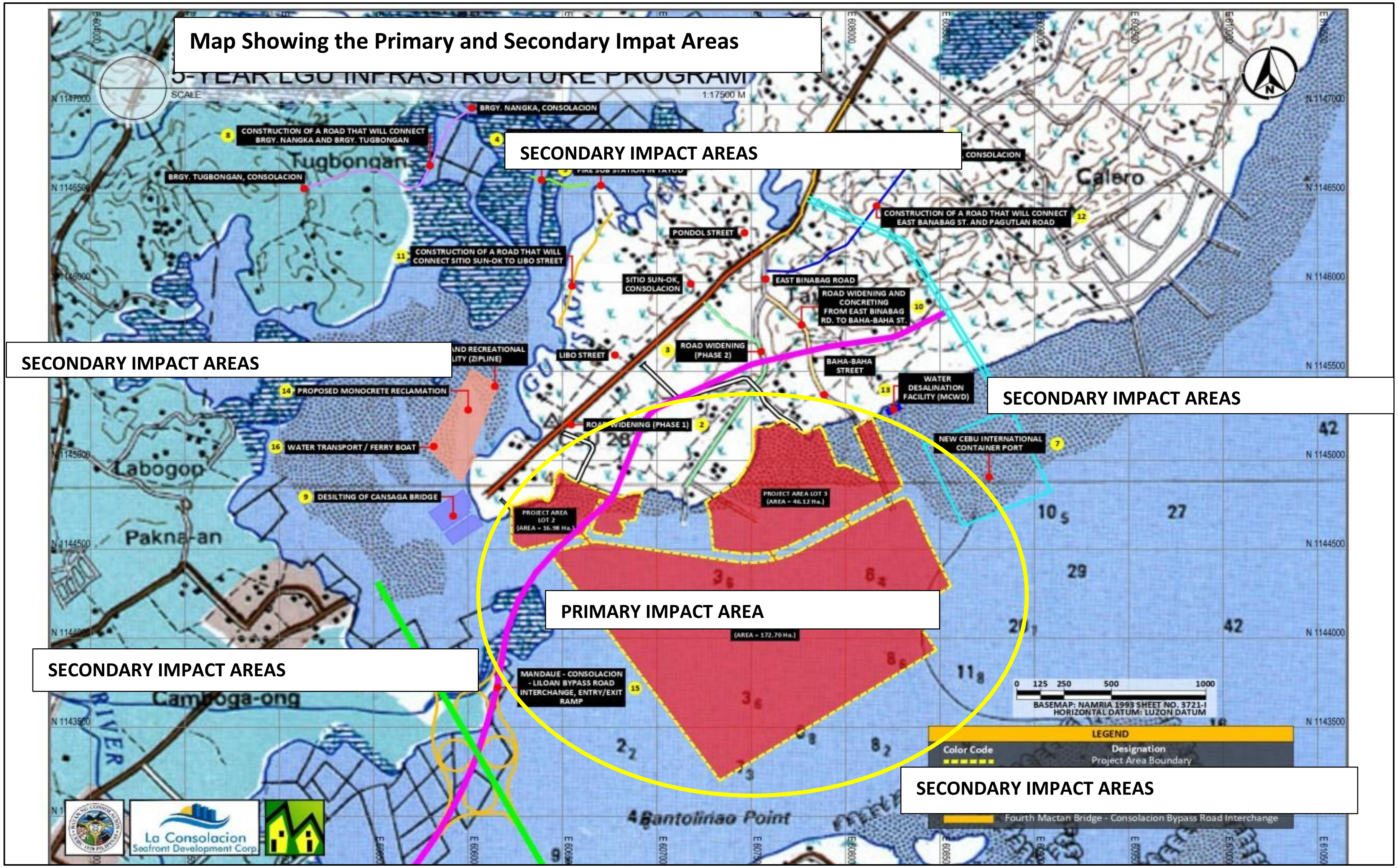


Figure 1-4: Project Impact Areas

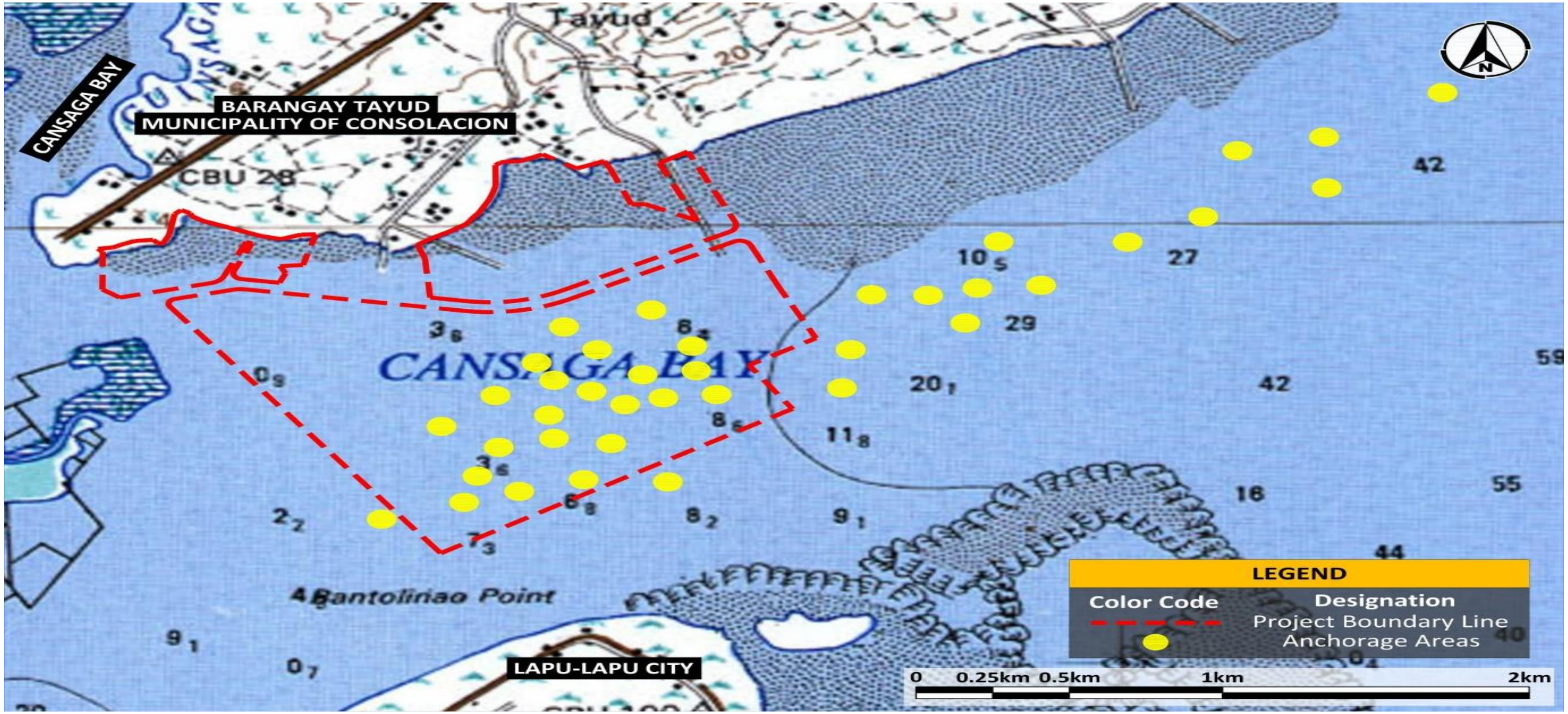


Figure 1-5: Map showing the achorage areas

1.1.2. Other Reclamation Projects Surrounding the Project Site

There are 14 other reclamation projects located in different areas of Metro Cebu which surround the proposed Seafront City Project in Consolacion. Among the 14, 3 projects currently exist namely: the South Road Properties, the North Reclamation Area and the Mandaue Reclamation Area; 2 are on-going namely: Cebu South Harbor and Container Terminal Complex (CSHCTC) and the Minglanilla Ming-Mori Reclamation Project; and 9 projects are still being proposed namely: New Cebu International Container Port, Monoconcrete Reclamation, Punta Engaño Reclamation Project, SM Prime Foreshore Development, Cordova Sugbo Prime Reclamation Project, Cordova Edview Ecopark, Mandaue Reclamation Project, Mactan North Reclamation and Development Project (MNRDP) and the MNRDP Extension Project.

Figure 1-5 provides a map showing the abovementioned projects relative to the location of Seafront City Project. Higher resolution and size of the map is attached in the annexes.

Figure 1-6: Map showing the existing, ongoing and proposed reclamation projects w/ Metro Cebu

1.2. Project Rationale

In general, the development of the Project will address the challenges of traffic congestion in the northeastern section of the Province of Cebu, increase internal revenue budget for Barangay Tayud, contribute to the economy of the Municipality of Consolacion, and the economy of the Province. Employment opportunities will be created and government tax revenues will be generated from the Project. In partnership with LCSDC and the host community of Barangay Tayud, the Proponent's community development programs and the Social Development Plan will improve delivery of basic services.

The Proponent aspires to accomplish the intention of Ordinance No. 6 Series of 2019 enacted by the Municipality of Consolacion which aims to convert the foreshore, and seas within the municipal territorial limits into an international investment, tourism, commercial, residential, and economic hub which was originally to develop a 200 hectares of reclamation project (not including the timberland areas). To include in the development, the existing shipyard areas that has expired tenurial instruments as part of the project area, the total applied area size wil now sum-up to 235.8 hectares. The Proponent is cognizant of the significant development changes in Metro Cebu, with the Municipality's close proximity to the 4th Cebu- Mactan Bridge Project with a completion date of 2028, full occupancy of Mactan Export Processing Zone (MEPZ), and the alignment of the proposed Mandaue-Consolacion-Liloan Bypass Road which will directly pass along the Project area.

1.2.1. Economic Development Impact of the Project

The population of Central Visayas in 2015 was recorded at 7.39 million from 5.70 million in 2000 increasing by 1.74% per year. This accounts 7.32% of the total population of the country. Cebu has the biggest population accounting 62.63% in 2015. Population land density is computed at 465.45 individuals per square kilometer - higher than the national average of 336.60.

Using a population growth of 5%, and given the population by age group, labor force participation rate (LFPR), and employment targets, the number of labor force and employment size.

Table 1-2: Projected Population, Labor Force and Employment of Region VII (2015-2050)

Item	2015	2020	2026	2030	2040	2050
Population	7,396,898	9,440,525	12,651,206	15,377,620	25,048,522	40,801,403
% of Pop. 14-64 years	0.59	0.59	0.60	0.60	0.61	0.61
Size of Potential LF	4,364,170	5,569,909	7,590,723	9,226,572	15,279,598	24,888,856
LFPR	0.66	0.66	0.67	0.68	0.69	0.69
Active LF	2,880,352	3,676,140	5,085,785	6,227,936	10,466,525	17,173,311

Employment Rate	0.93	0.93	0.94	0.94	0.95	0.96
Unemployed Rate	0.07	0.07	0.07	0.06	0.06	0.04
No of Employed	2,678,727	3,418,810	4,363,365	5,854,260	7,471,684	16,486,378
No of Unemployed	201,625	257,330	328,425	373,676	476,916	686,932

Gross Regional Domestic Product (GRDP)

Total value of goods and services produced in the Philippine economy in 2020 was recorded at Php 17.527 trillion from Php 11.183 trillion in 2010 (at constant 2018 prices) increasing by 4.60% per year. The largest contributor is the National Capital Region accounting 31.93 % with Central Visayas ranking fourth contributing 6.45 % behind CALABARZON and Central Luzon. In terms of growth, Central Visayas grew by 5.42% higher than the national average of 4.60%.

At constant 2018 prices Gross Regional Domestic Product (GRDP) for Central Visayas Metro Cebu is projected to increase by an average of 6.50% per year from 2020 to 2025, 7.0% from 2026 to 2030; 7.50% from 2031 to 2035, 6.5% from 2036 to 2040, 6.00% from 2041 to 2045, and 5.5% from 2046 to 2050. Using this growth rates, annual Gross Value Added will increase from Php 1.128 billion in 2026 to Php 7.469 billion in 2050.

Table 1-3: Projected GRDP of Central Visayas at Constant 2018 Prices (in Billion pesos)

Year	GRDP in Php Billion (at constant 2018 prices)	Average Annual Growth Rate (%)
2020 (base year)	1,129.84	-
2026	1,656.34	6.50
2030	2,171.13	7.00
2035	3,116.93	7.50
2040	4,270.47	6.50
2045	5,714.85	6.00
2050	7,469.08	5.50

Estimated Share of Metro Cebu to Central Visayas' GRDP

Total value of goods and services produced within Metro Cebu in 2020 is estimated at Php 723,099 million in 2020 (at constant 2018 prices) accounting 64% of total GRDP of Region VII. The north wing portion of Metro Cebu defined as the service area of Consolacion Seafront City Project is estimated to have contributed Php 202.3 billion in 2020.

Table 1-4: GRDP of the Project Area (2020)

Location	2020 GRDP at constant 2018 prices (in Php million)	GRDP Distribution (%)

Cebu Province	903,874	80.00
Rest of Region VII	225,969	20.00
Total	1,129,843	100.00
GDP Distribution in Cebu Province	-	-
Cebu City	234,140	25.90
North Wing of Metro Cebu (Consolacion to Danao)	202,323	22.38
South Wing of Metro Cebu (Talisay to Carcar)	167,904	18.58
Fronting Cebu City (Lapulapu and Cordova)	118,733	13.14
Total for Metro Cebu	723,099	80.00
Outside Metro Cebu	180,775	20.00
Total for Cebu Province	903,874	100.00

1.2.2. Economy and Tourism of Consolacion

The municipality is moving towards greater development with several medium to large size manufacturing industries. Housing subdivisions proliferate in the area catering to relatively high-income bracket of the population. The municipality has malls and supermarkets where most residents buy their daily needs. It has also entertainment cinemas and restaurants.

Consolacion has a rich cultural heritage. It is the originator of the famous dance called "*Maligoy de Cebu*". This dance is performed by a couple of dancers during special events such as weddings, baptisms and other social celebrations. Sarok Festival a well celebrated event in the locality to commemorate the town's foundation anniversary. *Sarok* is a hat made of bamboo worn to protect natives from scorching tropical sunlight.

Revenue

According to the Bureau of Local Government Finance, the annual regular revenue of Consolacion for the fiscal year of 2016 was Php. 300,974,038.69. Table 1-5 shows the historical annual income of the municipality.

Table 1-5: Annual Revenue of the Municipality of Consolacion

Fiscal Year	Annual Regular Income (in Php)	Change
2009	129,042,554	-
2010	137,733,452	6.73%
2011	148,656,073	7.93%
2012	159,962,405	7.61%
2013	200,301,213	25.22%
2014	230,546,542	15.10%

2015	271,902,825	17.94%
2016	300,974,038	10.69%

Developmental Target

The developmental plan of the municipality aims to encourage large scale development in the municipality specifically along its foreshore and off-shore areas since about 70% of the area of Consolacion is mountainous and large-scale developments require significant flat land areas that will displace residents and cause unwanted traffic problems if not planned properly. This plan also aims to meet the goals of growth and progress in Metro Cebu especially the entirety of the Province of Cebu.

To fully implement this plan the Municipality enacted Ordinance No. 6 S.2019 titled, An Ordinance Declaring the Foreshore, Offshore and Sea within the Municipal Territorial limits from the Boundary of Liloan and Mandaue City waters into an International Investment, Tourism, Commercial, Residential and Economic Hub of the Municipality of Consolacion. One prime area for development is in Brgy. Tayud which has the largest land area and is currently an industrialized area with its shipyards and shipbuilding activities. Brgy. Tayud is also the barangay directly facing the Mactan Channel.

Economy of Barangay Tayud

A dominant industry in the municipality of Consolacion is the shipyard located in Barangay Tayud. The area is classified as an industrial zone where large factories and shipyards proliferate. Among the shipyards operating in the area are the following: Sandoval Shipyard, Nagasaka Shipyard, Fortune Shipworks, Inc., Colorado Shipyard, Santiago Shipyard and Shipbuilding Corporation and, PKS Shipping Company Incorporated. Other large factories are Universal Feed Mill Corporation, BMEG Feeds, Philippine Rigid Construction Corporation, and the Monocrete Construction Philippines Incorporated. The depot and pier of the Phoenix Petroleum Philippines Inc. is located in the northeast boundary of the project site.

The current income generation of the LGU out from these 11 shipyard operators that will be affected by the project will increase when the project will be fully implemented. The loss of employment will be handled by the proponent by offering them alternative job to compensate the affected personnel. Table 1-6 presents the LGU Infrastructure Programs showing the development of the Barangay which will attract more business investments in the barangay resulting to higher employment opportunities.

The existing mangroves which are within the project area will be preserved and protected. The area of the existing mangroves will be enhanced as a Mangrove Ecopark. The said conservation program will not only attract tourists but at the same time rehabilitate, preserve and protect the mangrove trees.

Table 1-6: Five year LGU Infrastructure Programs including Barangay Tayud from 2021-2025

NO.	PROJECT	BRIEF DESCRIPTION	SCHEDULE OF IMPLEMENTAT-ION	REMARKS
1	Road Widening (Phase 1)	Widening of the Cebu-North Coastal Road from the Cansaga Bay Bridge up to Pondol Street.	February 2021 - January 2022 (Ongoing)	The LGU will coordinate and closely work with DPWH for the implementation of this project.
2	Road Widening (Phase 2)	Widening of the Bagakay and Tawagan Street	August 2021 - July 2022	The LGU will coordinate and closely work with DPWH for the implementation of this project.
3	Laray Rd. Bridge Upgrade	Upgrading of the existing Laray Road bridge that connects Brgy. Jugan and Brgy. Tayud	September 2021 - April 2022	A part of the Municipal Development Investment Program CY 2020-2022 for Barangay Tayud, Consolacion, Cebu.
4	Fire Sub Station in Brgy. Tayud	Construction of a fire substation in Brgy. Tayud	December 2021 - November 2022	A part of the Municipal Development Investment Program CY 2020-2022 for Barangay Tayud, Consolacion, Cebu.
5	Road Widening (Phase 3)	Widening of the Cebu-North Coastal Road from Pondol Street up to Sitio Simborio	January 2022 - December 2022	The LGU will coordinate and closely work with DPWH for the implementation of this project.
6	New Cebu International Container Port	Construction of a new international port which will be built on reclaimed land in Tayud, Consolacion.	January 2022 - December 2024	The LGU will closely coordinate with implementing and line-agencies for the implementation of this project such as DOTr, PPA/CPA, DPWH, among others.
7	Road Opening (Tugbongan to Jugan)	Construction of a road that will connect Brgy. Tugbongan to Brgy. Jugan and Brgy. Tayud	February 2022 - January 2023	The LGU will coordinate and closely work with DPWH for the implementation of this project.
8	Dredging of Cansaga Bridge	Dredging work in the immediate vicinity of the Cansaga Bay Bridge	March 2022 - May 2022	The LGU will coordinate and closely work with DPWH for the implementation of this project.
9	Road Widening and Concreting	Concreting and widening of an existing road which	April 2022 - January 2023	A part of the Municipal Development

	(East Binabag to Baha-Baha)	connects East Binabag Rd. to Baha-Baha St.		Investment Program CY 2020-2022 for Barangay Tayud, Consolacion, Cebu.
10	Road Opening (Sun-ok to Libo)	Construction of a road that will connect Sitio Sun-ok and Libo Street, Consolacion	June 2022 - May 2023	A part of the Municipal Development Investment Program CY 2020-2022 for Barangay Tayud, Consolacion, Cebu
11	Road Opening (Pagutlan- East Binabag)	Construction of a road that will connect Pagutlan Road and East Binabag Road	June 2022 - May 2023	The LGU will coordinate and closely work with DPWH for the implementation of this project.
12	Water Desalination Facility (MCWD)	Construction of a water desalination facility in Brgy. Tayud to provide an additional water source to Consolacion	July 2022 - June 2023	The LGU will coordinate and closely work with MCWD for the implementation of this project.
13	Proposed Monocrete Reclamation	A Proposed reclamation inside the Cansaga Bay	August 2022 - July 2025	PPP Project
14	Mandaue - Consolacion - Liloan Bypass Road, component of the Fourth Mandaue-Mactan Bridge	Construction of a highway/viaduct interchange and entrance/exit ramp which leads to the coastal areas of Mandaue, Consolacion, and Liloan.	July 2021 - December 2025	The LGU will coordinate and closely work with DPWH for the implementation of this project.
15	Water Transport / Ferry Boat	Construction of a ferry terminal facility inside the Cansaga Bay for water transport	July 2025 - September 2025	PPP Project
16	Tourism & Recreational Facility (Zipline)	Construction of a tourism and recreational facility which includes a zipline inside the Cansaga Bay	July 2025 - December 2025	PPP Project

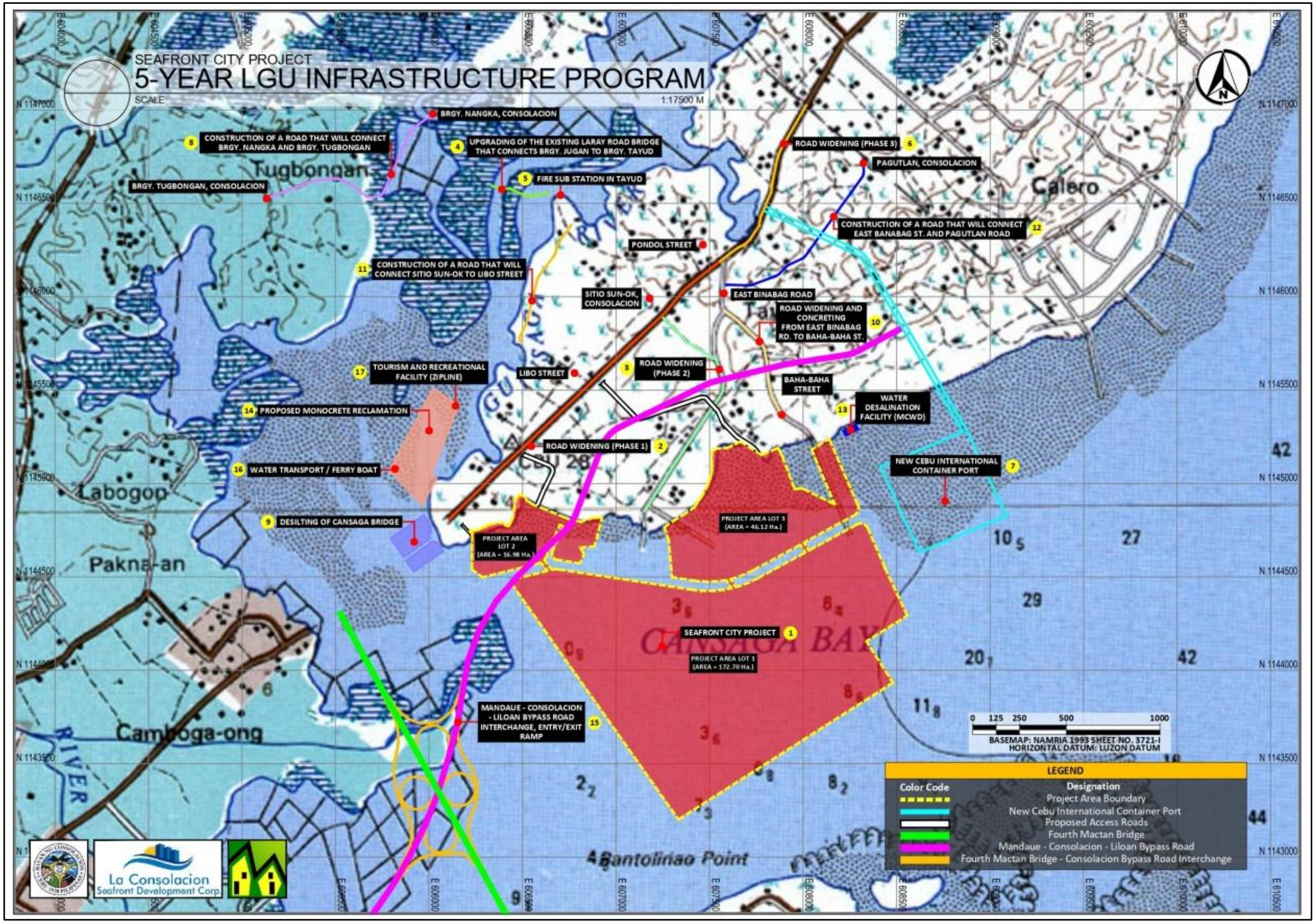


Figure 1-7: Map showing the 5-year Infrastructure Program of LGU Consolacion

1.3. Project Alternatives

The site was chosen in consonance to the multi-nodal development strategy that is suggested for Metro-Cebu to re-direct development away from its core center (i.e. Cebu City, Mandaue City, Lapulapu City), towards the peripheral growth nodes Consolacion-Liloan Corridor in the north and the Naga-Minglanilla Corridor in the south of Cebu City. This approach is intended to decongest the core center to achieve economic efficiency, physical order, and sustainable development. Under this concept, the core center will provide higher-level and more specialized facilities in health, education, transportation, and banking. The lower level and market-oriented trade and service facilities are encouraged to be established in the peripheral growth nodes to minimize the movement of people and commodities towards the core center. This also complements the developmental plan of the Municipality as stated in the ordinance they enacted, Ordinance No. 6 S.2019 titled, An Ordinance Declaring the Foreshore, Offshore, and Sea within the Municipal Territorial limits from the Boundary of Liloan and Mandaue City waters into an International Investment, Tourism, Commercial, Residential and Economic Hub of the Municipality of Consolacion. Per conducted Cost-Benefit Analysis, the income that may generate if the project will be implemented versus the existing income of the project area is more than equivalent higher if the Seafront City Project will be push through considering more investment and more income will come in and more jobs will be offered that will benefit not just the local constituents but even the constituents from other LGUs. However, in the event that the project will not be push through, project area will remain as is with the existing shipyard operations.

The key to siting of the project is to determine the best option available that will not result in serious environmental and social impacts.

With respect to territorial jurisdiction:

The most basic criterion in siting alternatives is that the site must be legally within the political jurisdiction of the LGU Proponent, which for this project is Muni. Conflict on jurisdiction with other LGUs should be avoided. The LGU Lapu-lapu City already issued a Letter of No Objection of the proposed project while there is still an ongoing negotiation with LGU Mandaue City for No Objection or any possible conflicts, if there's any. LGU Liloan on the other hand is already quite distant away from the applied project area in which a No Objection from them is already unnecessary.

With respect to environmental/social impacts:

The severity of impacts is essentially the same for the feasible sites because the sites are essentially dictated by marine resources and bathymetry. Water depths have to be compatible with the dredging requirements and cost considerations, thus limiting the options to sites with depths of approximately 10 meters or shallower.

The perception of affected communities is considered neutral with respect to the site because the community concerns i.e. livelihood, employment, floods, storm surge and threats of earthquakes are essentially independent of the feasible site options.

With respect to resources:

The project will be supplied by VECO, water resources will be supplied by local water concessionaire, and sources of filling materials will be supplied by the nearby legitimate sources. In any case that these sources will not be sufficient enough or not available to supply the project, other alternative sources of power will supply by using renewable resources such installation of solar panels to the future buildings. As part of the 5-year LGU infrastructure plan, there will be future desalination near the project which can served as potential water source also. Part of the components of the project is also to have several cistern tanks for rainwater harvesting as well as the Mangrove EcoPark as water recharge point. An adequate drainage system will be installed to prevent flooding with silt trap and silt curtain to avoid siltation. The proponent will also encourage the future locators to make building as green building with environmental-friendly concept. And same with the raw materials and other resources, the proponent has also other sustainable sources that will be sufficient enough to supply or support the project.

With respect to risk factors:

The geological and met-ocean risks are the same for the coastal areas of the Province of Cebu, and therefore, are not germane to site selection. Moreover, engineering/design and construction methodology interventions will be adapted and applied to the landforms in whichever site is selected.

With respect to other possible reclamation projects:

As planned, there will be sufficient buffer zone between the site and these other projects.

In addition, the site must not be in conflict with existing settlers, if any; and must be in reasonable distance from the source of filling materials.

With respect to configuration:

Site and configuration must be acceptable to concerned other government entities, e.g. the PPA as would be established during the securing of the Letters of No Objection (LONOs).

The Master Plan and the configuration should be in harmony. Configuration and site must be in conformance with the PLUP/CLUPs. Configuration must not be in conflict with existing and future reclamation plans of the host municipality/province; and the design of the viaduct will be influenced by the configuration and site inasmuch as the viaduct must connect to the shore and must be feasible in terms of length.

With respect to reclamation methodologies

The project has multiple options for its construction methodology. From the type of containment structure to the mode of delivery for the fill materials. In selecting the proper methodology requires the understanding of both the options and the site parameters. Reclamation projects can utilize different types of containment structures that prevent the reclamation fill materials from being eroded by the sea. Below are the major types of Containment structures:

- Sheet piles are mostly used as containment structures whether made from steel, timber, and reinforced concrete. The sections of these piles have interlocking edges that would form retaining walls that prevent soil from sliding and in the case of reclamation projects, erosion by the sea. Since sheet piles are basically retaining walls, they are highly sufficient at minimizing the area taken up by containment structures.

- Revetments are low-cost structures built or placed along the banks of rivers or shorelines and are designed to absorb the energy from incoming waves from the sea and tidal currents. These structures are usually made from natural stones or prefabricated concrete blocks. This type of containment structures would require a wider area since they are mostly sloped along the plane facing the sea.

For the filling materials, the sources of these suitable fill materials are from other established quarry sites within and outside Cebu Province but ideally within a 100-kilometer radius from the project site. Source can be from land-based quarries or from river mouths and deltas, as well as foreshore and offshore seabed provided that all the government regulatory requirements are secured by the quarry operator(s) / supplier(s).

Site options with Analysis and Evaluation of Site Engineering Geological Conditions:

Evaluation of the Site Stability and Suitability

The geological structure activity in the investigated area is relatively stable, and no adverse geological action such as neotectonic movement, active fault zone, and landslide, etc., and obstacles affecting the project are seen. Soft muddy soil with some thickness is distributed in the shallow part of the survey site. It is in the adverse section for building seismicity. However, according to the analysis for engineering geological conditions of the site, the overall stability of the site is good. This region has obtained rich building experience that overcomes these unfavorable factors. Therefore, the survey site is a general site for construction, which is suitable for the construction of this project

The geological and met-ocean risks are the same for the coastal areas of the Province of Ceby, and therefore, are not germane to site selection. Moreover, engineering/design and construction methodology interventions will be adapted and applied to the landforms in whichever site is selected.

Assessment on Engineering Geological Conditions for Marine Levee

There is a good natural shallow foundation bearing layer available in the proposed area. Therefore, the soil type in the proposed area is the key which affects the design and construction of the cofferdam. The soft soil layer of the superficial part shall be strengthened necessarily to improve the bearing capacity of the shallow foundation soil layer and ensure the stability and safety of the cofferdam during construction and after being put into use.

Siting

The site was chosen in consonance to the multi-nodal development strategy that is suggested for Metro-Cebu to re-direct development away from its core center (i.e. Cebu City, Mandaue City, Lapulapu City), towards the peripheral growth nodes Consolacion-Liloan Corridor in the north and the Naga-Minglanilla Corridor in the south of Cebu City. This approach is intended to decongest the core center to achieve economic efficiency, physical order, and sustainable development. Under this concept, the core center will provide higher-level and more specialized facilities in health, education, transportation, and banking. The lower level and market-oriented trade and service facilities are encouraged to be established in the peripheral growth nodes to minimize the movement of people and commodities towards the core center. This also complements the developmental plan of the Municipality as stated in the ordinance they enacted, Ordinance No. 6 S.2019 titled, An Ordinance Declaring the Foreshore, Offshore, and Sea within the Municipal Territorial limits from the Boundary of Liloan and Mandaue City waters into an International Investment, Tourism, Commercial, Residential and Economic Hub of the Municipality of Consolacion.

Since portion of the project area are timberland areas, the area where the mangroves are located will be design as mangrove rehabilitation area with ecotourism concept to ensure that these mangroves are protected and preserved. While, for the other portion of the timberland areas where there are no mangrove trees but has existing shipyard operations, in view of the DENR recommendation that will affect the original land form of the project, these timberland areas have already existing shipyards whose tenurial instruments have expired and can no longer operate in the area. In addition, a court decision emphasized that a new foreshore lease agreement/tenurial instrument with the DENR is an indispensable requirement before petitioners could continue utilizing the foreshore areas for their operations, so that there was no abuse of discretion on the part of LGU Consolacion in not renewing their business permits. It added that the shipyard owners are not entitled or eligible to be issued with business permits as they do not have valid and subsisting tenurial instruments/lease agreements.

Summary of the Alternatives Considered

- Facility Siting – the site chosen is currently within the Urban Core of the municipality. The proposed project will boost the economic development of the area which is currently classified as industrial zone. Existing mini reclaimed lands were present already within the applied area which are used as causeway of the shipyard projects. Environmental impacts are most likely minimal due to its existing environmental setting. There is no other alternative area for reclamation project during the siting consideration other than the current project area since the municipality has no other bigger coastal area where the proposed project can be develop successfully without any negative impacts considering the other coastal areas of the municipality are filled with mangrove trees, used as fishing grounds, or conflict to ther government projects such as the Cebu International Port of the CPA;

- Development Design – the choices of the engineering design for the project were done considering the existing baseline environmental conditions of the project area such as ecological profile, tidal current, depth, and etc. The design considerations were also based on the possible lesser environmental impacts that might be brought by the project during project implementation. 2 types of reclamation methodologies or designs considered, either through sheet piles or revetment method;

- Process/Technology Selection – the process or technology selections during project implementation such as dredging activities, barging, and land filling of the project area should be considered carefully as to not affect the existing tidal current, damage the aquatic environment, flooding of the adjacent inland areas, and avoid siltation. Land transport was part of the alternative option, however, considering the existing current heavy traffic situation of the access road, land transport was eliminated in the option, hence, barging method of the transport of the filling materials, land filling activities, and delivery of construction materials was chosen as the best option;

- Resource Utilization – several sources of filling materials were already identified to ensure sufficient supply of the filling materials. The reason to have several back-ups of the sources of filling materials as to not exhaust the supply of the filling materials. Source of the filling materials will be through a legitimate 3rd party supplier with ECC and complete permits. Other option as filling materials will be the dredged sediments/silts within the project area provided it will be treated first due to possible existing heavy metals or oil content in it.

1.4. Project Components

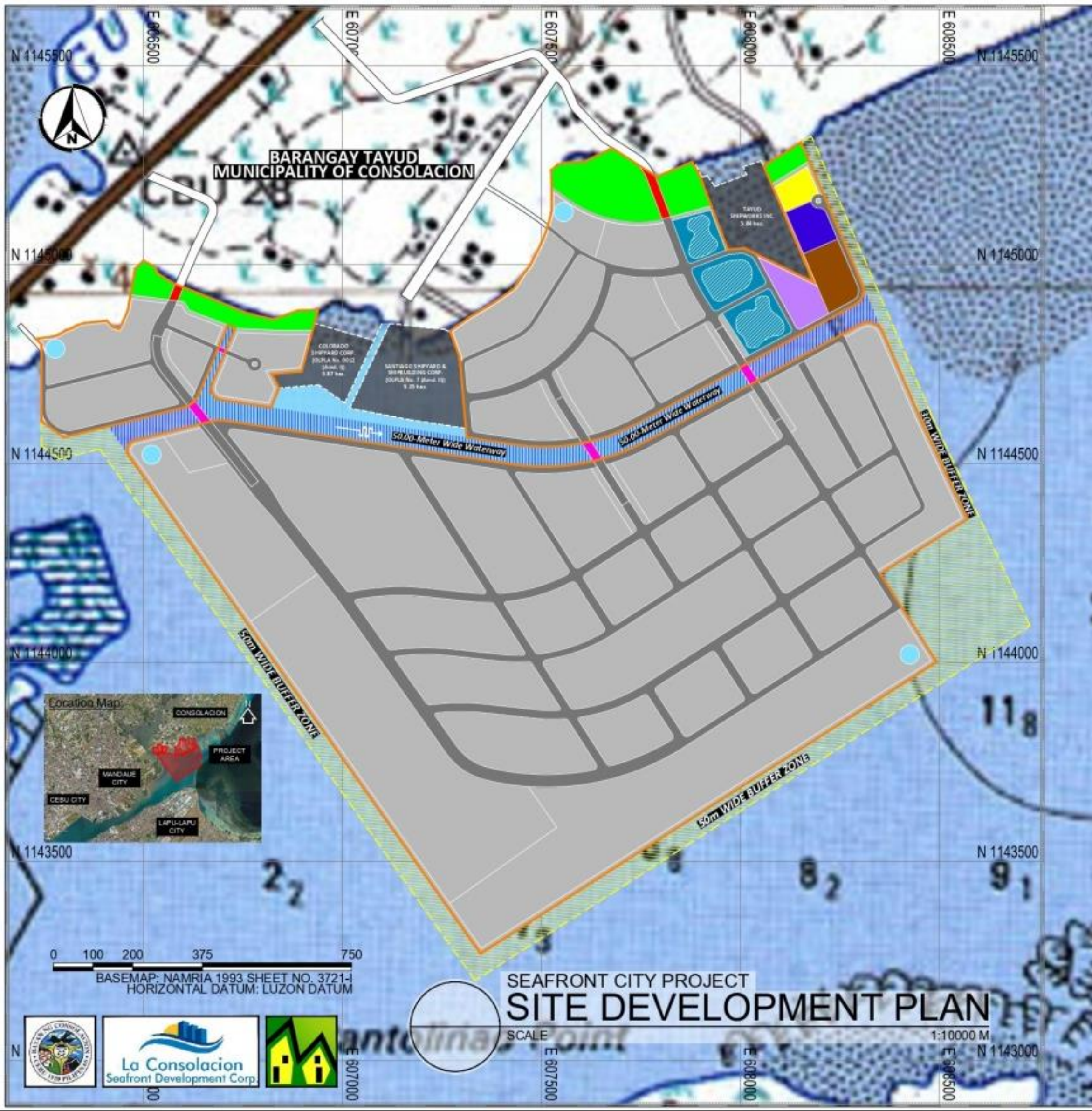
The Master Plan will undergo iterative process prior to finalization. Among the decision parameters are: (a) project cost (b) timetable (c) market considerations (d) long term vision of the Municipality and (e) environmental considerations. Table 1-7 shows the list of the project's components while Figure 1-7 shows the Site Development Plan of the proposed reclamation while Figure 1-8 shows the project's Utilities and Land Use Plan.

Table 1-7: Project Component List

Component	Description
MAJOR PROJECT COMPONENTS	
Lots (Areas for Development)	• Lot-1: 1 x 172.70 Hectares • Lot-2: 1 x 16.98 Hectares (14.18 Hectares to be filled land and 2.18 Hectares for Mangrove rehab. and enhancement) • Lot-3: 1 x 46.12 Hectares (41.12 Hectares to be filled land and 5.00 Hectares for Mangrove rehab. and enhancement)
Road Network (L x W)	• 174.26m x 10.00m (2-Lane, 2-Way Road) • 3,439.46m x 12.00m (2-Lane, 2-Way Road w/ Bike lane) • 880.60m x 13.00m (2-Lane, 2-Way Road w/ Bike lane) • 1,414.43m x 16.00m (3-Lane, 1-Way w/ Bike lane) • 2,116.55m x 17.00m (3-Lane, 1-Way w/ Bike lane) • 1,409.27m x 17.50m (3-Lane, 1-Way w/ Bike lane) • 304.14m x 20.00m (Walking Boulevard) • 6,826.30m x 22.00m (4-Lane, 2-Way w/ Bike lane) • 1,462.39m x 32.00m (6-Lane, 2-Way w/ Bikelane)
Interconnecting Bridges between Lots	• 2 x 100m Long x 22m Wide Prestressed Girder Deck Bridge • 1 x 85m Long x 22m Wide Prestressed Girder Deck Bridge • 1 x 20m Long x 12m Wide Box Culvert Bridge
Bridges for Ingress and Egress	• 1 x 100m Long x 22m Wide Box Culvert Bridge • 1 x 45m Long x 22m Wide Box Culvert Bridge
Ecotourism Park	• 7.18 hectares of rehabilitated, enhanced and protected Mangrove Area (originally 4.56 hectares)

Rainwater Harvesting Parks including Poinds	• 1x1.13 hectares • 1x1.69 hectares • 1x1.62 hectares • Total capacity of 80,000 cubic meters
Water Supply System	• 18,500 meters of dual piping system main distribution lines (potable and non-potable or treated water) • 6 x 300 cubic meters elevated water tanks • 150 fire hydrants
Wastewater Facility	• 18,500 meters of sewer lines • Appurtenances • 5 lift stations • 1-unit Centralized Wastewater Treatment Facility
Electrical System	• 1 substation • 36 kilometers of underground utility lines for both electrical and telecommunications • 250 Ring Main Units (RMUs) • 450 units x 30ft 250W lamp posts • 3 units of 500KVA generator sets (for land development purposes only
Solid Waste Segregation Area, Materials Recovery Facility, Composting, Temporary Storage for Hazardous Materials	• 1 lot (part of the land allocation for utilities)
Storm Water Drainage System	• 18,500 meters of covered canals • 5 Retention Cisterns • 3 Rainwater Collection ponds • 5 lift stations
Others	• Telecommunications and cable network
OTHER PROJECT COMPONENTS	
Waterway	• 1 x 2000m long x 50m wide (Main Waterway) • 1 x 180m long x 20m wide (Secondary Waterway for Mangroves)
Buffer Zone	• Maximum: 50m wide • Minimum: 30m wide
Staging Area for the Construction Phase	• Staging areas for heavy equipment and heavy materials • Intended areas for temporary facilities necessary for the construction phase

There are 5 major utility facilities that the project will provide namely: 1.) the water treatment and distribution facility, 2.) power and telecommunications facility, 3.) wastewater treatment facility, 4.) materials recovery facility, and 5.) rainwater harvesting facility, as shown in Figure 1-8b.



Site Development Plan

Major Project Components

Color Code	Component	Description
Orange	Lots (Areas for Development) (Total Area = 235.80 Hectares)	• Lot-1: 1 x 172.70 Hectares • Lot-2: 1 x 16.98 Hectares (14.18 Hectares to be filled land and 2.18 Hectares for Mangrove rehabilitation and enhancement) • Lot-3: 1 x 46.12 Hectares (41.12 Hectares to be filled land and 5.00 Hectares for Mangrove rehabilitation and enhancement)
Gray	Road Network (L x W)	• 174.26m x 10.00m (2-Lane, 2-Way Road) • 3,439.46m x 12.00m (2-Lane, 2-Way Road w/ Bikelane) • 880.60m x 13.00m (2-Lane, 2-Way Road w/ Bikelane) • 1,414.43m x 16.00m (3-Lane, 1-Way w/ Bikelane) • 2,116.55m x 17.00m (3-Lane, 1-Way w/ Bikelane) • 1,409.27m x 17.50m (3-Lane, 1-Way w/ Bikelane) • 304.14m x 20.00m (Walking Boulevard) • 6,826.30m x 22.00m (4-Lane, 2-Way w/ Bikelane) • 1,462.39m x 32.00m (6-Lane, 2-Way w/ Bikelane)
Magenta	Interconnecting Bridges between Lots	• 2 x 100m Long x 22m Wide Prestressed Girder Deck Bridge • 1 x 85m Long x 22m Wide Prestressed Girder Deck Bridge • 1 x 20m Long x 12m Wide Box Culvert Bridge
Red	Bridges for Ingress and Egress	• 1 x 100m Long x 22m Wide Box Culvert Bridge • 1 x 45m Long x 22m Wide Box Culvert Bridge
Green	Eco-Tourism Park	• 7.18 Hectares of rehabilitated, enhanced, and protected Mangrove Area (Originally 4.56 hectares)
Teal	Rainwater Harvesting Parks including Ponds	• 1 x 1.13 hectares • 1 x 1.69 hectares • 1 x 1.62 hectares • Total Capacity: 80,000 cubic meters
Lavender	Water Supply System	• 18,500 meters of dual piping system main distribution lines (potable and non-potable or treated water) • 6 x 300cu.m. elevated water tanks • 150 fire hydrants
Brown	Wastewater Facility	• 18,500 meters of sewer lines • Appurtenances • 5 lift stations • 1-unit Centralized Wastewater Treatment Facility
Yellow	Electrical System	• 1 Substation • 36 kilometer of underground utility lines for both electrical and telecommunication • 250 Ring Main Units (RMUs) • 450 units x 30ft 250W lamp posts • 3 units of 500KVA generator sets (for land development purposes only)
Blue-violet	Solid Waste Segregation Area, Materials Recovery Facility, Composting, Temporary Storage for Hazardous Materials	• 1 lot (part of the land allocation for utilities)
	Storm Water Drainage System	• 18,500 meters of covered canals • 5 Retention Cisterns • 3 Rainwater Collection Ponds • 5 lift stations
	Others	• Telecommunications and cable network

Seafront City Project Total Project Area: 235.80 Hectares

Other Project Components

Color Code	Component	Description
Blue hatched	Waterway	• 1 x 2,000m long x 50m wide (Main Waterway) • 1 x 180m long x 20m wide (Secondary Waterway for Mangroves)
Light green	Buffer Zone	• Maximum: 50 Meters Wide • Minimum: 30 Meters Wide
Light blue	Staging Areas for the Construction Phase	• Staging areas for heavy equipment and filling materials • Intended areas for temporary facilities necessary for the construction phase

Figure 1-8: Site Development Plan of the Proposed Project

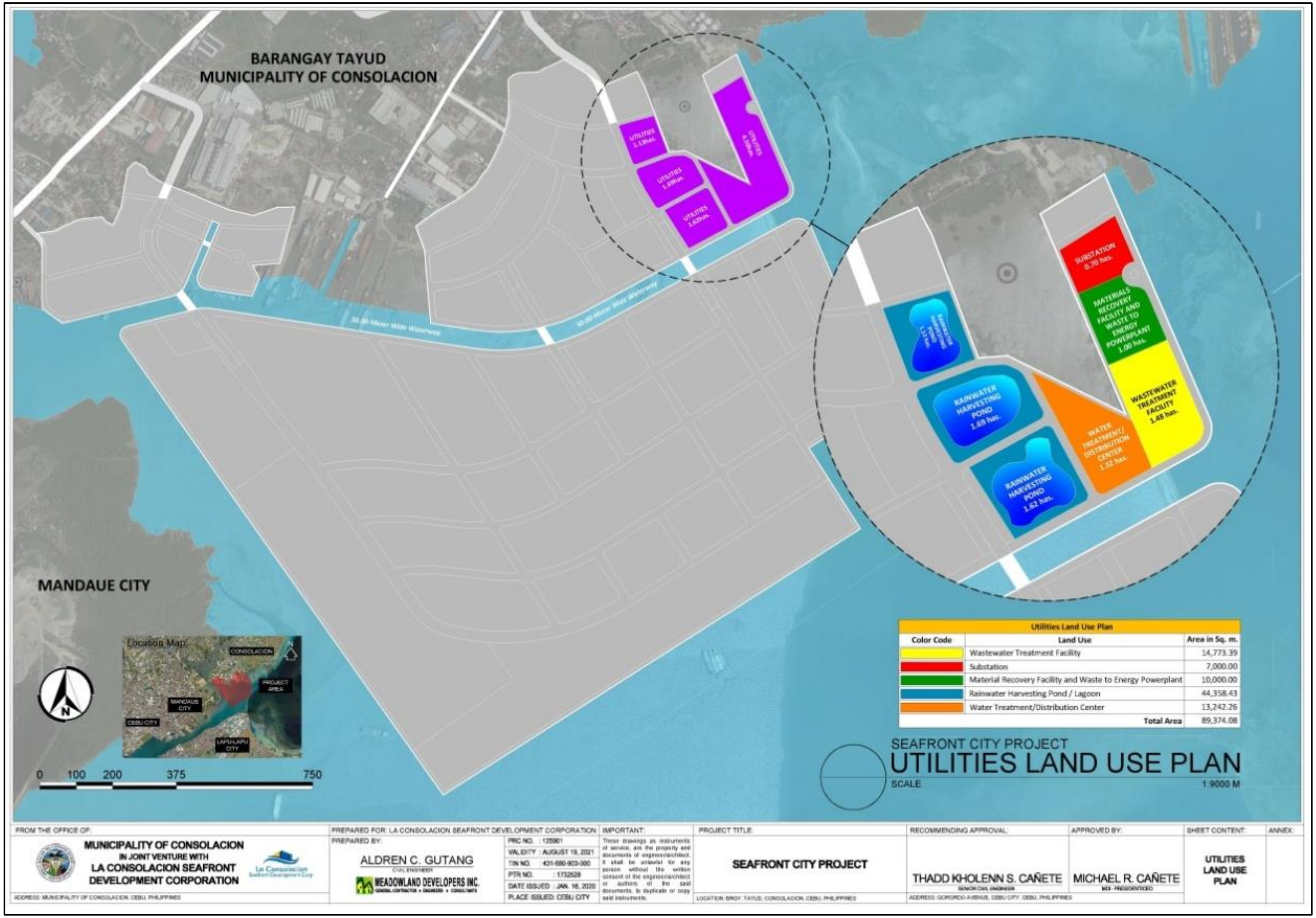


Figure 1-9.a: Project Utilities and Land Use Plan

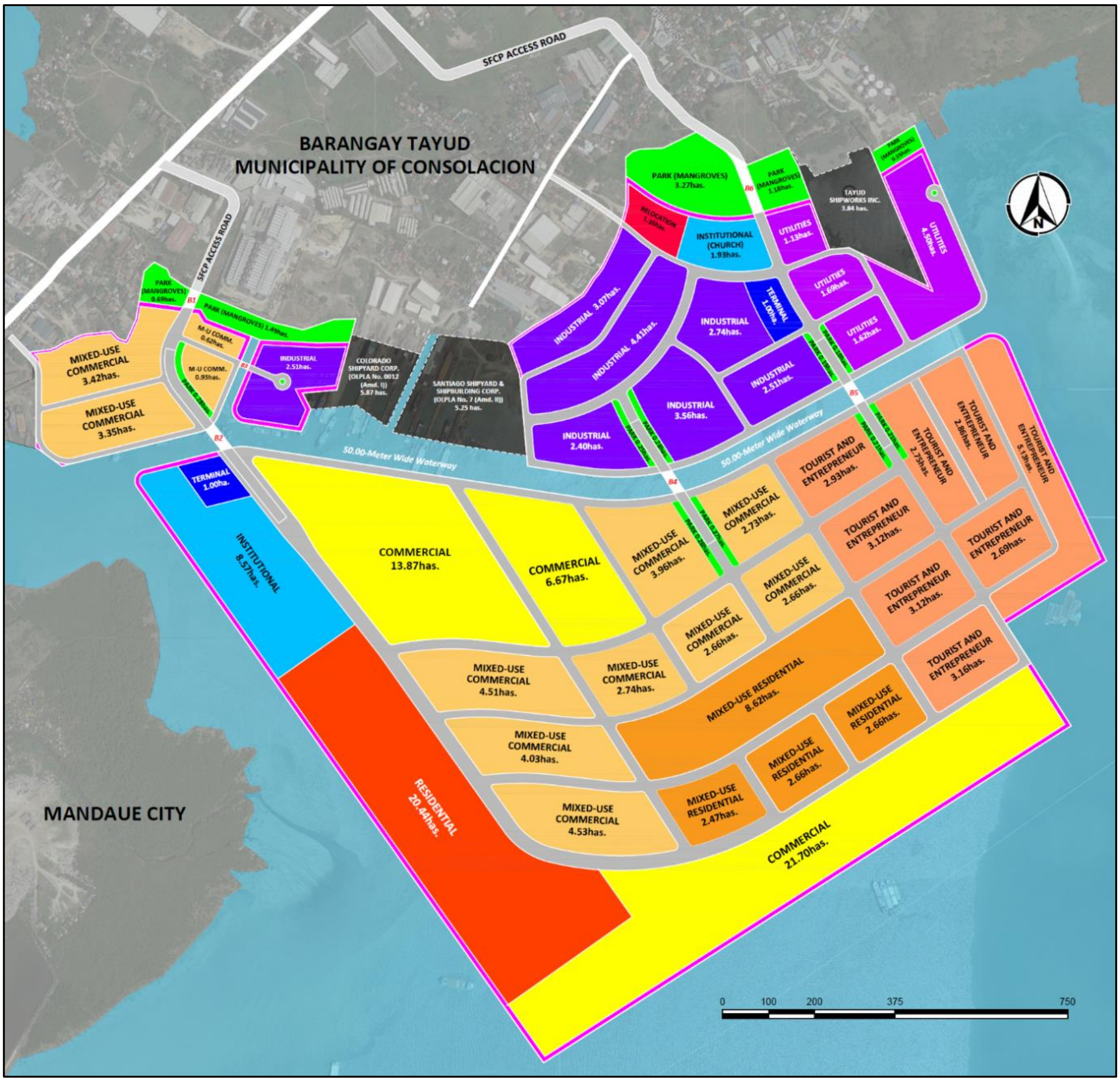


Figure 1-8.b: Project Utilities and Land Use Plan (blown-up)

OVERALL (LOT-1, LOT-2, AND LOT-3) LAND USE PLAN				
Color Code	Land Use	Area (Sq.m.)	Area (Ha.)	Percentage
Saleable Area				
	Commercial	422,479.67	42.25	17.92%
	Mixed-Use Commercial	361,312.84	36.13	15.32%
	Tourist and Entrepreneur	257,642.72	25.76	10.93%
	Residential	204,429.46	20.44	8.67%
	Mixed-Use Residential	163,984.96	16.40	6.95%
	Industrial	212,041.12	21.20	8.99%
	Institutional	105,037.61	10.50	4.45%
	Total Saleable Area	**1,726,928.37**	**172.69**	**73.24%**
Non-Saleable Area				
	Easements	64,350.91	6.44	2.73%
	Parks	93,438.24	9.34	3.96%
	Road Network*	352,257.23	35.23	14.94%
	Terminals	20,017.74	2.00	0.85%
	Utilities	89,374.08	8.94	3.79%
	Relocation	11,629.28	1.16	0.49%
	Non-Total Saleable Area	**631,067.47**	**63.11**	**26.76%**
	Total Area	**2,357,995.84**	**235.80**	**100.00%**

Note: The developers of the saleable lands will respectively be required to allocate parks, roads and open spaces, accumulatively covering the balance of the 30% required ROS under PRA EO-74

1.5. Process / Technology Options

Project construction is divided into three major phases: (1) pre-construction phase; (2) construction phase; and (3) demobilization phase. The first phase shall commence after the issuance of the Notice to Proceed (NTP) from the Philippine Reclamation Authority (PRA) and all necessary permits including the Environmental Compliance Certificate (ECC) for the project. It is assumed that the project will be implemented through an Engineering, Procurement and Construction (EPC) or Turn-key Contractor.

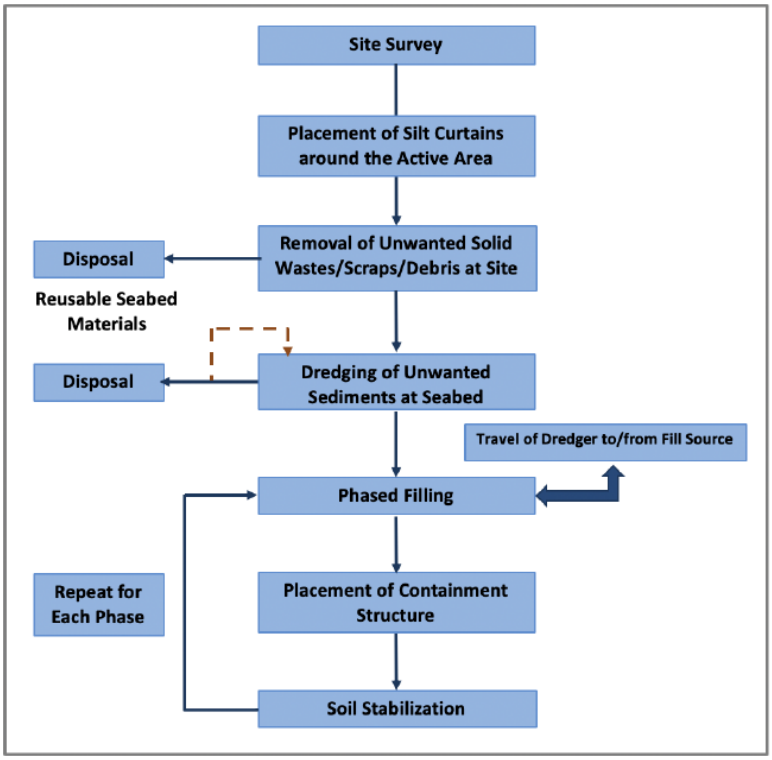


Figure 1-10: Process Flow Diagram for Reclamation Projects

1.5.1. Pre-Construction Phase

This Phase refers to the activities involved before the commencement of the construction proper such as the following:

1.5.1.1. Validation and Site Surveys

Prior to the start of reclamation, surveys will be conducted to determine the existing elevation of the pre-identified fill area and designated source of fill materials. Data gathered will be used as reference to determine the degree of fill, establish the volume of fill, and to check the elevation of the fill material. A record of the bathymetry and the topography of the fill area will be submitted and validated by a monitoring team to form part of the overall progress report.

Impacts and Mitigation Measures

- Domestic solid, liquid and hazardous wastes to be generated by the workers during setting of temporary facilities, barracks, among others.
    - Use of portable toilets or portalets for construction workers
    - Provision for temporary treatment facility such as portable septic purifying tanks
    - Segregation and disposal through a disposal entity or the LGU solid waste management unit in compliance to RA 9003.
    - Segregation, proper labeling and temporary storage of hazardous wastes

1.5.1.2. Removal and Disposal of Unwanted Solid wastes/Scraps/Debris

Identifying Locations

Clearing of the site of debris, scraps, plastic wastes and silts shall be done at the site as part of the preparation process. The locations of these unwanted seabed soil will be determined priort to the start of the construction phase by grab sampling and shallow core drillings.

Extraction and Transport

The solid wastes at the seabed (e.g. plastics, metallic scraps, etc.) will be collected and disposed onshore through a third-party disposal entity. Also to be cleared are silts, which have accumulated with wastes, discharged with storm water onshore.

The unwanted seabed soil will be extracted using either through hydraulic dredging and/or clamshell dredging. The extracted soil will then be transported by barges and trucks to the designated disposal site.

Disposal

These wastes will most likely be relocated first in a secured area within the project site to be hauled by a 3rd party treater and will be disposed in an area pre-approved by DENR-EMB. Before disposal, the soil will be tested for any traces of oil, elements, metals, and other hazardous materials. If such materials exist, then the soil will undergo treatment by a DENR accredited third-party entity. For soil that does not have any hazardous materials, it will be mixed or blended by suitable fill materials before disposal.

A specialized contractor will be engaged by the Main Contractor for the proper removal, relocation, treatment, and disposal of unwanted and hazardous materials from the seabed within the project area. A temporary relocation area of 4.00Has. will be provided and will be in the foreshore area. The typical section plan of the relocation site is shown below.

Impacts and Mitigation Measures

- During removal of unwanted solids, it is expected that domestic solid, liquid, hazardous wastes and other wastes will be generated including disturbance of the area such as marine and existing fish lifts structures.

  - Coordinate with LGU for proper disposal
  - Transfer/scrape net marine lives
  - Relocation/transfer of lift nets or fish lifts

Figure 1-11.a: Relocation Site of Unwanted Seabed/Silts

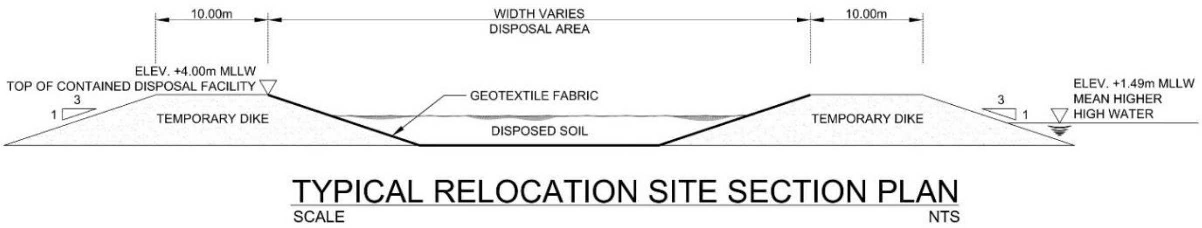


Figure 1-12.b: Typical Relocation Site Section Plan

1.5.1.3. Management of Existing Structures

The identification and validation of existing structures such as buildings, port facilities, shipyards, local drainage and water pipelines, and other existing utilities in the area will be conducted.

Demolition

Existing buildings, port structures and facilities, and other obstructions will be demolished, removed, or relocated.

Utility Tapping and Redirecting

The existing drainage and water pipelines used in the area, will be tapped, or extended to be redirected and may be incorporated in the project utility layout plan.

Ground Clearing and Preparation

The existing reclamation areas within the project site will be cleared of abandoned equipment and other items left by previous occupants and shipyards. The ground will be prepared by scouring and removing portions of the top layer to remove any buried materials and to ensure that the underlying layers are suitable to be part of the project's reclamation plan.

Waste Management from the Demolished Structures

Solid wastes from the demolished structure will be handler properly to avoid negative environmental impact. There will temporary sorting facility or material recovery facility to segregate the solid wastes. Recyclable materials will be collected by a 3rd party scrap buyers while hazardous wastes such as used oil, used batteries, e-wastes, used tires, solvents, and etc. will be separately contained and collected by a 3rd party hazardous wastes treater.

1.5.1.4. Silt Curtain Installation

A 50-meter buffer from the peripheral boundaries of the reclamation area will be designated as the working area. The working areas will be installed with silt curtain throughout the duration of the project to contain particle dispersion. Other mitigating measures such as prevention of oil / gas spill from marine equipment will be guided by the Philippine Coast Guard (PCG) rules or guidelines. Figure 1-9 shows the silt curtain lay out plan of the project area.

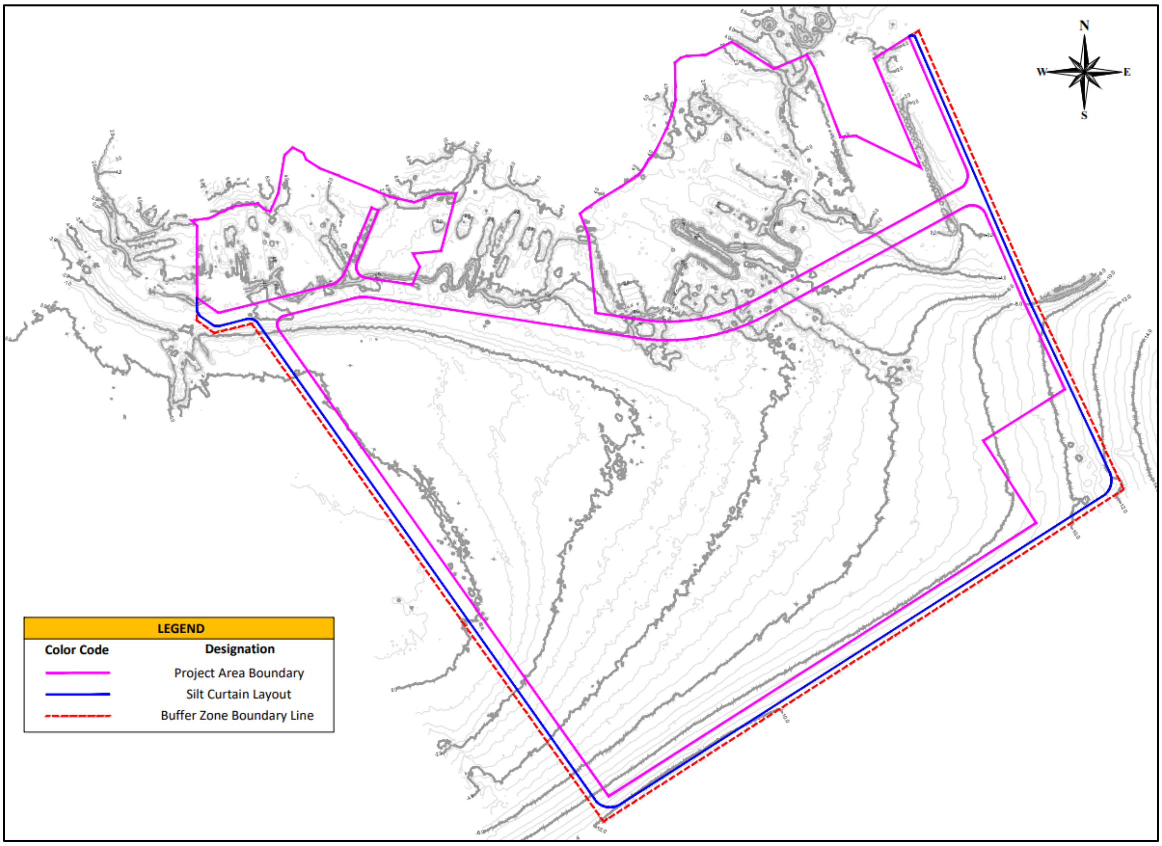


Figure 1-13: Silt Curtain lay-out Plan

Silt curtains will be installed in all working area to prevent silt / other contaminants from the reclamation fill activities from spreading to the surrounding waters. The silt curtain will be installed from the seabed up to the highest tide (Figure 1-10). The bottom portion of the silt curtain will be anchored on the seabed using heavy concrete blocks to prevent silt curtain from slipping. The upper portion of the silt curtain (floaters) will be anchored on buoys to limit the turbid area. Length of the silt curtain varies with the extent of the dredging area. Figure 1-11 shows the cross section plan of a silt curtain.

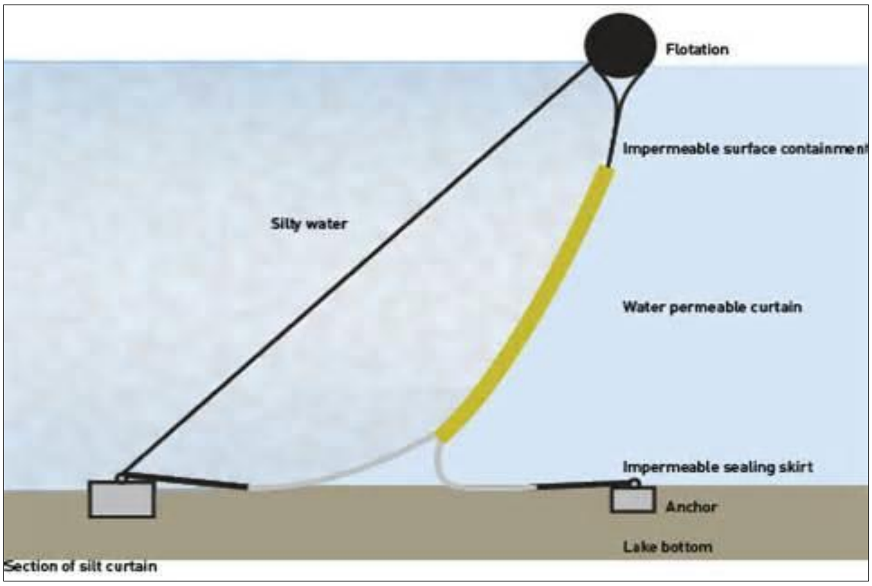


Figure 1-14: Silt Curtain Cross Section Plan

The depth will depend on the depth of the seawater from the seabed to the highest tide level. Silt curtains will be maintained throughout the entire duration of the project.

Typical specifications of a silt curtain are as follows:

- Weight: 600 g/cm2 (minimum)
- Thickness: 0.90 mm (minimum)
- Mean wide Width Tensile Strength (wet condition): 100 KN/m (minimum)
- Mean tensile Extension at Maximum Load (wet condition): 15% minimum, 30% maximum
- Shrinkage under seawater: 0.20% (maximum)
- Seawater permeability: 7.5 x 103 cm/sec (maximum)
- UV Resistance: 80% of mean strip tensile strength after 90 days prolonged exposure to sunlight
- Installation depth: up to seabed

Figure 1-12 shows an image of a silt curtain separating sludge from adjacent water bodies.

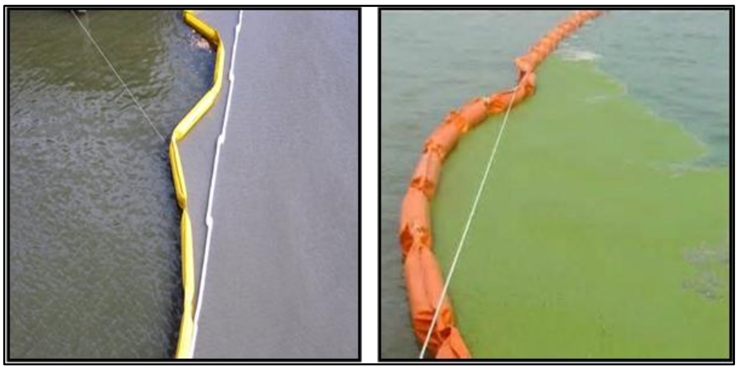


Figure 1-15: Silt Curtain Separating Sludge

1.5.1.5. Preparatory Works

This works pertains to the activities such as construction of temporary facilities and structures that are essential in the commencement of the construction phase.

Temporary Facility

Prior to the mobilization of the major equipment and materials on site, construction of temporary facilities for the Engineers and Contractors shall commence immediately. These include the temporary field office, warehouse, barracks, equipment yard, etc. These facilities will be located near or within the construction site as much as possible.

Staging

Temporary staging areas for heaving equipment, stockpile as well as berthing areas for barges will be strategically identified within the foreshore and offshore areas of the project site. Figure 1-13 and Figure 1-14 illustatrate the location of these staging areas.

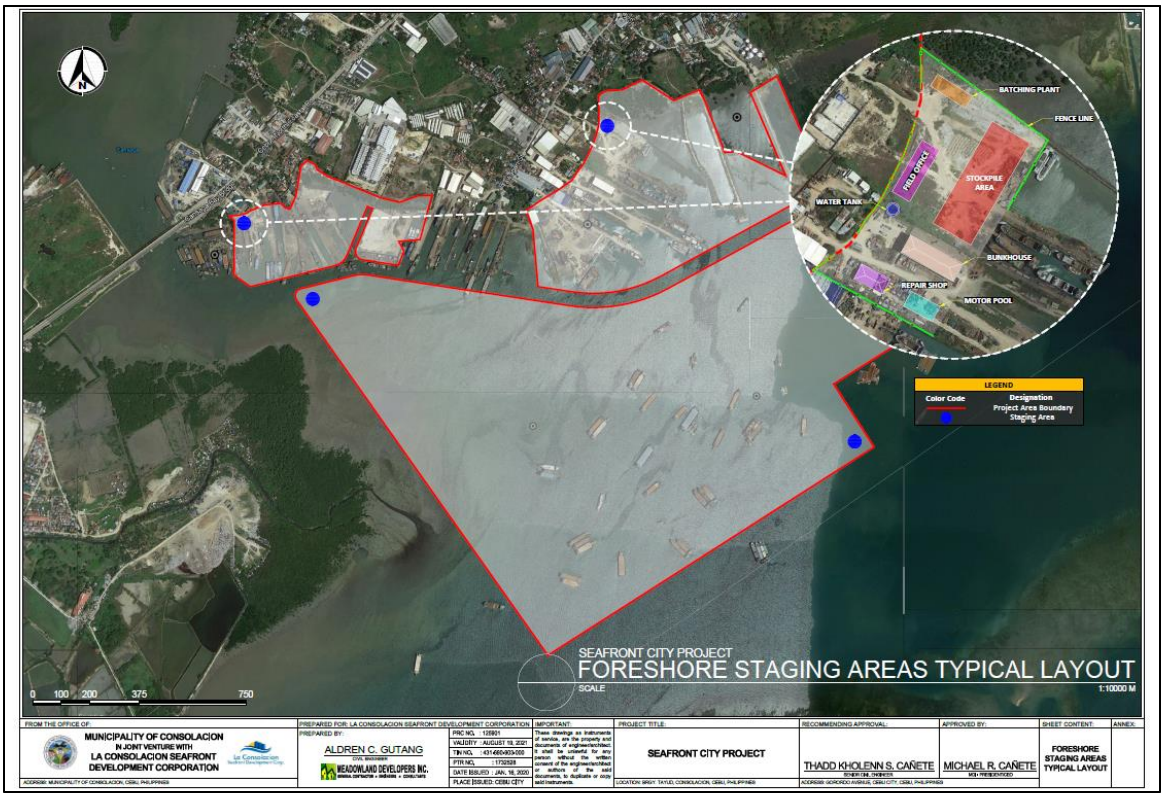


Figure 1-16: Staging Area Lay-out located in the Foreshore

Figure 1-17: Staging Area Lay-out located in the Offshore

Setting Out

Establishment of baseline to serve as reference for the construction of the Revetment wall and reclamation of the proposed area shall be carried out with utmost care and accuracy. This will be done using a distomat transit equipment. Intermediate point along the line will be stacked out temporarily by wooden stakes driven into the ground and the primary reference point shall be established on a stable location on the land by concrete monument.

Temporary Dike and Causeway

A 50-meter working area will be constructed in a form of temporary dike (See Figure 1-15). The construction of a temporary dike will initially be done using a materials barge and backhoe barge. Simultaneously a temporary causeway will be constructed which will connect the mainland with the temporary dike. This will provide access for the construction materials, equipment, and workers into the construction site.

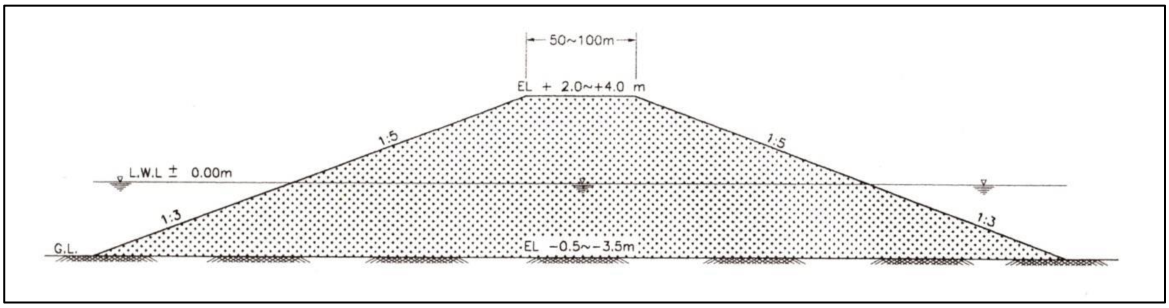


Figure 1-18: Temporary Dike and Causeway

After the pre-construction phase has been done, the construction phase will commence. This phase will have five major works, namely, containment structures, reclamation fill, road works, bridges, and utilities. The activities for these works will simultaneously commence. Each work has its own construction methodology and specifications that will be put into detail by the Contractor. But for the purpose of this study the general methodology of each work and the technical specifications will be discussed below.

1.5.2.1. Containment Structures

This work will consist of the construction and installation of containment structures along the perimeter of the project lots. These structures are designed to contain and stabilize the reclamation fill and prevent it from being washed out by the waves and tides. There will be two types of containment structures that will be used in the project. One will be sloped revetment and the other will be Steel Sheet Piles. Figure 1-16 shows the location and lay-out of each type of containment structures.

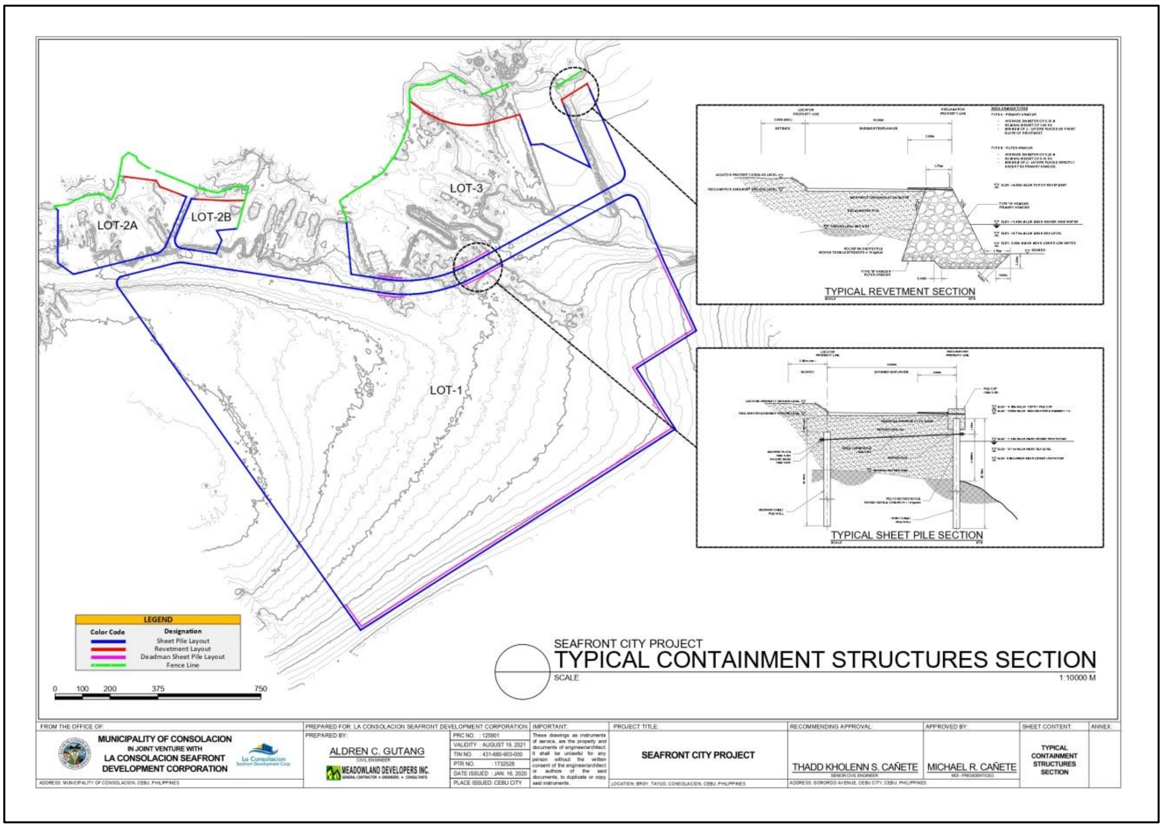


Figure 1-19: Containment structure lay-out

Sloped Revetment

The main purpose of the sloped revetment is to protect the perimeter of the reclamation from the tendency of the tides and waves to scour the edges of the reclamation fill. The slope of this revetment will be 1:2. Figure 1-17 shows the slope revetment cross sectional view.

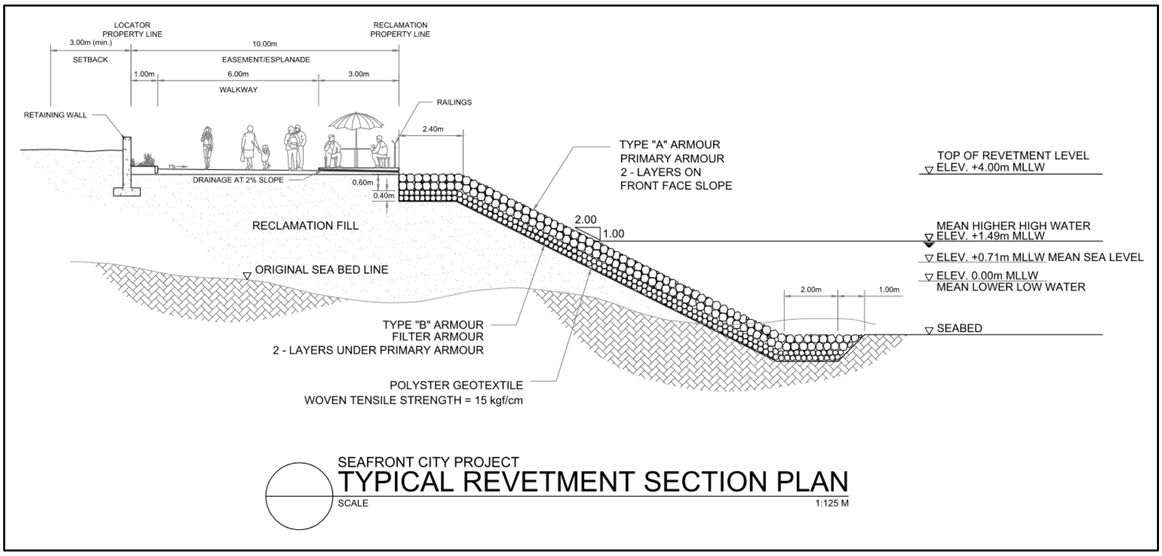


Figure 1-20: Slope Revetment Section Plan

The revetment will consist of two layers of different sized armor rocks. The top layer will have a maximum boulder diameter of 0.85 m while the bottom layer will have a maximum boulder diameter of 0.45 m. See Table 1-8 for the estimated volume of boulders per size per lot in cubic meters that will be required for the project. The volume was calculated using the containment layout plan.

Table 1-8: Revetment Volume Summary

Lot	Top Layer Volume 0.85m Size Boulders (cu.m.)	Bottom Layer Volume 0.45m Size Boulders (cu.m.)	Total (cu.m.)
LOT-1	38,281.98	19,140.99	57,422.97
LOT-2A	4,658.57	2,329.29	6,987.86
LOT-2B	3,362.20	1,681.10	5,043.29
LOT-3	28,925.28	14,462.64	43,387.93
TOTAL	**75,228.03**	**37,614.02**	**112,842.05**

The construction of this containment structure, generally, has four (4) phases, namely:

Phase 1: Restructuring Temporary Dike

The temporary dike that was set to restrain the filling materials within the construction area will be restructured and trimmed such that it will follow the designed dimensions and slope of the sloped revetment. Figure 1-15 shows a sample of Dike Restructuring.

Figure 1-21: Sample Dike restructuring

Phase 2: Installation of Geotextile

Prior to the placement of backfill crushed rocks that will become the revetment, a geotextile membrane will be placed such that it will cover the whole face of the dike facing the water as shown in Figure 1-16. Installation of the membrane will be in accordance with the manufacturer's specification and recommendation. Sufficient lapping and anchorage will be maintained.

The geotextile that will be used in this project will be a Woven Geotextile Membrane with the following specifications:

- Minimum tensile strength of 12 kN/m
- The minimum Permeability normal to the plan of the geotextile will be 85 l/m2/sec
- Characteristic opening size range will be from 0.05 mm to 0.200 mm

Figure 1-22: Sample Geotextile Installation

Phase 3: Placing of Crushed Rocks

Laying and arranging of crushed rocks 5-15 kg/pc along the slope of the trimmed sides of the reclamation will be executed by hand with the assistance of back hoes and cranes. It will be done layer by layer to minimize voids between rocks.

Figure 1-23: Sample of Facing of Crushed Rocks

Phase 4: Placing of Facing Rocks

Laying and arranging of facing rocks 100 kg/pc will be executed by hand on top of the crushed rocks. Back hoes and cranes will assist in this process.

Figure 1-24: Sample of Placing of Crushed Rocks

Steel Sheet Piles

When project limits are established and marked, the piling barge will be positioned in a designated line where the first enclosure piles are driven. These piles are made of steel which is delivered on site. Steel sheet pile is preferred over prestressed concrete sheet piles for easy and fast installation. The specifications for the steel sheet pile which will be used are shown Table 1-9 below.

Table 1-9: Steel Sheet Pile Specifications

Parameter	Measurement
Width	700 mm
Height	500 mm
Flange Thickness	16 mm
Web Thickness	12.2 mm
Cross Sectional Area	151.2 cm^2/m
Weight Per Pile	126.5 kg/m
Weight Per Wall	180.7 kg/m
Elastic Modules	3,800 cm^3/m
Moment of Inertia	94,980

The surveyor shall constantly peer through his station and guide the barge on its alignment to make absolute the verticality of the piles through triangulation and assure exact distance and alignment before giving the signal to start driving. Pile driving shall be done using hydraulic pile hammer with a fixed integral rig mounted on the barge. Plump and alignment are ensured with constant use of station instrument.

The estimated number of sheet piles per length and its corresponding weight is shown in Table 1-10 below. This was calculated based on the containment structures layout plan and the steel sheet pile specifications.

Table 1-10: Steel Sheet Pile Requirement Summary

Sheet Pile Length	No. of Sheet Pile	Weight per Pile (kg)	Weight per Sheet Pile Length (kg)
6	102	759	77,418
9	180	1,139	204,930
12	186	1,518	282,348
18	2,124	2,277	4,836,348
21	888	2,657	2,358,972
24	5,577	3,036	16,931,772
27	712	3,416	2,431,836
30	4,368	3,795	16,576,560
Total	**14,137**	**Total**	**43,700,184**

To protect the sheet piles from being damaged or tampered by future land development such as the construction of buildings and other structures, a 10.00-meter easement will be implemented. Additionally, as there will be some sheet piles that will be placed in depths up to -9.00 meters MLLW, Deadman Sheet Piles will be placed to act as supplementary support.

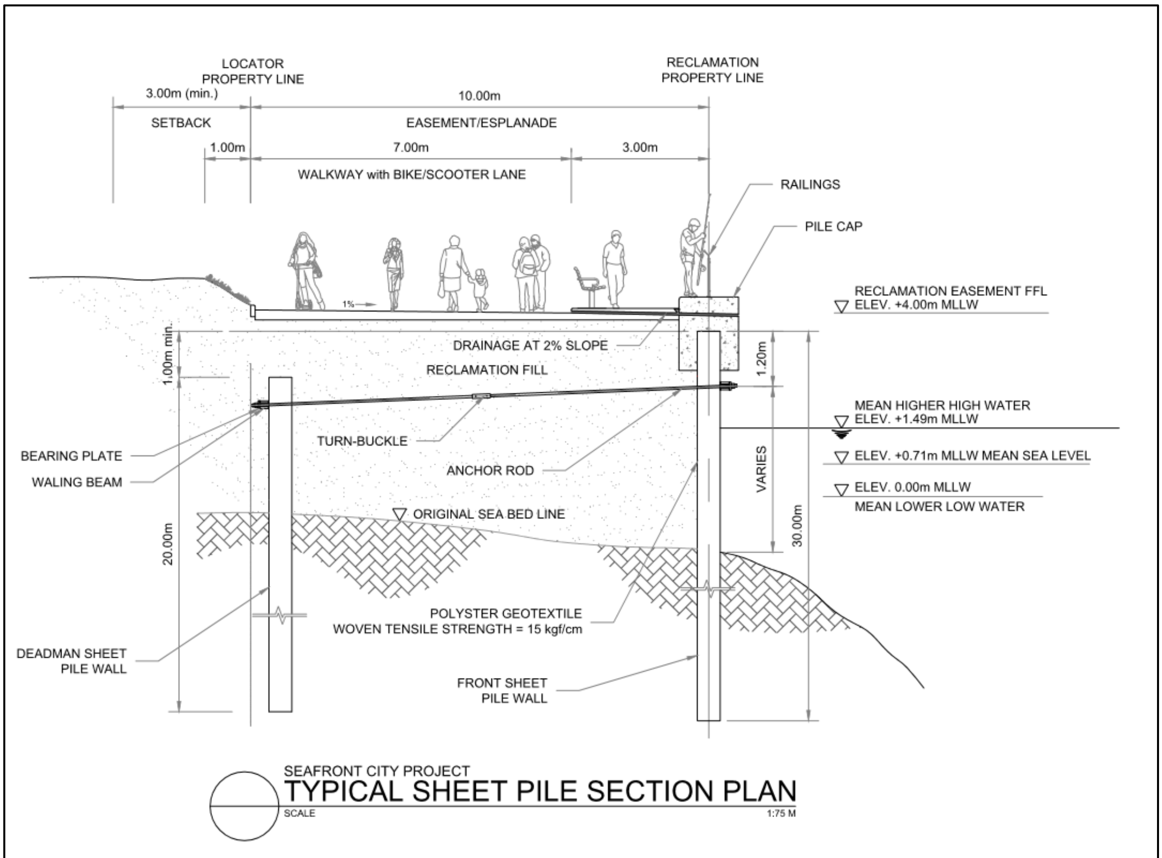


Figure 1-25: Typical Sheet Pile Section Plan

The installation of the sheet piles will have five (5) phases, namely:

Phase 1: Channel Excavation

Prior to the installation of the Steel Sheet Piles, a shallow portion along the proposed channel shall be dredged up to an elevation of ± 0.00 m by a backhoe barge as shown on Figure 1-20 to enable a free movement of marine equipment during the construction period. All excavated materials shall be loaded to a scow barge which soon be towed by a tugboat to the specified dumping site.

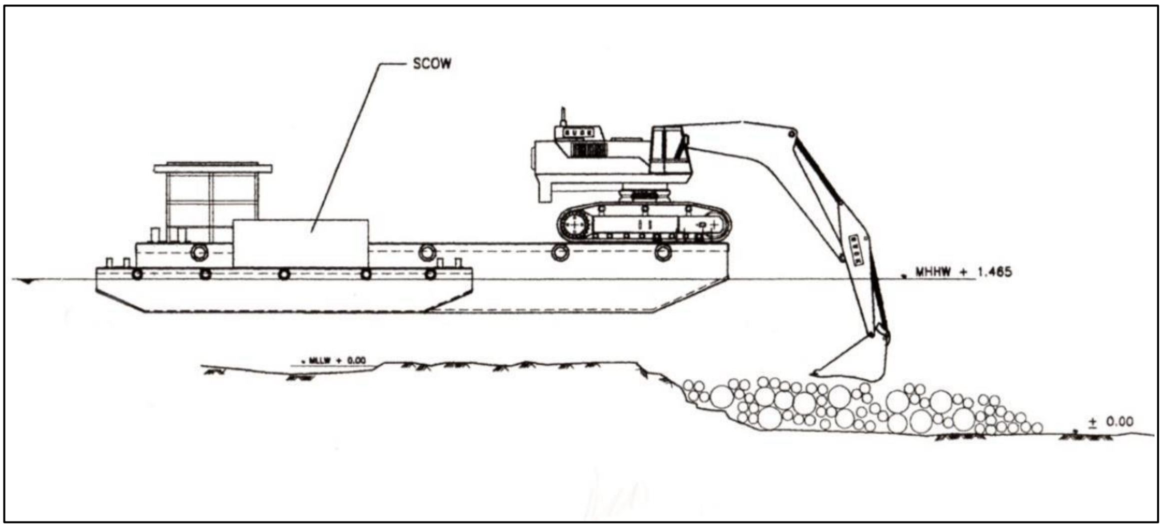


Figure 1-26: Channel Excavation

Phase 2: Steel Sheet Pile Driving

As soon as the area is available for the marine equipment to work on the proposed revetment wall, a pile driving barge 50 tons capacity equipped with a vibro hammer will commence the work by driving the guide pile foundation which is two H-beams at an even interval parallel to the alignment of the Steel Sheet Pile on both sides. This will keep the alignment of the piles to be driven on the correct position and plumbness. A modified pile cap shall be installed on the Steel Sheet Pile head during the driving operation. During pile driving operation, the surveyor will continuously monitor alignment and elevation of each pile to ensure that everything is done properly.

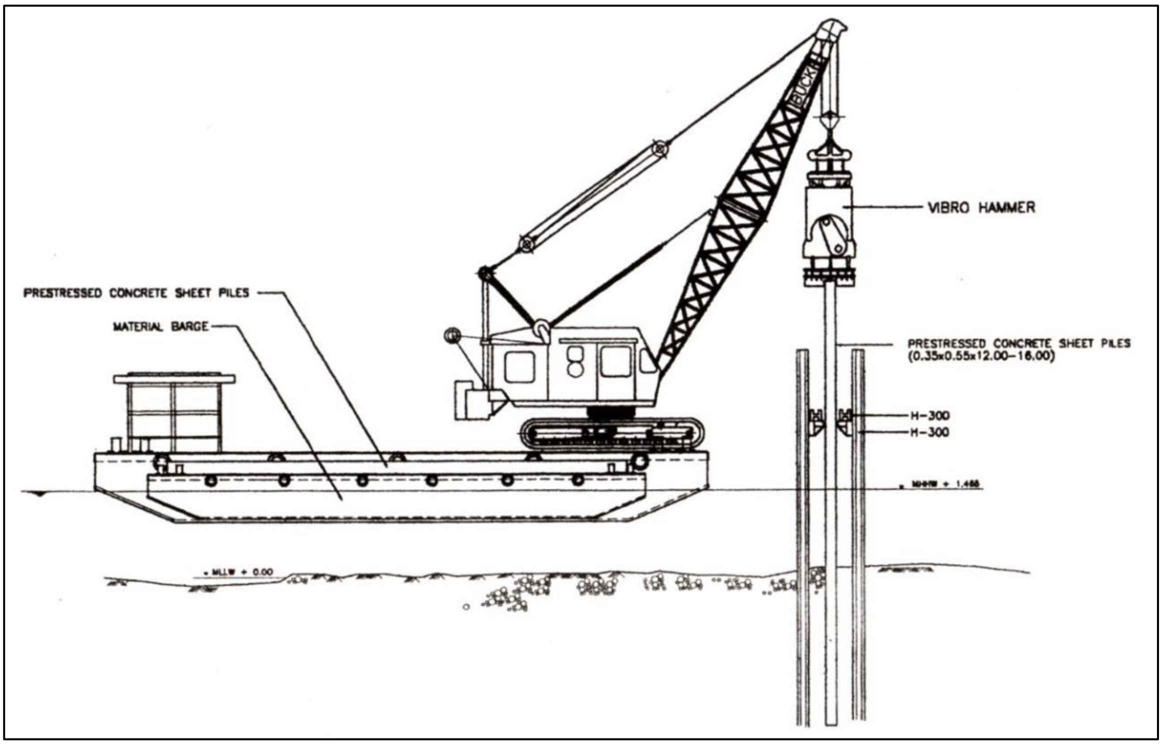


Figure 1-27: Steel Sheet Pile Driving

The barge will have its own integral feeder crane to feed the piles to the hammer. Steel sheet piles shall be driven to elevation of +3.5 meters for the desired embedment to the beam cap. Pile heads will then be hacked ensuring a minimum embedment to the concrete beam cap of at least 0.50 meters.

Phase 3: Structural Excavation

As soon as the pile driving work is completed, structural excavation for the foot protection will immediately commence. Structural excavation shall be done in accordance with the plan design elevation. Control monitoring of excavation activity shall be done by a surveyor for final checking and approval of the engineer.

Figure 1-28: Sample of Structural Excavation

Phase 4: Geotextile Installation

Prior to placement of backfill crushed rocks behind the Steel Sheet Pile wall, a protection sheet 3 mm in thickness made from PVC materials shall be installed against Steel Sheet Pile wall. In addition to this a geotextile membrane will be placed such that it will cover a part of the revetment. Installation of the protection sheet and the geotextile membrane will be in accordance with the manufacturer's specification and recommendation. Sufficient lapping and anchorage will be maintained.

Figure 1-29: Sample of Geotextile Installation

Phase 5: Filling Using Crushed Rocks

Crushed rocks preferably 5-50 kg will fill the sides of the revetments and PCSP facing the reclamation area. The rocks will be placed and arranged by hand with the help of back hoes and cranes. The rock face will have a slope of 1.2:1.

Figure 1-30: Sample of Filling Using Crushed Rocks

Phase 6: Pile Capping

After driving the steel sheet piles to the specified depth, a reinforced concrete pile cap will be constructed on the pile covering a portion of its top. Scaffoldings, formworks, and corrugated reinforcement bars will be installed after the Steel Sheet Pile has been driven to its specified elevation. Concrete will be poured every 50 meters of installed steel sheet piles. The total volume of concrete required is shown in Table 1-11 below.

Table 1-11: Reinforced Concrete Pile Cap Volume

Lot	Volume
LOT-1	12,414.69
LOT-2A	2,205.22
LOT-2B	1,443.10
LOT-3	5,842.36
TOTAL	**21,905.37**

1.5.2.2. Reclamation Filling

The reclamation will be filled with pre-determined and pre-verified suitable materials which will be delivered on site via land and/or sea. The sources of these materials can come from two places. One source can come from on-land quarry sites located as close as within the municipality of Consolacion itself or as far as from other neighboring islands, and the other source can be from the seabed through the process of dredging. Figure 1-27 shows the location of the potential sources of filling materials.

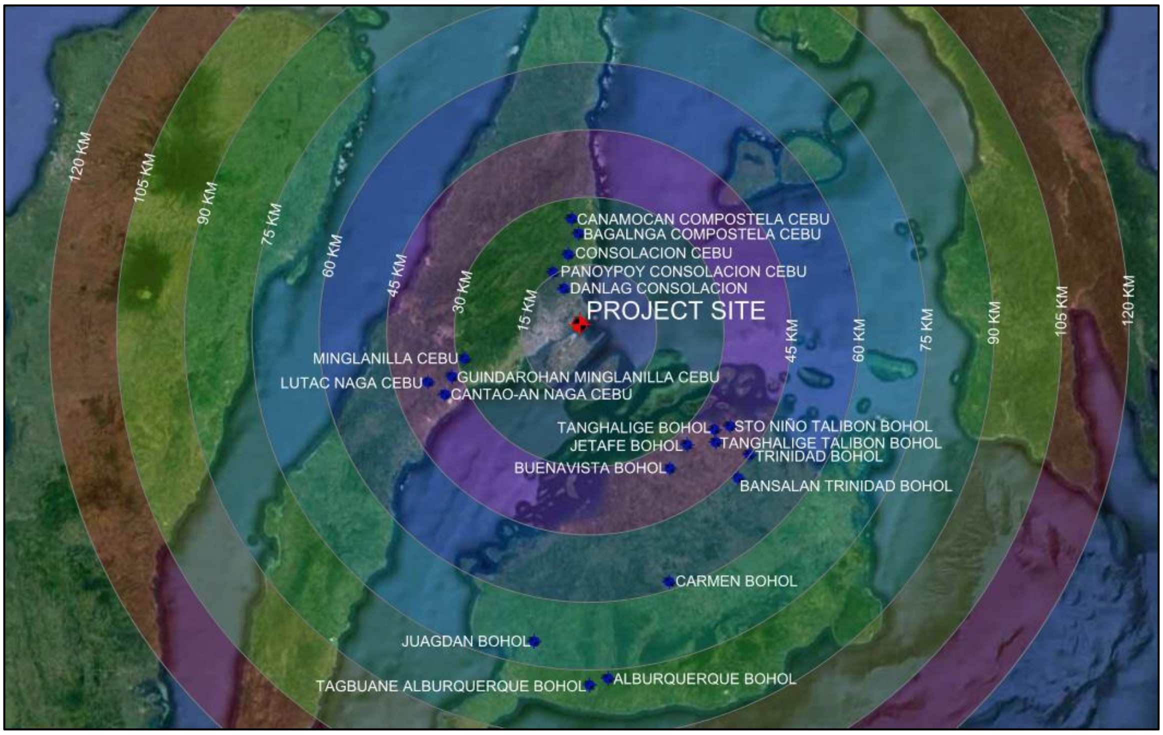


Figure 1-31: Map showing the sources of filling materials

Reclamation Fill Requirements

The volume required for the reclamation fill was calculated using the bathymetry of the project site and the designed final reclamation land surface elevation of +4.00 meters above MLLW. The total volume of filling materials required by the project is approximately 17.9 million cubic meters. Figure 1-26 shows the reclamation fill sequence plan of the project.

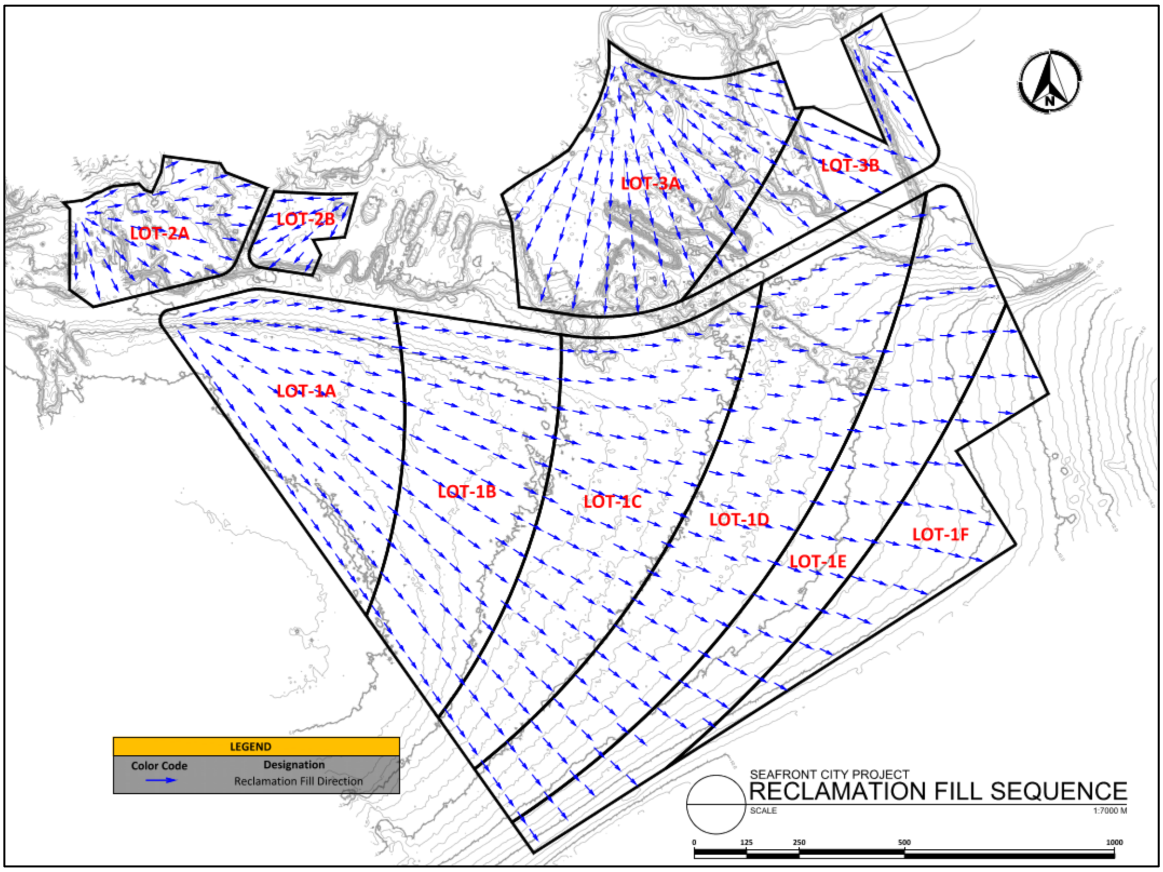


Figure 1-32: Reclamation Filling Sequence Plan

Filling via Trucks and/or Barges

Suitable filling materials will be delivered via trucks and/or barges. Initially the temporary dike will be constructed by filling the designated dike areas using backhoe barges but when the temporary bridge that will connect the temporary dike to the mainland will already be constructed then trucks will also be used. When the dike has been constructed then filling will continue all throughout the designated reclamation area. Bulldozers will be used to properly grade and level the reclaimed land while backhoes will be used to slope and trim the edges.

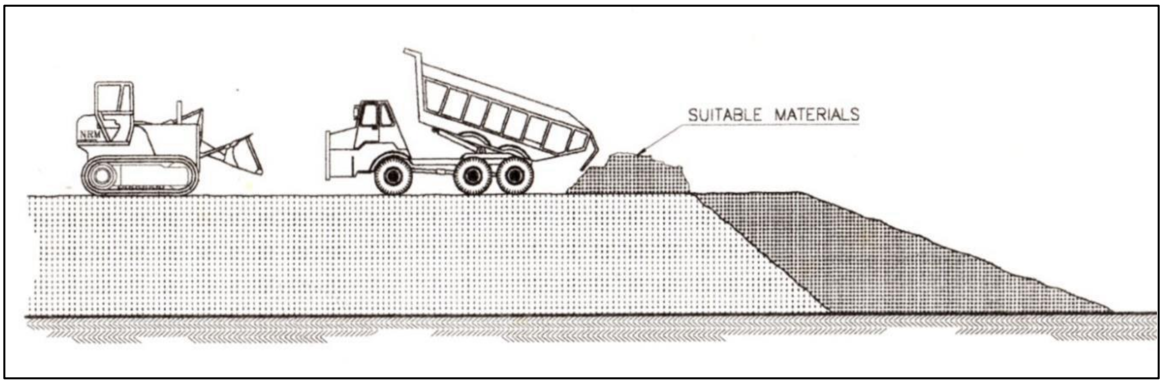


Figure 1-33: Filling via Trucks

<u>Filling via Dredging</u>

Phase 1: Pre-Dredge Survey

Prior to the start of any dredging activity, the owner's representative together with the sub-contractor's engineer shall conduct a joint pre-dredge survey to determine the actual existing elevation of the Proposed fill area and the designated source area. The corresponding data shall then be used as reference in determining the extent of the accomplishment of the dredging works to establish the volume already dredged and to check the elevation of the dredge material source area. A record of the seabed topography and the topography of the fill area shall be duly kept and submitted to the owner's representative duly checked and signed by the authorized representatives and shall form an integral part of the accomplishment report regularly every billing month.

Phase 2: Dredging by Trailing Suction Hopper Dredgers

Dredging works will be carried out by Trailing Suction Hopper Dredgers. These dredgers are equipped with one or two suction pipes ending in drag heads. The drag head moves slowly over the bed collecting the sand like a giant vacuum cleaner. The mixture of sand and water is pumped into the hopper of the dredging vessel. Excess water flows out through so-called overflows. Dredging stops when the maximum hopper capacity is reached.

The vessel can discharge its load in various ways, depending on the project specifications.

One method used is Rainbowing wherein the vessel can get close to the discharge location and the previously reclaimed sand body is above or almost above the surface. The sand is sprayed through a nozzle in the bow rainbowing in an arch through the air.

Figure 1-34: Sample of Trailing Suction Hopper Dredgers

Another discharge method consists of pumping the sand ashore by floating or sunken pipelines. This approach is used for example in land reclamation or coastal protection projects. The sand is pumped through floating pipelines into the reclamation area. The sand can also be deposited through doors located in the bottom of the vessel.

Compaction

Compaction will be self-weight. Given that the seabed and underlying soil is stable and is a mixture of sand and coarse limestone, the settlement and consolidation will only take 1 to 2 years. Settlement will be accelerated using Plastic Vertical Drains (PVD) along the designed roadways. This will enhance stabilization further.

Figure 1-35: Sample Plastic Vertical Drain Installation

Land Development

The land development aspect of the project will follow the Philippine standard codes, procedures and methodologies compliant with the National Building Code of the

Philippines, and as directed by the LGU's Office of the Building Official (OBO), and pertinent national government agencies such as the Department of Public Works and Highways for the roads and bridges, the National Water Resources Board for the water permits on the sources of water, the Department of Energy for the transmission line and the Department of Environmental and Natural Resources for the waste management system.

Solid Waste Management

These same three prescriptions should be practiced on the construction site. Contractors will be required to implement the Reduce, Reuse, Recycle scheme in the construction site as well as in the staging area.

Reduce: Wherever possible, minimize the production of solid waste. Reduce packaging wastes by purchasing materials in greater quantities or purchase materials packaged in reusable or recyclable containers. Prohibit littering by construction personnel.

Reuse: Wherever possible reuse waste generated during the construction of the project.

Recycle: Recycle material as appropriate. Scrap metal and wood pallets are readily recyclable. For the waste materials that have no reusable value, properly dispose of the waste in accordance with the contract plans and specifications.

The Contractor will provide an area for waste segregation, MRF and temporary storage of hazardous materials during construction. Collection of solid waste will be done in coordination with the local government. Recyclables and recovery of plastics for reuse as raw materials for chairs and building blocks will be included as part of the project's Social Development Program in partnership with the municipality. Collection of hazardous wastes will be done through DENR accredited treaters and transporters.

Vessels that will be utilized to deliver construction materials, will use a combination of complementary techniques to manage garbage, and must have written procedures or a Garbage Management Plans, duly approved by the PCG and shall be incorporated into the crew and vessel operating manuals. This procedure is designed for minimizing, collecting, storing, processing and disposing of garbage, including the use of the equipment on board. Procedures should be defined to enable the crew to sort the materials that can be reused onboard the ship or recycled at an appropriate port reception facility. It should dispose garbage at the PCG/MEPCOM approved port reception facilities and retain on board appropriate facilities to be approved by the PCG/MEPCOM, for the discharge of garbage on Philippine waters. Domestic vessels are required to have Sewage Pollution Prevention (SPP) Certificate on board at all times or a waiver that certifies her exemptions as applicable. Table 1-12 and Figure 1-33 show the Waste Categorization Scheme during Construction for estimated construction manpower of 3,000.

Table 1-12: Waste Categorization Scheme during Construction (3000 manpower)

Waste	Percentage	Volume (kg)
Food Waste	27	960
Metal	7	300
Plastic Cellophane	14	456
Wood	8	324
Paper	6	276
Glass	11	432
Electronics / Electrical	15	480
Special Wastes (Paints, Thinner, Spray Canisters, Oils and Tires)	9	372
Residual Waste (Styro-Materials, Worn-out Rugs, Ceramic and Others)	3	108
Total	**100**	**3,708**

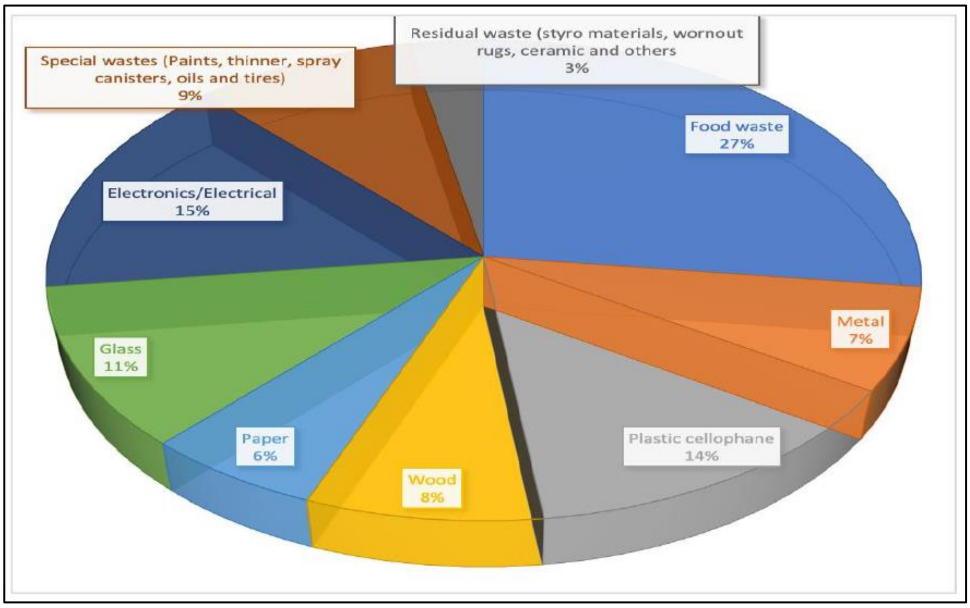


Figure 1-36: Waste Characterization Scheme During Construction (in pie graph)

1.5.2.3. Roadworks

A total of 18.027 kilometers of roads will be constructed. Of the total length, 8.3 kilometers or 46% will be composed of 32-meter two-way road at +4.00 m MLLW and 22 m two-way road at +4.00 m MLLW to serve as major thoroughfare. The rest will serve as ancillary roads with various dimensions as shown in Table 1-13. Access road going to the project area are all existing and no new access road will be developed, however, will be enhanced and widened.

Table 1-13: Road Work Length and Distribution

Type of Road with Dimension	Length (linear meter)	Distribution (%)
32.0m Roadway @ + 4.00m MLLW (two way)	1,462.39	8.11
22.0m Roadway @ + 4.00m MLLW (two way)	6,826.30	37.87

17.5m Roadway @ + 4.00m MLLW (one way)	1,409.27	7.82
17.0m Roadway @ + 4.00m MLLW (one way)	2,116.55	11.74
16.0m Roadway @ + 4.00m MLLW (one way)	1,414.43	7.85
13.0m Roadway @ + 4.00m MLLW (one way)	880.60	4.88
12.0m Roadway @ + 4.00m MLLW (two way)	3,439.46	19.08
10.0m Roadway @ + 4.00m MLLW (two way)	174.26	0.97
20.0m Walking Blvd. @ + 4.00m MLLW	304.14	1.69
Total	**18,027.40**	**100.00**

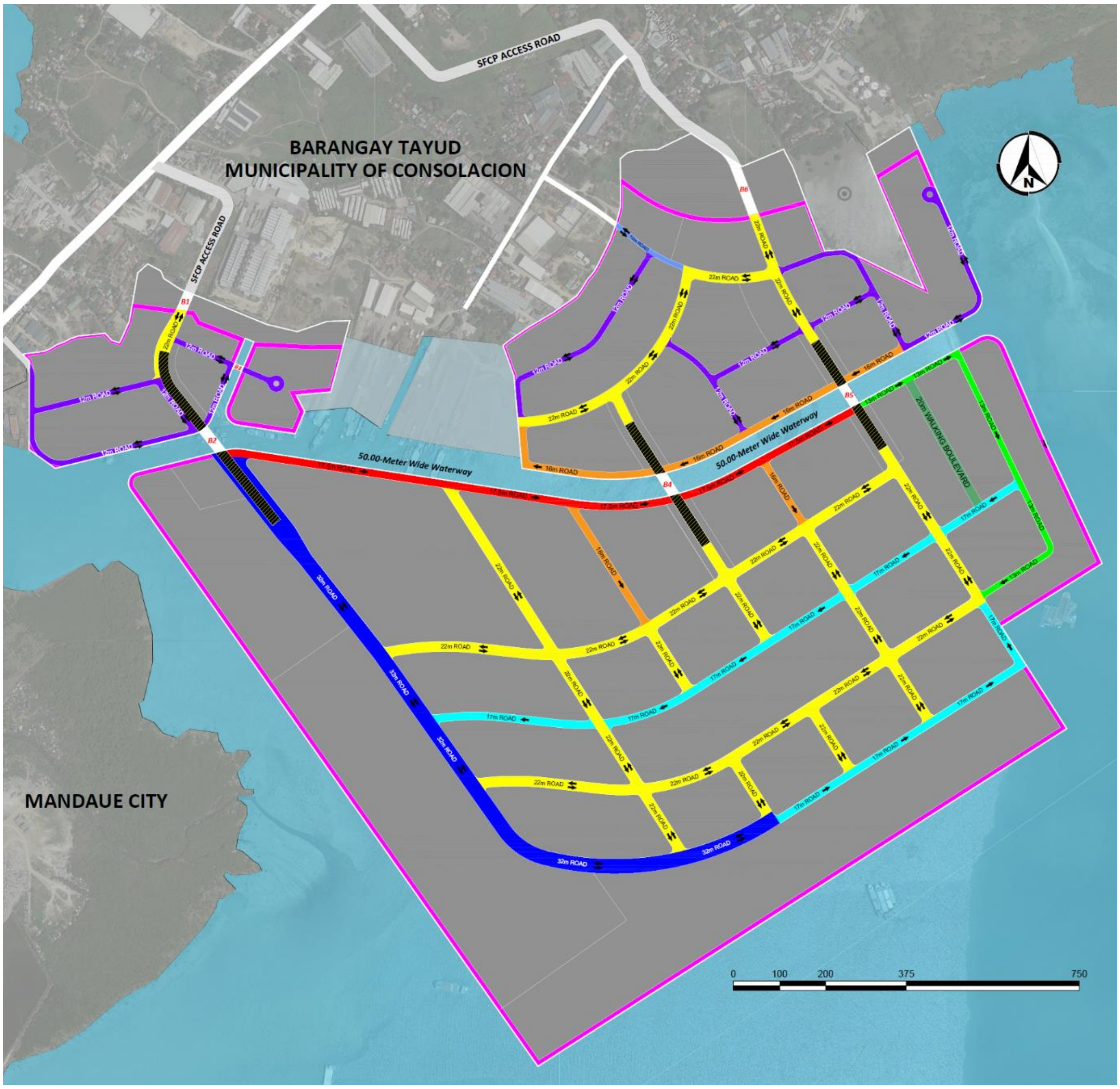


Figure 1-37: Road Network Plan

1.5.2.4. Bridges

Six bridges of two bridge types will be constructed to interconnect the 3 Lots with each other and with the mainland. The first type of bridge is the Box Culvert Type while the second type is the Prestressed Concrete Girder Bridge. Figure 1-34 and 1-35 show a cross section of each types of bridge.

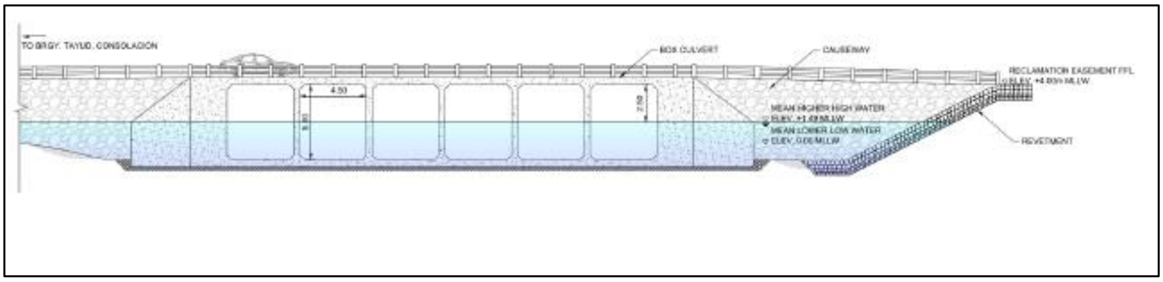


Figure 1-38: Cross Section of a Box Culvert Bridge

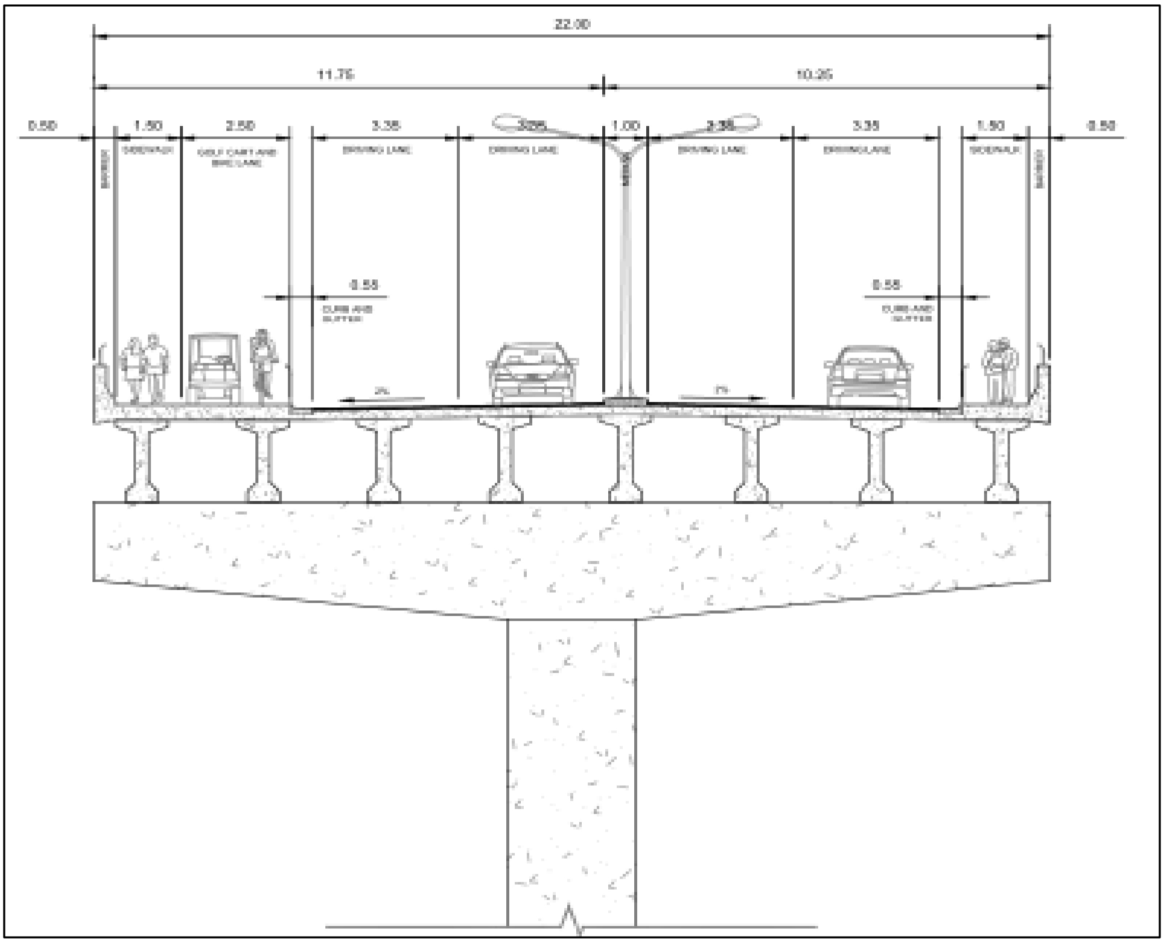


Figure 1-39: Cross Section of a Prestressed Concrete Girder Bridge

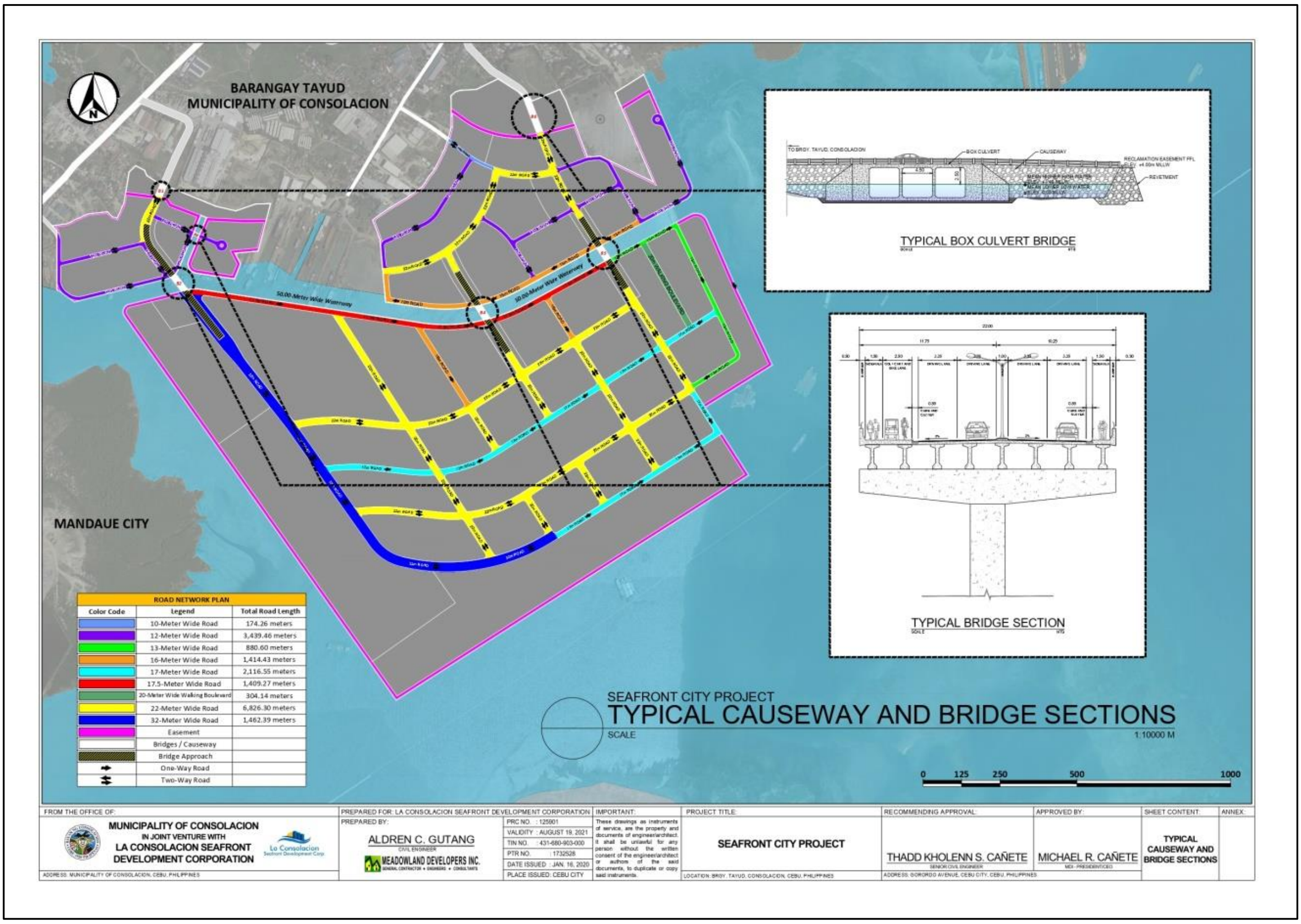


Figure 1-40: Map showing the location of the different bridges

1.5.2.5. Demobilization after Reclamation and Land Development

After all the reclamation works are done, the proponent will make sure that everything is clear of equipment on land or on sea. The area should be clear of all debris, rubbish and anything that will affect the environment (e.g. water quality of the area). Water quality monitoring will be done to check any discrepancies with the baseline conditions. Mitigating measures will be done in case any damage was done in the area especially on the mangrove areas. If the damage was done on the private properties of any person or on a community, proper monetary compensation will be awarded to the affected person or community based on an agreed amount.

All other materials or equipment that is foreign to the area will be demobilized. Corresponding clearances from the LGU, the PRA, PCG and other concerned agencies will also be secured.

1.5.3. Alternative Reclamation Technologies

The different reclamation methodologies were presented in the previous section from the type of containment structure to the mode of delivery of filling materials. Selecting the appropriate methodology requires understanding of both of the options and site parameters. The different reclamation technologies are again presented below:

1.5.3.1. Containment Structures

Reclamation projects can utilize different types of containment structures that prevent the reclamation fill materials from being eroded by the sea. These structures are designed in such a way to withstand not just the pressure of the soil it trying to contain but also the impact of the waves. There are two major types of containment structures Sheet Piles and Revetments.

a.) Sheet Piles

Sheet piles are mostly used as containment structures whether made from steel, timber, and reinforced concrete. The sections of these piles have interlocking edges that would form retaining walls that prevent soil from sliding and in the case of reclamation projects, erosion by the sea. Since sheet piles are basically retaining walls, they are highly sufficient at minimizing the area taken up by containment structures.

Timber Sheet Piles

This type of sheet pile is mostly used for short spans in temporary structures, and to resist light lateral loads. The disadvantages of using this type of piles are that it requires constant maintenance and preservative treatment especially when exposed to water.

Reinforced Concrete Sheet Piles

This type of sheet pile is precast either in on-site or off-site facilities. Special molds are used to retain the designed shape of the pile. Significant amounts of steel reinforcement bars and concrete will be used in this type of sheet pile. Also, a large staging area is needed for fabrication and storage of these sheet piles.

Reinforced Concrete Sheet Piles are prestressed to facilitate handling and driving. Since the steel reinforcement is covered by concrete, it is mostly protected from rust and corrosion but when cracks form in the concrete then salt water can enter.

Steel Sheet Piles

This type of sheet pile is the most common type, and it is easily fabricated off-site by manufacturers and delivered to the site either through hauling and/or barging. Installation is easy and fast. It can be installed the same day it is delivered.

b.) Revetment

Revetments are low-cost structures built or placed along the banks of rivers or shorelines and are designed to absorb the energy from incoming waves from the sea and tidal currents. These structures are usually made from natural stones or prefabricated concrete blocks. This type of containment structures would require a wider area since they are mostly sloped along the plane facing the sea.

The two most common type of revetments are made either using Armor Rocks or by constructing Rubble Masonry.

Armor Rocks

This type of revetment is mainly used to protect the sloped edges of reclamation projects from being eroded by the waves and changing tides. Due to the irregular shapes of the rocks used and the slope of the revetment, the force of the waves would be dissipated.

Rubble Masonry

This type of revetment is also called a revetment wall. This revetment is made by binding similar sized rocks together using concrete or grout and forming a sloped wall. Compared to using armor rocks, this type of revetment can be built with a steeper slope thus, minimizing its footprint but this significantly lessens its capability of dissipating waves.

c.) Reclamation Fill

The fill material to be used in the project will be clear of rock boulders, garbage, metals, oil, wood, and should have minimal organic content. Its properties are as follows:

- Pass sieve No. 200: <10%
- Maximum particle size: 75mm
- Compaction: 95%
- Plasticity Index (AASHTO T 90): <6%
- Soaked CBR (AASHTO T 193): >25%

1.5.3.2. Sourcing and Delivery

a.) Barging

The sources of these suitable fill materials are from other established quarry sites within and outside Cebu Province but ideally within a 100-kilometer radius from the project site. Source can be from land-based quarries or from river mouths and deltas, as well as foreshore and offshore seabed provided that all the government regulatory requirements are secured by the quarry operator(s) / supplier(s) such as but not limited to:

- Quarry Permits
- Government Seabed Quarry Permits (GSQP)
- Environmental Compliance Certificate (ECC)
- Others

b.) Trucking / Hauling

Suitable fill materials can be sourced directly from quarries within Cebu Island itself which have Quarry Permits, ECC and all other regulatory requirements.

c.) Dredging

Sourced from identified and established foreshore and offshore marine sand sources by use of Cutter-Suction dredger, Clamshell, and Hopper-Suction Dredger which are the most common. The extracted fill materials will be delivered to the project site whether by the dredger itself or by filling up barges. As mentioned, these marine sources must have Government Seabed Quarry Permits.

1.5.3.3. Site Conditions

The reclamation methodology that will be used for any reclamation project will depend on the site conditions such as the site location, adjacent area status, environmental conditions, and physical characteristics.

a.) Site Location

The project site presented on Figure 1 shows that at the southeastern area of the project area is the Mactan Strait which is the busiest water body in Cebu. It caters to all types of shipping vessels coming in and out of the Ports of Cebu. While the southwestern area is directly along path of the water exiting the mouth of Cansaga Bay thus the project must maintain a water channel with a minimum distance of 100-meters from the mangrove areas in Mandaue City.

Another consideration is that since there are still existing and operating shipyards, the project must maintain a water channel with a minimum distance of 50-meters from the nearest port structure to the Island-type reclamation (Lot-1).

b.) Environmental Condition

The environmental situation in the area is an important factor in the design of the project and its objectives. One of the objectives of the project is to improve the overall economic usability of the foreshore and offshore area of barangay Tayud while maintaining, rehabilitating, and minimizing the impact to the environmental.

c.) Existing Reclamation Structures

The project site is the location of multiple shipyards and ship repair facilities which are owned by private entities. Most of these tenurial lease holders have expired Foreshore Lease Agreements (FLA). Only three have active FLAs namely, Colorado Shipyard, Santiago Shipyard, and Tayud Shipworks. Figure 1-34 shows the location map of these shipyard projects.

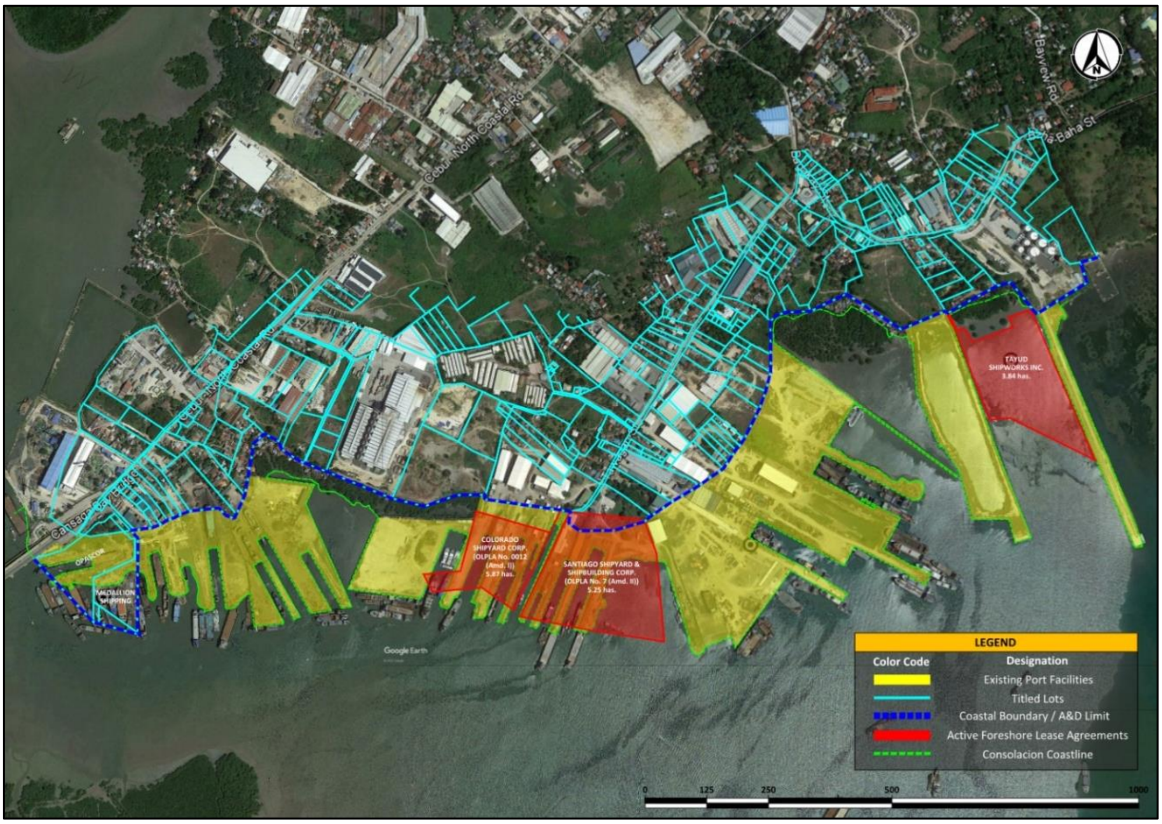


Figure 1-41: Map showing the existing reclamation projects surrounding the proposed project

As seen on the figure, the area has artificial land formations that are outside the Coastal Boundary/A&D Limit. These areas are undocumented reclamation infrastructures that were left behind by the expired shipyard and ship repair operators.

One of the objectives of the project is to consolidate all the existing reclamation structures into one and be converted from being heavy industrial to commercial, light industrial and residential.

d.) Mangrove Areas

The project site has patches of mangroves outside the Coastal Boundary/A&D Limit. The Community Environmental and Natural Resources Office (CENRO) has inventoried 7,874 Mangrove Trees in the area. The total area of the existing mangroves is 42,532 sq. m. Map of existing mangrove areas is shown in Chapter 2 under Land Use and Classification.

As one of the commitments of the project is to rehabilitate and improve the area, these mangrove areas, will be part of the development and will be converted into parks and aviaries for tourism to protect it from any future incursions and prevent further proliferation of informal settlers after the project has been implemented.

1.5.3.4. Determining Reclamation Methodology

Based on the understanding of both the options and the site conditions, the determined reclamation methodology are as follows:

1.) To maintain the project landform while minimizing the impact on the water channels and navigational route, the type of containment structure to be used along these channels will be sheet piles (See Figure 4). While for the enhancement and rehabilitation of the mangrove areas, and for aesthetic purposes, the containment structure to be used along these areas will be revetments. Figure 1-38 shows an image of a typical waterway section plan.

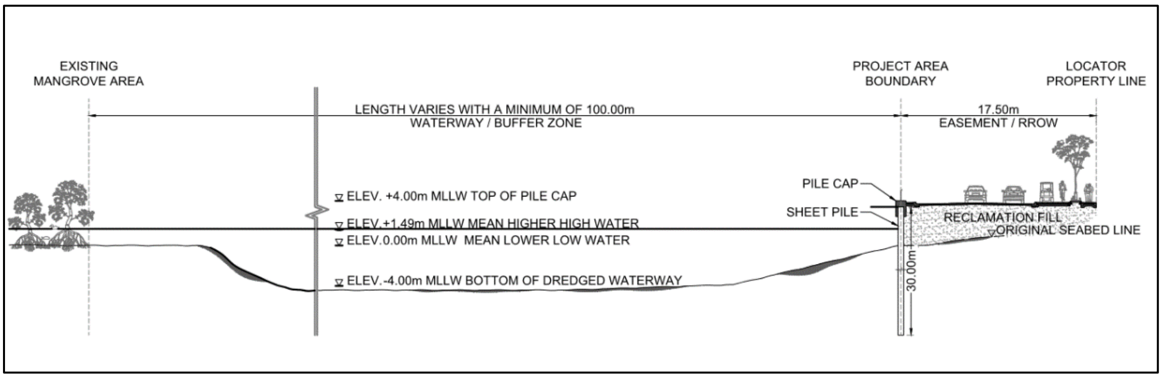


Figure 1-42: Typical Waterway Section Plan

2.) To minimize environmental impact of the area, the type of sheet piles that will be used are steel sheet pile which will eliminate the on-site fabrication process usually needed for reinforced concrete sheet piles. While for revetments, the type that will be used is rubble masonry which will have a smaller footprint than that of using armor rocks as shown in Figure 1-39.

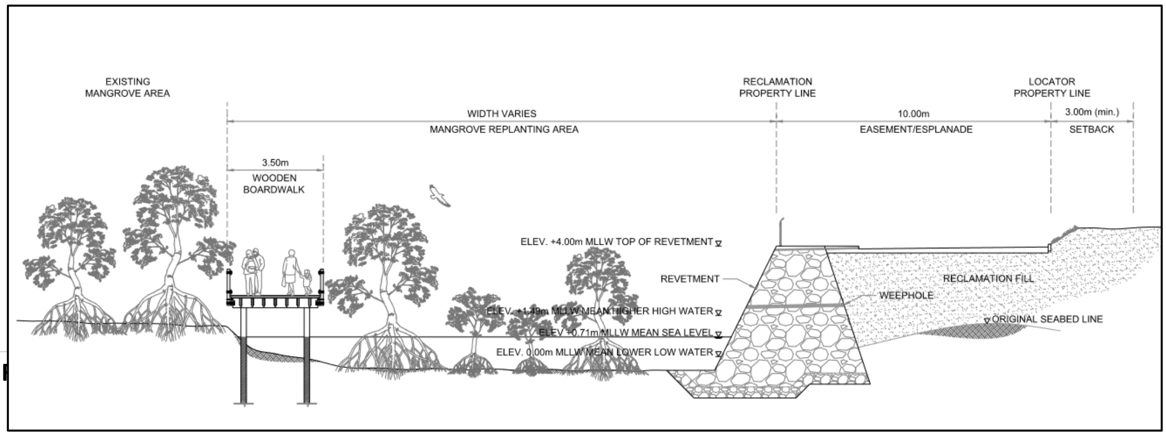


Figure 1-43: Typical Mangrove Area Section Plan

3.) Lastly, to minimize the impact on the existing traffic conditions of Consolacion and Metro Cebu in general, the mode of delivery for fill materials will be through barging. A Dredge-to-Site mode can be viable if the contractor will be able to comply all regulatory requirements and permits.

1.5.4. Utilities

There are 5 major utility facilities that the project will provide namely: 1.) the water treatment and distribution facility, 2.) power and telecommunications facility, 3.) wastewater treatment facility, 4.) materials recovery facility, and 5.) rainwater harvesting facility. See Figure 1-40 for the Utility Locations.

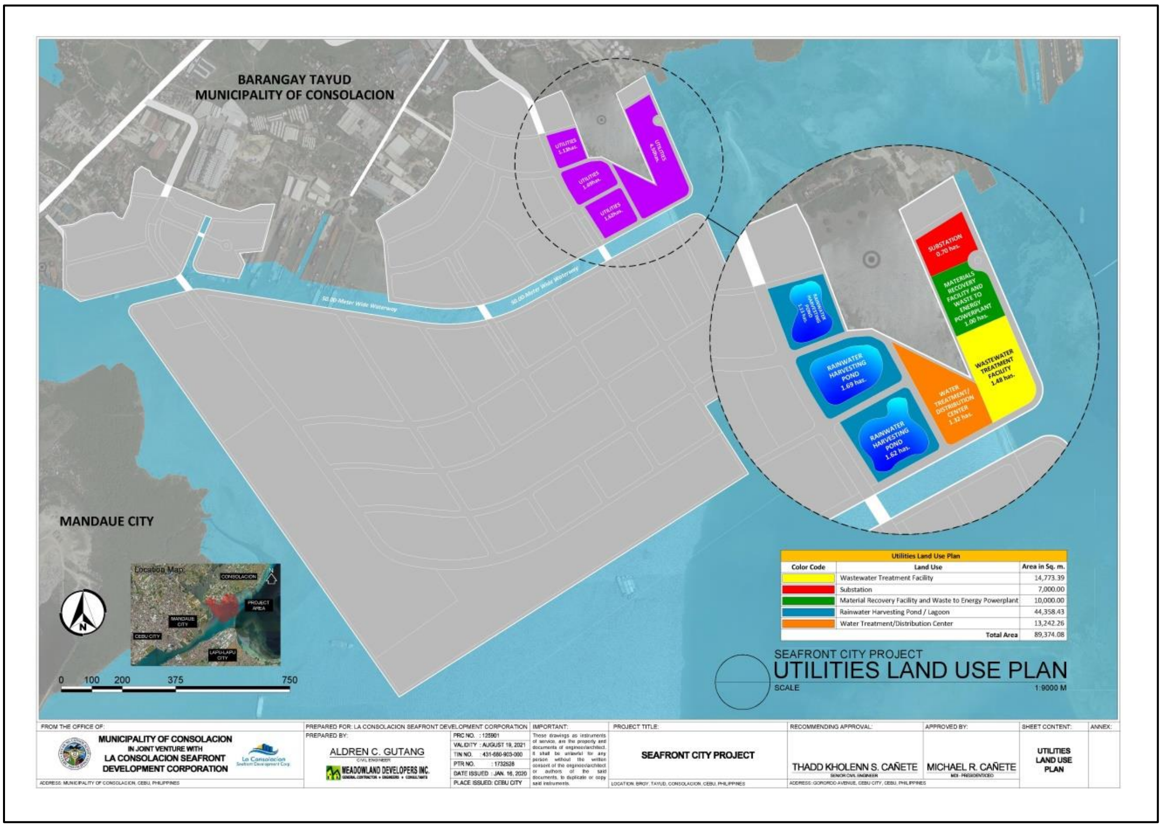


Figure 1-44: Map Showing the Utility Facilities of the Project

1.5.4.1. Water Supply Resources

The main objective of the water supply project is to develop the identified off-site areas in Consolacion and Liloan areas for the reclamation project in Tayud and in Northern Mactan Reclamation Project across the Mactan Channel.

Several potential areas for groundwater and surface water sources have been identified in Consolacion and Liloan that could be developed to achieve the main objective. These sources are cheaper to develop than seawater desalination, which could be the more futuristic source of water supply if cheaper energy than today's technology would be available.

Sources of water supply in Metro Cebu are now available mostly from facilities of water district and individually developed groundwater sources. The coastal aquifers in Cebu City and Mandaue City are now being over pumped so that seawater intrusion created more brackish water than decades ago. Reliance of water resources outside the brackish zone is now the reality. Consolacion and Liloan have the identified potential water sources that could be developed in the near future with the expansion of their economy.

The Cotcot surface water resources will also be considered in the plan but will be pushed towards the later part when the reclamation will be implemented.

These water resources developments will be implemented in stages.

Identified Water Resources

The water resources in proximity of the reclamation area are the brackish groundwater the proposed reclamation area in Tayud, Consolacion. The groundwater will be extracted in calibrated rate of less than 600 m^3/d with 3-4 wells. The drainage area in this well field is about 0.61 km^2.

The other water resources in not so near the proposed reclamation area are the surface water in the wetland of Tayud, Liloan. The drainage area of the wetland is about 2.7 km^2 and the potential rate of extraction is about 4,600 m^3/d. Groundwater could also be developed with 6–8 small wells with total extraction rate of 1,500 m^3/d.

Another water resource in Consolacion is located in the wetland of Pitogo-Yati area. However, it is several km away from proposed reclamation area. The drainage area of the wetland is about 4.5 km^2 and the potential rate of extraction is about 7,800 m^3/d.

Cotcot River at Panangban will be another source of surface water that could have drastic improvement of water supply.

This source will be developed into reservoir with extraction rate of about 30,000 m^3/d. This surface water will be treated with conventional water treatment system and transmitted to Mactan using submarine pipeline across Mactan Channel.

The Cogon-Cabadiangan Valley in Compostela will also be another groundwater resource to be developed. However, these Cotcot and Compostela Valley resource will need high political and social engineering.

The water sources at Tayud Consolacion and Tayud Liloan could meet the water demand of the reclamation area, which has a net buildable area of about 235.80 ha. The estimated water demand of 235.80 hectares could be at an average of 15,500 m^3/d when fully developed. With dual water supply pipe system (grey and potable), the supply for grey water could be developed from rainwater harvesting. Surplus of supply water from Tayud and Pitogo-Yati could be used for the nearby north Mactan reclamation area. Thus, these water sources will be developed first, then Pitogo-Yati after 5 years interval.

Figure 1-45: Map showing the Water Sources Location

List of Proposed Activities for the Preparation of Detailed Engineering Design and Implementation of the Project

- Conduct survey of properties to be acquired as well-sites, water treatment plant sites, tanks sites and road right of way for pipeline routes
- Conduct groundwater assessment using geo-resistivity survey to determine saline water boundary in the area
- Conduct route elevation profiles of identified road right of ways from sources to water treatment plant, service tanks sites and infusion points in the reclamation
- Conduct water quality sampling and analyses of groundwater and surface water
- Conduct hydrologic water balance calculations on surface water resources in Tayud, Liloan and in Pitogo-Yati areas, and of Kotkot River at proposed dam site in Panangban, Liloan-Compostela area.

- Conduct hydrogeological water balance calculation on groundwater resources in Tayud, Consolacion, Tayud in Liloan, in Poitogo-Yati and in Cogon-Cabadiangan Compostela.

- Conduct detailed engineering design of bulk water system in Tayud in Consolacion, Tayud in Liloan and in Panangban.

- Conduct costs estimates of the bulk water system using specific costs of materials and services

- Run financial viability calculations in regard to return of investments, present value analysis among others with proposed range of selling prices of bulk water.

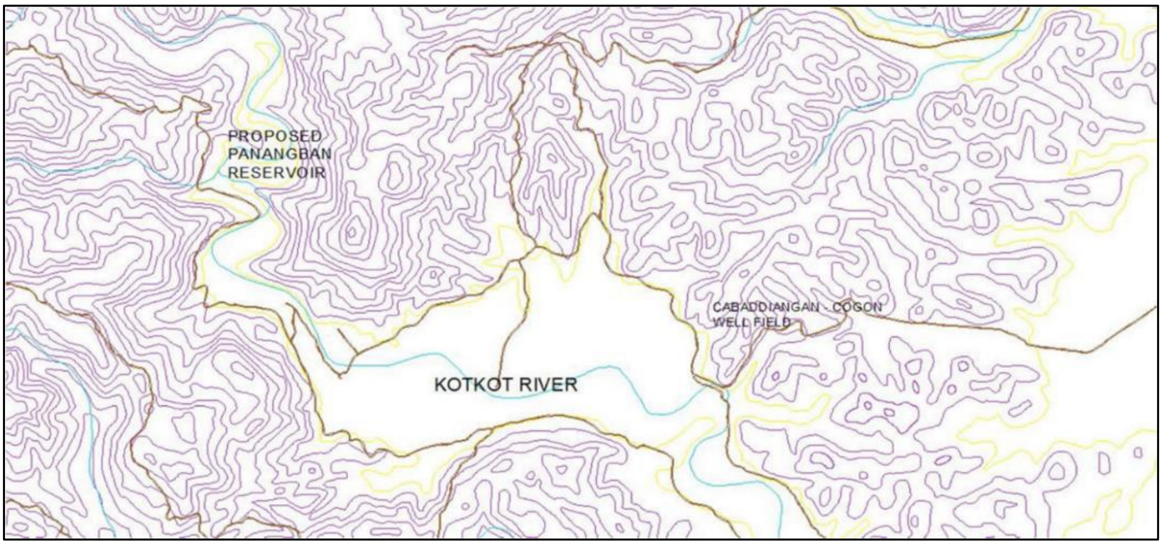


Figure 1-46: Map showing the potential surface and groundwater resources in Liloan and Compostela

The potential combined capacity of Panangban reservoir and Cabadiangan-Cogon wellfield could reach 40,000 m^3 / day. These water resources could be developed for bulk water supply of Mactan. Lapu-Lapu City is the fastest growing city in the province and has a current water deficit of 30,000 m^3 / day.

Water Distribution

The water distribution will be a dual-piping system which will house both potable (drinking) water and non-potable (non-drinking) water. Total distribution lines are approx. 18,500 meters. The raw water from the water source will be treated before it will be distributed. The project will allocate approximately 1.3 hectares for the water treatment and distribution facility.

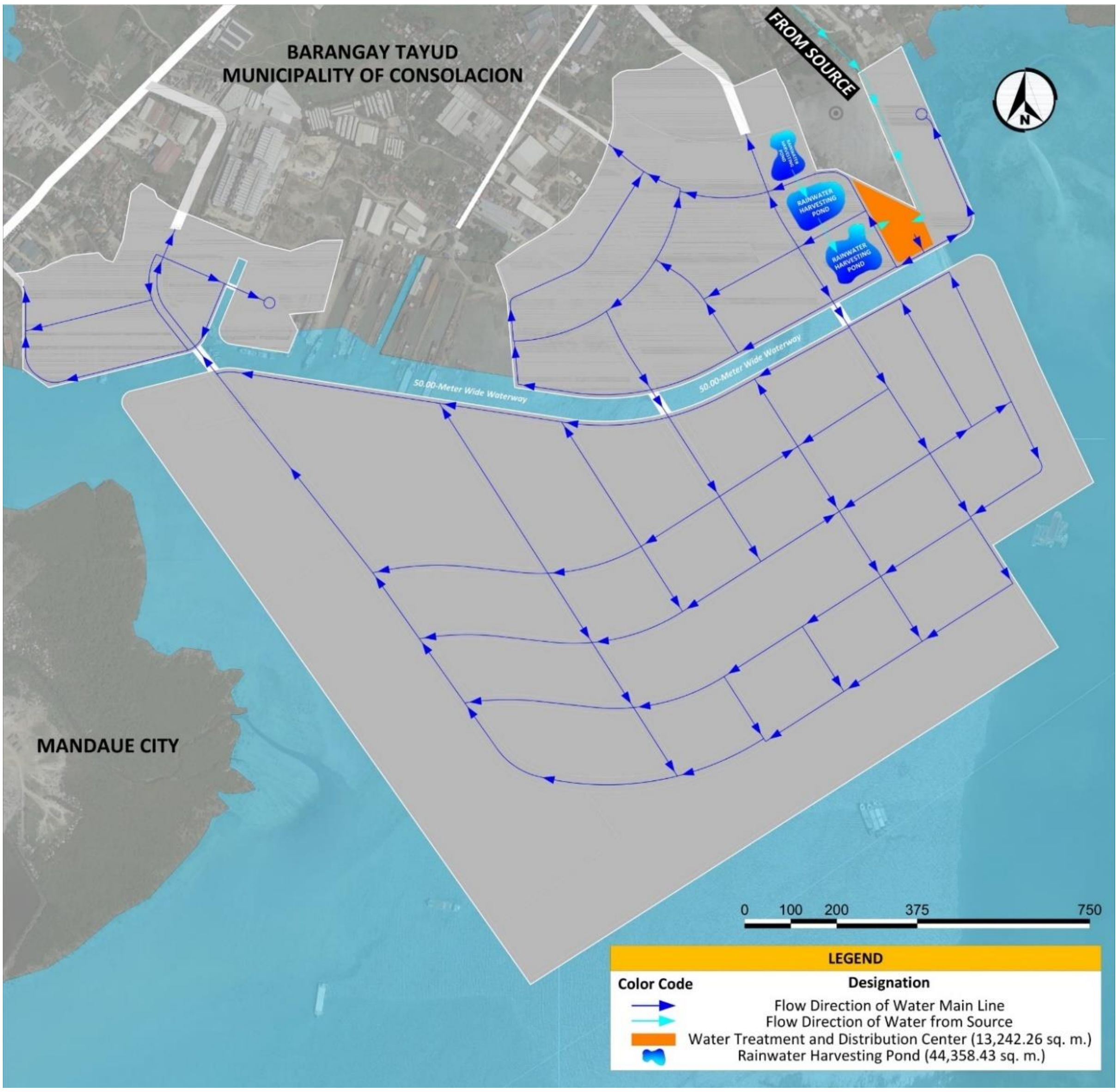


Figure 1-47: Water Distribution Layout Plan

Stormwater Water Recycling and Management Plan

The Stormwater recycling and management plan of the project during operations consists of four stages. Stage one is the collection of the rainwater runoff from the roads and the locator. This starts from the road drains and outfall from the locators and into slump pits along the roads. Then the water will go into the main stormwater drainage pipes. Most of the water will then go out from the strategically placed outfalls as seen on the figure and into the open sea. However, in Stage 2, some of the water will be collected through underground cisterns located in five intersections within the proposed road network. Stage three is the pumping of the collected stormwater in the cisterns towards the rainwater harvesting ponds. Stage four is utilizing the collected stormwater for the wastewater treatment process which will produce non-potable water to be used in watering plants and flushing.

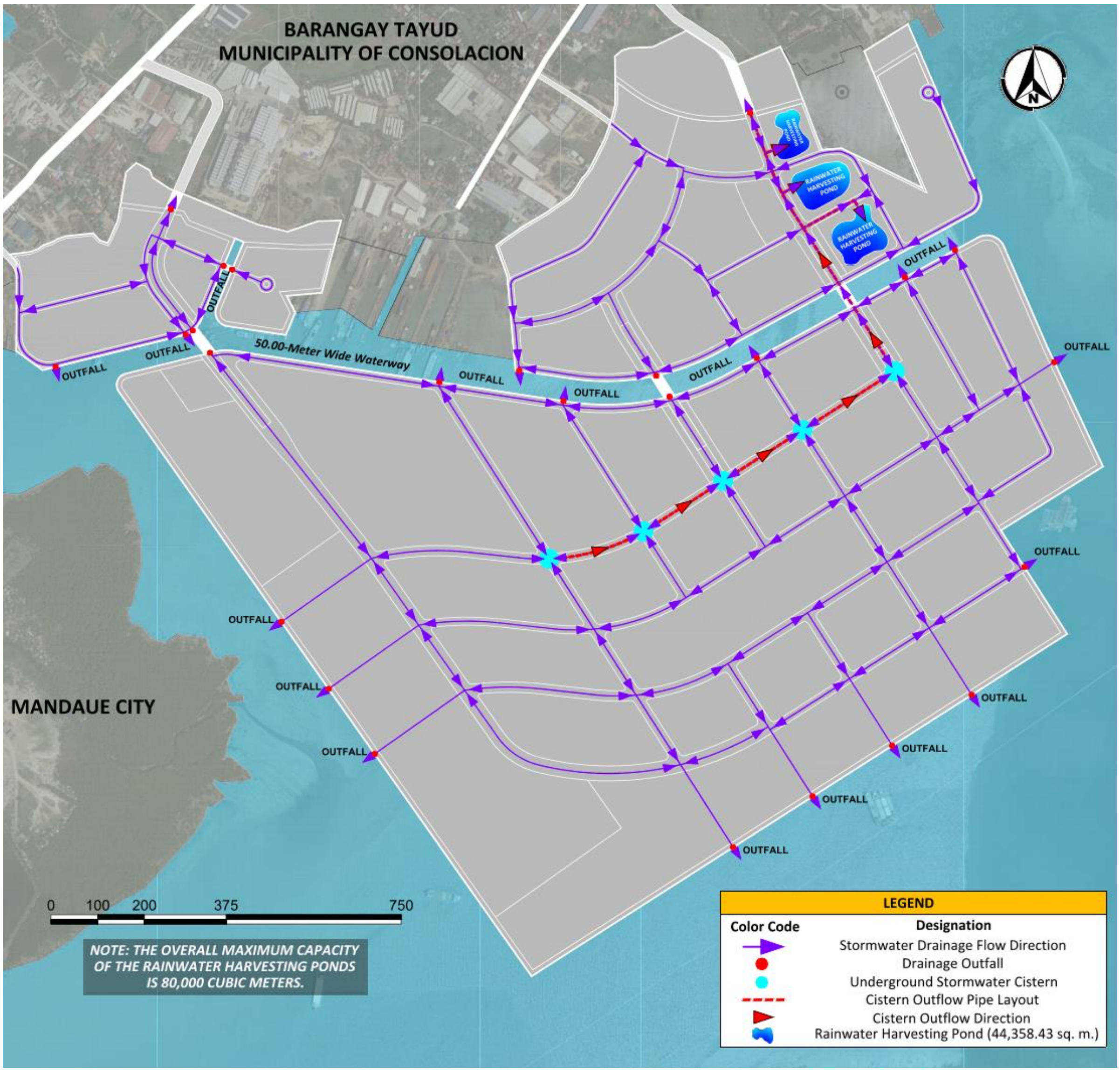


Figure 1-48.a: Utilities Stormwater Drainage Plan

Stormwater Discharge of the Project

Of the 235.80 hectares of the project area, only 2,282,525.46 sq.m. or 228.25 hectares will be reclaimed with fill materials up to an elevation of 4.00 meters above mean low lower water (MLLW). Thus, the total catchment area to be catered by the drainage system of the project is 228.25 hectares. With an average rainfall of 1.6 m/year, the estimated total average discharge of the project is calculated using the Rational Method as seen below.

Formula (Rational Method):

$$Q = CiA$$

Where:

Q = Average Discharge in cu.m./year

C = Coefficient of Runoff, assumed to be 1.0

i = Rainfall Intensity in m/year, 1.6 m/year

A = Catchment Area in sq.m., 2,282,525.46 sq.m.

1 x 1.6 x 2,282,525.46 = 3,652,040.73 cu.m./year

<u>Discharge Outfall</u>

The outfall locations of the stormwater drainage of the project are placed in twenty-five (25) strategic locations as seen on the figure. The Figure also shows the catchment area for every outfall.

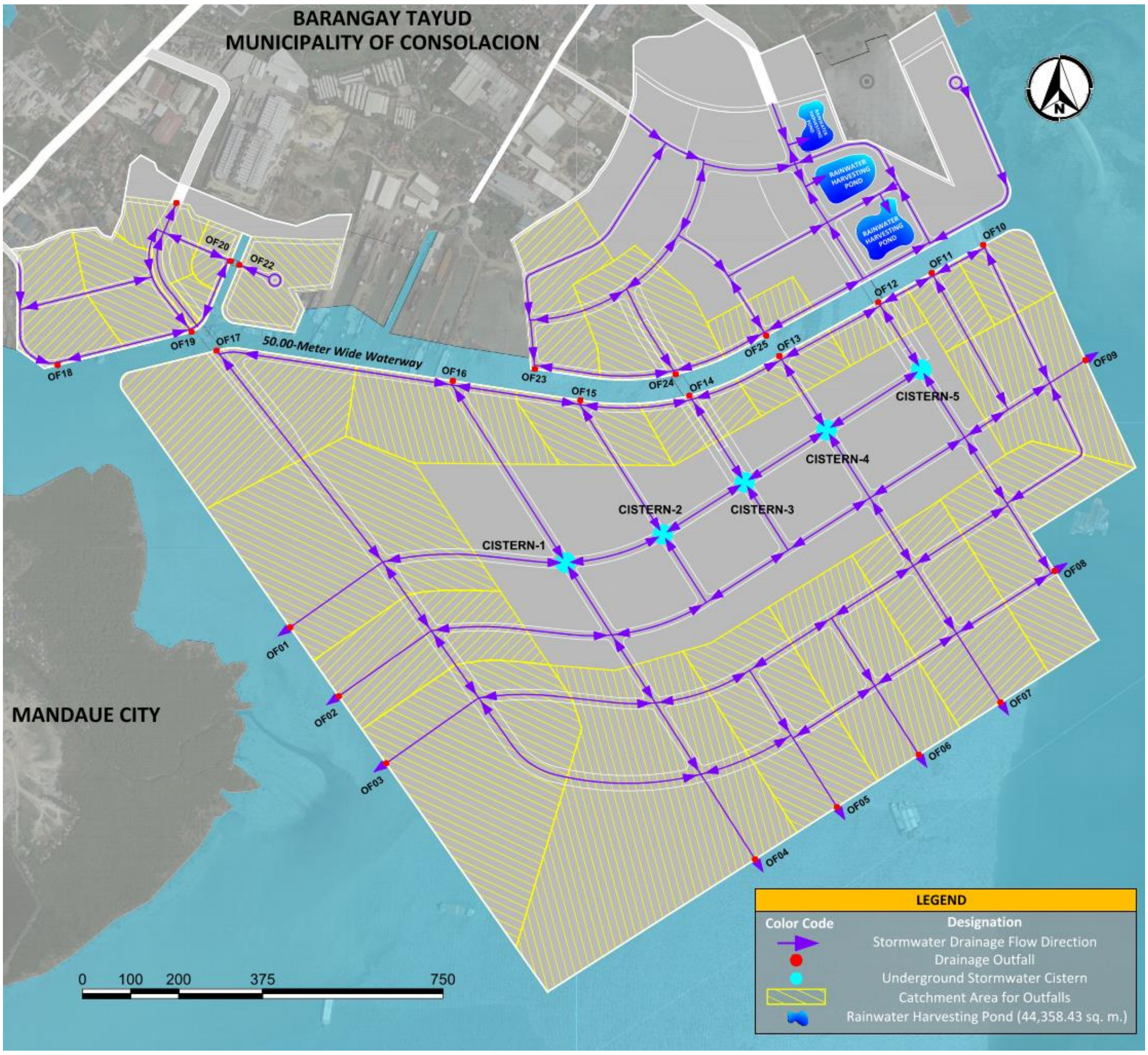


Figure 1-49.b: Outfall Location and Catchment Areas

The estimated daily discharge as seen on Table 1-14 was also calculated using the Rational Method. The Table shows that with the collection of the stormwater through cisterns and harvesting ponds, the total discharge was reduced from an average of 10,000 cu.m./day to 6,947 cu.m./day.

Table 1-14: Estimated Average Daily Discharge per Outfall

ESTIMATED AVERAGE DAILY DISCHARGE PER OUTFALL					
LOT	Outfall	Catchment Area		Estimated Ave. Daily Discharge	
		In Sq.m.	In Hectares	In cu.m./day	In cu.m./sec
LOT-1	OF01	149,243.60	14.92	654.22	0.454
	OF02	70,787.05	7.08	310.30	0.215
	OF03	149,369.18	14.94	654.77	0.455
	OF04	225,329.71	22.53	987.75	0.686
	OF05	86,011.22	8.60	377.04	0.262
	OF06	86,747.95	8.67	380.26	0.264
	OF07	91,978.36	9.20	403.19	0.280
	OF08	81,579.39	8.16	357.61	0.248
	OF09	74,488.71	7.45	326.53	0.227
	OF10	23,654.21	2.37	103.69	0.072
	OF11	18,837.20	1.88	82.57	0.057
	OF12	16,058.86	1.61	70.40	0.049
	OF13	19,354.63	1.94	84.84	0.059
	OF14	23,364.23	2.34	102.42	0.071
	OF15	33,456.14	3.35	146.66	0.102
	OF16	63,658.13	6.37	279.05	0.194
	OF17	103,894.08	10.39	455.43	0.316
	Sub-Total	**1,317,812.67**	**131.78**	**5,776.71**	**4.012**
LOT-2	OF18	40,353.99	4.04	176.89	0.123
	OF19	39,624.02	3.96	173.69	0.121
	OF20	9,186.22	0.92	40.27	0.028
	OF21	24,008.42	2.40	105.24	0.073
	OF22	34,024.52	3.40	149.15	0.104
	Sub-Total	**147,197.17**	**14.72**	**645.25**	**0.448**
LOT-3	OF23	47,658.28	4.77	208.91	0.145
	OF24	55,052.23	5.51	241.32	0.168
	OF25	17,096.99	1.71	74.95	0.052
	Sub-Total	**119,807.49**	**11.98**	**525.18**	0.365
TOTAL		**1,584,817.33**	**158.48**	**6,947.14**	**4.824**

The outfall with the highest discharge is at OF04 with an estimated average daily discharge of 987.75 cu.m./day or 0.686 cu.m./sec.

Underground Cisterns

One integral component in the stormwater or rainwater collection process of the project are the underground cisterns located in five (5) strategic locations (Please See Figure 1-43).

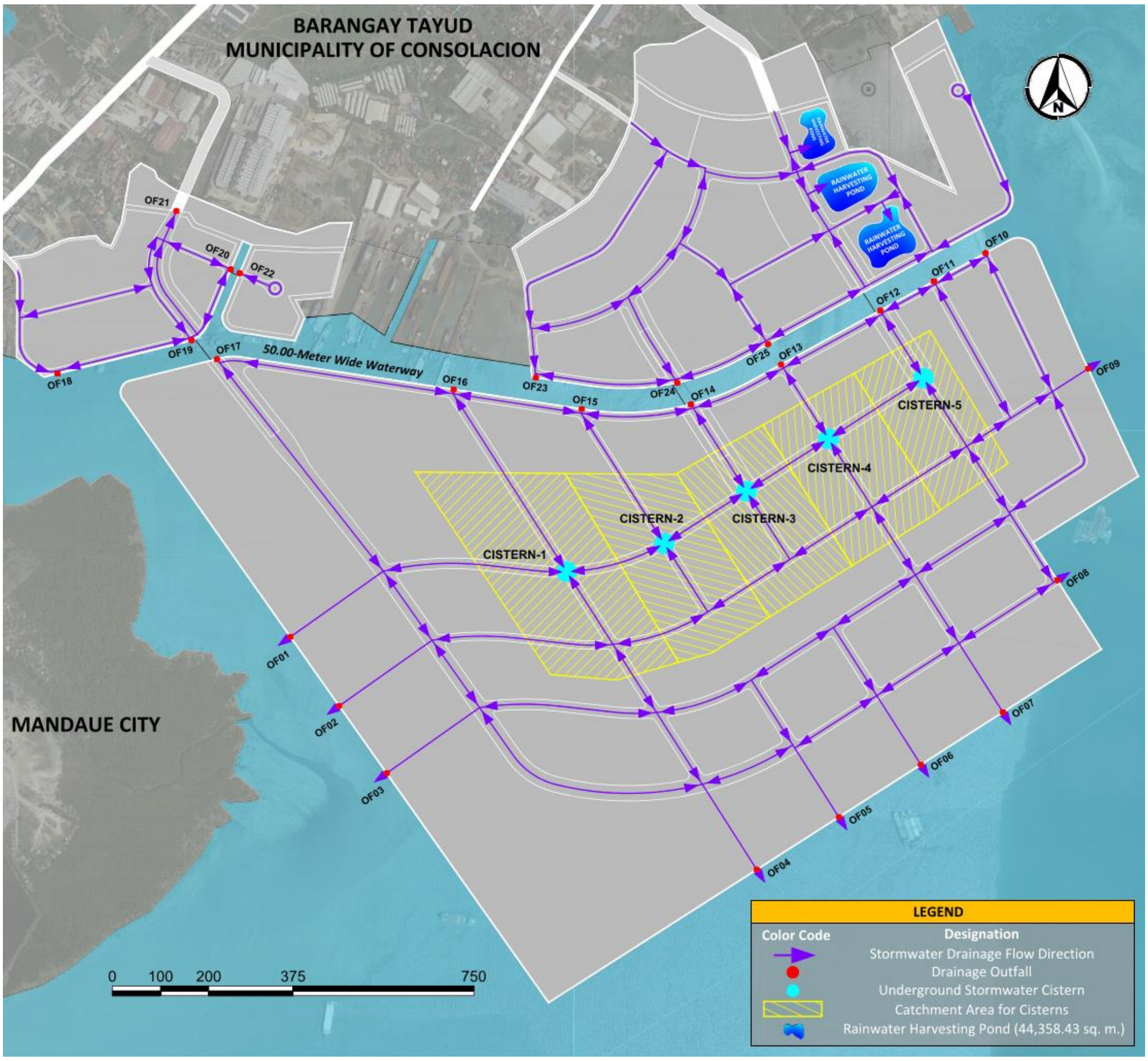


Figure 1-50.c: Cistern Location and Catchment Areas

Still using the Rational Method, the estimated daily collection of each underground cistern was calculated as seen on Table 1-15. The cistern with the largest daily collection is Cistern-1 with 540 cu.m./day or 0.375 cu.m./sec.

Table 1-15: Estimated Average Daily Collection per Cistern

ESTIMATED AVERAGE DAILY COLLECTION PER CISTERN				
Cistern	**Catchment Area**		**Estimated Ave. Daily Discharge**	
	In Sq.m.	**In Hectares**	**In cu.m./day**	**In cu.m./sec**
CISTERN-1	123,184.72	12.32	539.99	0.375
CISTERN-2	83,349.05	8.33	365.37	0.254
CISTERN-3	71,278.35	7.13	312.45	0.217
CISTERN-4	73,874.68	7.39	323.83	0.225
CISTERN-5	57,475.98	5.75	251.95	0.175
TOTAL	**409,162.78**	**40.92**	**1,793.59**	**1.246**

Rainwater Collection

To augment the water supply of the project, rainwater collection ponds will be put in place with a total area of 4.44 hectares and a total capacity of 80,000 cubic meters. These ponds will also be used as parks.

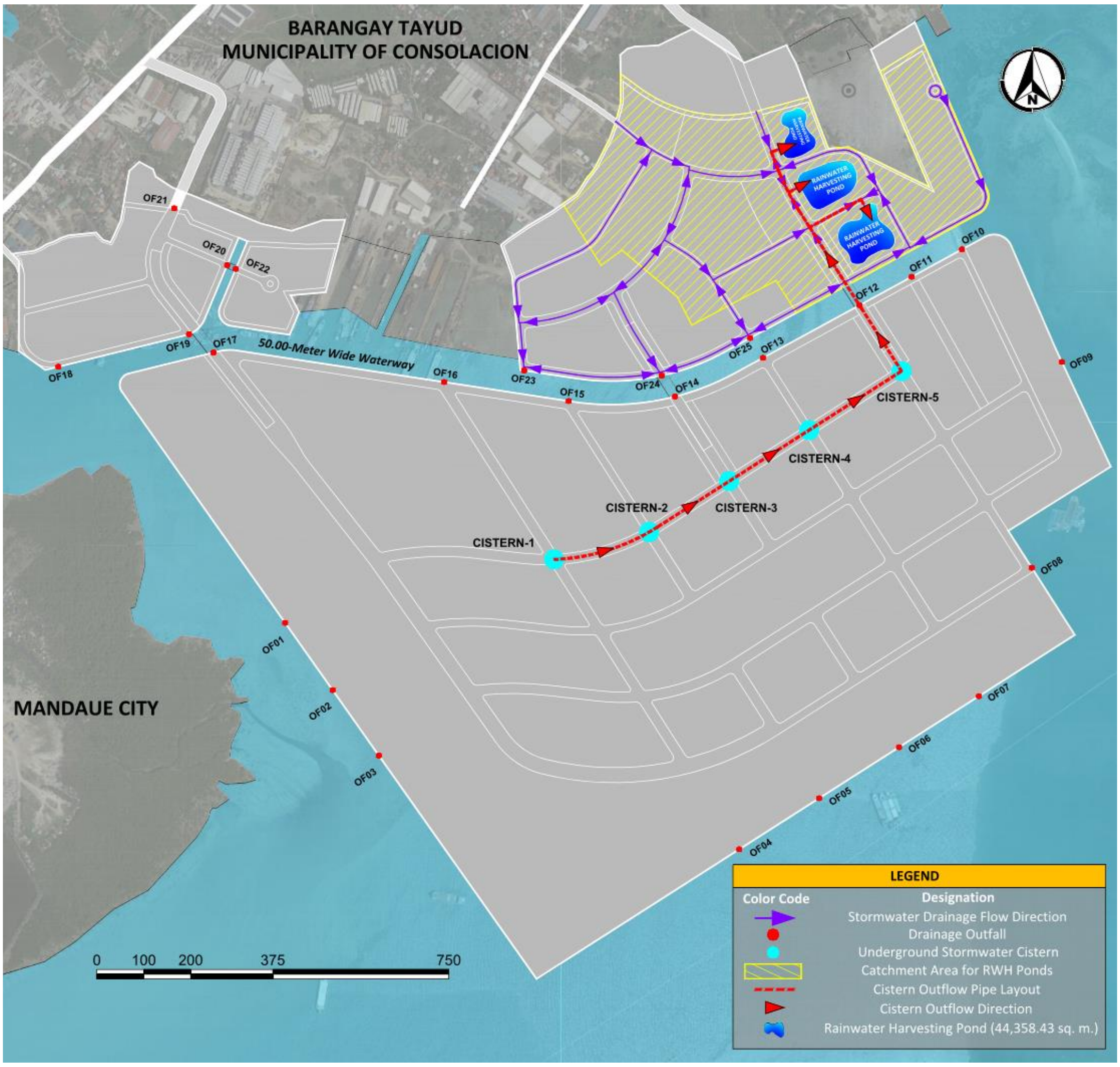


Figure 1-51: Rainwater Catchment Area and Cistern Pumping Direction

Using 365 days per year, the Estimated Daily Average Discharge of the project is 10,005.60 cu.m. per day or 6.95 cu.m. per second. However, as stated, a portion of the discharge will be collected through underground cisterns and by the Rainwater Harvesting Ponds.

Also using the Rational Method, the estimated stormwater or rainwater runoff of the catchment area for the ponds was calculated to be 1,264.86 cu.m./day or 0.878 cu.m./sec. With the addition of the estimated daily collection from the underground cistern of 1,793.59 cu.m./day or 1.246 cu.m./sec, the total estimated average daily collection of the rainwater harvesting system is at 3,058.45 cu.m./day or 2.124 cu.m./sec.

Table 1-16: Estimated Average Daily Collection per Cistern

ESTIMATED AVERAGE DAILY COLLECTION IN RAINWATER HARVESTING PONDS				
Source	Catchment Area		Estimated Ave. Daily Discharge	
	In Sq.m.	In Hectares	In cu.m./day	In cu.m./sec
Catchment Area	288,545.34	28.85	1,264.86	0.878
Cisterns	409,162.78	40.92	1,793.59	1.246
TOTAL	**697,708.13**	**69.77**	**3,058.45**	**2.124**

Projected Water Demand of Seafront City

The nature of the land use is mainly for mixed commercial-industrial with some residential housing projects. The rate of water demand in the various type of land uses are assumed in Table 1-17. With the given definition for regular and transient population, the rate of water demand of each type is multiplied with the type of population to arrive with the projected total water demand of the project, set in Table 1-15. See Annex 2 for the Yearly Water Demand at Medium Assumption.

Table 1-18: Estimated Rates of Water Demand

Estimated Rate of Water Demand, cu.m./p-d		
Land Classification	Regular	Transient
Commercial	0.08	0.06
Mixed Use - Commercial	0.08	0.06
Mixed Use - Residential	0.1	0.06
Residential	0.2	0.06
Tourist and Entrepreneur	0.2	0.06
Industrial	0.08	0.06
Institutional	0.08	0.06
Utilities	0.06	0.06
Terminal	0.06	0.06
Relocation Site	0.15	0.06

Table 1-18: Water Demand at Start of Full Project Operations

Water Demand of Resident and Transient Population in Year-7 of Project Operations								
Land Classification	Regular			Transient/Resident	Transient			Total Demand cu.m. /p-d
	Population	Rate cu.m. /p-d	Demand cu.m. /p-d		Population	Rate cu.m. /p-d	Demand cu.m. /p-d	
A. Saleable Area								
Commercial	33,122	0.08	2,650	50%	16,561	0.06	990	3,640
Mixed Use - Commercial	26,557	0.08	2,125	50%	13,278	0.06	797	2,921

Mixed Use - Residential	16,071	0.10	1,607	30%	4,821	0.06	289	1,896
Residential	6,678	0.20	1,336	10%	668	0.06	40	1,376
Tourist and Entrepreneur	12,624	0.20	2,525	200%	25,249	0.06	1,515	4,040
Industrial	6,234	0.08	499	5%	312	0.06	19	517
Institutional	7,720	0.08	618	50%	3,860	0.06	232	849
Total for A	109,006		11,358		64,749		3,881	15,240
B. Non-Saleable w/ Workers								
Utilities	292	0.06	18	10%	29	0.06	2	19
Terminal	70	0.06	4	50%	35	0.06	2	6
Relocation Site	1,140	0.15	171	20%	228	0.06	14	185
Total for B	1,502		193		292		18	210
Total for A and B	**110,508**		**11,550**	**59%**	**65,041**		**3,900**	**15,450**

1.5.4.2. Wastewater Treatment

The wastewater production of the project is estimated to be 15,000 m^3 / day which is based on the land use plan and the projected average daily water demand of the project. The project will be allocating 1.0 hectare for wastewater treatment. The treated wastewater will be distributed through the dual-piping system as non-potable water for plant watering and toilet flushing.

Sewage Line Layout

A separate sewage line will be installed along the major roads with a total length of 18.5 kilometers. Please refer below for the layout of the sewage line.

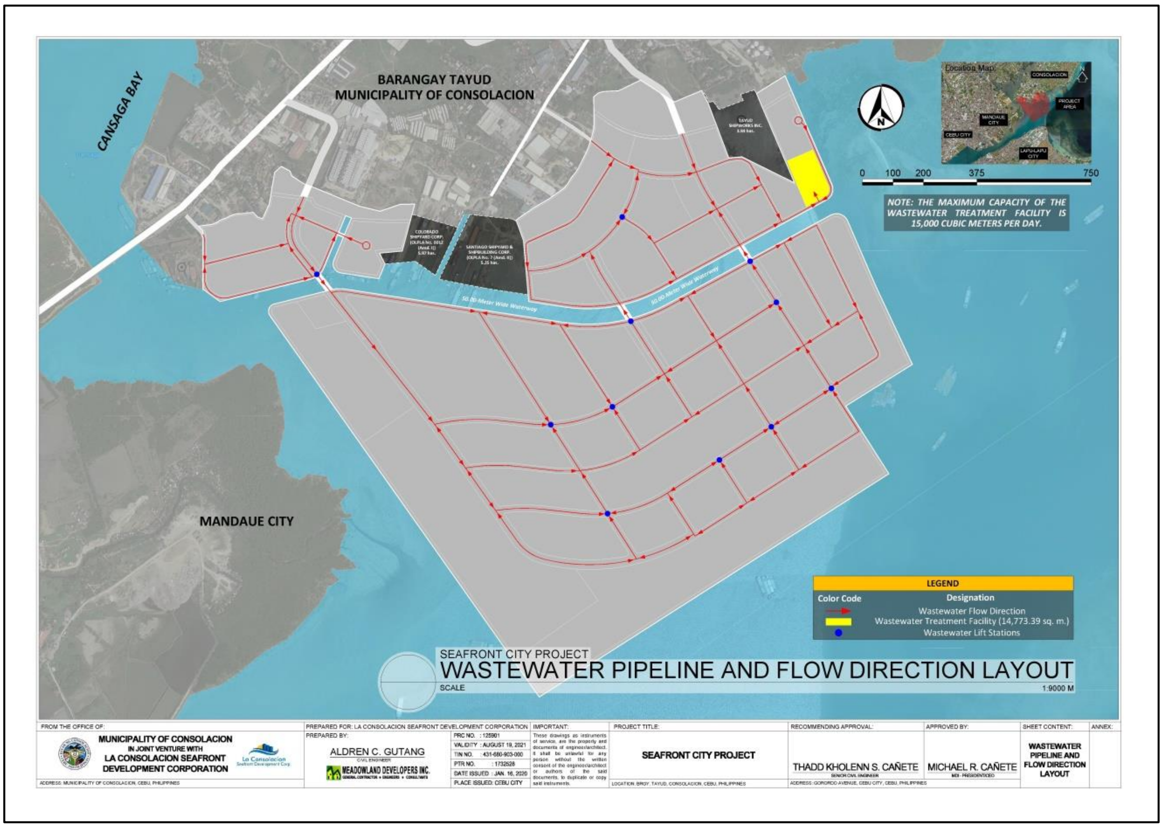


Figure 1-52: Sewage Layout Plan

Components of the Wastewater Management System

- Sewer lines
- Appurtenances
- 10 Lift Stations
- Wastewater Treatment Facility (including Dual Piping System)

A sludge drying bed will be part of the facility constructed in an area of around 3,000 m^2. The technology will use the sequencing batch moving bed bioreactor to provide a high-rate processing system for organic bio-stabilization.

Wastewater Treatment Facility

The essential process to be employed to treat the wastewater of the Seafront City Project is the moving bed bio-film reactor (MBBR). The system offers compact footprint and does not require sludge return making the system fewer tanks. The sewage collection system conveys wastewater from buildings directly to the wastewater treatment plant. An equalization tank is needed to act as temporary storage and even out the variability of organic loading. The capacity of equalization tank is about 10% of the 15,000 m3/d mean daily wastewater generation. Air from rotary air blowers will provide the oxygenation of the aerobic processes. The essential parts of the system are one-equalization tank, two aerobic bio-film reactors, bio-film carriers, the air supply from blowers and two-settling tanks. Figure 1.54 shows the various components of the proposed wastewater treatment system.

Equalization Tank

The equalization tank receives sewage from the lift station. The wastewater will be free from debris and grit and will reside in the tank in less than 1 hour to avoid smell production. The bottom elevation of this tank will be designed to be above the floor level of the bio-film reactor. This will act as temporary storage of peak flow and variability of concentration.

Aerobic Bio-film Reactor

The biologic treatment processes will consist of two (2) aerobic sequencing biological reactors and two settling tanks. The reactors are operated as moving bed bio-film reactors with HDPE fluidized media or carriers. The plastic carriers are inert and durable. Biologic growth attaches to the carriers in large area and will move in the reactor randomly as agitated by air bubbles. Under this condition the biologic growth will consume the organic contents in wastewater as food with oxygen uptake. The usage of attached biologic growth has the advantage of high surface area per volume of carrier. This high surface density will create a large biomass content in the reactor, thus resulting to high bio-kinetic rate (fast rate of uptake) of organic removal in wastewater. The biologic system of MBBR accepts shock loading and high organic loading because of the presence of readily available biomass attached to the carrier. Old biomass will slough off the carriers and will form part of endogenous respiration of the system. Sludge return is not needed as the biomass is always present in high quantities.

Aeration Facility

The design volume of air needed in the aerobic reactors is based on the design parameters of incoming organic loading, effluent residual organics and the amount of dissolved oxygen and nitrogen content in wastewater. The properties of air at normal conditions are 1.29 g/m3, 20% content by volume is oxygen and transfer efficiency of 0.075 per meter depth of liquid, and nitrification requires the same amount of oxygen for organic contents to be stabilized. Nitrification process proceeds carbonaceous process and under high dissolved oxygen content. Thus, oxygen requirement is about twice as much compared to carbonaceous process alone.

Bio-Carrier Volume

The volume of bio-carriers needed in the reactors to achieve 95% removal is based on the pollutant-carrier surface loading rate of 20 mg BOD5-20/m2-day and pollutant-carrier surface loading rate of 2 mg TKN/m2-day. The surface area of carriers is assumed from literatures to be 466 m^2 / m^3 of plastic carriers.

Sedimentation Tank

Particulates generated as residual or formed as refractory of organics in wastewater and heavy enough are removed from effluent by gravity in sedimentation process. The sedimentation basin must have quiescent condition to avoid entrainment by ripple or by wind. Thus, sedimentation basin is baffled to form longer path.

Sludge Removal Facility

Generation of excess sludge from aerobic process in MBBR unavoidable but the quantity is manageable. Excess sludge from the reactors is collected weekly or bi-weekly by a sludge handling unit from the bottom of the reactor. Dewatering filter will remove much of the water from the sludge. Sludge cake is air-dried and sent to composting unit to produce soil conditioner for the farm.

Dual Piping System

The sewage pipeline system will deliver the wastewater generated by the locators to the sewage treatment facility (STF) (see Figure 1.55) then the wastewater will be processed and will be recycled as non-Potable water which will then be delivered back to the locators through a separate pipeline system. Each locator will be provided with a Dual Piping

System such that one pipeline will provide non-potable water and the other would be potable water.

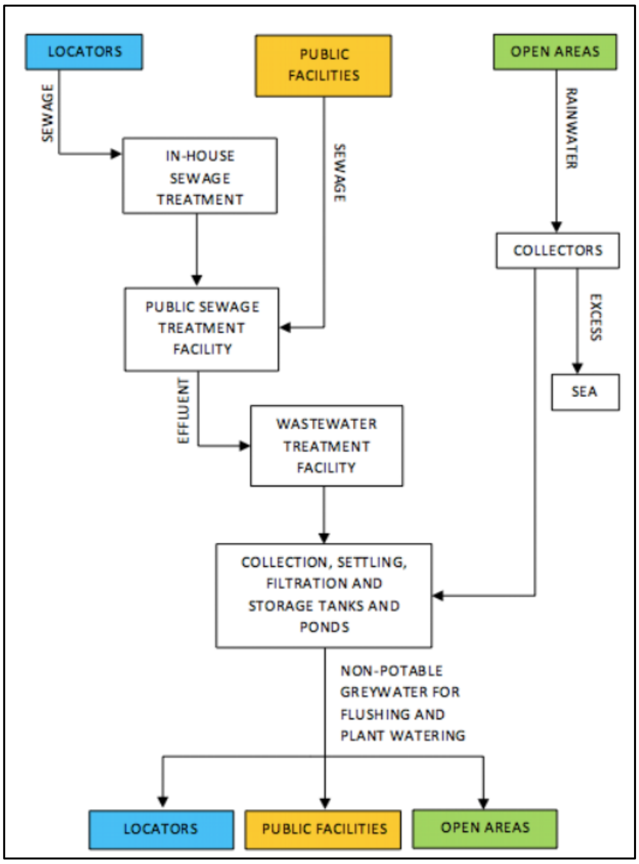


Figure 1-54: Schematic Process Flow of the Sewage and Wastewater Treatment

Projected Wastewater Production

The Wastewater Treatment Facility of the project will be designed to cater 20-years of project operations. At the end of which, the facility and all its technologies will be updated. Table 1-19 shows the projected water demand of the project at 20 years of operations.

Table 1-19: Water Demand at year 20 of Project Operations

Water Demand of Resident and Transient Population in Year-20 of Project Operations								
Land Classification	Regular			Transient /Resident	Transient			Total Demand cu.m. /p-d
	Population	Rate cu.m. /p-d	Demand cu.m. /p-d		Population	Rate cu.m. /p-d	Demand cu.m. /p-d	
A. Saleable Area								
Commercial	40,195	0.08	3,216	50%	20,098	0.06	1,210	4,430
Mixed Use - Commercial	32,228	0.08	2,578	50%	16,114	0.06	967	3,545
Mixed Use - Residential	19,503	0.10	1,950	30%	5,851	0.06	351	2,301

Residential	8,104	0.20	1,621	10%	811	0.06	49	1,669
Tourist and Entrepreneur	15,320	0.20	3,064	200%	30,641	0.06	1,838	4,902
Industrial	7,565	0.08	605	5%	379	0.06	23	628
Institutional	9,369	0.08	749	50%	4,684	0.06	281	1,031
Total for A	132,284		13,784		78,577		4,719	18,507
B. Non-Saleable w/ Workers								
Utilities	354	0.06	21	10%	35	0.06	2	23
Terminal	85	0.06	5	50%	42	0.06	3	8
Relocation Site	1,383	0.15	208	20%	277	0.06	17	224
Total for B	1,823		234		354		21	255
Total for A and B	**134,107**		**14,020**	**59%**	**78,931**		**4,740**	**18,760**

See Table 1-20 for the Yearly Projected Wastewater Production of the project within 25-years of its operations.

Table 1-20: 25-Year Projected Wastewater Production

Year	Water Demand (cu.m./d)	Wastewater, 80% of Water Demand (cu.m./d)
1	2,210	1,768
2	4,410	3,528
3	6,630	5,304
4	8,830	7,064
5	11,040	8,832
6	13,240	10,592
7	15,450	12,360
8	15,680	12,544
9	15,920	12,736
10	16,160	12,928
11	16,400	13,120
12	16,640	13,312
13	16,900	13,520
14	17,150	13,720
15	17,410	13,928
16	17,680	14,144
17	17,940	14,352
18	18,210	14,568
19	18,480	14,784
20	18,760	15,008
21	19,030	15,224
22	19,320	15,456
23	19,610	15,688
24	19,910	15,928
25	20,200	16,160

With the total Water Demand of 18,760 cu.m./p-d, the estimated wastewater production to be catered by the treatment facility is calculated to be 80% of the water demand or approximately **15,000 cu.m./day**.

1.5.4.3. Power System of the Reclamation Project

The power system of the proposed reclamation shall be mainly composed of a distribution substation and a medium voltage distribution network. Adequate areas in the reclamation shall be allocated to these important utility infrastructures. To meet locators' power needs, both the substation and distribution network should be reliable, flexible, and expansion ready. Figure 1-48 shows the power distribution network lay-out.

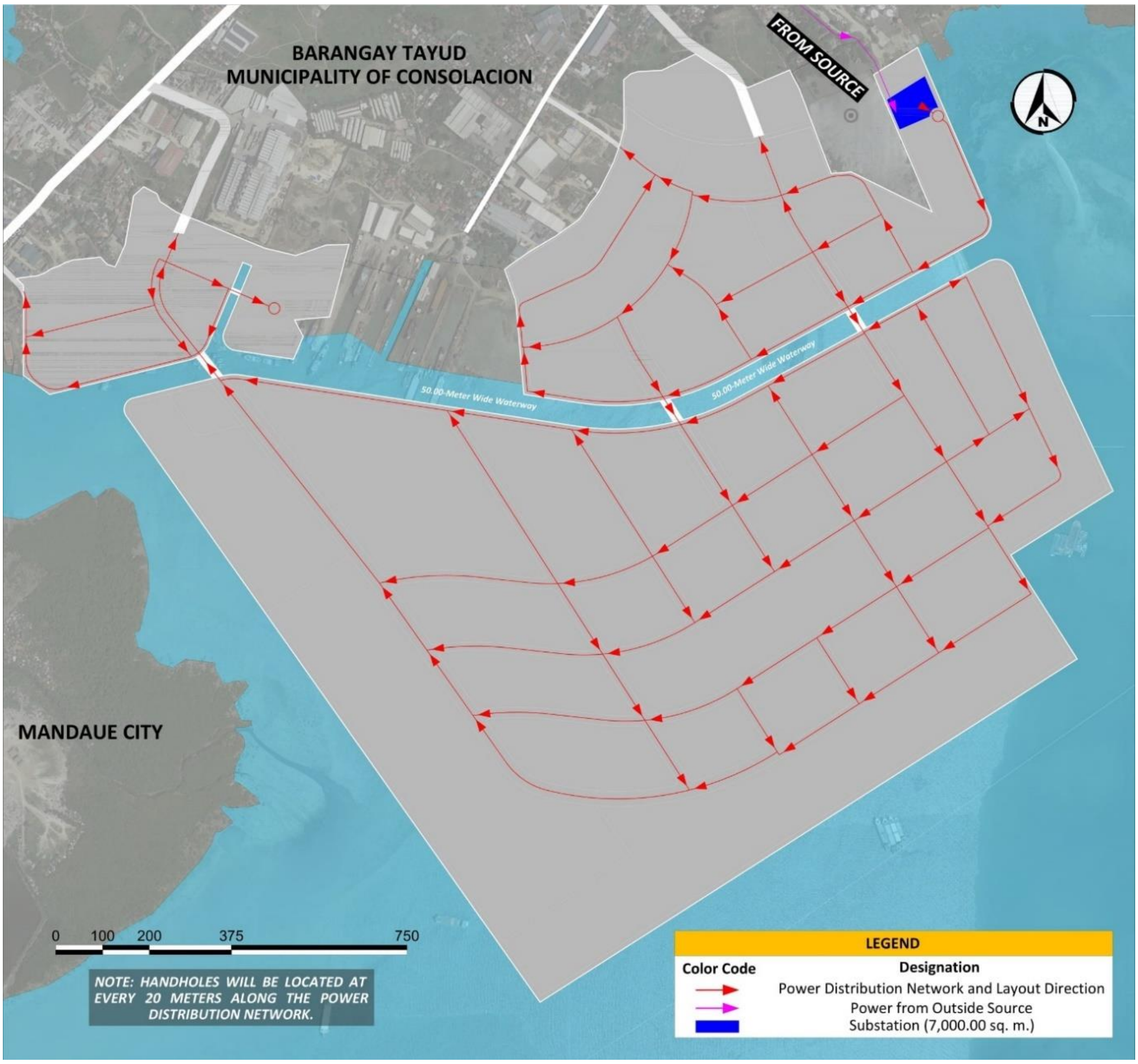


Figure 1-55: Power Distribution Network Layout of the Proposed Project

Power Substation

The proposed substation can be connected along the existing Paknaan-Consolacion 69 kV line of the Visayan Electric Company (VECO). The Project Proponent can put up the 69/23 kV substation in advance taking into account VECO's standards and specifications. The same can be turned over to VECO and have its cost refunded. In such arrangement, substation maintenance will be handled by the distribution utility. In this setup, there is no need of keeping critical inventories of spare parts and special tools related to the high voltage substation. Its maintenance personnel will also be trimmed down. VECO, like any other distribution utility or electric cooperative, has service level guarantees as mandated by law. Relative to other utilities, VECO has good systems reliability. This gives the locators an assurance of a reliable power supply that meets quality parameters required by the Philippine Distribution Code.

Figure 1-56: Existing VECO Substation in Consolacion

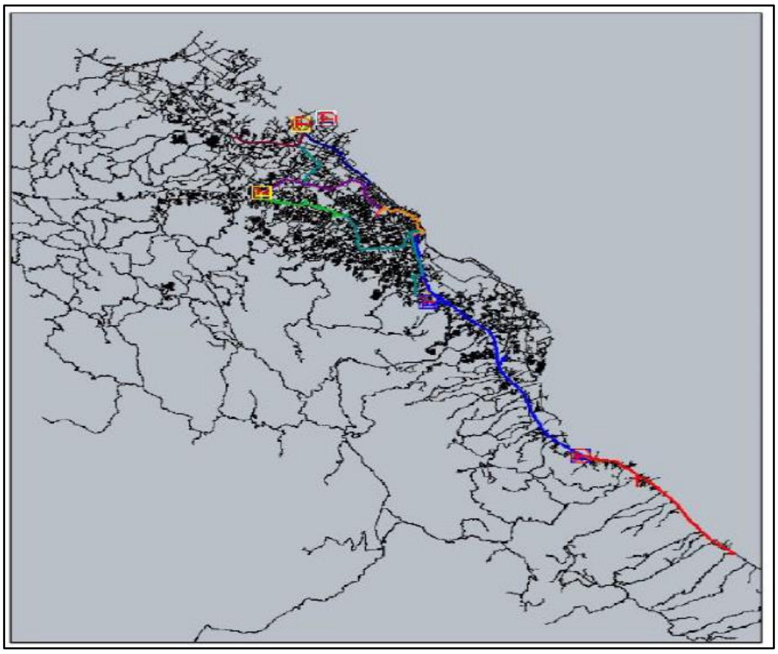


Figure 1-57: VECO 69KV System Map

Table 1-21 shows the clustering and substation capacity of VECO while Figure 1-44 shows the relative location of Paknaan and Consolacion substations in a map.

Table 1-21: Substation Capacity and Clustering

Cluster	Substation		Capacity (MVA)	No. of Feeders	Location
North	Consolacion Ss	CLC	1 x 33	2	Poblacion, Consolacion
	Pakna-an Ss	PKN	2 x 33	4	Pakna-an, Mandaue City
	Cabancalan Ss	KBL	1 x 33	4	Talamban, Cebu City
East	Banilad Ss	BNL	1 x 33	3	Kasambagan, Cebu City
	Mabolo Ss	MBL	2 x 33	4	Cebu Port Center, Cebu City
	Mandaue Ss	MDW	2 x 33	4	Guizo, Mandaue City
	Mandaue Reclamation Area Ss	MRA	1 x 33	4	Subangdaku, Mandaue City
West	Ayala Ss	AYL	1 x 33	2	Ayala, Cebu City
	Calamba Ss	CLB	1 x 33	3	Calamba, Cebu City
	Camputhal Ss	CPH	2 x 33	4	Kamputhaw, Cebu City
	Lorega Ss	LRG	2 x 33	4	Lorega (San Miguel), Cebu City
South	Don Gil Garcia Ss	DGG	2 x 33	4	Ermita, Cebu City
	Naga Ss	NGA	1 x 33	3	Colon, Naga
	Pardo Ss	PRD	1 x 33	2	Bulacao, Cebu City
	Talisay Ss	TLS	1 x 33	4	Mohon, Talisay City
TOTAL SYSTEM			**693**	**51**	

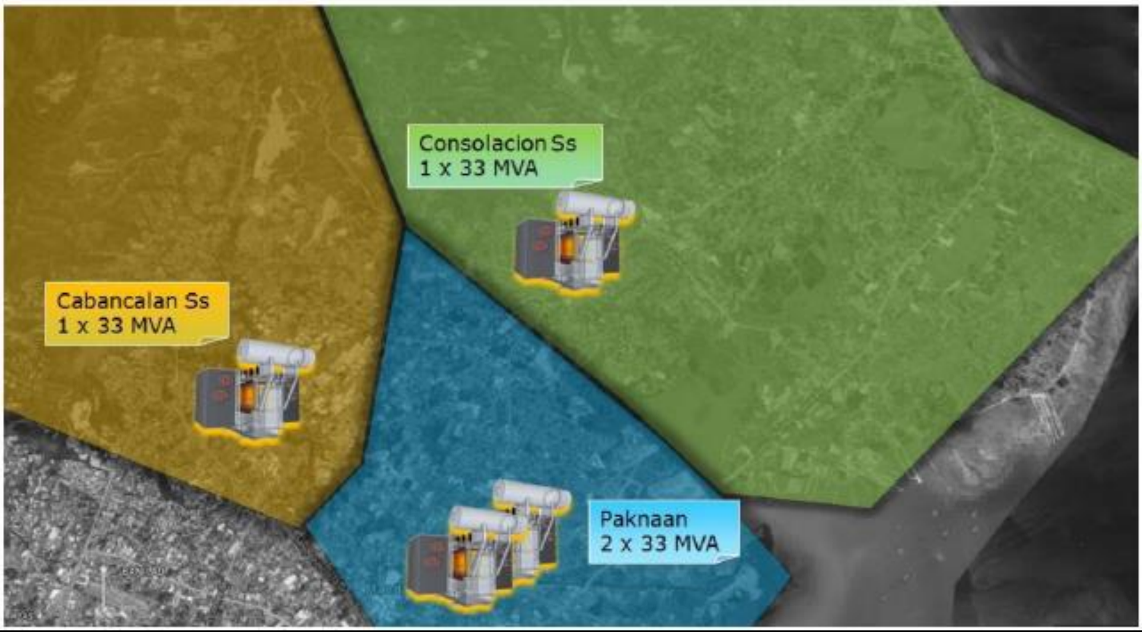


Figure 1-58: Map showing the location of the Paknaan and Consolacion Substation Cluster

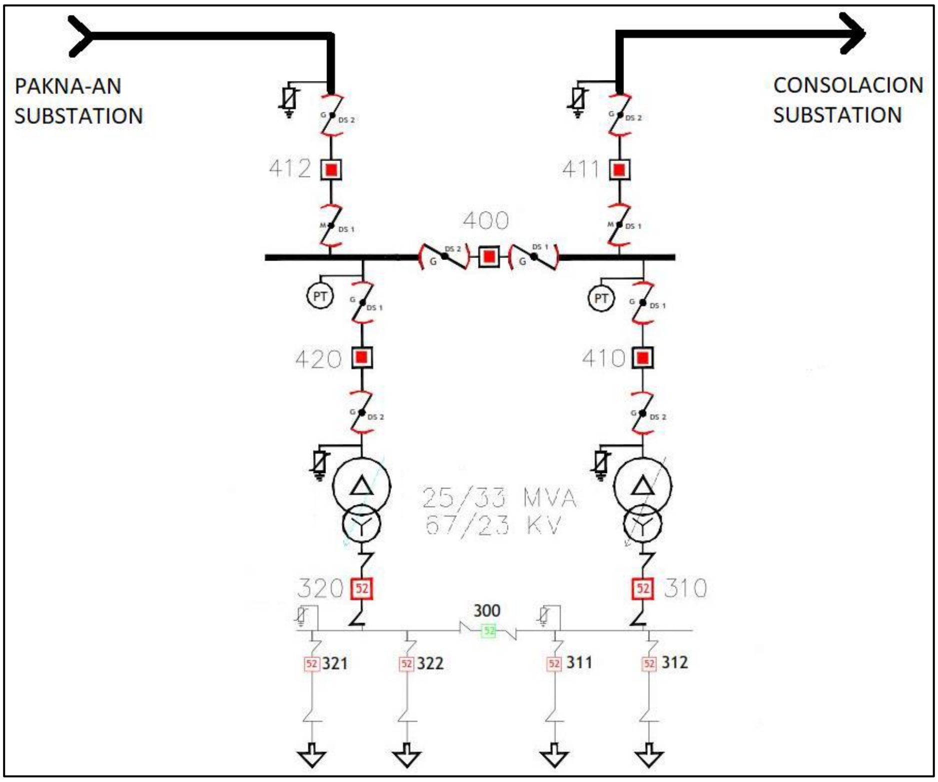


Figure 1-59: Simplified Single Line Diagram of the Proposed 69/23 kV Substation

It also includes the possible connection points of the substation. VECO nomenclatures and standards are being used in conceptual single line diagram as the said substation will most likely form part of its distribution system.

Power Distribution

The distribution system of the reclamation area will be mainly underground. This means that power conductors will either be installed along utility trenches or directly buried under ground with both adhering to well-accepted standards. Insulated power cables will be used for both medium voltage and low voltage distribution. To facilitate switching and protection, ring main units (RMU) will be used on field. These 23 kV RMUs will be used to connect the various distribution transformers in the network. A pad-mounted transformer can serve one or more customer facilities.

Based on various distribution utilities' statistics, an underground system is proven to be several times more reliable compared to overhead lines. The latter can be easily affected by strong typhoons, vegetation, and other external factors. The former is also a lot better in terms of improving aesthetics of the property.

Figure 1-60: Typical Outdoor Distribution Main Ring Unit

Supply Reliability

Power supply reliability is highly important to the operations of commercial and light industrial establishment. With this, system redundancy will be given utmost consideration. Specific discussions on redundancy will be included in the electrical system design philosophy.

The 69 kV incoming line of the proposed substation can source out power from either Banilad Substation or Mactan Gas Insulated Switchgear (GIS) Substation of National Grid Corporation of the Philippines (NGCP). It is also possible that the proposed substation will be connected to the proposed 230/138/69 kV substation of NGCP in Umapad, Mandaue if the latter will be realized first. The said proposed transmission substation in Umapad is already included in the approved transmission development plan of NGCP. If maximized reliability is sought, it is best to tap to the proposed Umapad Substation as it is part of the main backbone of the Visayas power grid.

The 23 kV medium voltage distribution system will be having a standard loop configuration. This configuration minimizes service interruption during preventive and corrective maintenance. Isolation of faulted sections can be efficiently done with the use of this line configuration.

In addition to the said 23 kV ring system, medium voltage distribution feeders from adjacent substations of VECO can be configured to link that of the proposed 69/23 kV reclamation substation. Through this arrangement, the latter can be maintained without switching off the distribution network of reclaimed property. As previously mentioned, VECO's power system is relatively more reliable. This is made apparent in its historical reliability indices. VECO's System Average Interruption Frequency Index (SAIFI) and

System Average Interruption Duration Index (SAIDI) are considered better compared to other distribution utilities and electric cooperative in the region.

For added power supply reliability, clients may also opt to install standby generators and uninterruptible power supply (UPS) system. Power supply redundancy at 69 kV, 23 kV, and utilization levels should be more than enough to meet customers' power needs.

Load Estimate

Considering the proposed land usage of the property, its load can go as high as 55 MW. Various electrical design references used by the Institute of Integrated Electrical Engineers (IIEE) were being used in coming up with such conservative load estimate. The load growth in the area will depend on several external factors. Regardless whether it is typical or drastic, it can be handled by the complementing infrastructures of both VECO and NGCP in the area. At the former's end, initially, a single 69/23 kV power transformer can be installed. VECO's standard capacity for its 69 kV transformers is 25/33 MVA. This has been standardized to easily manage its power transformer inventories and corresponding spare parts. 25 MVA is the rated capacity at ambient air cooling while the 33 MVA is the capacity when using forced-air cooling. Considering the aforesaid forecasted peak load of reclamation area, a VECO-standard 2 x 25/33 MVA substation can be deemed adequate. A space for its mobile substation can be allotted to facilitate major maintenance with minimal service interruption.

The proposed reclamation project will not be having problems pertaining to power supply adequacy. The Visayas grid has adequate power generation capacity to cater to forecasted loads in the region. All these capacities will be put to good use once the grid congestion will be fully addressed. There is an ongoing installation of the 230 kV backbone grid. Reconfiguration of 138 kV lines connecting the Southern Cebu to its Central part is also in progress. Despite the congestion, supply availability in Consolacion area should not be an issue. Electrical power can be wheeled to the area without transmission constraints. Currently, it is the Cebu-Negros power link that is mainly congested. It should not substantially affect availability of power at the Northern and central parts of Cebu.

The ongoing power interconnection works of Visayas, and Mindanao can also enhance power adequacy and reliability in the region. There is a good synergy between the Visayas and Mindanao grids. Their electricity usage peak hours occur at different time. Currently, there is a huge capacity surplus in Mindanao. With the transmission congestion issues addressed, Cebu-based loads can greatly benefit with this excess capacity as the submarine power line coming from Mindanao will be directly connected to Cebu.

With the said grid enhancements and availability of surplus generation capacities, it is deemed not necessary to construct an additional power plant solely to supply to the proposed reclamation loads.

1.5.4.4. Telecommunications

Telecommunication is an important tool for businesses and for people. It enables anyone to communicate effectively with everyone. This will be integrated into the project, and the respective telecommunication providers (Telcos) will have to install their own telecommunications systems around the project, passing through an underground trench which will be provided by the project proponent. There are currently three Telcos in the Philippines, namely, Globe Telecom, Smart, and PLDT. A fourth Telco is in the offing. They offer telephone, cellular, as well as internet connectivity. Figure 1-54 shows the cable network layout of the proposed project.

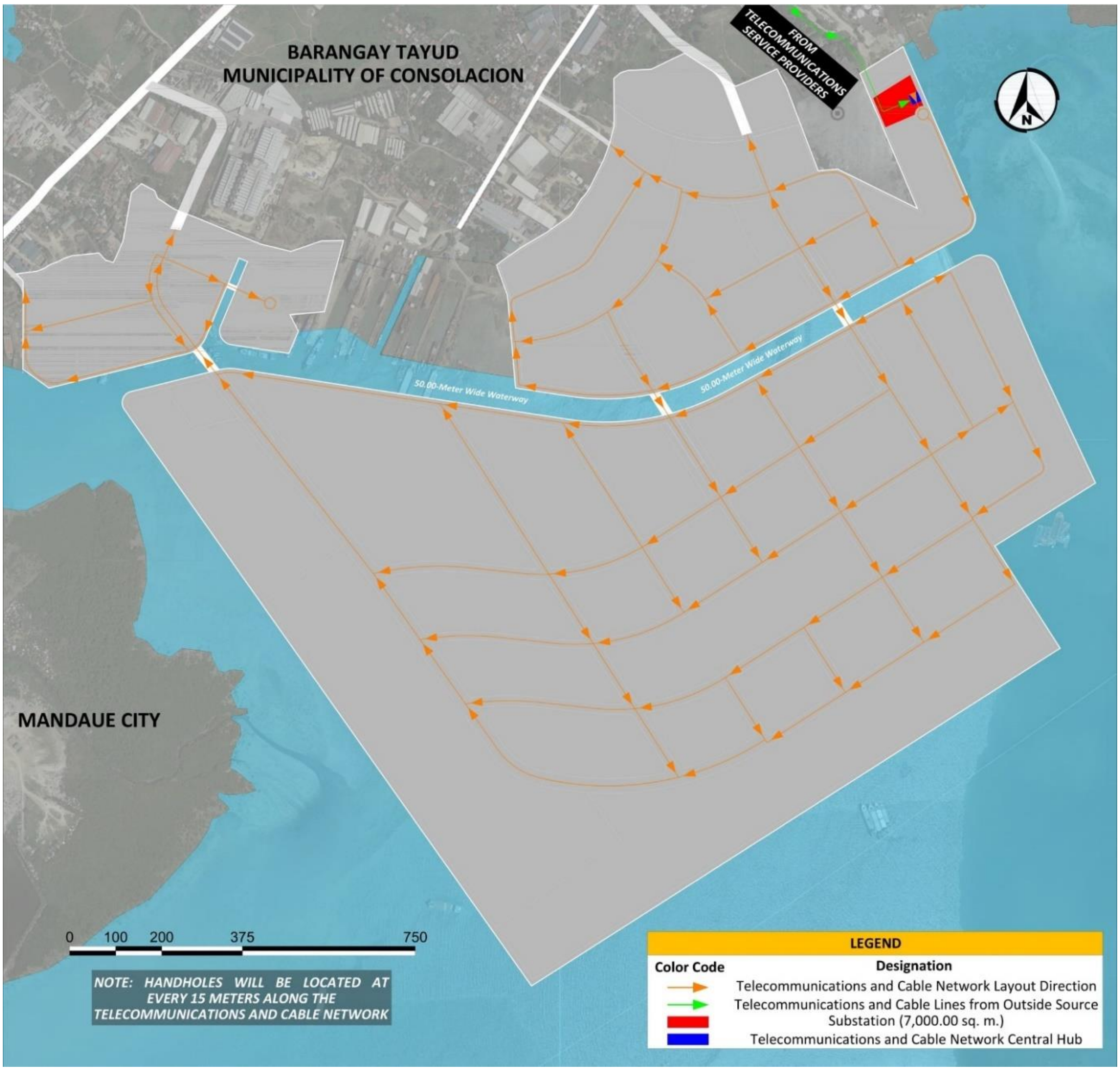


Figure 1-61: Telecoomunications and Cable Network Layout

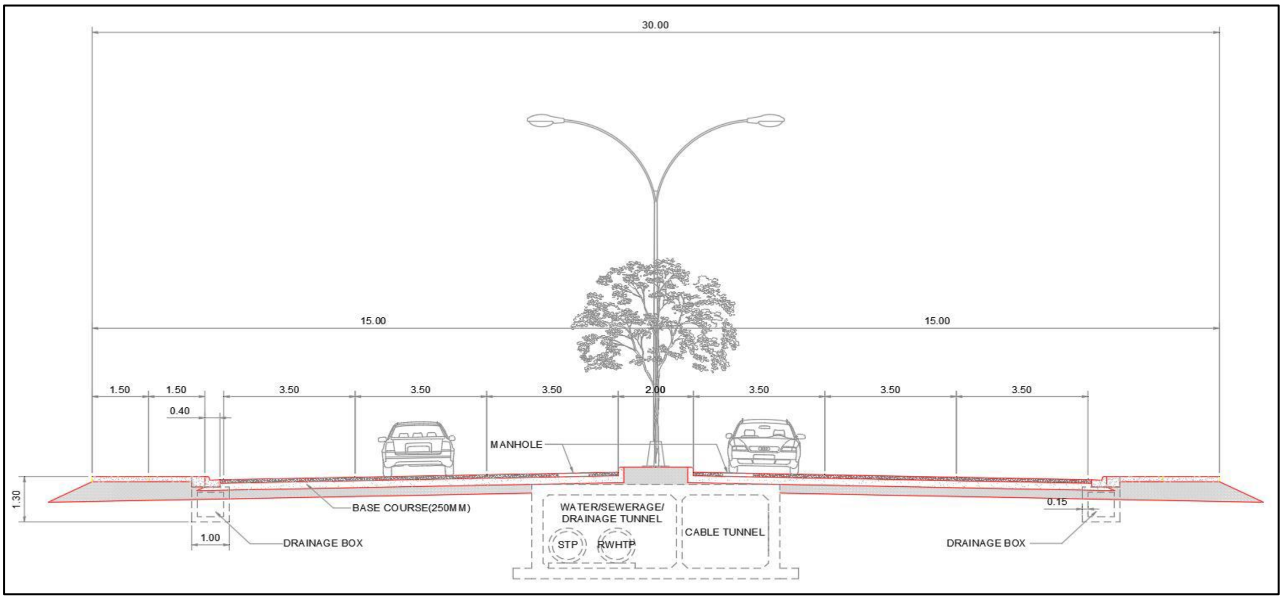


Figure 1-62: Typical Utility Trench

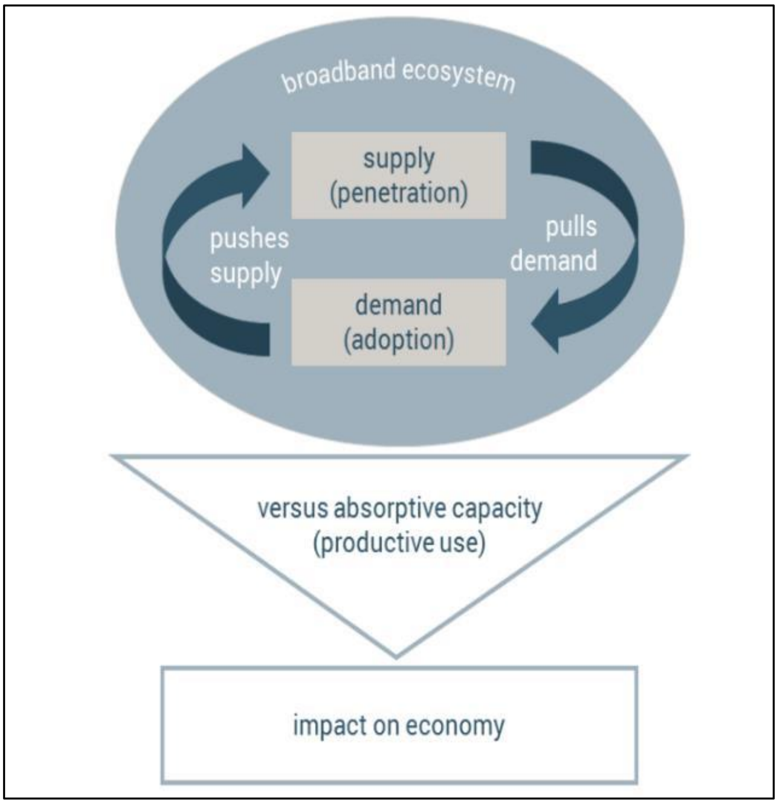
Once the Telcos have installed their systems into the project, Information and Communications Technology (ICT) will be used to enhance quality, performance, and interactivity of urban services, to reduce costs and resource consumption and to increase contact between citizens and government. It will transform the project into a Smart City, integrating advanced and state-of-the-art technologies into the daily lives of the residents and businesses.

The Project will use various electronic sensors to collect data, and then use the data gathered to manage assets, resources, and even services efficiently.

The data collected will include data gathered from citizens, devices, and assets that will be processed and analyzed to monitor and manage traffic and transportation systems, power plants, utilities, water supply networks, waste management, crime detection, information systems, schools, libraries, hospitals, and other community services.

These technologies will allow government officials to interact directly with both community and project infrastructures. It will also allow them to monitor what is happening within the project and how it is evolving.

Integrated into the project, will also be broadband internet connections, and alongside it, multiple Wireless Internet Access Points, commonly known as “Wi-Fi”. These will provide access to the World Wide Web for anyone within the project. Broadband internet is widely considered as a fourth utility. It will provide substantial efficiencies and innovative solutions which will help in the project’s growth.



1.5.4.5. Eco-Engineering

Through the years, eco-engineering is introduced to mitigate adverse environmental impacts and restore degrading ecosystems caused mostly by human activities and other perturbation. It is incorporated in the design for a sustainable ecosystem that is beneficial to the human and natural environment. This reclamation project commits to provide prospects to alleviate the environmental impacts of urbanization and recover ecosystem function through replantation of coastal mangrove forest, coral transplantation, and replication of artificial reefs.

Mangrove Area Replanting and Tourism

As the world faces climate change, the deforestation of mangrove caused disturbance of the ecosystem and it also led severe losses of biodiversity. Mangroves are known to be significant in keeping the coastal zones healthy. Replanting of coastal mangrove forests helps improve the degrading ecosystem of the project area. It aims to provide habitation for many species from marine organisms to hundreds of shorebirds and migratory birds, prevents erosion by holding the soil in place, and serves as a protection against waves and storms. In addition, it maintains water quality through its complex root systems by filtering nitrate and phosphates that other waterways carry. The project will enhance the existing mangrove areas from 4.56 hectares to 7.81 hectares and convert them into eco-tourism areas. As part of the goal of the project, the mangrove area will act as a park and aviary for tourism. Boardwalks, viewing vistas, and a management office will be put in place for this purpose.

Figure 1-65: Proposed Mangrove Boardwalk and Tourism

Coral Transplantation

Coral reefs are said to be teeming with diverse life. Even in one reef, thousands of species can be found. Coral reefs provide an important ecosystem for marine life. As this project supports biodiversity, it is essential corals must survive and thrive. It intends to be abundant with coral reefs to establish a functional and diverse ecosystem underwater. One of the potential fisheries management tools is coral transplantation. It is the physical relocation of corals to a place where it is more likely to prosper. The tourism industry in a coastal area can also benefit from coral transplantation because this improves the aesthetics of a place wherein coral reefs seem to be scarce.

Figure 1-66: Sample Image of Coral Transplantation

Artificial Reef

Artificial reefs are substituted as natural reefs to provide a habitat for marine life. It protects the coral reefs from human-induced damages. It is usually a man-made underwater structure and is made from a variety of materials like concrete, tires, bamboo fiber, oil rigs, construction debris, and shipwrecks. As time passes the reef is characterized by sponges, hard and soft corals, algae, numerous fish species, and many other creatures. It can be used to maintain fisheries management and promote ecotourism. It must ensure that artificial reefs are hefty, not poisonous, and erosion resistant.

Figure 1-67: Sample of Artificial Reef

Reef Balls are artificial reefs that are designed by Todd Barber. It is composed of a special concrete additive that has a similar pH scale to seawater so that it is compatible with the marine environment. In the design, the height varies from one foot to five feet and altering the placement of holes. These holes function as a shelter for fishes and other marine species. It also allows the growth and propagation of corals. Reef balls are deployed by large or small boats depending on their size.

Another way of managing coastal areas is the establishment of a living shoreline. It is a natural way of approach for shoreline protection and is done by placing natural materials like plants, stone, and sand. This provides the first line of defense for incoming swells and wakes. By mimicking the physical properties of natural habitats, it increases biodiversity. This living shoreline will be positioned in front of the sheet piles. This replicates the Eco Rap Living Shoreline modified by the Reef Ball Foundation.

Figure 1-68: Eco Rap Living Shoreline

1.6. Project Size

The applied project has an area of 2,357,962.30 m^2 or 235.80 Hectares to be located in Barangay Tayud, Municipality of Consolacion, Province of Cebu. Hence, the proposed project is covered under Category A of EMB MC No. 2014-005, which covers projects undertakings that are classified as Environmentally Critical Projects (ECPs) and are required to secure an Environmental Compliance Certificate (ECC).

Figure 1-69: Project Lot Plan

Lot 1 is an island-type reclamation covering an area of 172.70 hectares. Lot 2 is foreshore-based type of reclamation which will be filed for conversion from timberland to alienable and disposal lan status classification with an area of 16.98 hectares. Lot 3 is still a foreshore-based type of reclamation which will be filed for conversion from timberland to alienable and disposal lan status classification with an area of 46.12 hectares. The first phase to be reclaimed will be Lot 1 considering Lot 2 and Lot 3 are both subject for conversion that will allow reclamation activities. For the meantime, a tenurial instrument will be temporarily filed by the project proponent while land status conversion still on process. If ever Lot 2 and Lot 3 will not be converted, the detailed engineering will be modified to ensure no reclamation will be done to the timberland areas. However, for the timberland areas that were already reclaimed illegally by the shipyard operators, these will have to remained as if or will be rehabilitated and enhanced so it could still be used as part of the original project concept adapting its original reclaimed landform.

The lots will be separated by a 50m channel that will accomodate the various equipments to be used during the construction phase of the project. This equipment includes barge mounted cranes and pile driving equipment that will be installing the containment structures, barges and dredgers delivering fill materials, and silt curtains. The bufferzone will ensure not just the safety of the workers and seafarers but also the protection of the project especially the structural integrity of the containment structures from the possible effects of future developments in the surrounding areas. The bufferzone also provides ample area for periodic maintenance of the containment structures as well as rehabilitation and replacement of structural components in the event of any damages would occur.

1.7. Development Plan, Description of Project Phases and Corresponding Timeframes

The reclamation project involves two (2) types of development. First is the development below or under the sea thru the reclamation activity method discussed above; and second is the development of above the sea. This section describes the development of based on the conceptual master development plan.

1.7.1. Pre-Construction Phase

There are no activities during this phase that will result in significant environmental impacts. As maybe seen in the table below on Project Implementation Schedule, the activities are: design and engineering, technical plans and documentations, securing of permits and clearances such as Letter of No Objections (LONO) from the different Government Agencies such as DA-BFAR, Cebu Port Authority, Philippine Coast Guard, Department of Public Works and Highways, Department of Energy, Department of Tourism, and Philippine Reclamation Authority.

Table 1-14: Required Clearances and Permits for the Reclamation Project

Item	Authorities Involved
ECC	• DENR – Environmental Management Bureau (EMB)
NTP/Area Clearance	• RED/DENR
Letters of No Objection (LONO)	• Department of Tourism (DOT) • Bureau of Fisheries and Aquatic Resources (BFAR) • Philippine Navy • Department of Energy (DOE) • Regional Development Council (RDC) • Philippine Reclamation Authority (PRA) • Department of Public Works and Highways (DPWH) • Department of Information and Communications Technology (DICT) • National Headquarters Philippine Coast Guard (PCG) • Philippine Ports Authority (PPA) • National Commission for Culture and the Arts • Department of Health (DOH)
Notice to Proceed (NTP)	• Philippine Reclamation Authority (PRA)
Construction Permits	• LG • DPWH

	• Philippine Coast Guard

The project has no issue with the PPA in view of the Letter of No Objection from the CPA. BFAR has also provided the project with a clearance. Based on the checklist given by the DENR 7 for the issuance of Area Clearance, the Philippine Navy (PN) is not one of the agencies that need to issue a clearance for the project. Instead, it is the Philippine Coast Guard that is being required to give a clearance and such was obtained by the proponent. The shipyards with valid and existing tenurial instruments will not be made part of the development until such time that their lease agreements will have expired.

1.7.2. Construction phase

There are two (2) types of construction activities, the landform preparation-structure and the horizontal development as discussed below: Waste Generation and Built-in Management Measures:

Landform Preparation -Structure (1 Reclamation Island-Dredging and Reclamation)

The land form shall be developed through construction of containment wall/dike, dredging and reclamation using hydraulic sand fill method, and soil stabilization with an estimated volume of approximately 31.93 million cubic meters of fill materials from a reliable and feasible sand source of offshore area up to a finished platform elevation of +4.5 meters above Mean Lower Low Water (MLLW).

Horizontal Development

Upon reaching the finished platform elevation of +4.5 meters above Mean Lower Low Water (MLLW), horizontal development based on conceptual development plan shall be constructed. This includes construction of Road and access and construction of utilities such as drainage system, sewer collection, power and telecommunication.

The Project, once completed, shall be ready for the development and construction of various structures such as commercial, industrial, institutional and residential buildings.

Table 1-15: Description of the Impact & Waste Management Measures During Reclamation

Key Environmental Aspects	Environmental Impact	Waste Management System
Earthmoving, and Re-filling of earth materials to achieve the designed elevation of the landform and soil stabilization	Water - Possible Siltation of the sea Road Safety and Traffic Dust Pollution and Increase in Noise Level	Immediate compaction of the area to further mitigate the dust • Implementation of traffic management that is appropriate for the area

		• Road signs shall be placed at appropriate locations to alert motorist along the highway • Traffic warden shall be stationed at strategic locations to guide traffic • Observed operating hours • Regular Maintenance of equipment and vehicles

Table 1-16: Description of the Impact & Waste Management Measures During Construction of Roads / Bridges

Key Environmental Aspects	Environmental Impact	Waste Management System
Construction of Road System/Bridge	Water - Possible Siltation of the sea Road Safety and Traffic Dust Pollution and Increase in Noise Level	Immediate compaction of the area to further mitigate the dust • Implementation of traffic management that is appropriate for the area • Road signs shall be placed at appropriate locations to alert motorist along the highway • Traffic warden shall be stationed at strategic locations to guide traffic • Observed operating hours • Regular Maintenance of equipment and vehicles

Table 1-17: Description of the Impact & Waste Management Measures During Construction of Utilities

Key Environmental Aspects	Environmental Impact	Waste Management System
Construction of Road System/Bridge	Water - Possible Siltation of the sea Road Safety and Traffic Dust Pollution and Increase in Noise Level	Immediate compaction of the area to further mitigate the dust • Implementation of traffic management that is appropriate for the area

	Solid Wastes Generation	• Road signs shall be placed at appropriate locations to alert motorist along the highway • Traffic warden shall be stationed at strategic locations to guide traffic • Observed operating hours • Regular Maintenance of equipment and vehicles • Implement Solid Waste management plan such as segregation at source

1.7.3. Operation Phase

The operations phase involves the construction of buildings and structures by various locators and the operation of their activities, e.g. food stores, convention centers, movie houses, etc. This phase is not included in the scope of this EIS and in the application for an ECC, however, there are utilities that will be developed already by the project proponent in preparation for project operations such as road network system, drainage system, centralized wastewater treatment facility, centralized materials recovery facility for solid waste management, power lines, water lines, and telecommunication lines.

1.7.4. Abandonment phase

Under this scenario, all the construction vessels and equipment shall be returned to the contractor. The Municipality of Consolacion and the members of the Project Consortium will decide on how the reclaimed land will be used. Hence, remediation of the site will not be relevant.

1.8. Manpower

1.8.1. Construction (Reclamation Phase)

Dredging / Reclamation Works

The payment of statutory benefits of workers will be in accordance with the Contractor's policy but shall observe Philippine labor laws, particularly of the DOLE.

The Reclamation/Dredging Contractor will directly hire these personnel because of the technical requirements prescribed by the Contractor. Policies on the hiring of men and women and on PWD and age will be dictated by the safety requirements of working in sea vessels and operating heavy equipment as well as the technical training required for the personnel.

There are no known indigenous peoples in the Municipality. The nature of the project construction and the needs for specialized works at the sea vessels may not encourage certain sectors of the society.

Soil Stabilization/Horizontal Works Phase

During the horizontal works, the needed skills will be more of the usual on-land construction works, and could serve as temporary employment opportunities for skilled construction workers of the Municipality as priority will be given to locals, if the skills are available. The proponent shall give priority to all qualified locals hires with proper coordination with the concerned barangay Local Government Units (LGUs).

1.8.2. Vertical Construction Works

After the creation of soil stabilized reclaimed land complete with horizontal components, vertical construction works will take place. These will provide substantial job opportunities. The job hiring will be undertaken by the individual contractors; they will be persuaded to give preferences to qualified locals. Payment of wages and provision for all benefits prescribed by the DOLE will be ensured by the Municipality since it will be part of the Consortium that will implement the Project.

It must be emphasized, however, that this phase is outside the scope of this ECC application. Table 1-19 shows the manpower requirement of the project.

Table 1-18: Manpower / Specialized Skill Requirement

No.	Personnel	Min. Amount
1	Project Director	1
2	Project Manager	3
3	Deputy Project Manager	3
4	Project Engineer	5
5	Project Supervisor	5
6	Lead Foreman	8
7	Mason	20
8	Steel Men	16
9	Carpenters	16
10	Welders/Fabricators	8
11	Crane Operators	16
12	Backhoe Operators	16
13	Pay Loader Operator	16
14	Road Grader/Compact Roller Operator	8
15	Dump Truck Drivers	120

16	Helpers/Aid/Unskilled Labor	120
17	Barge Crew	60
18	Electrician	12
19	Mechanic	12
20	Support/QS/QA Engineers	12
21	Safety Engineer	6
22	Warehouse Men	12
23	Accountant	3
24	Security Guard	24
25	Secretary	6
26	Rigger	12
27	Surveyor	6
28	Plumbers/Pipe Fitters	16
29	Concrete Truck Drivers	18
30	Service Drivers	14
31	Utility Men/Janitor/Messenger	14
32	Environmental Engineer/Specialist	3
33	Marine Biologist	2
34	Administrative Officer	1
35	Public Relation Officers	2
36	First Aid/Medical Personnel	3
37	Water Truck Operator/Driver	6

Hiring Policy

It shall be the policy of the proponent to hire qualified local applicants based on the following order of priority:

- First Priority: Residents within the direct impact area;
- Second Priority: Residents within the indirect impact areas; and
- Third Priority: Resident of Barangays adjacent to the secondary impact areas.

In the event that there is an inadequacy of qualified applicants, the following will be given preference:

- First Preference: Residents of Barangay Tayud
- Second Preference: Residents of any city or in the Province of Cebu
- Third Preference: Applicant from other provinces or regions.

1.9. Indicative Project Investment Cost

The estimated total investment cost for the reclamation project, including attendant expenses, is estimated to be at **Php 18,742,843,125.00**. The estimated cost of reclamation and land development including supporting data (i.e., existing labor force, structure and average cost and available equipment and average cost/rental rates) would be divulged by the contractor during the competitive bidding process.

2. ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1. THE LAND

This section describes the baseline condition of the project site in terms of its land use and classification, geology, geomorphology, geo-hazards, pedology, and terrestrial ecology. Key impacts of the project's activities on these land components are discussed in this section.

2.1.1. Land Use and Classification

2.1.1.1. Change/Inconsistency in Land Use

This sub-section describes the existing land classification and land use within the project site, and includes mitigating measures that address identified impacts by the projects. Under Philippine Law, the implementation of a project within a specific area is covered by an official declaration of land classification. Certain specific exclusions also exist as a matter of national interest, such as those under the Philippine Constitution (1987) or as local interest under the Philippine Local Government Code (1991), together with other associated laws. Since the project will involve a significant change to the current land use, it is important to determine and understand the existing land use, and other compare this to what was legally classified both by the local and national government.

Since the available latest Comprehensive Land Use Plan of the LGU is for the year 2001-2010, the assessment for existing land use will be based on the existing land use provided in the CLUP compared against the actual site visit and field validation conducted recently for the study.

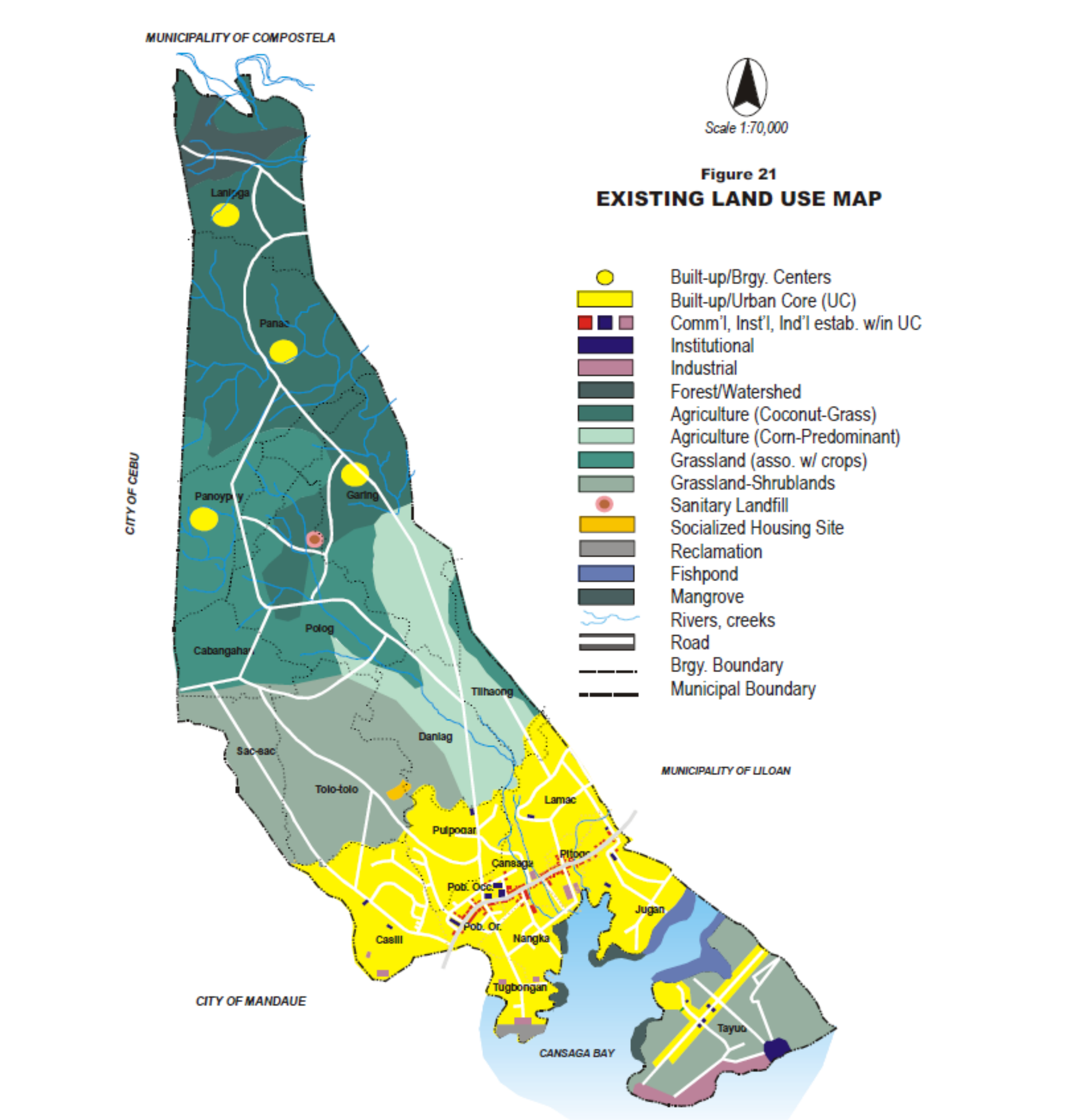
During the historical period, the municipality is predominantly characterized with grasslands - shrubs, coconut, bamboo, and others. Cornlands were also evident in other barangays of the municipality. Built-up areas also used to comprise only about 10% of the total land area of Consolacion. The existing land use and vegetative cover in 2010 is presented below:

Table 2-1: Historical Land Use / Vegetation Cover

Land Use/Vegetative Cover	Area (Has.)	Percentage (%)
Coconut associated with corn	**1,062.21**	**27.25**
Grassland associated with shrubs, bamboo, etc.	**1,598.18**	**41.00**
Corn associated with coconut	**701.64**	**18.00**
Built-up	**389.80**	**10.00**
Fishpond, mangrove,swamp	**146.18**	**3.75%**
Total	**3,898.00**	**100.00**

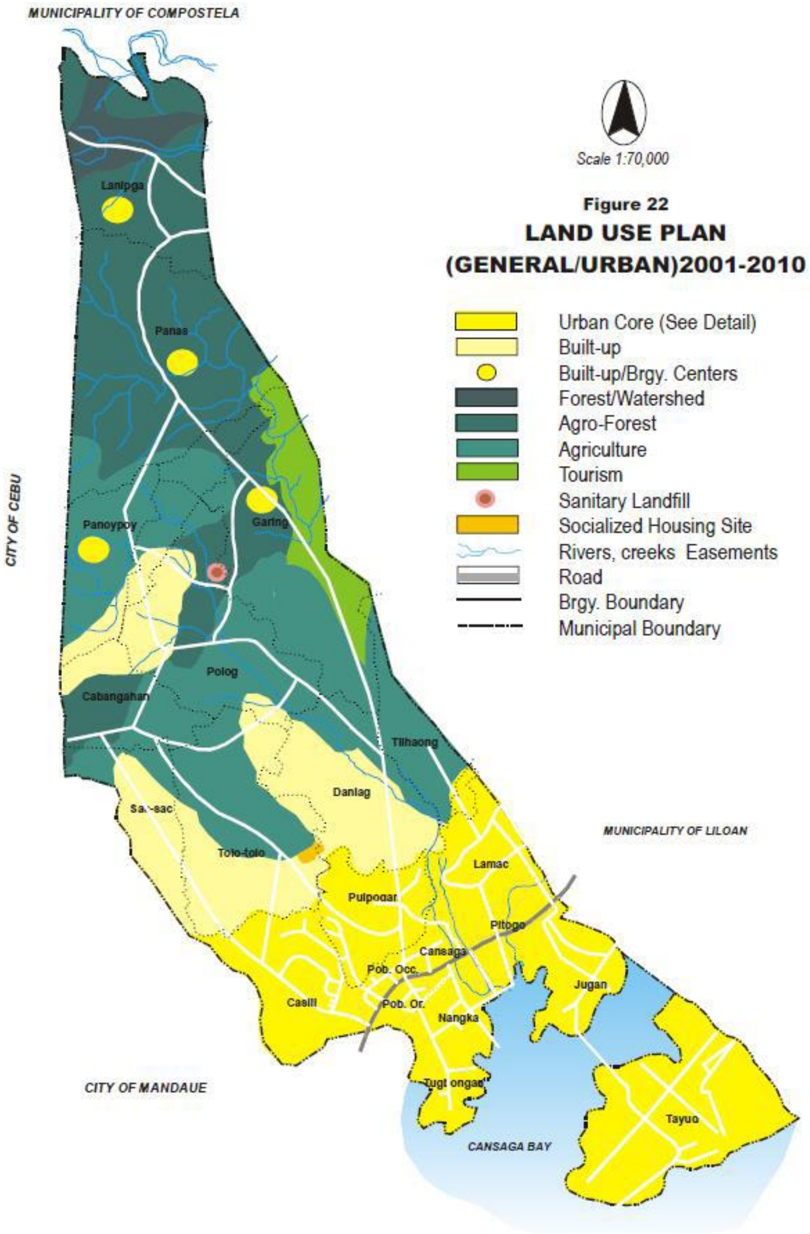
Source: *Comprehensive Land Use Plan of the Municipality of Consolacion, 2001-2010*

However, since the Municipality is adjacent to the Metro Cebu Cities, there are several barangays already in the Municipality that was classified into Built-up area or Urban Core Area where majority of the commercial industries were located in these barangays. But for the location of the proposed project, since the area has several shipbuilding/shipyards, manufacturing industries, and fuel depot, the project area was already classified as Industrial Zone per Municipality's Land Use Plan.



Source: *Comprehensive Land Use Plan of the Municipality of Consolacion, 2001-2010*

Figure 2-1: Existing Land Use Map of Consolacion



Source: *Comprehensive Land Use Plan of the Municipality of Consolacion, 2001-2010*

Figure 2-2: Land Use Plan of Consolacion

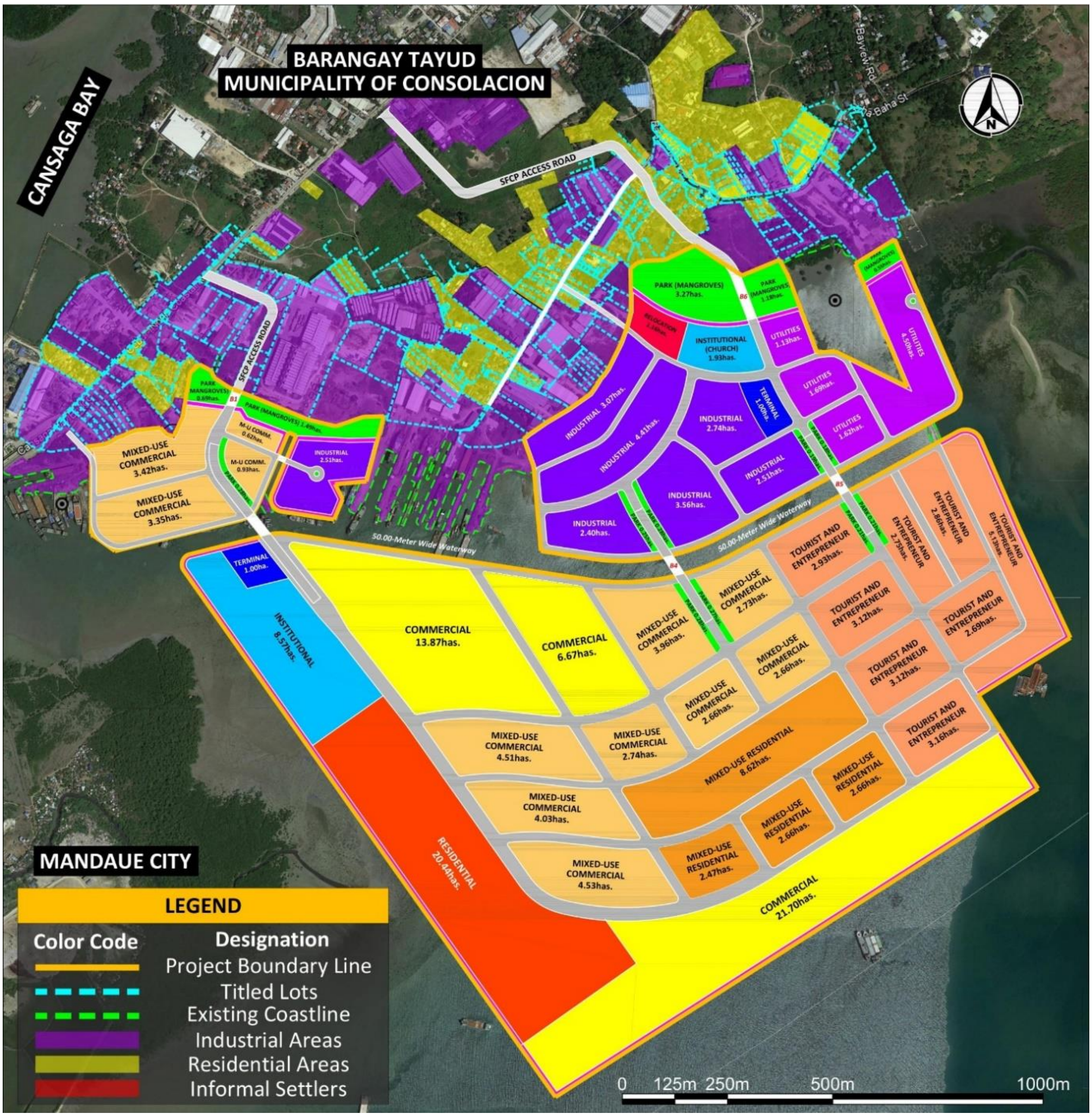


Figure 2-3: Superimposed Existing Municipal Land Use Near the Project Area and Consolidating the Project's Proposed Land Use

Table 2-2: Proposed Urban Core Land Use Plan of Consolacion, Cebu (2001-2010)

Land Use	Area (Ha.)	Percentage (%)
Residential		
High Density	113.000	8.848
Medium Density	115.000	9.004
Low Density	235.00	18.400
Socialized Housing	1.840	0.144
Institutional	39.310	3.078
Commercial		
Medium Density	125.350	9.815
Low Density	53.400	4.181
Industrial		
Heavy Intensity	182.000	14.250
Medium Intensity	119.320	9.343
Open Space-Parks/Recreation	30.990	2.426
Open Space-Easements, Buffers, Salvage Zone	6.000	0.470
Agricultural Area	37.120	2.906
International Port	75.000	5.875

Source: *Comprehensive Land Use Plan of the Municipality of Consolacion, 2001-2010*

2.1.1.2. Impact in Existing Land Tenure Issue/s

The inland portion of the reclamation area is classified as an industrial zone under the jurisdiction of the local government of Consolacion. The local government will be directly responsible for the removal of illegal settlers should there be any as well as the existing shipbuilding/shipyards operators that has expired or will soon expire tenurial instruments within the project area. The census of the area relative to the existence of such is currently being validated. The offshore portion where the proposed project will be developed has been designated as a reclamation area in the preparation for mixed-use development.

Since the project applicant with the PRA for the reclamation project is the Municipal Government of Consolacion, and since the Special Patent to be issued by DENR on the Inalienable is in the name of PRA, and since PRA will request the Register of Deeds for the issuance of the Original Certificate of Title (OCT) in the name of PRA, and since PRA is authorized to transfer Titles to the LGU of Consolacion as the applicant.

Simultaneous to the municipality's application for an Environmental Compliance Certificate (ECC), the LGU of Consolacion has initiated processing the required Area Clearance since 2020. The application processing remains active to date. Available documentation on the processes the proponent and the LGU has secured are herein attached as part of the Annexes (e.g. Municipal and Provincial Resolutions endorsing the project, documentation of area clearance application.). The Environmental Impact Assessment and the ECC is part of the requirements for the issuance of the Area Clearance.

2.1.1.3. Encroachment in Protected Areas under the NIPAS

Per acquired CENRO Certification on Land Status of the applied project area, there is no encroachment of any declared protected area under the National Integrated Protected Areas System (NIPAS) or any Locally Declared Protected Areas under LGU ordinance. The nearest Locally Managed Marine Protected Area (LLMPA) is the Catarman Marine Sanctuary in the Municipality of Liloan (Liloan Municipal Ordinance 01-2000). The said marine sanctuary is approximately more than 6 km from the project site. The nearest protected area also declared under NIPAS is the Central Cebu Protected Landscape (CCPL) with approximately more than 13 kilometers from the project site.

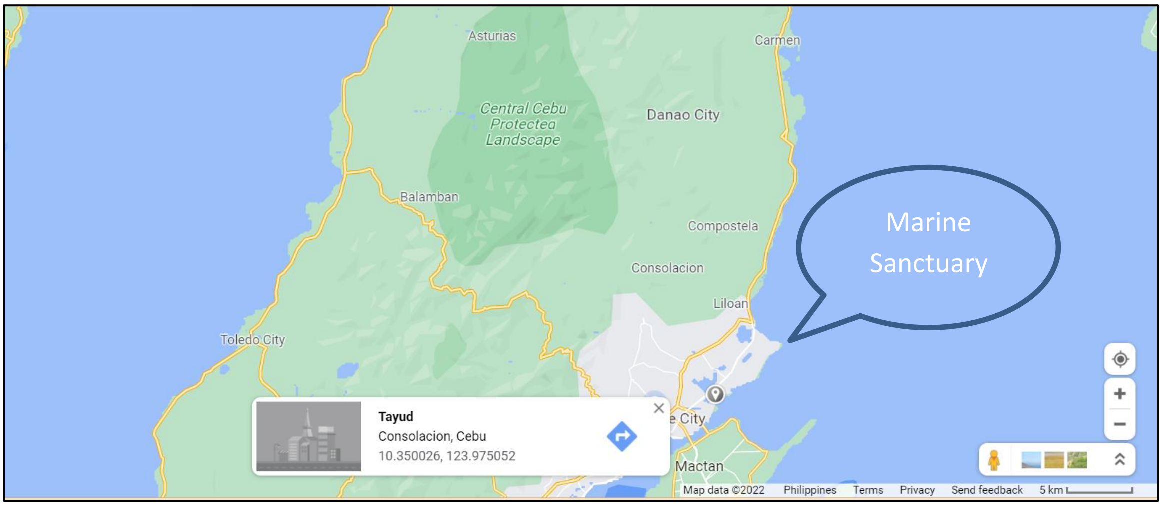


Figure 2-4: Map showing the location of nearest Protected Areas

Since its distance is several kilometers away from the project site, the project development and operation will not cause any negative environmental impacts. Unless, unforeseen and unavoidable accidents will occur (such as explosions or fire) in which the effect of smoke/air pollution emissions might reach to the nearest protected area.

2.1.1.4. Encroachment in other Environmentally Critical Areas (ECAs)

There are 12 categories of Environmentally Critical Areas (ECAs) under Proclamation No. 2146, series of 1981, guided by the DAO 2003-30. These include the following:

1. All areas declared by law as national parks, watershed reserves, wildlife reserves and sanctuaries;
2. Areas set aside as aesthetic potential tourist spots;
3. Areas which constitute the habitat for any endangered or threatened species of indigenous Philippine Wildlife (flora and fauna);
4. Areas of unique historic, archaeological, or scientific interests;
5. Areas which are traditionally occupied by cultural communities or tribes;

6. Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.);
7. Areas with critical slopes;
8. Areas classified as prime agricultural lands;
9. Recharged areas of aquifers;
10. Water bodies characterized by one or any combination of the following conditions:
    a. Tapped for domestic purposes
    b. Within the controlled and/or protected areas declared by appropriate authorities
    c. Which support wildlife and fishery activities
11. Mangrove areas characterized by one or any combination of the following conditions:
    a. With primary pristine and dense young growth;
    b. Adjoining mouth of major river systems;
    c. Near or adjacent to traditional productive fry or fishing grounds;
    d. Which act as natural buffers against shore erosion, strong winds and floods;
    e. On which people are dependent for their livelihood.
12. Coral reefs characterized by one or any combinations of the following conditions:
    a. With 50% and above live coralline cover;
    b. Spawning and nursery grounds for fish
    c. which act as natural breakwater of coastlines.

Portion of the project area contains existing mangrove trees as well as per DENR-CERO Land Status, portion also of the project area are classified as Timberland Area which is are both considered within ECA. The existing mangroves will not be cut down nor be displaced since the area where the mangroves are located will serve as the Rainwater Harvesting Area to cultivate and rehabilitate the mangroves. These areas will also serve as boardwalk and ecotourism area of the project. The proponent will secure appropriate tenurial instrument for Timberland Areas and DENR Area Clearance for the authority over the project site.

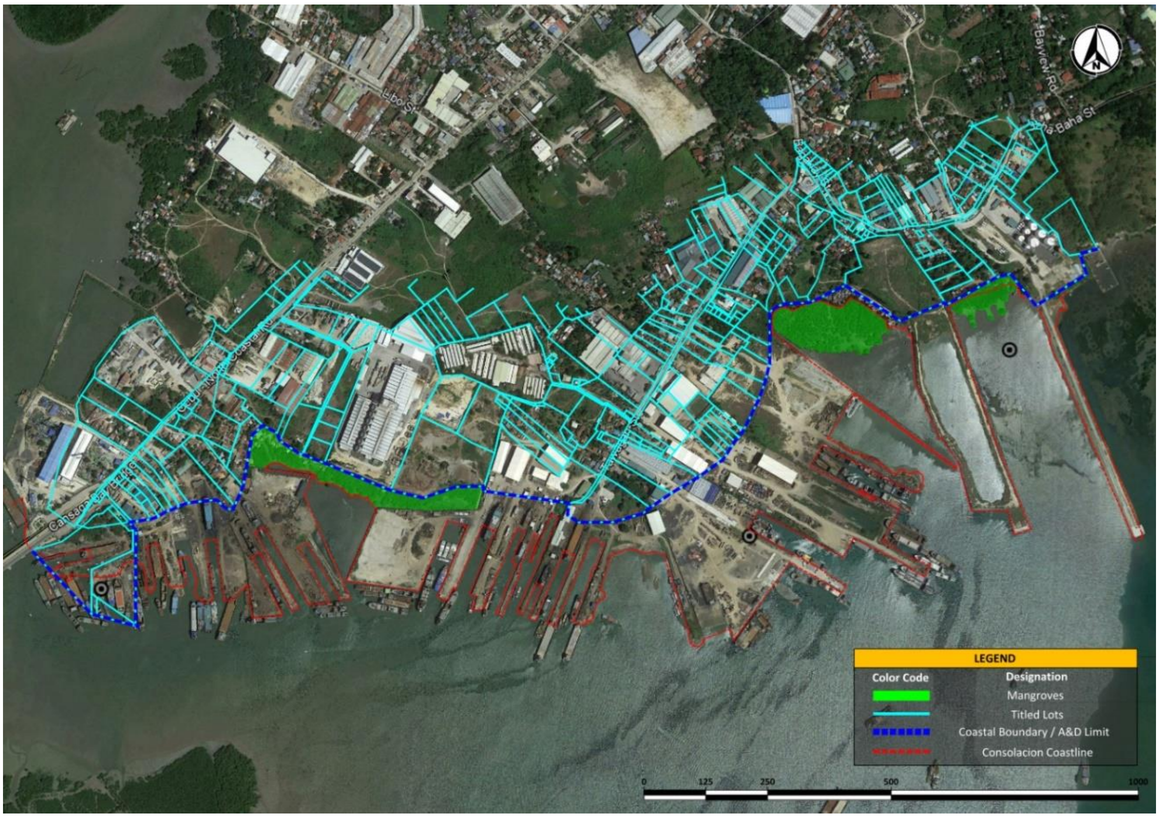


Figure 2-5: Map showing the mangrove areas surrounding the project site

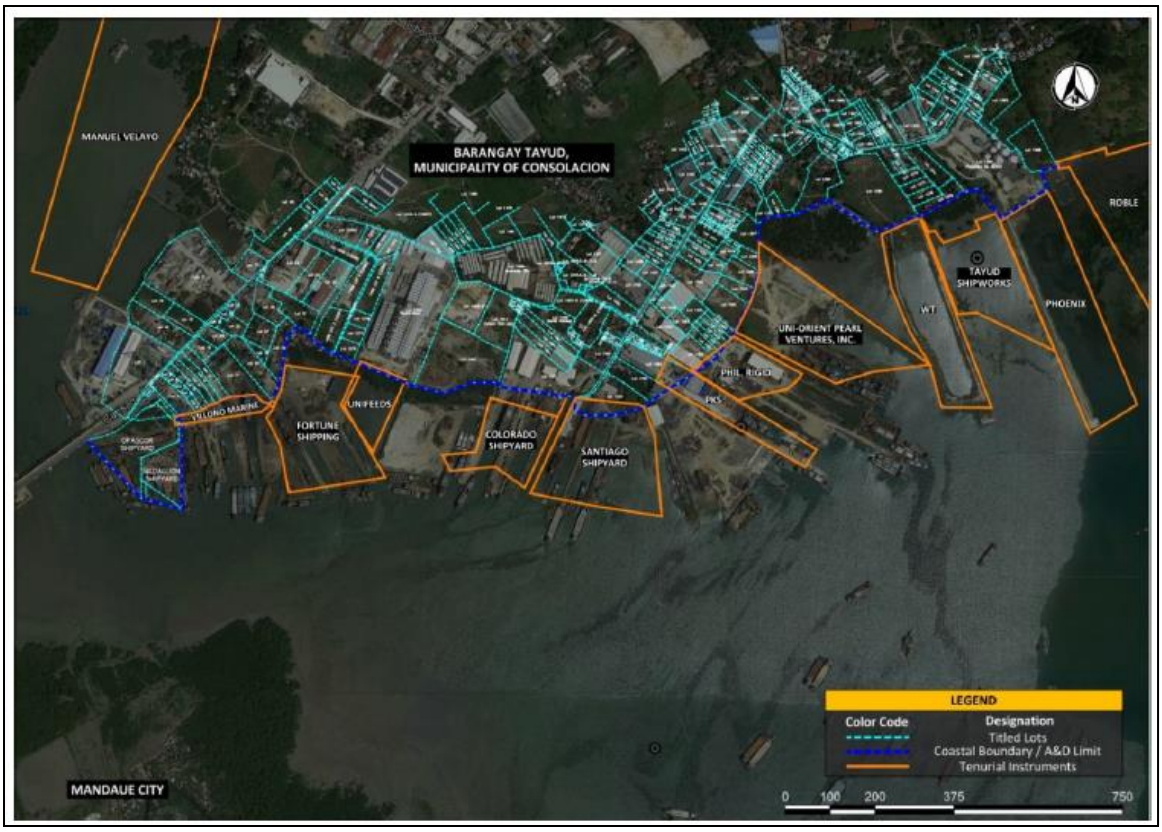


Figure 2-6: Map showing the Tenured Areas within the project site

The Department of Agriculture – Bureau of Fisheries and Aquatic Resources Region 7 issued a Letter of No Objection on June 28, 2021 for the project in view of their findings that the project will include the protection and rehabilitation of the mangroves in the project area. Another important consideration for their issuance is based on their findings that the project area has no history of fishpond operations or other fisheries development and that it has a low fishery production with minimal fishery activities due to the existence of the shipyards. It can be also observed that the project site is located within Alluvial Lands as shown in Figure 2-7. However on March 2, 2022, BFAR-7 retracted the said Letter of No Objection in support to the application for Area Clearance citing that they have no authority to endorse any reclamation projects above 25 hectares. The new Letter of No Objection from BFAR is currently being processed at the National Director's Office in Metro Manila. Other Government Agencies as well such as Philippine Coast Guard, Philippine Reclamation Authority, and etc. has no declared existing significant preservations that will not make the project feasible in the applied project area.

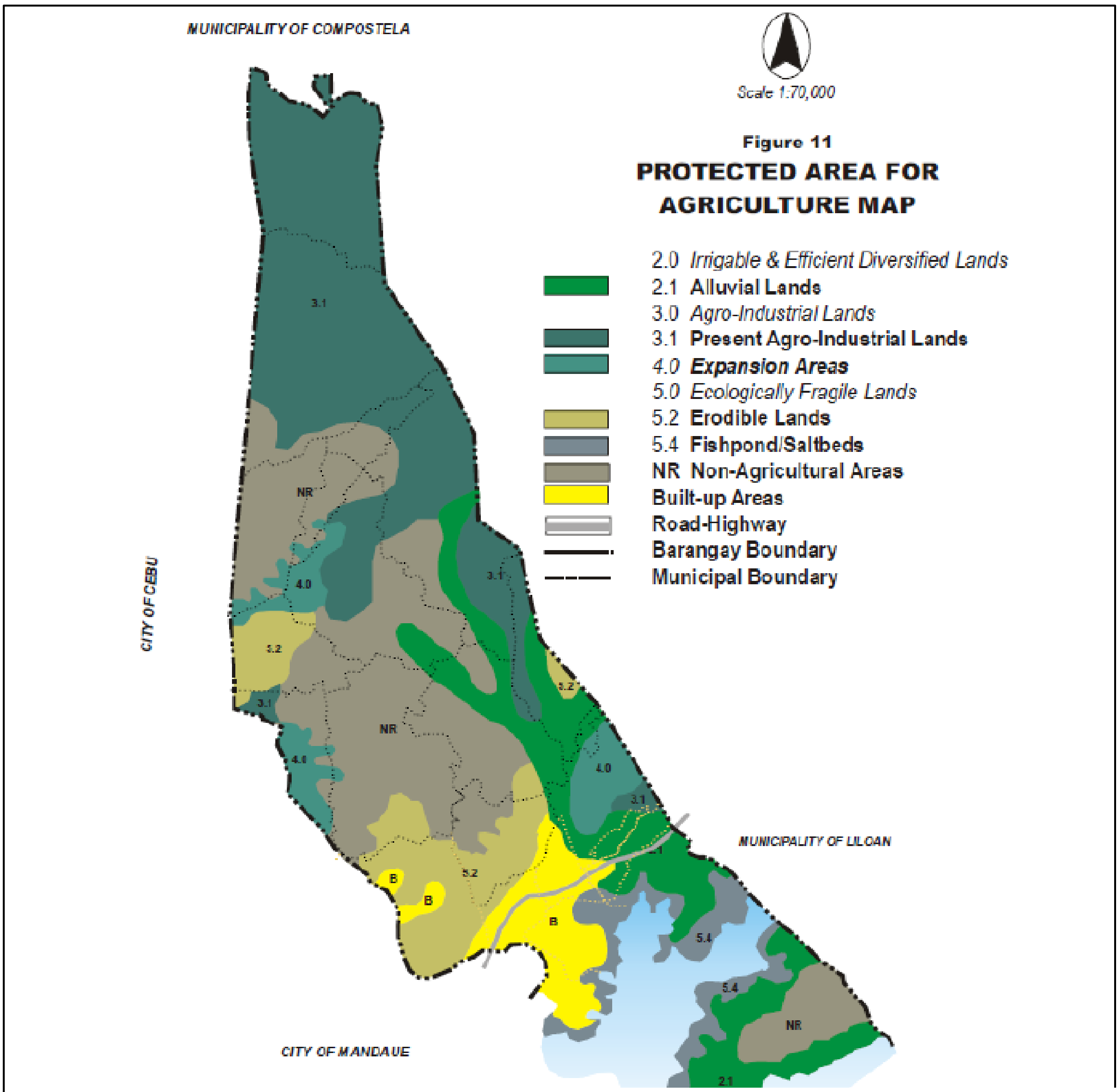


Figure 2-7: Protected Area for Agricultural Map

2.1.1.5. Impairment of Visual Aesthetics

Currently, the coastline of the proposed reclamation project is heavily built-up with the presence of both residences and industrial establishments (i.e. Shipbuilding/shipyards). With the development of the reclamation project, it is expected that visual aesthetics of the area will be enhanced with a well-planned design particularly in terms of a balanced land use.

Quality infrastructure will be established to promote production efficiency, safety, beauty, and good access to market and other service facilities. This includes the provision of space for an international standard facility to cater the need of locators, a mangrove ecopark to preserve and protect the existing mangroves, and develop open spaces to preserve the aesthetic beauty of the place as a mixed-use island estate.

2.1.1.6. Devaluation of Land Value as a Result of Improper Solid Waste Management and Other Related Impacts

To minimize devaluation of the land due to improper solid waste management, measures such as proper housekeeping, waste minimization and segregation, and proper machine maintenance will be employed. Proper housekeeping is basically keeping a clean, orderly construction site. It will involve implementation of rules and regulations within the Project site that will reduce, if not eliminate, the possibility of accidental spills, improve the response time if there is a spill, and reduce safety hazards as well. Related to this, waste minimization and segregation should be practiced to prevent soil contamination. Waste recycling and timely waste collection and disposal are just a few of the numerous techniques that can be used in the Project site. This will be done in coordination with the LGU. Likewise, proper machine maintenance of equipment involves regular maintenance check-up, timely fuel and oil change, and proper machine handling to minimize the risk of soil and water contamination. A designated machine shed and fuel/oil depot with oil collectors and proper floor protection further minimizes soil contamination. As much as possible, major maintenance works for equipment will be done outside the project area. Each worker shall also be given instructions on the proper storage, use and disposal of supplies used. A space allocation has also been made to house a waste-to-energy facility in the future.

The proliferation of residential houses and shipyards tributaries discharging to the sea, has caused the accumulation of solid wastes along the coastal area and at the discharge point. While the noted garbage may not necessarily be the representative quantity of improperly disposed solid waste of the municipality, the study considered an estimated average of 0.4 kilos per capita waste generation for the worst-case scenario. With a population of 131,528 (based on the 2015 census), Consolacion's population generates a total of about 52,611 kilos of garbage per day. Assuming that 5% of this waste is improperly disposed in the waterways, 2,630 kilos of solid waste pollute waterways. As included in the project components, the LGU has programmed the installation of centralized Material Recovery Facility for proper solid waste management during project implementation and operation. LGU has also conducted intensified IEC on waste segregation, recycling and re-reuse and proper solid waste disposal, has been included in the project's IEC plan.

2.1.2. Geology/Geomorphology

2.1.2.1. Geological Setting

The geologic knowledge of an area is of great significance when undertaking an engineering project. First, the Philippines is a geologically complex and seismically active region and is subject to multiple geologic hazards. The geologic and geotechnical properties are critical concerns when choosing appropriate engineering structures; Second, it follows that environmental and biological properties of the site is dictated by its underlying geology. The properties of the substrate, seafloor, soil and sediments are main abiotic factors that control the distribution and character of the biological components that live in the area; and Third, Geologic knowledge is also important in gaining insight to short-term and long-term changes in a region. Looking at past trends and natural process that occur in the site will enable planners' foresight on how to deal to future events and changes.

The province of Cebu has a mountainous topography along its center and bordered with a narrow strip of lowlying valley plains and coastal areas. It is is an NNE-SSW flacking island that lies in a tectonically-active region known as the Philippine Mobile Belt. Older rocks are concentrated on the core of the island. It has Mesozoic basement of ultramafic, metamorphic and volcanic rocks overlain by sedimentary rocks. These are unconformably overlain by Middle Eocene to Late Pleistocene sedimentary units. Most coastline areas are covered by young limestone units and recent alluvial deposits. The province is underlain mainly of metamorphosed rocks and overlain by younger volcanic rocks and sedimentary sequences. The metamorphic rocks belong to Tunlob Schist, the oldest rock formation in the island dating from Jurassic to Early Cretaceous in age. These are chloritic orthoschist and micaceous paraschist exposed in the central highlands.

The sedimentary rocks are exposed mostly near the coastlines while the volcanic rocks are hosted at the center of the island. The sedimentary rocks consist mostly of coralline limestone belonging to the Carcar Formation which is of Late Pliocene to Early Pleistocene age. The limestones are coralline, porous, bedded to massive which are fossiliferous and at times, dolomitic. The thickness of the Carcar Limestone increases towards the coast where it exceeds 300 m.

The low-lying areas within Cansaga Bay are underlain by Quaternary alluvium and with elevated portions of Carcar Limestone. Upstream areas are underlain by older units of Malubog Formation, Cansi Volcanics, Pandan Formation and Tunlob Schist (Figure 2-8).

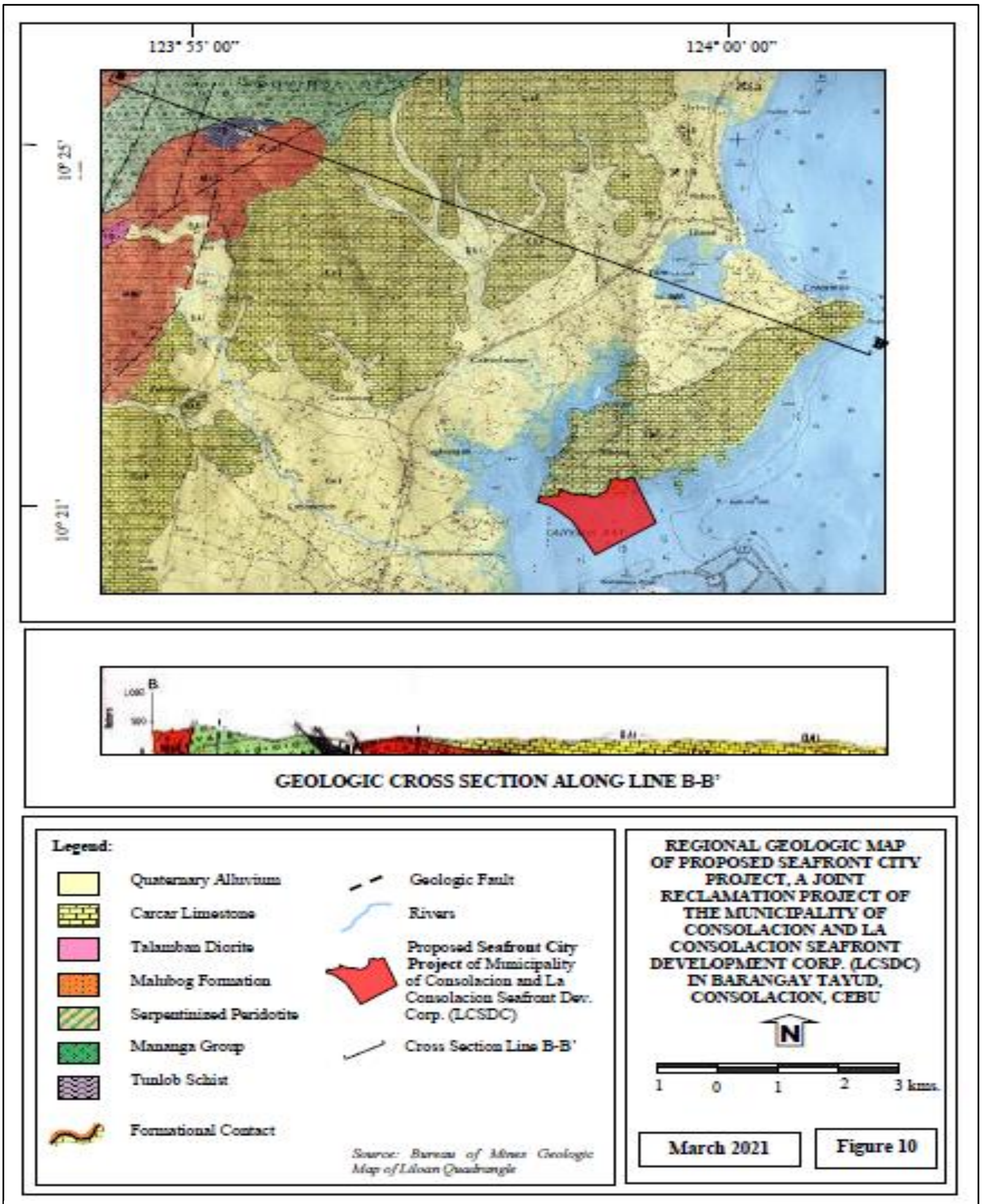


Figure 2-8: Geological Cross Section of the Proposed Project

The proposed project will occupy a tidal flat with mangroves. However, these mangrove areas will not form part of any reclamation activities but will be presereved as an eco-park. Provisions on R.A. 7161 on the prohibition of mangrove cutting will be strictly followed and complied.

2.1.2.2. Change in Geomorphology / Bathymetry / Shoreline

Topography

Site topography is of low relief with elevations from sea level to about 53 m at the central part of the area. Slope grades from level to nearly level (0 – 3%), to gently sloping (3 – 8%). 50% of the municipality's land area is characterized by steep slopes and rugged mountainous terrain with an irregular contour relief. The highest elevation stood at 500 meters above sea level (masl).

Consolacion's land area is comprised of very steep hills and mountains. However, as seen in Figure below, the project site will be in level to nearly level and undulating to rolling slope of the land area of the municipality. Based on the CLUP, steeper slopes are found in Panoypoy and Panas, Sacsac, Tolotolo, Casili, and Lamac while Tayud and Pulpogan have 8 to 19% slopes. Generally flatter areas are in Brgys. Cansaga, Jugan, Tubongan, Nangka, Pitogo, Poblacion Oriental and Occidental.

With reference to the National Mapping and Resource Information Authority (NAMRIA) published topographic map of Cebu City Quadrangle at 1:50,000 scale, the topography of the onshore areas in the northern sections of the project area in the Tayud Peninsula is generally flat with elevations less than 5.0 meters above sea level.

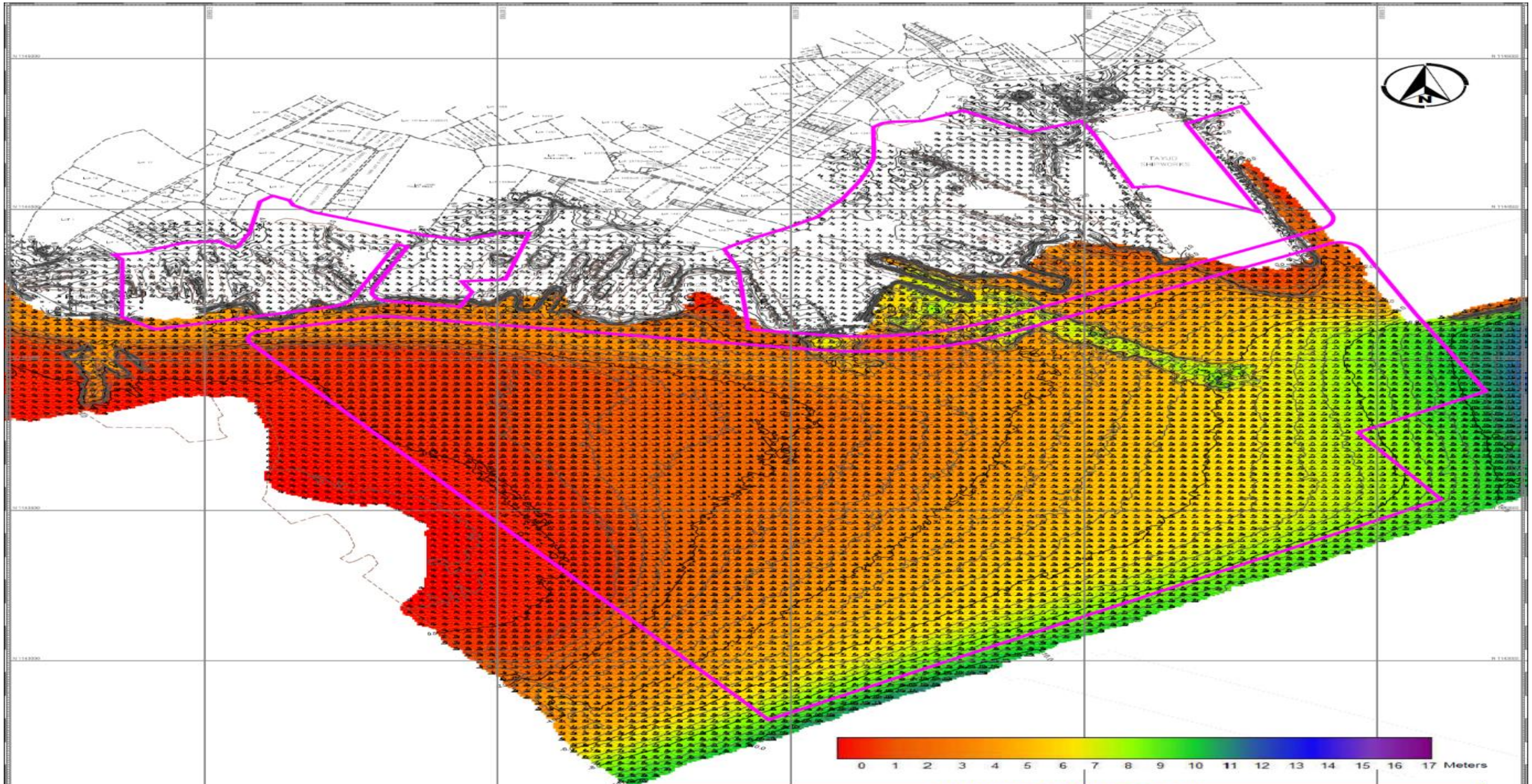
Table 2-3: Land Management Unit Categories of Consolacion

Description	Area* (has.)	Total %
Tidal Flats, Alluvial Plains	116.94	3%
Active Tidal Flats developed (Fishpond)		
Active Tidal Flats undeveloped (Mangrove)		
River Terraces	311.84	8%
Lower River Terraces		
Upper River Terraces		
Limestone Hills	701.64	18%
Limestone Hills (Low and High Relief)		
Limestone/Karst Plains/Lower Terraces		
Low limestone hills		
Shale/Sandstone hills (Low and High Relief)	1,169.40	30%
Volcanic Hills	1,013.48	26%
Low Meta-Volcanic Hills		
Meta-Volcanic Hills (low and high relief)		
Built-up Areas	584.70	15%
Total	**3,898.00**	**100.00**

Source: *Comprehensive Land Use Plan of the Municipality of Consolacion, 2001-2010*

Detailed topographic and bathymetric survey was conducted in the project area. A detailed bathymetric plan at sounding of 0.5-meter contour interval and an onshore 0.5-meter contour interval. The detailed map shows hydrographic contours of the offshore areas of the project range from -10.5 to 0 meters from sea level. Lowest elevation or deepest water level (-10.5 meters) is located in southeastern and southwestern boundaries of the project. Both are located towards the Mactan Channel while highest elevation (0 meter) is located along the shoreline in the northern sections of the Project where the existing shipyards are located.

The possibility of sea level rise was projected due to climate change which cannot be avoided if time will come. Therefore, the reclamation project was designed to have a 4-meter freeboard above the mean low low water level elevation of the project as preparation for sea level rise.



BENCHMARK DETAILS (WGS 84 ZONE 51N)					
BM NO.	EASTING	NORTHING	LATITUDE	LONGITUDE	ELEVATION
EGS BM1	606256.702	1144400.174	10° 21' 04.17816" N	123° 58' 13.98611" E	8.965 m. (Above MLLW)
EGS BM2	606911.154	1142060.560	10° 19' 47.94688" N	123° 58' 35.26864" E	3.674 m. (Above MLLW)
EGS BM3	608108.618	1145071.091	10° 21' 25.83469" N	123° 59' 14.94388" E	11.966 m. (Above MLLW)
EGS B1	607855.759	1144938.979	10° 21' 21.5593" N	123° 59' 06.6165" E	10.566 m. (Above MLLW)
EGS B2	607808.644	1144966.375	10° 21' 22.4559" N	123° 59' 05.0702" E	10.909 m. (Above MLLW)
EGS B3	607640.808	1144986.758	10° 21' 23.1363" N	123° 58' 59.5539" E	12.876 m. (Above MLLW)
EGS B4	607598.708	1144930.573	10° 21' 21.3114" N	123° 58' 58.1639" E	11.912 m. (Above MLLW)
EGS B5	607049.409	1145161.845	10° 21' 28.8955" N	123° 58' 40.1265" E	7.765 m. (Above MLLW)
EGS B6	606925.961	1145047.870	10° 21' 25.1974" N	123° 58' 36.0561" E	7.978 m. (Above MLLW)
EGS B7	606698.907	1144828.525	10° 21' 18.0792" N	123° 58' 28.5685" E	9.448 m. (Above MLLW)
EGS B8	606665.095	1144794.151	10° 21' 16.9636" N	123° 58' 27.4533" E	7.997 m. (Above MLLW)
EGS B9	606205.322	1144364.962	10° 21' 03.0369" N	123 °58' 12.2932" E	5.944 m. (Above MLLW)
EGS B10	606204.417	1144316.891	10° 21' 01.4721" N	123° 58' 12.2587" E	4.399 m. (Above MLLW)

Figure 2-9: Topography and Bathymetry of the Project Site

Bathymetry

A possible shallowing of the bay area is inferred when comparing nautical charts created by NAMRIA in the 1990 and recently collected bathymetry in the bay. The apparent shallowing of the bay may be attributed to the increase in sedimentation in the site. Former forested areas are subject to conversion for quarrying, agricultural, and industrial use. This, in turn, increased soil erosion and siltation in the rivers that lead into the bay.

High-resolution multibeam bathymetry showed sites of elongated scours close to coast due to dredging as shown in Figure 2-12. These were used to deepen the seafloor and give way to ships coming to ports and shipyards. Dredging activities related to reclamation work results in siltation and anoxic conditions in surrounding waters. This can potentially damage the surrounding marine habitats. Recovery from such activity may sometimes lead to permanent damage in the habitat (Montenegro et al., 2005).

Figure 2-10: Bathymetry of the Project Site Using High Resolution multibeam

Sidescan sonar imagery showed an overall uniform seafloor due to silt and mud-rich bottom. Relatively harder substrates are found on the western side of the mouth of Guinsaga River. This may be a relict deltaic bar or accumulation that was formed due to its location near the opening of the river.

The acoustic character of the subsurface at ˜2 m below the seafloor showed a very similar soft mud sediment. This indicates that the subsurface is also rich in mud. Ground surveys show that the upper meter of the seafloor is composed of high amount of suspended mud and soft mud substrate. Given that the watershed opening to Cansaga Bay is relatively small, the first few meters already represent decades of natural accumulation from the river.

Slope and Elevation Map

The municipality of Consolacion is generally characterized by steeply hills and mountainous terrains. The coastal areas are normally flat, but less than a kilometer away from the shoreline, the slope changes from gently sloping to steep hills and mountains. More than 30% of Consolacion has a very steep terrain (slope >50%) with ground elevation up to 300 to 358 masl. There are ten (10) barangays in the municipality which are characterized by level to undulating terrain namely; Cansaga, Jugan, Lamac, Nangka, Pitogo, Pob. Occidental, Poblacion Oriental, Polog, Pulpogan, Tayud and Tugbongan, while the rest of the barangays going upland are characterized rolling to moderately steep hills and mountains. The highest elevation of Consolacion is at 300-358 masl covering mostly the barangays of Lanipga, Garing, Panas, Polog, and Panoypoy.

Table 2-4: Slope Distribution per Barangay in Consolacion

Barangay	Slope in Area (ha)				
	0 - 8	8 - 18	18 - 30	30 - 50	Over 50
CABANGAHAN		83.194	43.494	2.341	
CANSAGA	49.78				
CASILI	50.82	114.26	12.16		
DANGLAG	92.7	0.19	49.65	62.55	
GARING	82.51	4.53	189.65	159.33	
JUGAN	160.52				
LAMAC	60.37	61.87			
LANIPGA		5.63	82.24	206.77	
NANGKA	114.4				
PANAS			238.35	232.57	
PANOYPOY		61.82	11.21	68.92	
PITOGO	67.23				
POB. OCCIDENTAL	23.31	5.26			
POB. ORIENTAL	19.32				
POLOG	41.61	73.31	141.67	66.63	
PULPOGAN	65.35	37.84	18.18		
SACSAC		0.03	151.03		
TAYUD	455.91				
TILHAONG	89.45	5.77	2.84	25.83	
TOLOTOLO	1.16	20.19	245.74	80.51	
TUGBONGAN	173.37				
TOTAL	**1,547.81**	**473.89**	**1,186.21**	**905.45**	**-**

Source: Department of Environment and Natural Resources VII, 2019

LEGEND:

Slope (%)	Description
0-8	Level to undulating
8-18	Undulating to rolling
18-35	Rolling to moderately steep
35-50	Steep hills & mountains
50 & +	Very steep hills & mountains

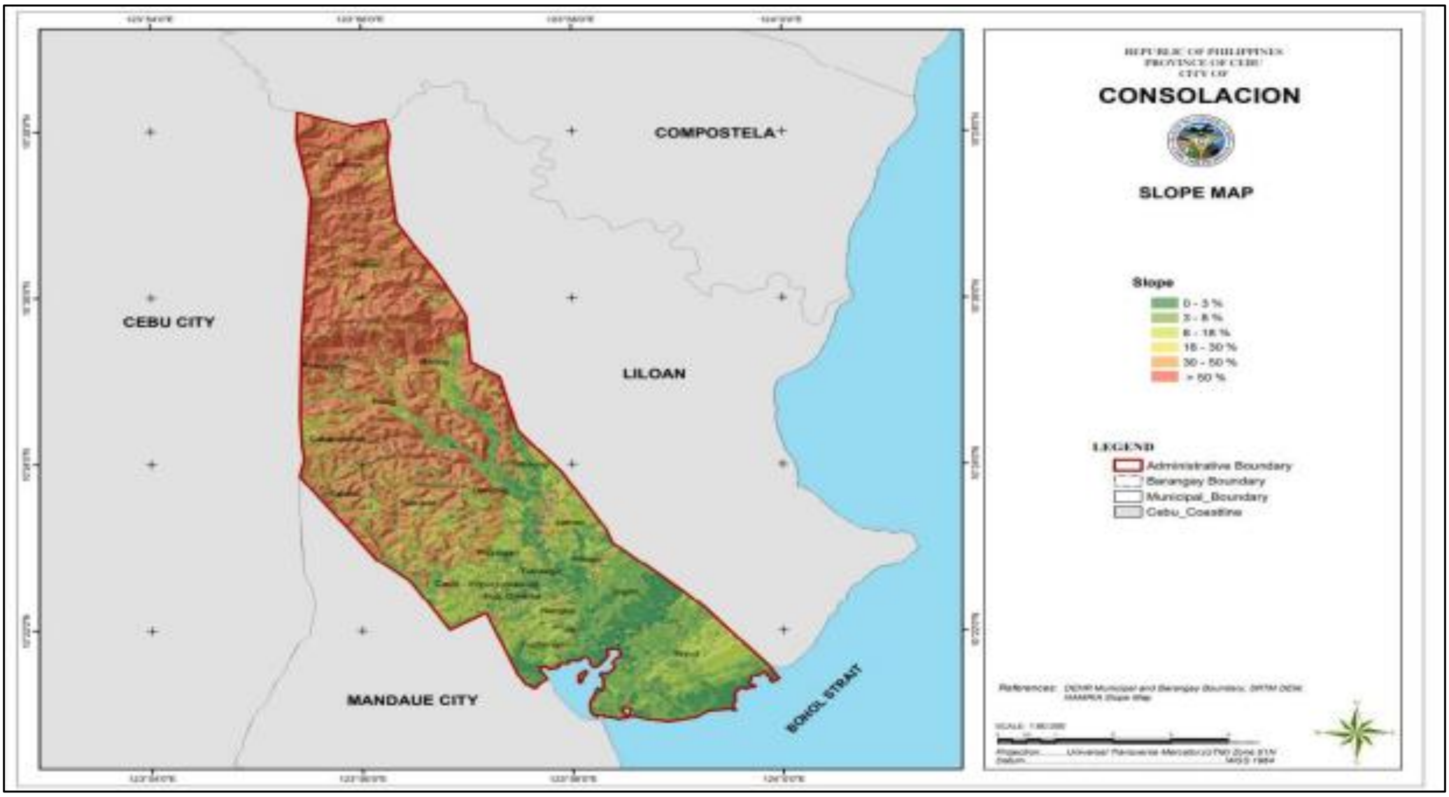


Figure 2-11: Slope Map of Consolacion

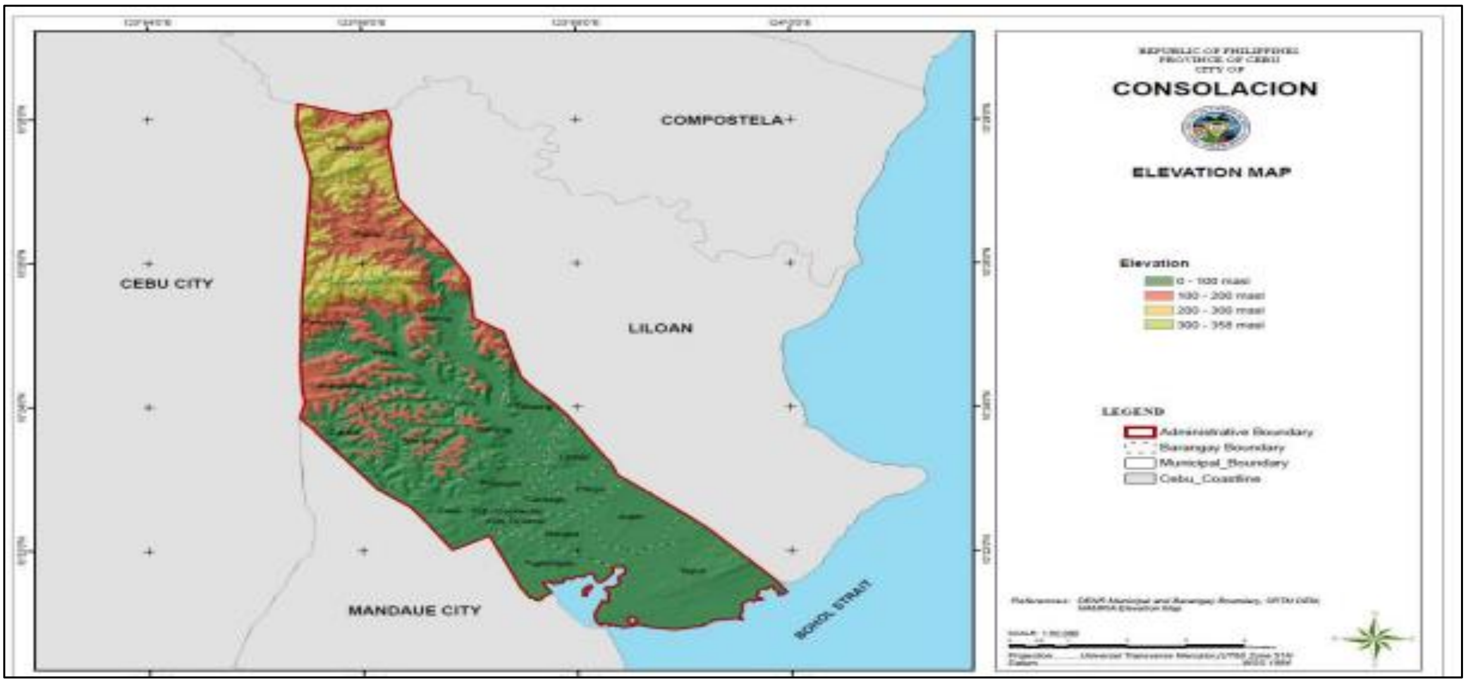


Figure 2-12: Elevation Map of Consolacion

There is also about 7.45% of Consolacion's land area that is suitable for controlled agriculture and livestock production having a slope of 18-30% while the greater portion of the municipality is about 50.16% which are composed of steeply hills and mountains and are classified as forestland areas. Reforestation and afforestation activities are highly suitable in mountainous areas with slopes of 30 to more than 50 percent.

Shoreline Change

Coastal land reclamation is primarily responsible for the degradation of wetlands and other coastal resources in Southeast Asia. The construction of man-made structures is a major factor in shaping the coastline of Cansaga Bay. In the site, there is a general advance of the coastline due to man-made activity. Since the 1990s, charts by NAMRIA have shown the presence of individual port structures. Over the succeeding decades, more ports and shipyards were built to its present configuration. This is especially true within the western coast of Cansaga Bay in Brgy. Tuburan. Another structure that has contributed to the coastal change in the area is the construction of aquaculture fish pens. This is prominent within the inner parts of the estuary and the eastern coast of the bay.

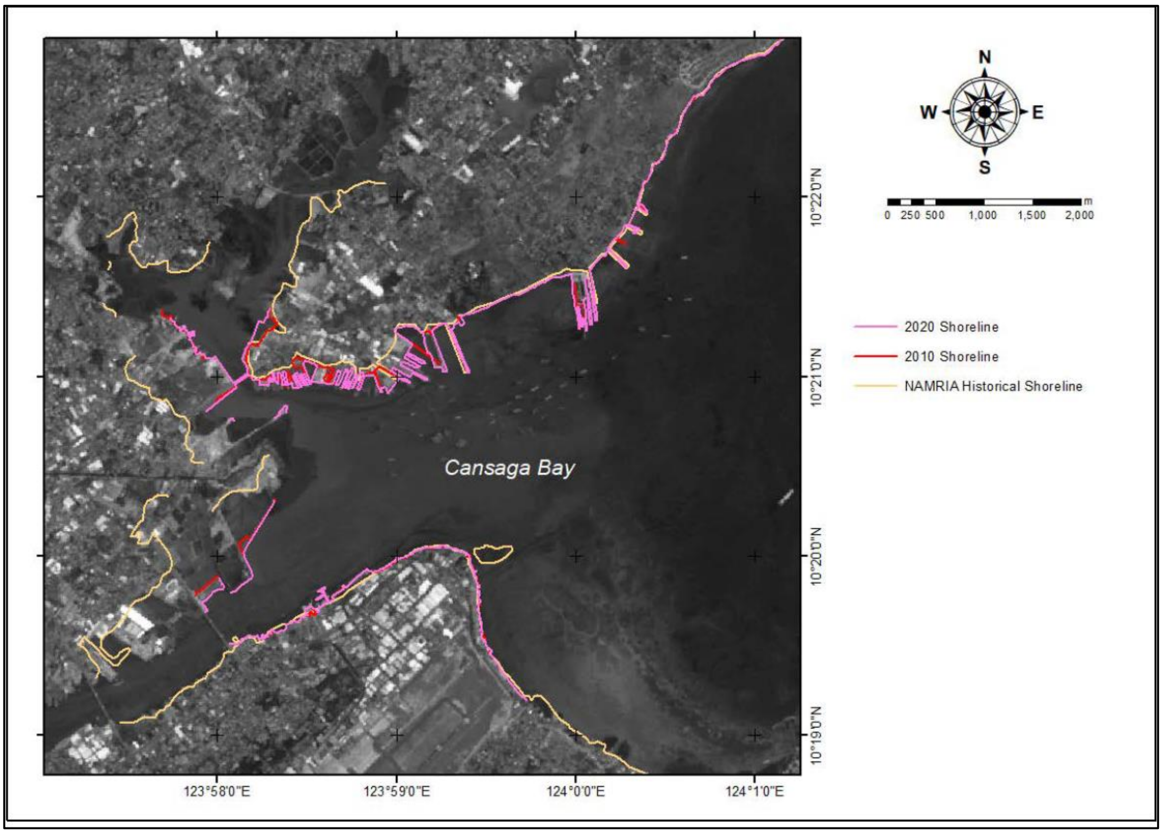


Figure 2-13: Shoreline change in Brgy. Tayud, Consolacion, Cebu

The remaining natural coastlines in the site are mangrove forests (Figure 56). Wetlands, including mangrove forests, provide valuable shoreline protection and storm damage buffer zones. These buffer zones are not implemented in the site. Mangrove forest cover has declined, especially in the inner parts of the bay within the estuary opening to Cansaga Bay. This significant decline is attributed to the increase of urban areas around Mandaue City and Consolacion, which replaced shallow mangrove areas with reclaimed lands for residential and commercial purposes. The conversion of mangrove forests to fish pens also contributed to this decline.

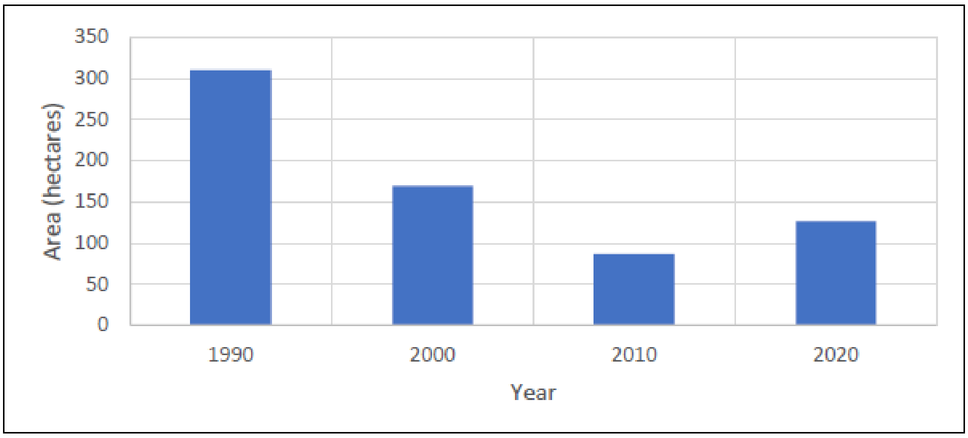


Figure 2-14: Estimated decadal change in mangrove cover in Cansaga Bay and its adjacent areas

Along the western side of the estuary, there is an increase of mangrove cover during the last decade. This is attributed to the advance of the shoreline due to man-made structures. These man-made structures have made it possible to trap sediments brought by river. Over time, sediments accreted around these structures which served as the substrate for new mangrove forests. Along Barangay Tuburan, small pockets of mangrove areas are identified which conformed to the existing structures. Local accretion of small mangrove areas was identified adjacent to a structure like ports and jetties.

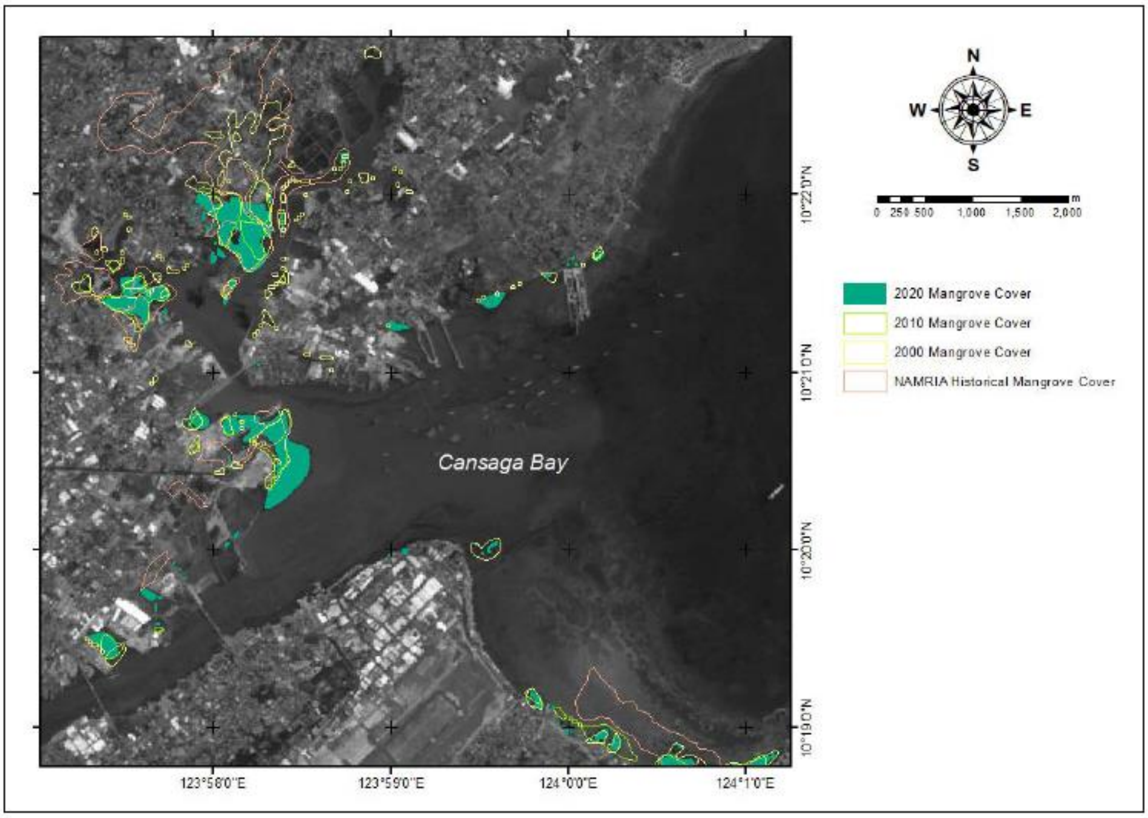


Figure 2-15: Decadal change in mangrove within the shoreline of Cansaga Bay

2.1.2.3. Change in Sub-surface geology/underground conditions

Tectonic Setting

The Philippine archipelago is situated in a complex tectonic zone created by the interaction between the Philippine Sea Plate and the south-eastern edge of the Eurasian Plate (Aurelio, 2000). The Philippine Islands is generally interpreted as a collage of insular arcs, ophiolitic suites and continental rocks of Eurasian affinity. The formation of this belt is controlled by subductions, collisions and major strike-slip faults. (Aurelio and Peña, 2002). It has evolved from the collision between the Eurasian Plate, South China Sea Plate, the Philippine Sea Plate, and the Pacific Plate. The collision resulted to several subduction zones marked by oceanic trenches. The development of the archipelago was caused by the active squeezing and magma rise producing a chain of volcanoes from the remelting of the subducting lithosphere. The formation of this Philippine Mobile Belt is influenced by subductions, collisions, and major strike-slip faults, notably, the 1,300-km long Philippine Fault Zone (PFZ) that transects the entire length of the archipelago.

The Philippine Mobile Belt (PMB) is surrounded by subduction zones moving in opposing directions simultaneously. On the western side, the Eurasian Plate (or South China Plate) subducts eastward beneath Luzon Island along the Manila Trench. On the eastern side, the Philippine Sea Plate subducts westward along the East Luzon Trench. This results to an actively deforming zone in between 2 active subduction systems as manifested by high seismic activity. (Aurelio and Peña, 2002).

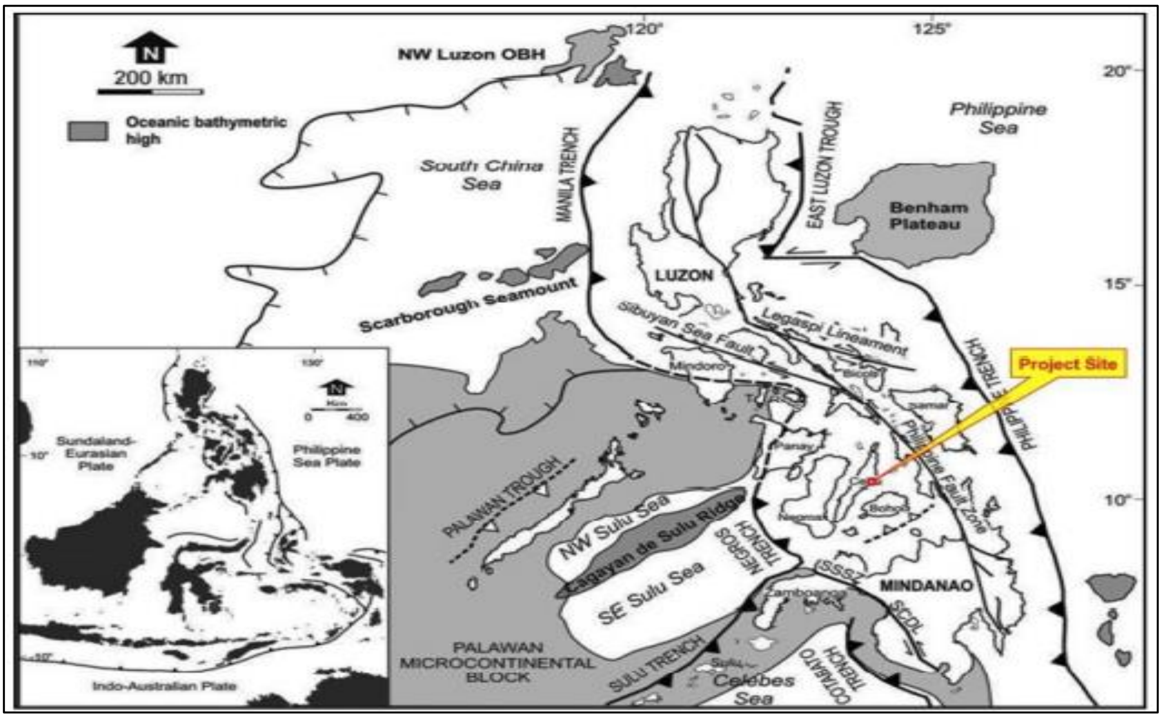
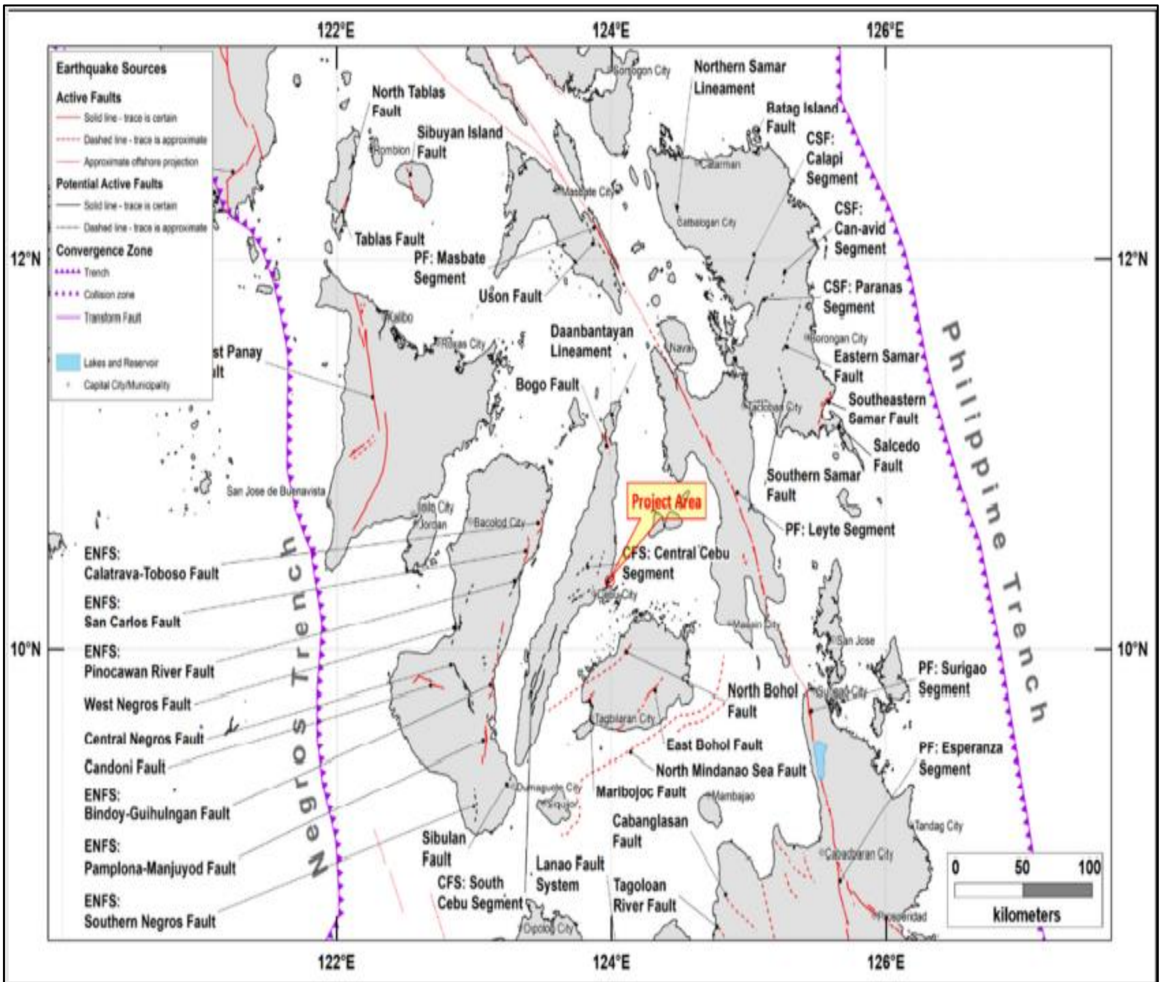


Figure 2-16: Tectonic Features of the Philippines *(Source: Yumul et al, 2008)*

The 1,300 km-long Philippine Fault Zone (PFZ), a major strike-slip fault extending from Lingayen to Davao, lies parallel to the subduction trenches. The PFZ is assumed to release the shear stress caused by the oblique subduction of the ocean plates. On the southwest, the seafloor of the Sulu Plate subducts near the west side of Negros Island along the Negros Trench and along Sulu Trench near the northwest side of Zamboanga. The Celebes Sea Plate subducts near the west side of Central Mindanao along the Cotabato Trench and in Davao Gulf along the Davao Trench.

Major tectonic features in the project region include the Philippine Trench, Philippine Fault, and the Negros Trench. Northeast trending lineaments transect the regional geomorphic fabric of Negros and Cebu islands, which continues offshore possibly terminating at its juncture with the Philippine Fault. Roughly parallel with regional strike of the Negros Trench is the Negros volcanic arc formed by the subduction of the Sulu Sea Basin beneath the island of Negros. A similar volcanic arc lies along the central portion of the Philippine Fault in the island of Leyte parallel to trend of the Philippine Trench. The major trenches serve as manifestation of subduction zones and major fault structure traces of the Visayas.



Source: Distribution of Active Faults and Trenches in the Philippines, PHIVOLCS, 2020

Figure 2-17: Trenches and Active Faults in the Visayas Region

Table 2-5: Annual Rates and Computed Return Periods of Earthquake Activity in the Region

Magnitude (Ms)	Seismic Source Zone					
	Zone 19 Negros Trench		Zone 9 Central Visayas		Zone 2 Philippine Fault: Central Segment	
5.2 to <5.8	0.04165	24	0.06367	16	0.22282	4
5.8 to < 6.4	0.01430	70	0.02387	42	0.08351	12
6.4 to < 7.0	0.00492	203	0.00894	112	0.03130	32
7.0 to < 7.3	0.00169	592	0.00335	299	0.01173	85
7.3 to < 8.2	0.00058	1724	0.00126	794	0.00440	227

Source: *Thenhaus et al., 1994.*

Stratigraphy

The 2010 Geology of the Philippines (GOP) of the Mines and Geosciences Bureau delineated the Philippine Islands into 32 Stratigraphic Groups (SG). A Stratigraphic Group corresponds to an area with distinct stratigraphic character that can be distinguished from those of adjacent areas. Cebu Island, where the Project is located, falls under to the Visayas Sea Basin Stratigraphic Group (SG 17) that also includes Bohol Island, Eastern Negros, and Northwest Leyte. As described in the 2010 GOP, the Visayas Sea Basin rest unconformably over a deformed volcaniclastic basement. The lower layers of the basin are dominated by Middle to Upper Oligocene platform limestones and clastic sequences, while the Pliocene-Pleistocene layers are characterized by a succession of volcaniclastics and carbonates, separated by at least three major unconformities (Porth and others, 1989; Müller and others, 1989 a and b as cited in MGB, 2010). The youngest major unconformity separates Pleistocene formations from Upper Miocene – Lower Pliocene units. The second major unconformity, well developed in the entire basin, is end of Middle Miocene. The basin axis is NNE-SSW and the sedimentary fill is around 4,000 m thick. Cebu Island consists of two stratigraphic sub-groups: the Southern Cebu and the Northern/Central Cebu which is the area of interest.

Figure 2-18 shows the Stratigraphic Column of Cebu Island adapted from Lexicon of the Philippine Stratigraphy.

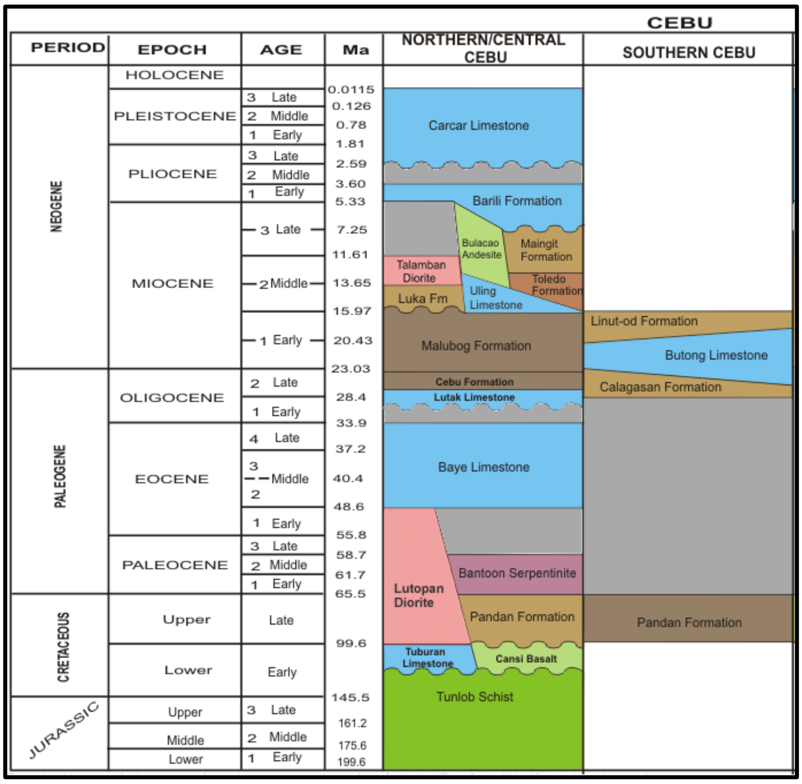


Figure 2-18: Stratigraphic Column of Cebu Island

Based on the land management map of the Bureau of Soils and Water Management (BSWM), the geomorphic features of the project site indicates that Barangay Tayud, where the proposed development is planned, consists of a low limestone hill surrounded by coastal plain. Carcar limestone is the main geological formation of the municipality which is a tertiary formation that covers mostly coastal areas.

2.1.2.4. Natural Hazards/Constraints

Siesmic Hazard

Active seismic generators of the Philippine Archipelago are associated with mobile belt boundaries specifically along convergent zones as exemplified by the East Luzon-Philippine trench to the east and the Manila-Negros-Sulu-Cotabato trenches to the west where the Philippine Sea Figure and the Eurasian Figure are being consumed respectively. Furthermore, several active fault systems within the Philippine Arc itself more importantly the sinistral Philippine Fault systems are also active and even worst contributors to damaging earthquakes.

The Active Faults Map of Cebu that was generated through a combination of analysis of geomorphic evidence of active faulting using aerial photographs, satellite images, geologic and topographic maps, available literature, and field survey data. Central Cebu Fault System is a Potentially Active Fault as classified by PHIVOLCS.

PHIVOLCS has classified two classification of faults – Active and Potential Active. An active fault shows strong evidence of displacement and deformation of young sediments and geologic features within the last 10,000 years and is definite to move again in the future. A potentially active fault shows insufficient evidence that the fault moved in the last 10,000 years; however, the possibility of future movement along these types of fault may not be discounted.

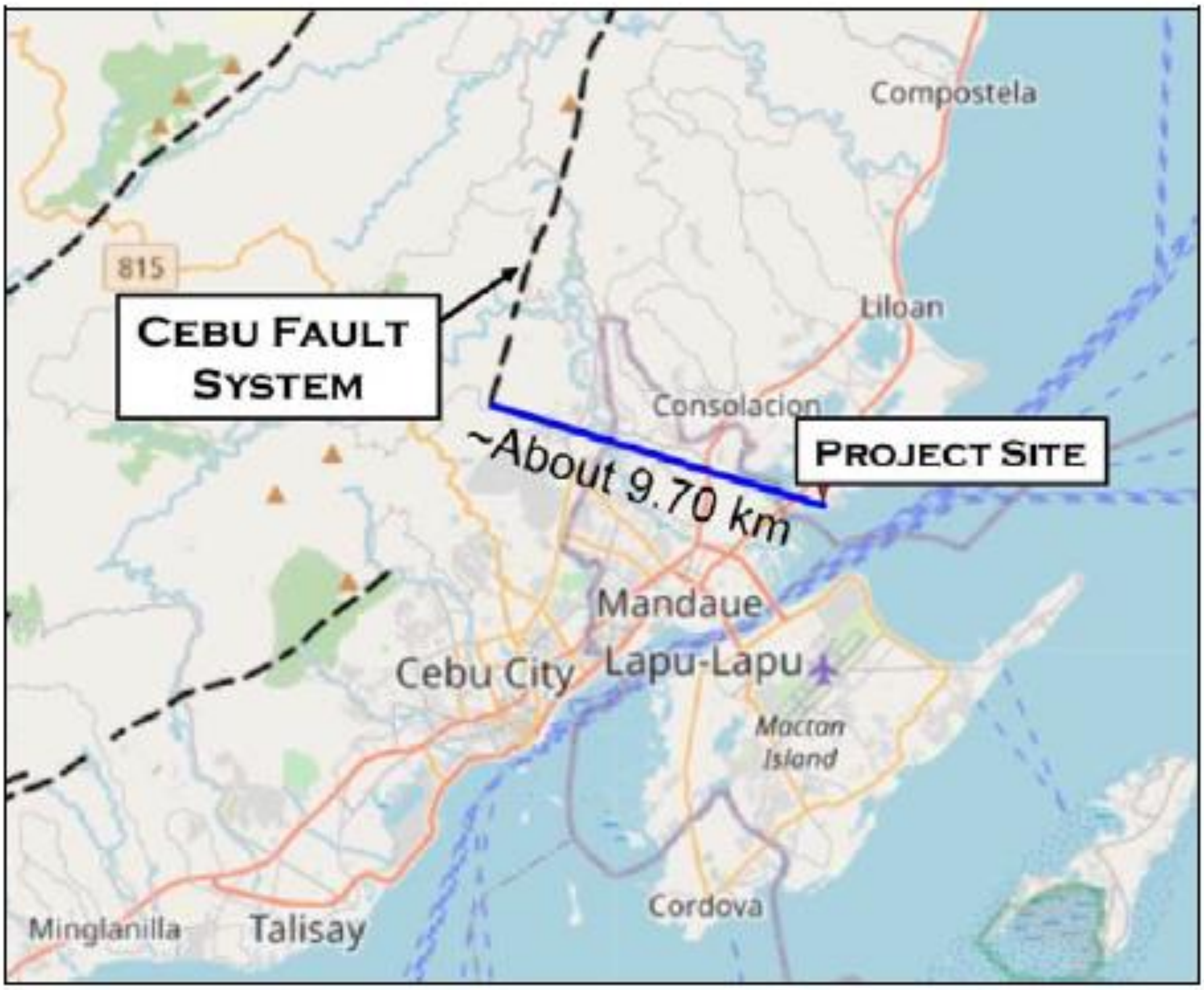


Figure 2-19.a: Approximate Distance of Project Site from Active Fault

Figure 2-20.b: Tectonic Map of the Philippines showing Major Structural Features

Earthquake Generators

Earthquake generators in the project region are the nearest active faults and trenches in the region. The HazardHunterPH identified the Central Cebu Fault as the nearest active fault located approximately 10.9 km northwest of the project site. Although the Central Cebu Fault together with the South Cebu Fault is categorized as potentially active faults, PHIVOLCS does not discount the possibility that these faults would move and generate a strong earthquake. Other potential earthquake generators and its approximate distances to the project site are shown below.

Table 2-6: Nearest Earthquake Generators in the Project Region

Earthquake Generator	Approx. distance and bearing from project site at coordinates 10.35786˚N, 123.99412˚
Central Fault System (Central Cebu Segment	10.9 km northwest
North Bohol Fault	40 km south southeast
Central Fault System (South Cebu Segment	49 km southwest
East Negros Fault (Bindoy-Guihulngan Segment)	88 km west southwest
Philippine Fault (Leyte Segment)	109 km northeast

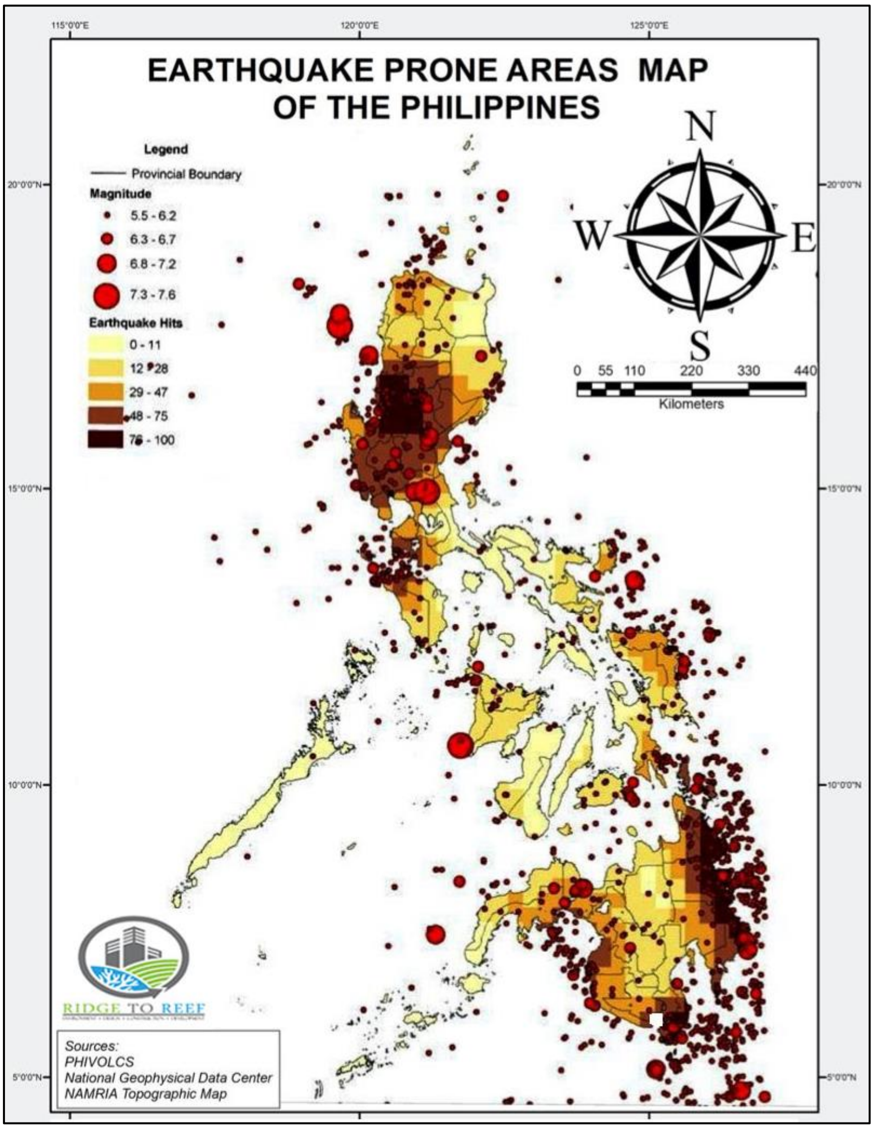


Figure 2-21: Map showing the Earthquake Prone Areas of the Philippines

Tropical Cyclone

Tropical cyclones or storms are not frequently experienced in Cebu Island including Mactan basically due to its strategic location being geographically covered by Leyte-Surigao mountain ranges on the eastern side. The frequency of typhoon passage in different parts of the country is shown in Figure 2-21.a and Typhoon Incidence Map of the Philippines in Figure 2-21.b. Despite of this, Cebu had been hit by at least 8 disastrous typhoons as per PAGASA record from 1948–2003. The province of Cebu normally gets typhoons once a year or none. The only recent typhoons that hardly hit Cebu are Typhoon Mike, Typhoon Fengshen (2008), Typhoon Utor (2006), Typhoon Hagibis, Typhoon Bopha (2012) and Typhoon Amy.

But in November 2013, a powerful typhoon - Typhoon Haiyan and the latest is in December 2021 Typhoon Odette that struck the province as a category 5 super typhoon. Several parts of Metro Cebu reported moderate to high damage as a result of strong winds brought by the storm. Northern towns of Cebu province including Bantayan Island were the worst hit when Typhoon Haiyan struck while Central Cebu to Southern Cebu were worst hit during Typhoon Odette, as those towns were almost totally wiped out.

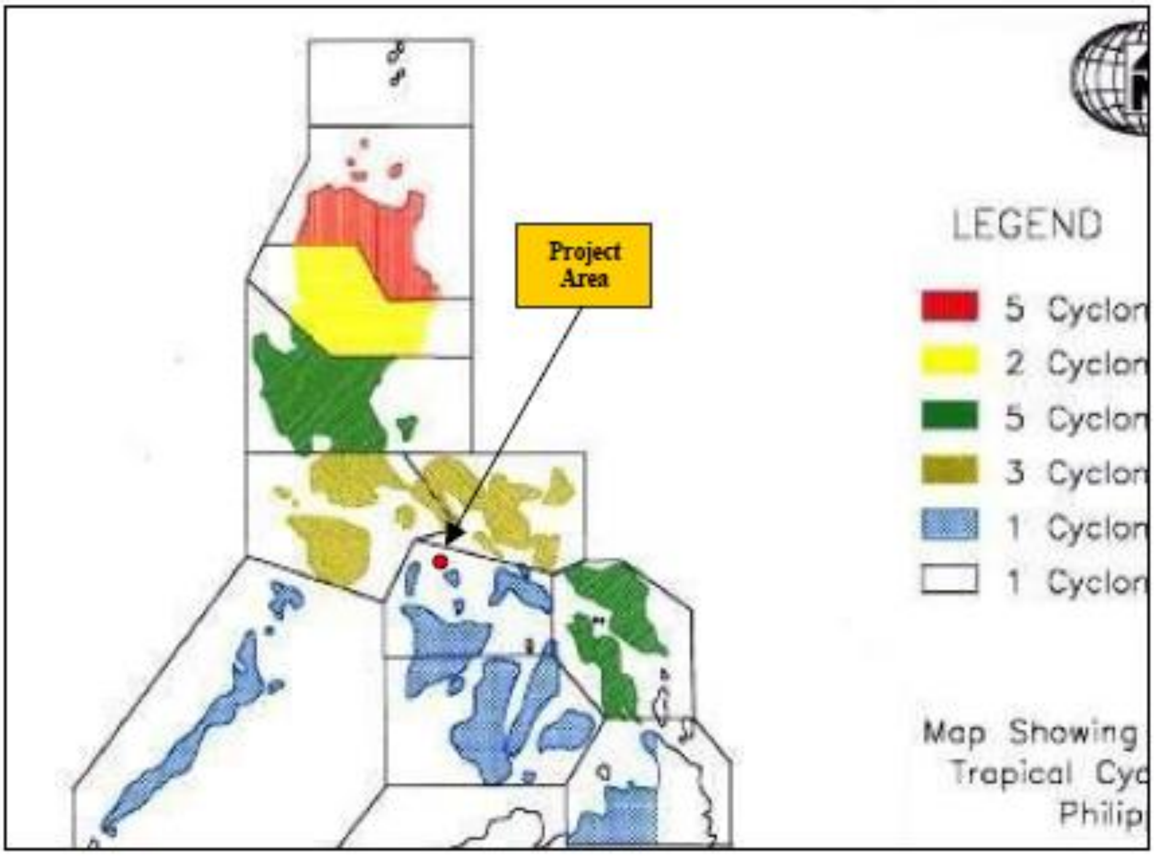


Figure 2-21.a: Tropical Cyclone Frequency Map

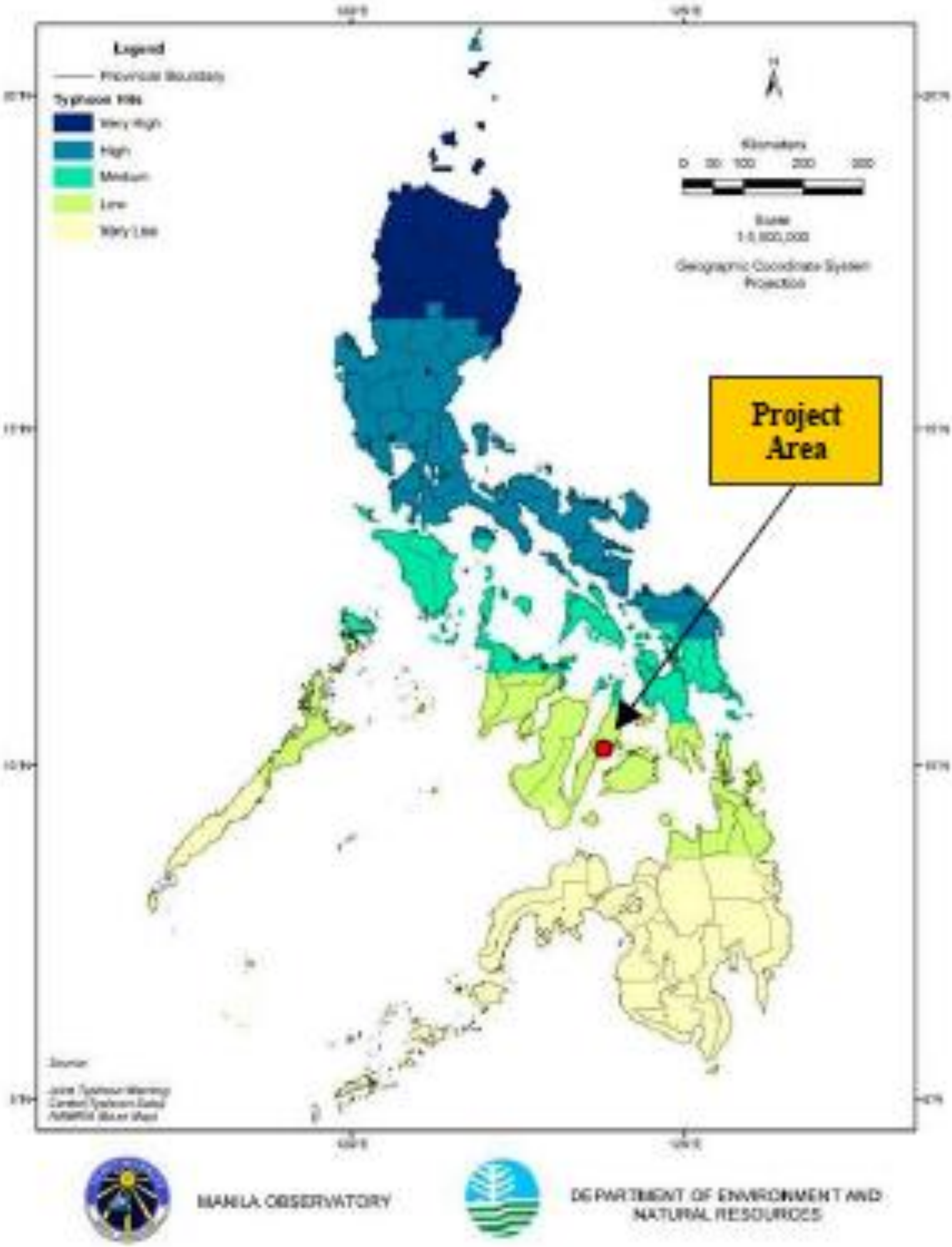


Figure 2-21.b: Tropical Cyclone Frequency Map

Flooding

The Philippines is located in the most typhoon-prone area in the world. On the average, the country is regularly visited on the average by about twenty typhoons of varying intensities annually, some of which may hit parts of the Central Visayas region where the Municipality of Consolacion is located. Typhoons that pass through the Philippines' Area of Responsibility (PAR) originate from the Pacific Ocean at about 50 North of the Equator and usually move towards the northwest. Cebu and the Metro Cebu area of which Consolacion belongs is expected to experience at least one tropical typhoon of strong intensity annually.

Flooding results from different causes namely: prolonged periods of precipitation, human actions and other artificial causes such as loss of vegetation and constrictions of streams. Flood prone areas identified in the project area are the low-lying areas near the coastline. Natural drainage in these low-lying areas is poor. Water is usually retained for a period of time and eventually seeps to the underlying porous alluvium. Based from the Mines and Geosciences Bureau (MGB) Landslide and Flood Susceptibility Map of Liloan Quadrangle at scale 1:50,000 and where the proposed reclamation at Barangay Tayud, Consolacion is located, the coastal areas of the project area are classified as low to moderate susceptibility to flooding (cream color) (Figure 2-21.c). However, coastal areas in the inner sections of Cansaga Bay and also areas near mouth of Butuanon River in Barangay Paknaan, Mandaue City are classified as high susceptibility to flooding (violet color). The said geohazard map also indicate that the flat and low-lying onshore areas of the proposed project has no susceptibility to landslide (MGB, 2009).

The lack of drainage and sewage systems for Barangay Tayud, Consolacion is possibly another factor, which resulted to possible flooding in some low areas to the north of project area during period of heavy rains. Absence of drainage outlet results into perennial flooding in some areas.

The drainage plan of the proposed reclamation project is designed in such a way that all storm waters will flow directly and drains towards the mouth of Cansaga Bay and into the Mactan Channel. The storm water including the waste water of the project will pass by the proposed waste water treatment facility prior to discharge from the reclaimed area to the sea. During development phase, there is possibility that the project may contribute or cause flooding to the nearby low-lying residential areas. The construction of the buildings, roads and other establishments later on will in effect minimize infiltration capacity and thereby run-off water will be increased.

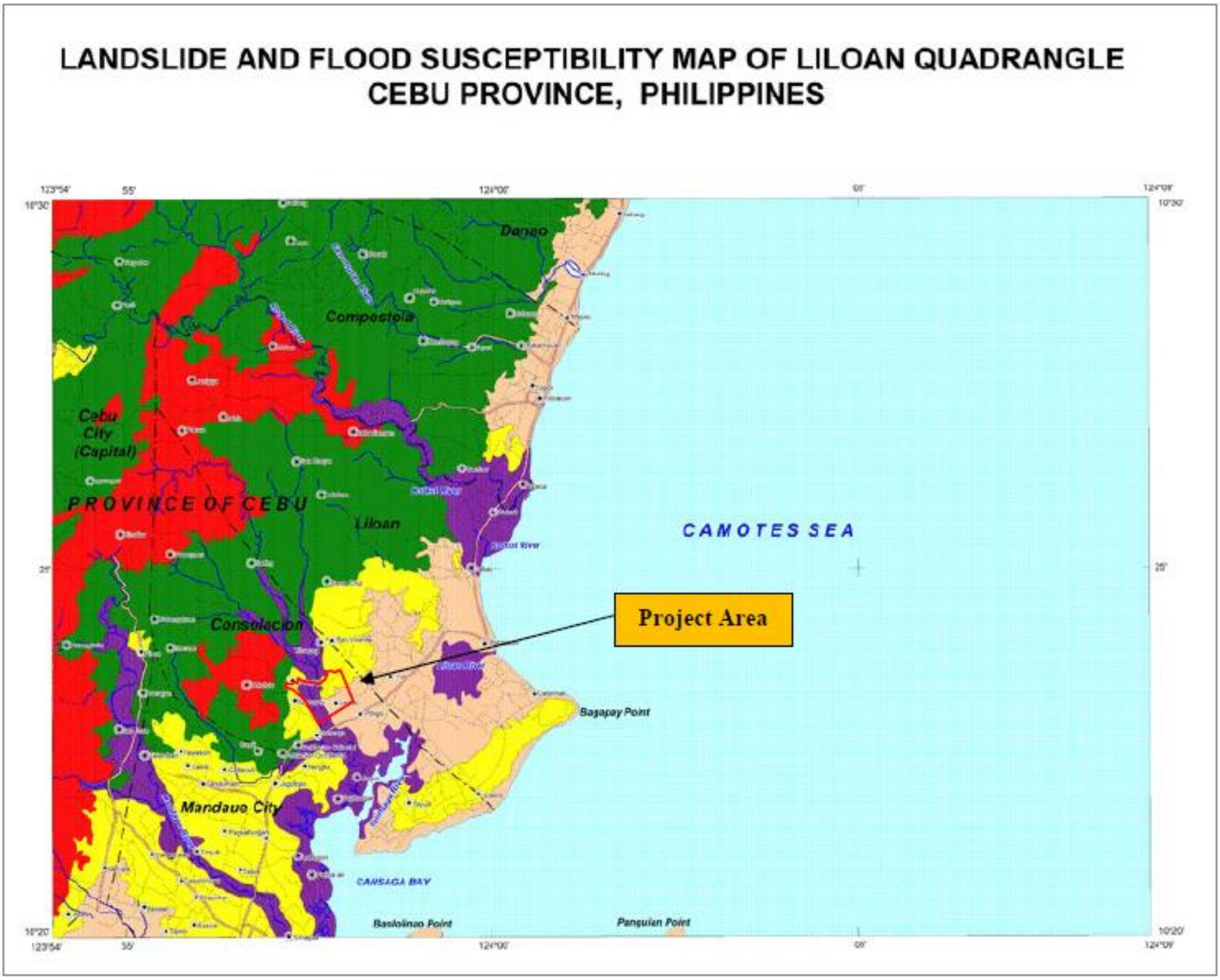


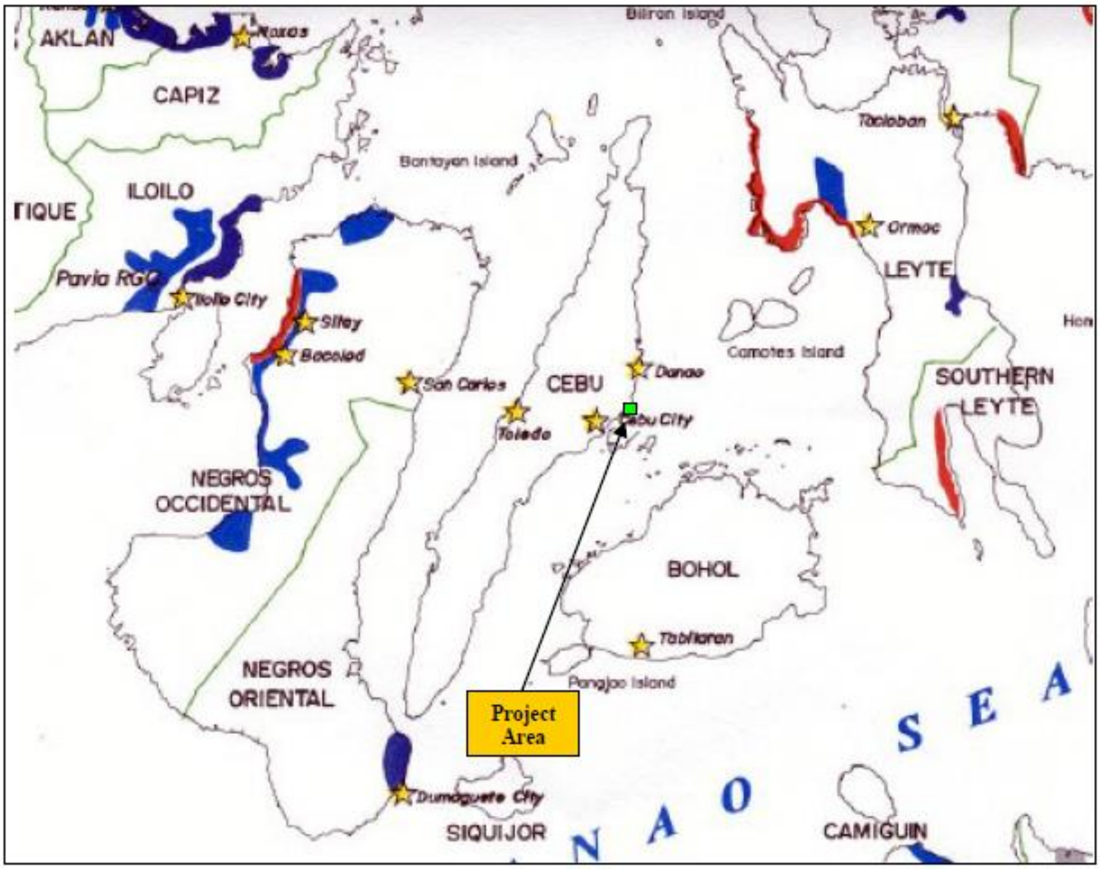
Figure 2-21.c: Landslide and Flooding Susceptibility Map of Liloan Quadrangle at scale 1:50,000 showing the location of proposed Seafront City Project, a joint reclamation project of the Municipality of Consolacion and La Consolacion Seafront Development Corp. (LCSDC) located in Barangay Tayud, Consolacion, Cebu (Mines and Geosciences Bureau, 2009)

Tsunami/Storm Surge

Storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm, and whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic high tide from the observed storm tide. When storm surge is combined with a normal astronomical high tide, a storm tide is created. Tsunami or seismic sea waves on the other hand, are long waves generated by sudden displacement under water, most commonly the sudden displacement along a submarine fault associated with an earthquake. Historical storm surges map of the Philippines showed that Cebu Island including the project site is not hit by any strong storm surges (Figure 2-21.d). Tsunamis are not experienced in Cebu Island including the project basically due to its strategic location being geographically near Mactan Island on the eastern side facing the Mactan Channel.

Tsunamis are earthquake-caused wave movements in the ocean. Generally, coastal areas in the Philippines experienced a tsunami or have a tsunami hazard potential. The PHIVOLCS' tsunami vulnerability mapping revealed the Municipality of Consolacion to prone from this hazard with an Inundation Depth of 2 to 2.99 meters. Further, tsunami threat to people's lives can be addressed by community preparedness and a tsunami evacuation plan. Advice for tsunami evacuation comes from public agencies and the local government. But more importantly, coastal communities must learn to evacuate themselves when they recognize the three natural signs of tsunami which are: 1. Strong ground shaking, 2. Unusual rise or fall of sea level, and 3. Strong at unusual sound coming from the sea.

The bufferzone or channel of 50 meters will not just accomodate the various equipments to be used during the construction phase of the project but will serve as good storm surge measures considering that there will be 4-meter freeboard in the reclamation elevation above the mean low low water. The bufferzone will ensure not just the safety of the workers and seafarers but also the protection of the project especially the structural integrity of the containment structures from the possible effects of future developments in the surrounding areas. The bufferzone also provides ample area for periodic maintenance of the containment structures as well as rehabilitation and replacement of structural components in the event of any damages would occur.



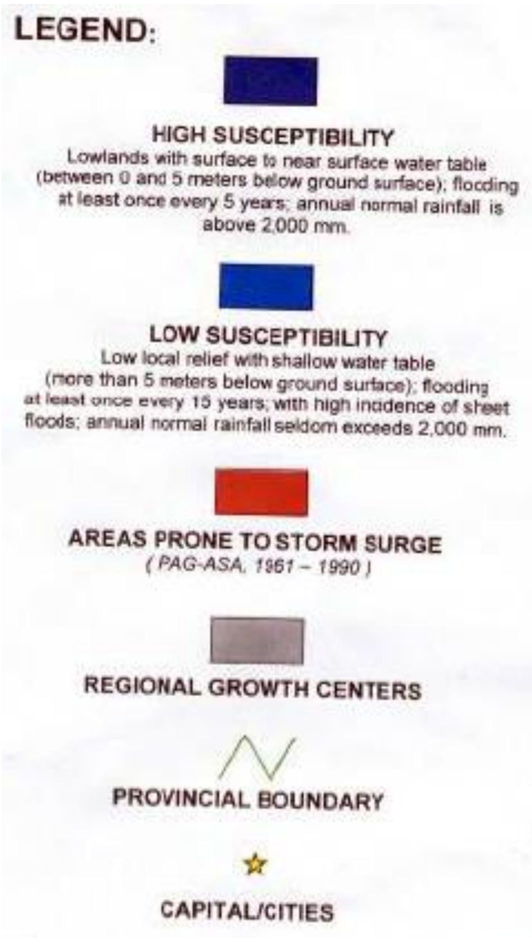


Figure 2-21.d: Historical Storm Surge Map of Central Visayas

Liquefaction

Other threatening type of movement that is also directly associated with seismicity is liquefaction. Liquefaction is the process that transforms the behavior of cohesionless water-saturated unconsolidated sediments from a solid to a liquid state usually caused by seismic stresses (Torres et al, 1994) that create ground shaking. Water saturated soils loose strength and liquefy and thus the material tends to flow causing buildings to sink and rotate or lean into the soil (Keller, 1985).

Saturated sandy soil may suddenly change into a liquid-like muddy water when subjected to earthquake shaking. Liquefaction is a phenomenon in which a granular material changes to a liquid state, whether the material is saturated with water or not. When sandy soil deforms due to shear stress caused by vibration during an earthquake, contact between the particles is lost, so that the shear resistance of the soil is lost.

Then, the force originally supported in a vertical direction through the contact points is then transmitted through the pore water. The soil will stabilize again when the pore water flows out, but settling (volume decrease) will have occurred. (K. Zen., et.al., 2007. Handbook on Liquefaction Remediation on Reclaimed Land. Edited by: Port & Harbor Research Inst.)

During strong earthquakes, the ground shakes when seismic waves move from the earth's subsurface to the ground surface. Liquefaction occurs when loosely packed and water-saturated sediments yield to strong vibration and assume a "quick sand" condition or a liquid state condition. During vibration, sand particles are rearranged into a more compact state (Figure 28).

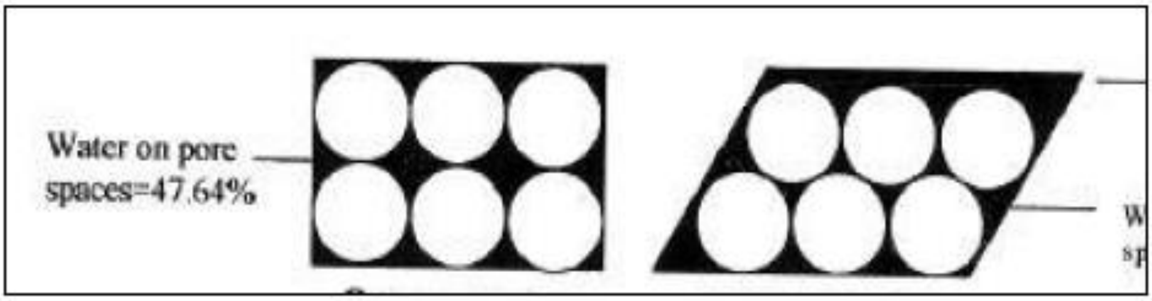


Figure 2-21.e: Compaction showing release of water from pore spaces during liquefaction.

The degree of liquefaction in a particular area is controlled by the intensity and duration of ground shaking during an earthquake, geological formation and the load of civil structure development in the area. The tendency of a sedimentary body to liquefy is determined by lithologic parameters such as porosity, grain size, degree of water saturation, sediment cohesion and age of deposition. The potential for liquefaction in the project area including the whole island of Cebu is low because it is not an earthquake-prone area.

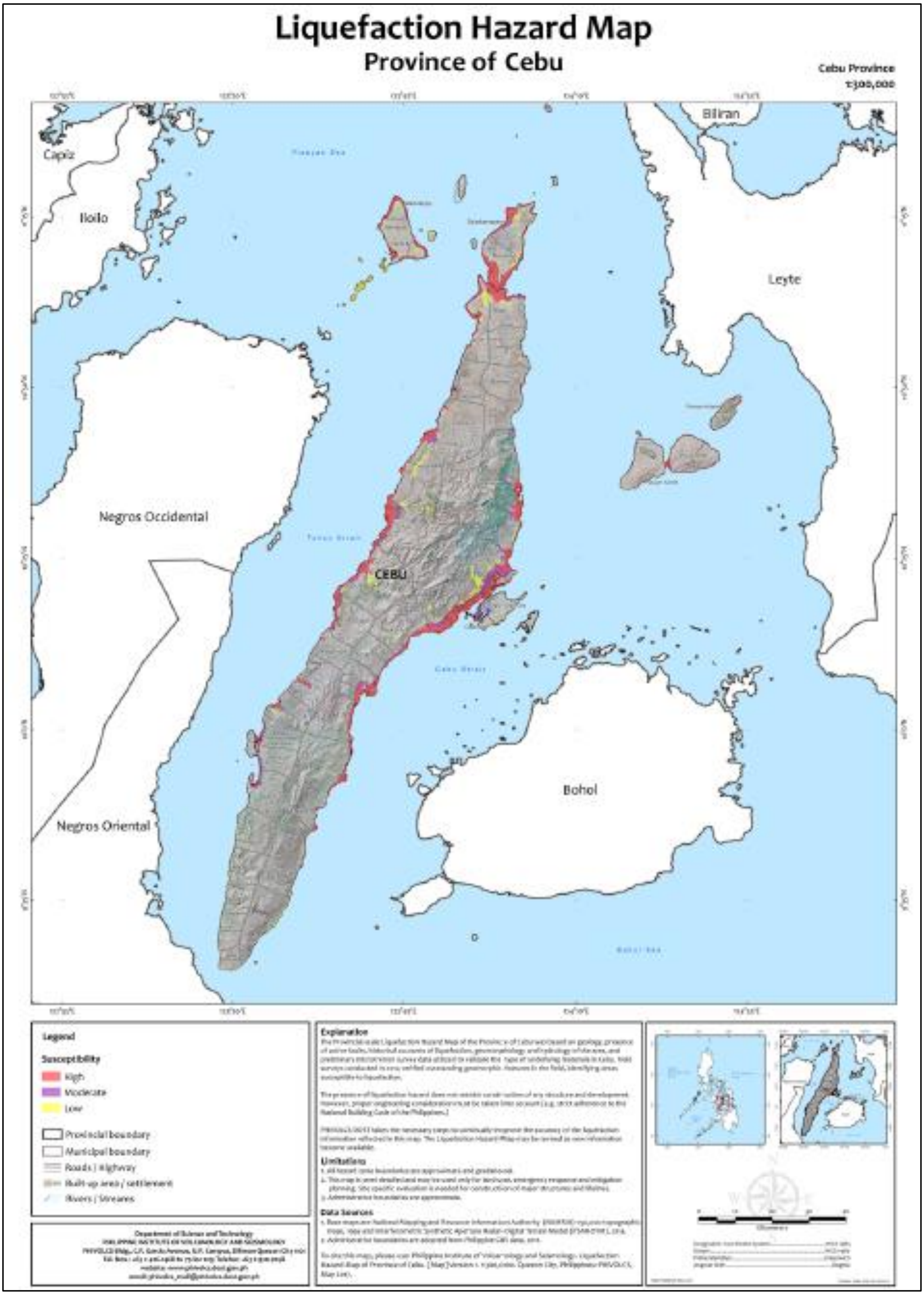


Figure 2-21.f: Liquefaction Map of Cebu

Ground Shaking

Ground shaking refers to actual trembling or jerking motion produced by an earthquake. Seismic magnitude, epicenter distance to earthquake generators and the modifying effects of subsoil conditions mainly influence intensity of ground vibration in an earthquake. Soil that is thicker, more unconsolidated and water saturated is more prone to ground shaking. A joint study of PHILVOLCS and the United States Geological Survey (USGS) entitled "Estimates of Regional Ground Motion Hazard in the Philippines" showed estimates of PGA (peak ground acceleration) "g" values for rocks, medium soil and soft soil. The calculation of a "g" value was based mainly on historical records of seismic events. For Cebu and Bohol Islands, the g value for rocks is 0.11, medium soil is 0.17 and soft soil is 0.27. These values have a 10% probability of exceedance in 50 years (Figures 25, 26 & 27) The selection of "g" values to be used for engineering design depends on the type of analysis to be performed whether static or dynamic load analyses. The "g" values are considered by Structural Engineers in engineering design to determine potential hazard of an earthquake occurring during the life of a structure.

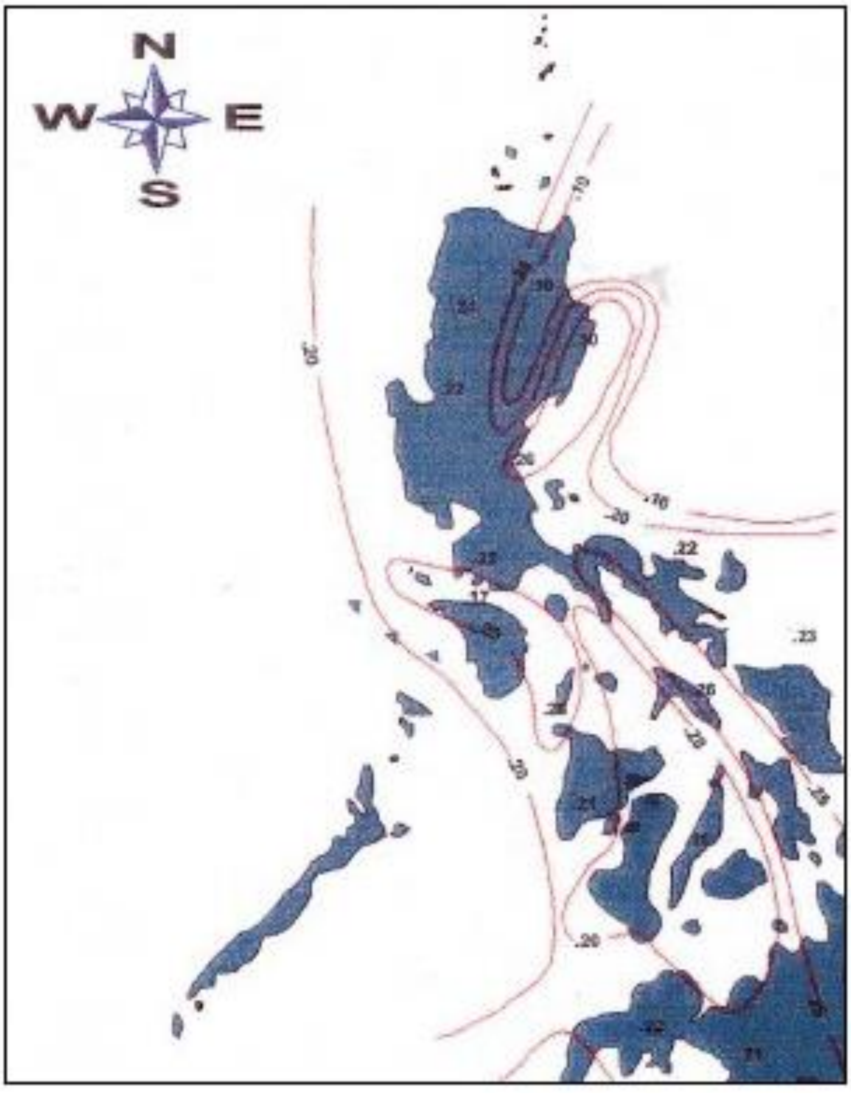


Figure 2-21.g: G-value isoline map of the Philippines for rock

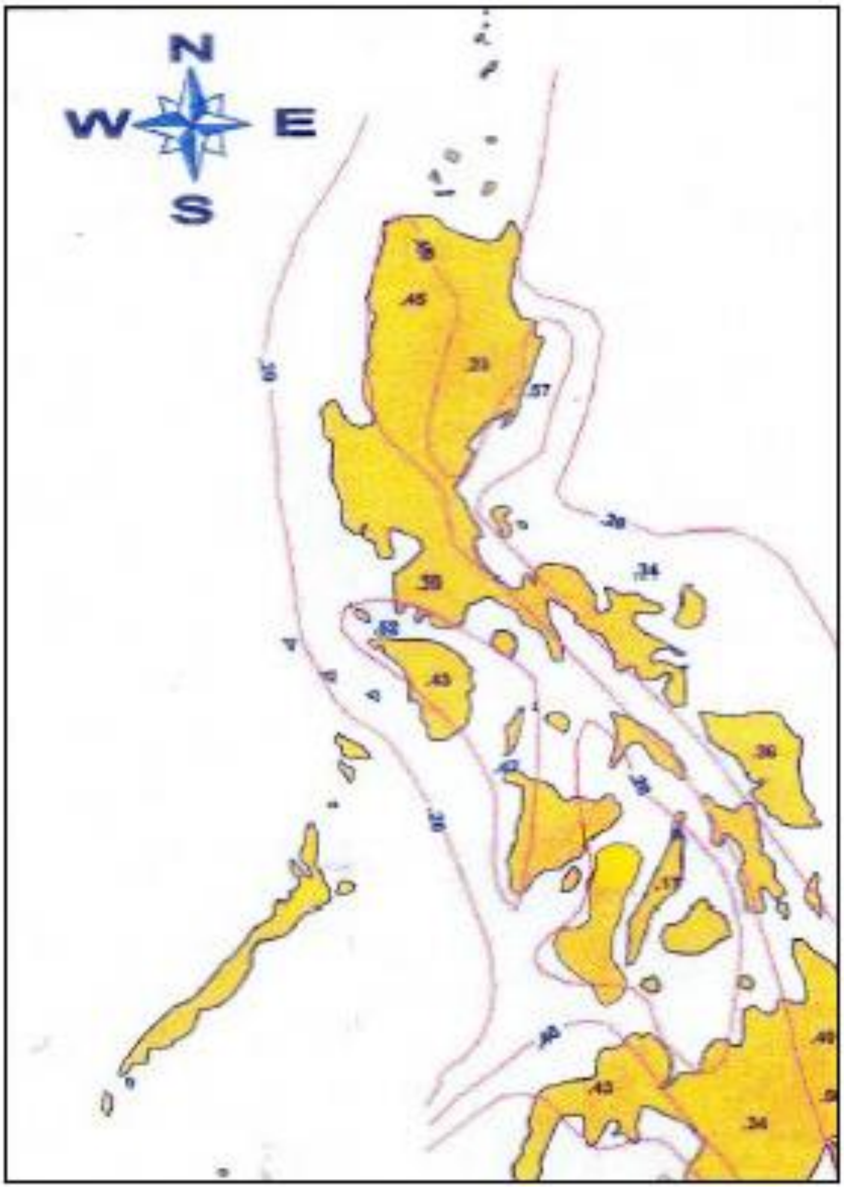


Figure 2-21.i: G-value isoline map of the Philippines for medium soil

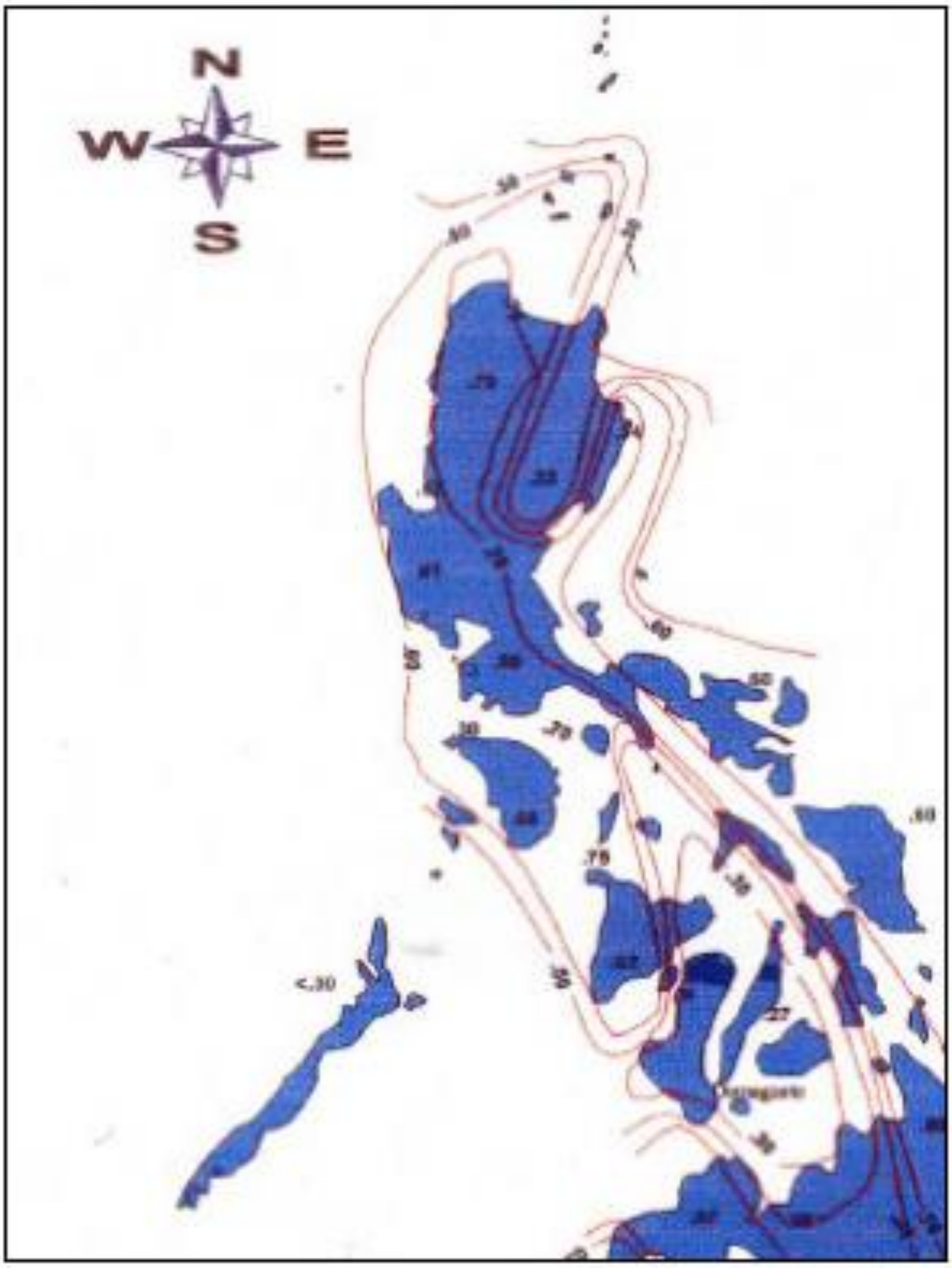


Figure 2-21.j: G-value isoline map of the Philippines for soft soil

Table 2-7: Hazard Identification, Assessment and Mitigation Relevant to Project Activities

Hazard	Assessment	Measures	LGU Contigency Plan
Geologic Hazard			
Seismic Hazard Ground Shaking/Acceleration Ground Rupture Differential Settlement Liquefaction Tsunami Landslide	• The area investigated is prone to ground shaking hazards due to the presence of several earthquake generators in the region. • Reclaimed lands in general, are considered prone to liquefaction. • Safe with regards to ground rupture; may be affected by strong ground shaking; highly susceptible to liquefaction; and prone to tsunami as it is within the tsunami inundation zone. The nearest active fault to the project site is the WVF, which is approximately 9.7 km to the east. • The project site may be affected by strong ground shaking • Buffer zone at least 50m on both sides of a fault trace or from the edge of deformation zone. This hazard is seemingly absent in the project area. • The proposed reclamation project will undergo backfilling and is considered to be highly susceptible to this hazard • The proposed project being a reclamation area located along the shoreline Barangay Tayud is inherently susceptible to liquefaction.	Engineering Intervention	- Conduct periodic Earthquake Drill - Build Disaster Resilient Structures
Mass Movement Landslide Settlement/Subsidence	• Landslides can be induced by heavy rains, which add weight and lubricate the soils. The project site, which sits on a flat	Engineering Intervention	- Conduct periodic Earthquake Drill

	terrain, is not susceptible to rain-induced landslides		- Build Disaster Resilient Structures
Hydrologic Hazards			
Flooding	• The project area falls within the delineated areas with high susceptibility to flooding. Considering that it is low-lying and has a flat terrain, the project site could experience localized flooding especially if the drainage systems are inadequate.	Engineering Intervention	
Coastal Hazards			
Storm Surges / Seiches / Storm Waves	• The reclaimed land will be in front of the existing coastline and therefore the reclaimed land will form the new sea front. This makes it most vulnerable to storm surge and flooding from the sea. • The proposed reclamation project may potentially shelter the existing coastal areas from direct impact from storm surges (wave impact).	To prevent flooding engineering measures will be implemented in project and the sea front will be designed so little flood risk are present; Preparation of Tsunami Contingency Plan	- Implementation of Greening projects such as planting bamboos and other trees in hilly areas and mangroves coastal areas. - Preemptive evacuation of families living near shorelines. - Identification of houses made of light materials for possible evacuation to safe areas.

2.1.3. Pedology

2.1.3.1. Soil and its Geologic Characteristics

Soil Types

The following are the soil type within Barangay Tayud, Consolacion, Cebu:

- Mandaue series (Mandaue silt loam) can be found along the banks of rivers, which form the prime agricultural lands of the municipality. Soil is suitable to a wide variety of crops, and high yields can be achieved provided that high yielding varieties and the proper kind and amount of fertilizer are used.
- Faraon series are, ordinarily, not suited for cultivation because of the steepness of the land. The increasing need for agricultural land causes a situation in which

farming is done on hillsides. The study team gives importance on the Faraon clay steep phase because of its erodibility; this type of clay can be found in Barangays Garing, Pulog and Danlag. During the 2021 environmental impact assessment for this project, the researcher identified that soil found in Barangay Tayud is belongs to Faraon Clay soil type.

- The area with the Lugo clay (Lugo series) is severely eroded. Practically the whole area is denuded of forest trees with poor vegetative cover. Some parts are covered with cogon grass. These can be abandoned farms where soils are so badly eroded that no substantial crops can be grown anymore.

- The Baguio siltloam is in a better physical condition as compared to the Faraon and Lugo series, it being a lighter soil. Steepness in areas where it is found still makes it unsuitable for agricultural use. However, there are some areas with more moderate slopes that may be cultivated. Crop returns are usually higher than on the Faraon clay steep phase.

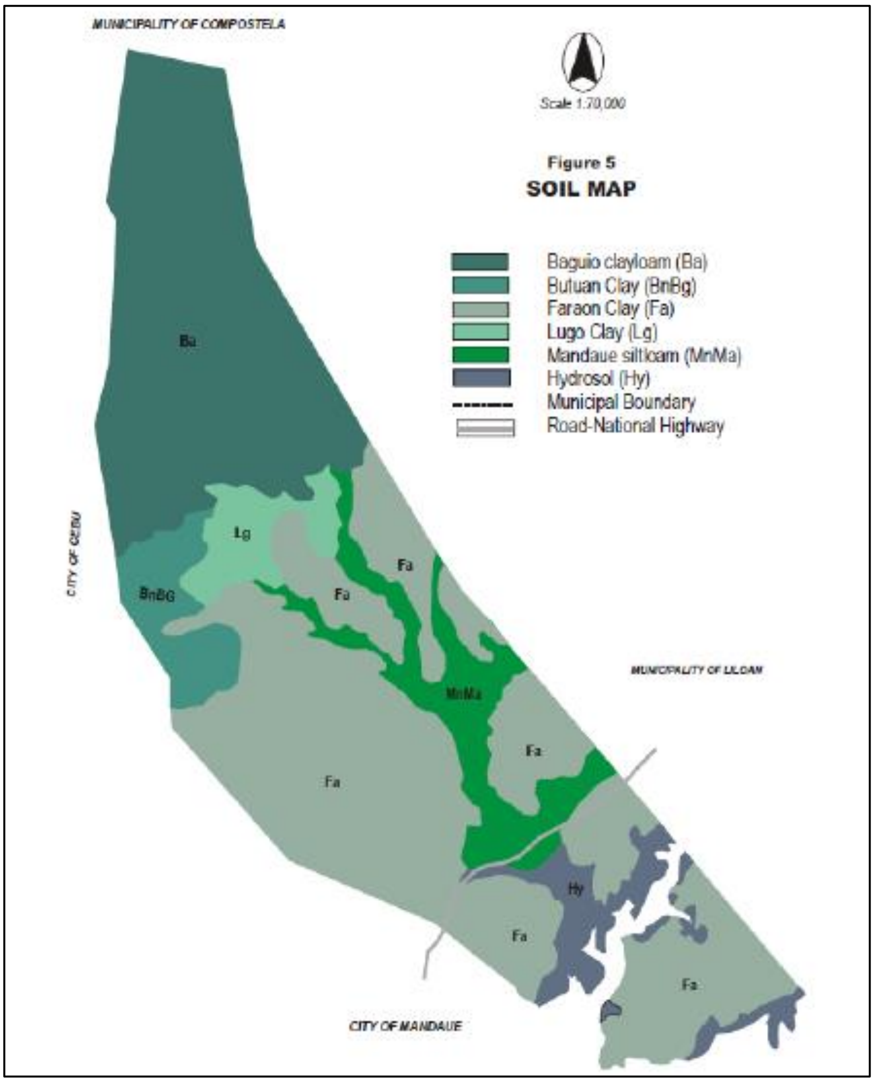


Figure 2-23: Soil Map of Consolacion

One (1) soil type, a rocky phase and Hydrosol a Miscellaneous land type with seven (7) soil mapping units were identified, characterized, and mapped along the proposed access road. The soil type is the Faraon clay which was subdivided into three (3) soil mapping units based on slope range differences. The Faraon rocky phase was also subdivided into three (3) mapping units based on slope range differences. The soil mapping units are:

Table 2-8: Soil Type and Equivalent Slope in Consolacion

Soil Type	Slope
Faraon Clay	
Faraon Clay	0-3%
Faraon Clay	0-3%
Faraon Clay	0-3%
Faraon Rocky Phase	
Faraon Rocky Pase	3-8%
Faraon Rocky Pase	3-8%
Faraon Rocky Pase	3-8%
Hydrosol with Mangrove	

Table 2-9: Soil Observation Location, Coordinates and Site Description

Soil Observation No.	Location	Coordinates	Site Description
1	East Binabag, Bgy. Tayud, Consolacion, Cebu	10° 21'56.06''N - 123°59'13.44''E	3-8% slope; shrub vegetation
2	Sitio Look, Fairview, Bgy. Tayud, Consolacion, Cebu	10°21'46.51''N - 123°59'27.73''E	0-3% slope; grassland vegetation
4	Mangrove area, Sitio Look, Bgy.Tayud	10°21'26.9''N - 123°59'38.89''E	Mangrove vegetation
CB 1	Fairview, Sitio Look, Tayud	10°21'44.66''N - 123°59'29.08''E	The site is composed of bare limestone rock/rocky surface on the escarpment
CB 2	East Binabag, Bgy. Tayud, Consolacion, Cebu	10° 21'56.78''N - 123°59'13.21''E	The site is an open land that dominated by grasses and sedges.

Table 2-10: Description of Seabed Sampling Stations

Station Name	Location	Coordinates	Depth (m) MLLW	Sample Description
BNO-01	West Point Cansaga Bay, 200m away from the Butuanon River Mouth	$10^0$20.367' N $123^0$58.736' E	1.1	Soft Mud Mixed With Oil
BNO-02	South East End Point of Cansaga Bay, 100m away from the Channel	$10^0$20.223' N $123^0$58.816' E	5.1	Soft Mud Mixed With Sand
BNO-03	North West End Point of Cansaga Bay, 200m away from	$10^0$20.800' N $123^0$58.680' E	0.5	Thick Mud

	the Shipyard located in the shoreline			
BNO-04	Entry Point of Cansaga Bay, 1km away from Colorado Shipyard and PKS Shipping Co.	10^{0}20.644’ N 123^{0}59.167’ E	4.5	Soft Mud
BNO-05	South East End Point of Cansaga Bay, near Phoenix Petroleum Jetty, 700m away	10^{0}20.731’ N 123^{0}59.439’ E	7.4	Soft Mud

Figure 2-24: Dried Samples of Collected Soil in the Seabed

2.1.3.2. Change in Soil Quality

The change of the existing soil quality of the project site will only occur when there will be leakage or spillage of oil or other fuel products into the soil. Since the project is located in Coastal Area, the only occurrence where the adjacent inland soils will be affected if there will be massive siltation and oil leakage from the heavy equipment used during project implementation.

The contamination with oil in the soil can have a profound effect on inland soils or seabed. It can even affect the survival and reproduction of earthworms. The oil pollution might affect soil physical properties. Pore spaces might be clogged, which could reduce soil aeration and water infiltration and increase bulk density, subsequently affecting plant growth. Oils that are denser than water might reduce and restrict soil permeability. Oil spillage does not only cause inland contamination but as well might affect the seabed or corals adjacent to the project area.

To avoid siltation or leakage or accidental spillage of oil, project operation must be handled with extra caution. The manpower that will be hired should be well trained on the operation as well as well knowledgeable in emergency contingency measures. The equipment and storage tanks of fuel should be in high standards. During project implementation, the applied area will be contained with silt curtain and spill booms.

The following should also be installed in case of oil spillage to avoid land contamination:

1. Land booms that look like large sausages. They are made from oil absorbent material causing them to act as a barrier. This prevents oil from leaving an area surrounded by land booms.

2. Oil absorbent pads will absorb a large quantity of oil. They are effective where there is a pool of oil, which needs to be soaked up. Once the pads are saturated, they can be collected in sealed plastic bags for disposal.

3. Floor-sweep absorbents look like sawdust or powder. It contains microbes, which are dormant until they come into contact with hydrocarbons. These microbes consume the oil, cleaning the soil of all evidence of the hydrocarbon spill. If the spill has seeped into the soil, it may be necessary to dig up the top layer and aerate the soil. Microbes function best when damp, so spraying the area with water also aids the clean-up operation.

2.1.4. Terrestrial biology

In general, the areas affected are mostly open space already or used to be shipyards/shipbuilding area with few scrublands, dominated by grass and other shrubs, with fewer large trees present.

2.2. THE WATER

2.2.1. Hydrology / Hydrogeology

The watershed of Guinsaga River and Butuanon River provides direct sediment supply to Cansaga Bay. The catchment area of Guinsaga River is measured at 26.9 sq. km with maximum creek length of 8.7 km. The catchment area of Butuanon River is measured at 50.8 sq. km with maximum creek length of 20.1 km. Illegal occupation of river zones are common within river channels. The construction of fill structures within the bay and river zones compromise the natural drainage of rivers. This increases the likelihood of inundation within coastal and floodplain areas during events of heavy rains and storm surges (JICA 2015).

Sediment sources are siliciclastic sediments coming from the erosion of the upstream areas and alluvium deposits along the coast. Other sources of sediment in the area come from longshore transport along the coast. This is enhanced by the construction of man-made structures in the coastline that trap sediments carried by the longshore currents that run along Cebu. Urban development, which includes on-land construction and coastal reclamation, requires quarrying activity to take place. Millions of cubic meters of quarried landfill are often necessary. In Cebu, coastal reclamation is coupled with quarrying activity upland. As such, reclamation not only changes the coastline, but also increases erosion and sedimentation coming from the upland areas.

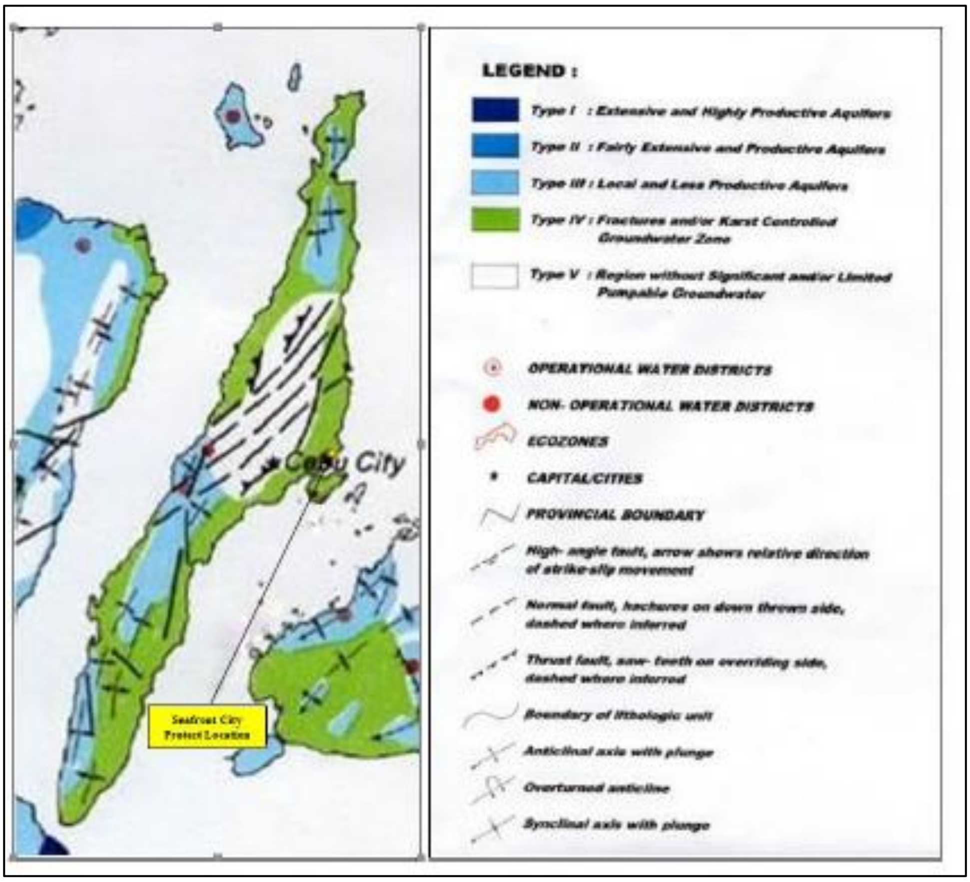


Figure 2-25.a: Regional Hydro-geologic Map

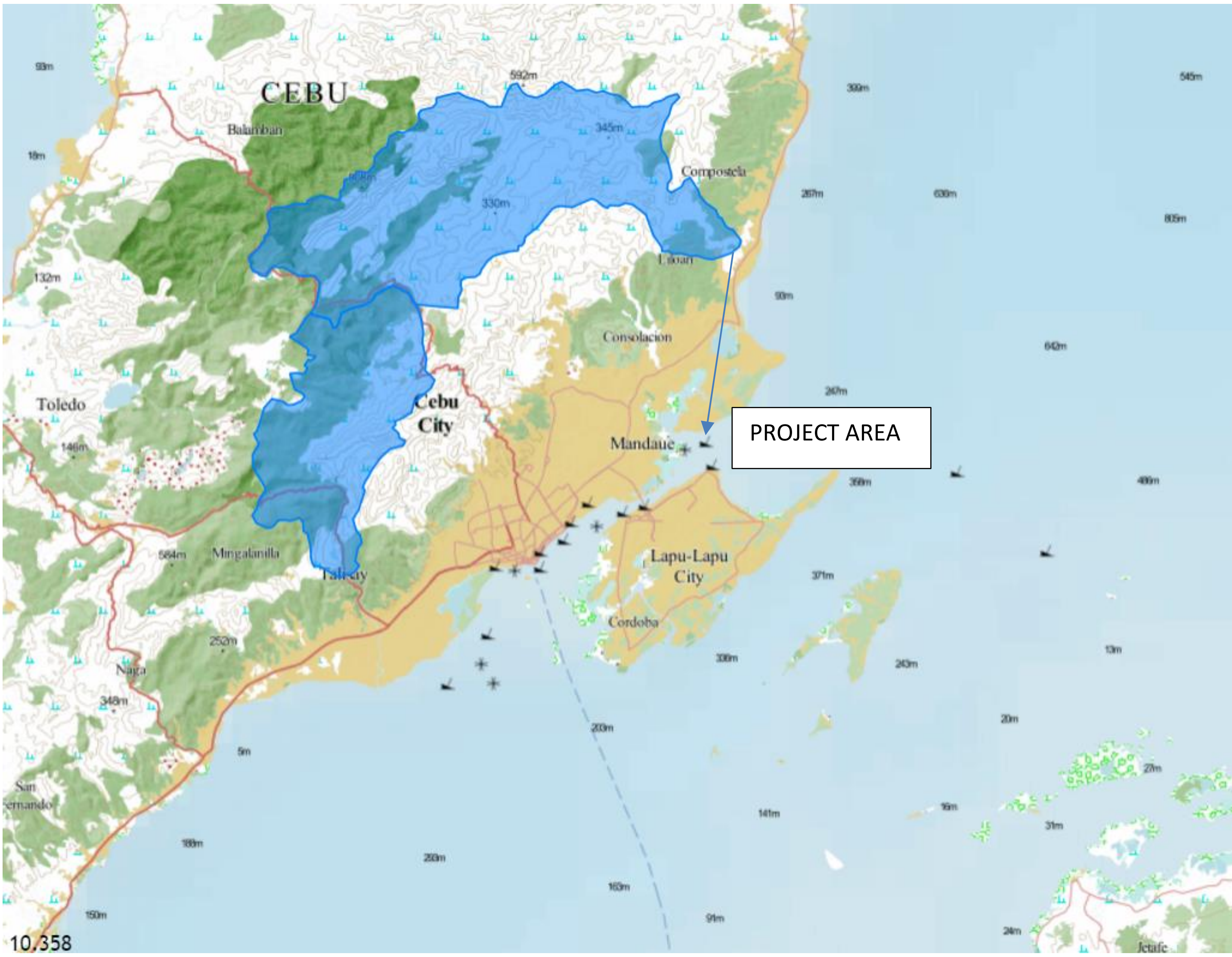


Figure 2-26.b: Map Showing Nearest Watershed (geoportal.gov.ph)

The above figure shows that the nearest watershed is located in the Municipality of Liloan, Cebu which has approximately more or less 10 kilometers away from the project site. Two (2) rivers also were identified as rivers flowing to the coastal water near the project site, the Cansaga River flowing from Consolacion area and Butuanon River flowing from Mandaue City.

Figure 2-27.c: Map Showing Cansaga River and Butuanon River

2.2.1.1. Change in Drainage Morphology

The absence of a drainage and sewerage system in Consolacion is a major factor in flooding incidents, as with urban development, illegal occupation of the river zones, waste disposal into the rivers during heavy rains and floods.

From the calculations of water balance of coastal groundwater resources in Consolacion, the potential groundwater from average recharge in the Carcar Limestone and alluvial deposits is about 26,000 m^3/d which is a significant data to determine the possible streamflow measurement of Cansaga River going to Cansaga Bay.

The potential surface water resources component in Consolacion is estimated from the drainage area of Cansaga River upstream of Carcar Limestone formation and the excess rainfall that generates into runoff. The topographic boundary of of Cansaga River is about 54.9 km^2. Deducting the areas of Carcar Limestone and alluvial deposits, the upstream drainage area is about 18.1 km^2. The estimated excess rainfall is about 0.2, which gives the average surface water potential of 3.62 million m^3/y or about 10,000 m^3/d which has an existing stream flow measurement from upstream of Cansaga River to downstream of Cansaga Bay of 0.3 feet per seconds.

In addition, part of Cansaga drainage area, the drainage of San Vicente Liloan towards Pitogo in Consolacion is about 10.4 km^2. With excess rainfall of 0.2, the potential surface resources in Pitogo is about 2,080,000 m^3/y or about 5,800 m^3/d. From above, the estimated total water resources potential of Consolacion of about 15,300,000 m^3/y or (26,000 + 10,000 + 5,800) or about 42,000 m^3/d. The potential surface water in the coastal alluvial deposits is mostly likely dependent of reservoir site at the wetland in Cansaga Bay, which could pose challenge in avoidance of human wastewater and seawater mixing with freshwater.

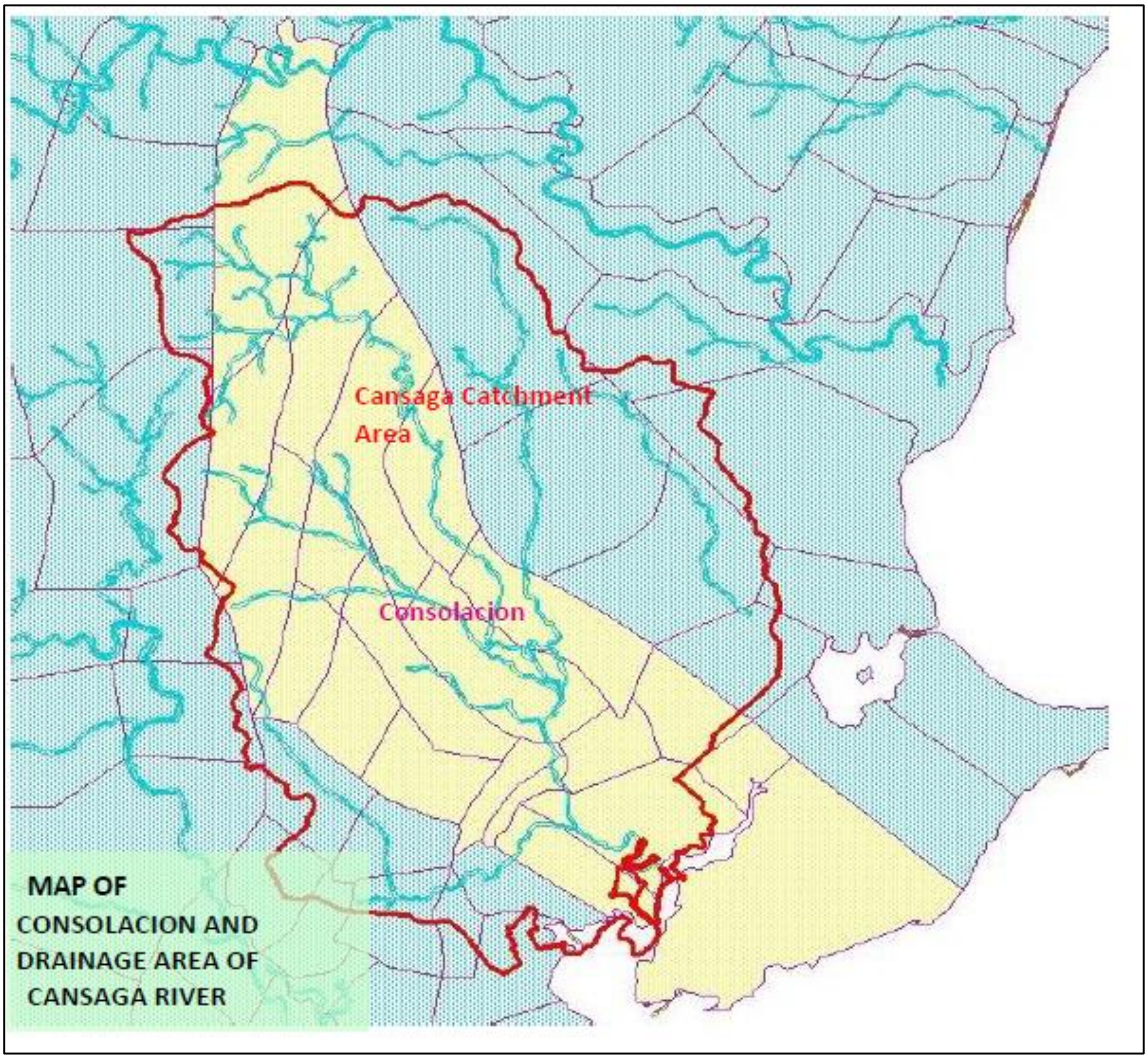


Figure 2-29.a: Drainage Area of Cansaga River

<u>Drainage System</u>

The drainage area indicates the area where rainfall would form into runoff on surfaces and flows towards natural channels leading to Cansaga River. Historically, Cansaga River meandered near Poblacion before 1990 but was rerouted into a straight channel near SM Consolacion towards Cansaga wetland.

The drainage system of the applied project shall cover the entire project area to control flood with 20 return years and the rainwater discharge volume is estimated by Rational Equation. A separate sewage removal system is used considering prevention of water pollution in public water area, maintenance of drainage faculties, treatment efficiencies of wastewater treatment, prevention of water pollution in discharge water area, etc. For drain system, gravity flow type is suggested, and the drainage facilities favorable to differential settlement considering ground condition are planned to be installed.

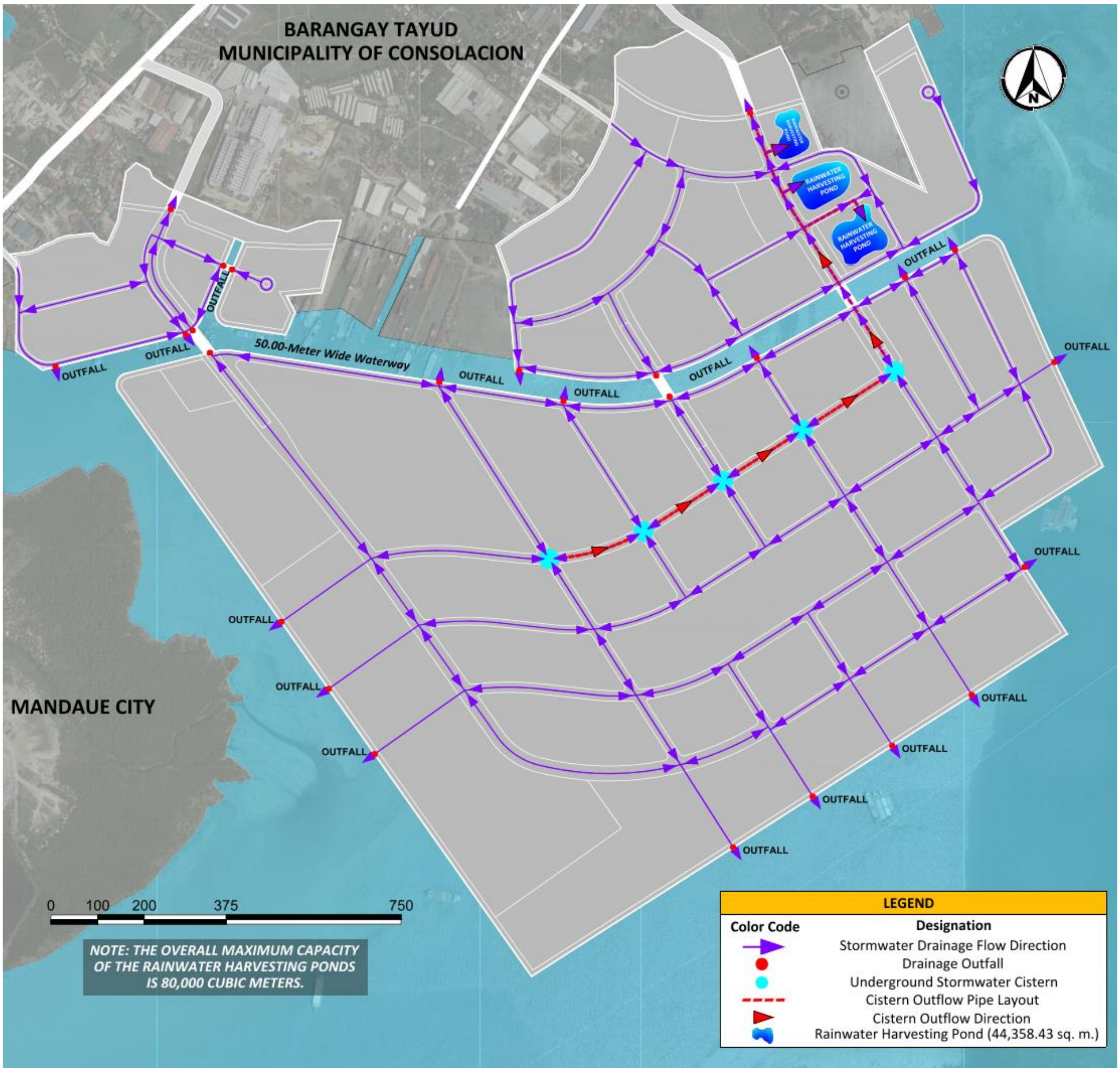


Figure 2-30.d: Drainage Lay-out Plan for Stormwater

Change in Stream Water Depth, Lake Water Depth / Stream Water Pollution

The land area to be created through reclamation is approximately 235.8 hectares and is located in the coastal area. Being the direct downfall area of the mouth of Cansaga River where rainwater will flow to the sea, there will be no change in water depth unless during the times of high tide.

Since the project area is located near the mouth of Cansaga River, all possible water pollution flowed downstream might affect the coastal water quality of the project area. Water pollution point sources from the upstream may come from the residential houses, backyard piggeries, fishpond fertilizer residues, and from restaurants/commercial establishments that directly discharged their wastewaters and solid wastes in the river.

<u>Water Flow/Sediment Transport</u>

The water flow, also called water discharge, is the single most important element of sediment transport. This to determine whether the 2 rivers that is flowing towards Cansaga Bay and Mactan Channel (both near the project site) can affect the project area. The flow of water will be the significant factor for picking up, moving and depositing sediment in a waterway. Without flow, sediment might remain suspended or settle out – and will not flow toward downstream area. Flow will initiate the transport of sediment usually by gravity. There are two basic ways to calculate flow. Water discharge can be simplified as area (a cross-section of the waterway) multiplied by velocity, or as a volume of water moved over time:

Flow (ft3/s) =Area (ft2) * Velocity (ft/s)
OR Flow (ft3/s) =Volume (ft3)/ Time (s)

The complexity of sediment transport rates is due to a large number of factors (e.g. bed geometry, particle size, shape and concentration), as well as multiple forces acting upon the sediment (e.g. relative inertia, turbulent eddies, velocity fluctuations in speed and direction). The sediment transport rate in particular is difficult to measure, as any measurement method will disturb the flow and thus alter the reading. Most flow rate and sediment transport rate equations attempt to simplify the scenario by ignoring the effects of channel width, shape and curvature of a channel, sediment cohesion and non-uniform flows (*Fondriest Environmental, Inc. "Sediment Transport and Deposition." Fundamentals of Environmental Measurements*).

Below is the computation for the sediment flow:

qs = f (τ, h, D, ρp, ρf, μ, g)
qs = sediment transport rate per unit width
τ = shear stress
h = depth
D = particle diameter
ρp = particle density
ρf = fluid density
μ = water viscosity
g = gravitational constant

As per onsite streamflow measuring for Cansaga River and Butuanon using float method to determine their respective velocities. Cansaga River has 0.3 ft/s while Butuanon River has 0.2 ft/s considering that Butuanon River is the most heavily silted of the 2 rivers that might obstruct the velocity flow of the river as well as Cansaga River is much narrower than Butuanon River.

Suspended sediment are any particles found in the water column, whether the water is flowing or not. The suspended load, on the other hand, is the amount of sediment carried downstream within the water column by the water flow. Suspended loads require moving water, as the water flow creates small upward currents (turbulence) that keep the particles above the bed. The size of the particles that can be carried as suspended load is dependent on the flow rate. Larger particles are more likely to fall through the upward currents to the bottom, unless the flow rate increases, increasing the turbulence at the streambed. In addition, suspended sediment will not necessarily remain suspended if the flow rate slows (*Fondriest Environmental, Inc. "Sediment Transport and Deposition." Fundamentals of Environmental Measurements*).

The higher the velocity or water flow of the river, the higher rate of sediments flow toward downstream also. The average particle sizes of the sediments are 0.00195 mm in diameter. Due to the existing profile of the Cansaga River and Butuanon River where the rivers both traversed residential houses (mostly informal settlers), the solid wastes thrown in the rivers became silts that obstruct the water flow. There are even portion of the rivers where it became stagnant to being heavily silted with solid wastes.

Butuanon River Lower Downstream (BLD)

Butuanon River Middle Downstream (BMD)

Butuanon River Upper Downstream (BUD)

Figure 2-31.b: Butuanon River Pictures

Cansaga River Lower Downstream (CLD)

Cansaga River Middle Downstream (CMD)

Cansaga River Lower Downstream (CLD)

Figure 2-32.c: Butuanon River Pictures

Streamwater Pollution

Several contributary factors were determined as source of pollution of Cansaga River and Butuanon River. Pollution from the upstream areas of these rivers might come from backyard piggeries and run-off water from agricultural farms. However, from the middle downstream to lower downstream areas, most of the riverbank areas are adjacent to residential houses or commercial establishments in which most of the domestic wastewater flow directly to Cansaga River and Butuanon River without any treatment. The direct disposal of solidwastes to the river is also another major factor of streamwater pollution.

The Butuanon River is one of the rivers with DENR Water Quality Monitoring Station. Shown in the latest sampling result conducted by EMB Region 7 the ambient water quality of Butuanon River showing most of the parameters taken were aboved the DENR water quality standards especially the fecal coliforms (complete report attached in the Annex).

Table 2-11: Physical and Chemical Analysis of Butuanon River

Parameters	Method	Date Analyzed	Station No.											
			1	2	3a	3	4	5	6	7	8	9	10	11
pH	[1]*4500-H^+ B*	4/25/2022	7.36	7.73	7.84	7.93	*	7.93	8.04	7.81	8.04	8.00	8.21	8.24
Temperature, °C	[1]*2550 B*	4/25/2022	29.42	29.07	28.28	28.78	*	29.38	29.51	29.57	29.59	30.15	29.29	29.69
Dissolved Oxygen, mg/L	[1]*4500-O C*	4/25/2022	0	0	2.30	2.59	*	2.71	8.01	7.34	7.94	8.19	8.57	8.68
BOD (5day), mg/L	[1]*5210 B*	4/27-5/2/2022	86	38	8	10	*	21	23	18	4	4	14	2
TSS, mg/L	[1]*2540 D*	4/26,27/2022	44	22	15	46	*	373	14	12	12	24	10	3
Chlorides, mg/L	[1]*4500-Cl^- B*	4/28/2022	278	81	50	41	*	36	30	34	19	19	16	27
Phosphates as PO_4^{3-}—P (Total, Reactive), mg/L	[1]*4500-P D*	4/27/2022	0.184	0.211	0.165	0.105	*	0.117	0.085	0.102	0.041	0.035	0.068	<0.018
Nitrates as NO_3^-N, mg/	[1]*4500-NO_3 D*	4/27/2022	0.03	0.02	0.28	0.56	*	0.80	1.08	0.89	0.51	0.46	0.29	0.29
Color, TCU	[1]*2120 B*	4/25/2022	50	15	10	10	*	10	10	10	10	10	10	10

Reference: [1]*American Public Health Association, American Water Works Association, & Water Environment Federation. (2017). Standard Methods for the Examination of Water and Wastewater. 23rd edition. American Public Health Association.*

Table 2-12: Bacteriological Analysis of Butuanon River

Parameters	Method	Date Analyzed	Station No.											
			1	2	3a	3	4	5	6	7	8	9	10	11
Fecal Coliforms, MPN/100 ml	[1]*9221 B-E*	4/25-28/2022	$13x10^6$	$13x10^6$	$94x10^4$	$13x10^5$	*	$24x10^5$	$49x10^4$	$33x10^4$	$49x10^3$	$79x10^3$	$7x10^4$	$24x10^3$

Reference: [1]*American Public Health Association, American Water Works Association, & Water Environment Federation. (2017). Standard Methods for the Examination of Water and Wastewater. 23rd edition. American Public Health Association.*

2.2.1.2. Inducement of Flooding

Flooding results from different causes namely: prolonged periods of precipitation, human actions and other artificial causes such as loss of vegetation and constrictions of streams. Flood prone areas identified in the project area are the low-lying areas near the coastline. Natural drainage in these low-lying areas is poor. Water is usually retained for a period of time and eventually seeps to the underlying porous alluvium. Based from the Mines and Geosciences Bureau (MGB) Landslide and Flood Susceptibility Map of Liloan Quadrangle at scale 1:50,000 and where the proposed reclamation at Barangay Tayud, Consolacion is located, the coastal areas of the project area are classified as low to moderate susceptibility to flooding (cream color). However, coastal areas in the inner sections of Cansaga Bay and also areas near mouth of Butuanon River in Barangay Paknaan, Mandaue City are classified as high susceptibility to flooding (violet color). The said geohazard map also indicate that the flat and low-lying onshore areas of the proposed project has no susceptibility to landslide (MGB, 2009).

The lack of drainage and sewage systems for Barangay Tayud, Consolacion is possibly another factor, which resulted to possible flooding in some low areas to the north of project area during period of heavy rains. Absence of drainage outlet results into perennial flooding in some areas.

The drainage plan of the proposed reclamation project is designed in such a way that all storm waters will flow directly and drains towards the mouth of Cansaga Bay and into the Mactan Channel. The storm water including the waste water of the project will pass by the proposed waste water treatment facility prior to discharge from the reclaimed area to the sea, however, as much as possible, the proponent will implement a zero-discharge scheme wherein the treated water will be recycled for greeneries or will be recycled back through dual piping system to be used for flushing the toilets. During development phase, there is possibility that the project may contribute or cause flooding to the nearby low-lying residential areas. To prevent stormwater discharges, the project will have an adequate rainwater harvesting ponds, designed to contained large volume of rainwater in case of heavy rains. Several wave deflectors will also be installed to the areas facing the coastal water as mitigating measures against storm surge or tsunamis. The reclamation elevation was also designed to have a 4-meter freeboard above the mean low low water level.

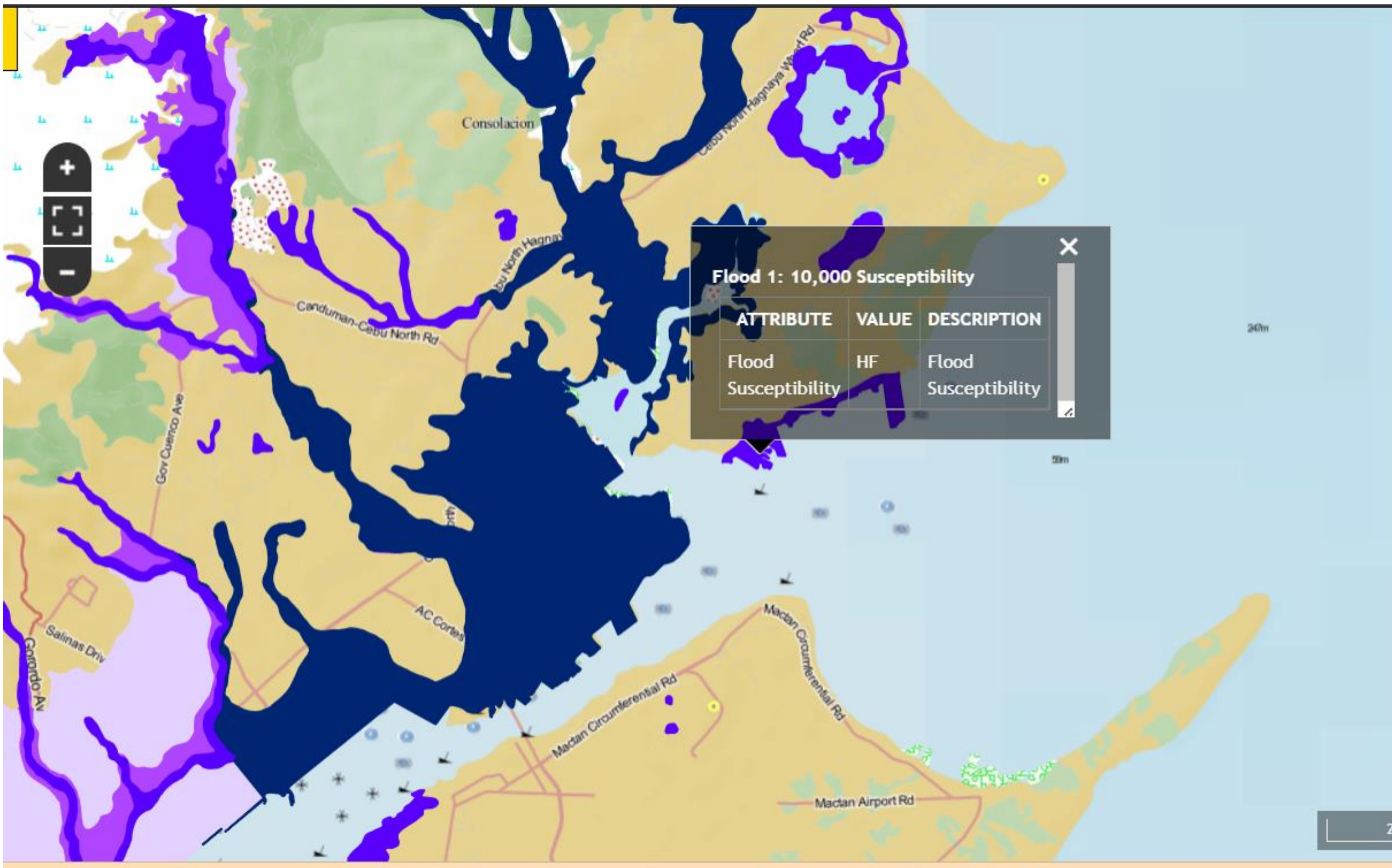


Figure 2-33.d: Map showing High Flooding Susceptibility of the Project Area

2.2.1.3. Water Resource Competition

The main objective of the water supply project is to develop the identified off-site areas in Consolacion and Liloan areas for the reclamation project in Tayud and in Northern Mactan Reclamation Project across the Mactan Channel.

Several potential areas for groundwater and surface water sources have been identified in Consolacion and Liloan that could be developed to achieve the main objective. These sources are cheaper to develop than seawater desalination, which could be the more futuristic source of water supply if cheaper energy than today's technology would be available.

Sources of water supply in Metro Cebu are now available mostly from facilities of water district and individually developed groundwater sources. The coastal aquifers in Cebu City and Mandaue City are now being over pumped so that seawater intrusion created more brackish water than decades ago. Reliance of water resources outside the brackish zone is now the reality. Consolacion and Liloan have the identified potential water sources that could be developed in the near future with the expansion of their economy.

As to water facility, the Barangay Tayud is served by the Consolacion Water System Inc. (CWSI) and Metropolitan Cebu Water District (MCWD). Although there are still a working deep wells, most of the residents get their water supply from the CWSI and MCWD.

The water for the Seafront City Project will be supplied by the MCWD. The tapping point of fresh water will be in the junction of Consolacion-Tayuid-Liloan Road.

2.2.1.4. Groundwater Hydraulics/Reduction/Depletion of Groundwater Flow/Groundwater Pollution

There will be no depletion of groundwater since the source of water for the project will be supplied by 3rd party water concessionaire. Hence, nearby deep wells or groundwater source will not be affected nor depleted as well as be polluted since project is within offshore coastal area.

2.2.2. Oceanography

2.2.2.1. Marine Hydrodynamics

Four different hydrodynamic modelling (physical oceanography simulations) were conducted in order to predict the impact of the proposed reclamation project. For the modelling, three months were used to represent three different seasons (J) January for the "Amihan" monsoon with predominant northeast wind, (M) May for the dry summer season without monsoon winds, and (A) August for the "Habagat" monsoon with predominantly south west winds. Listed below are the 4 physical oceanographic simulations / hydrodynamic modelling conducted:

- Surface Tidal Currents
- Circular Patterns
- Predicted Tidal Full Cycle
- Sediment Particle Transport Modelling

Surface Tidal Current

The water circulation before the Project development is flowing all around the project area arriving to the river estuary, while after the development the water circulation flows directly to the estuary which compensates the decreasing of the water circulation.

Figure 2-34: Surface Tidal Currents Modelling After the Project Development

Before and after Project development, the difference of circular patterns is minor, the water exchange in Cansaga Bay is weakly affected, the remaining channel is wide enough to maintain a connection to the ocean. Moderate increases in flow speed are expected. A narrowing of the Mactan Strait at its northernmost end will lead to an increase in current velocities. These are however moderate and local. The changes do not propagate to the narrowest parts of the Strait, to the south-west of the project area, where current reach a local maximum before and after the planned land reclamation.

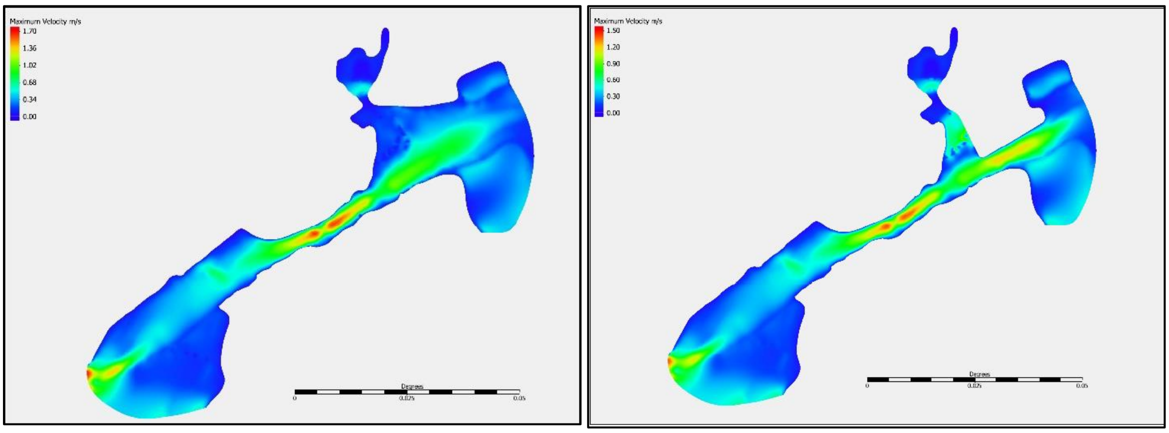


Figure 2-35: Maximum Surface Tidal Currents before (left) and after (right) the project development

The most severe increase in surface current will occur in front to the southeast of the reclamation area. This is an area with a sandy bottom in the center of the northern part of the Mactan Strait devoid of any corals which could potentially be negatively affected by the current velocity increases.

Ocean conditions post-Project implementation will be qualitatively similar to pre-reclamation conditions. This is due to the fact that the prevailing currents are aligned with the Mactan Channel (north-east to south-west), and the reclamation presents a novel barrier only for water movement perpendicular to these currents. The majority of the particles released at the edge of the Project area will be moved along the deepr parts of the Mactan Channel, and not into Consolacion Bay.

There is a slow rise of sea level based from the tide gauge data dating back to 1935. A general rate of 1.3 mm/year increase in sea level in the region is recorded since 1935. However, an increase to 5.9 mm/year from 1990 to Present is recorded. This is much higher than the global mean rate of sea level rise which was recorded at 3.3 mm/year (IPCC 2015). A study by Kulp and Strauss (2019) estimated the vulnerability of communities to sea level rise utilizing Coastal Digital Eleveation Map (CoastalDEM) and Shuttle Radar Topography Mission (SRTM). This dataset can be accessed through climatecentral.org website. By 2050, portions of Cebu City, Consolacion and Mandaue City will be deemed underwater. This also includes the inner regions of Cansaga Bay and the inundation of existing mangrove areas. Former estuarine areas that are now converted to urban areas are susceptible. Vulnerable areas around the bay are portions of barangays Paknaan, Basak, Tugbongan, Nangka, Opao, Guizo, Looc, Pajo, and Centro. Residential areas, commercial areas and industries within the coast have a high exposure for any coastal related hazards.

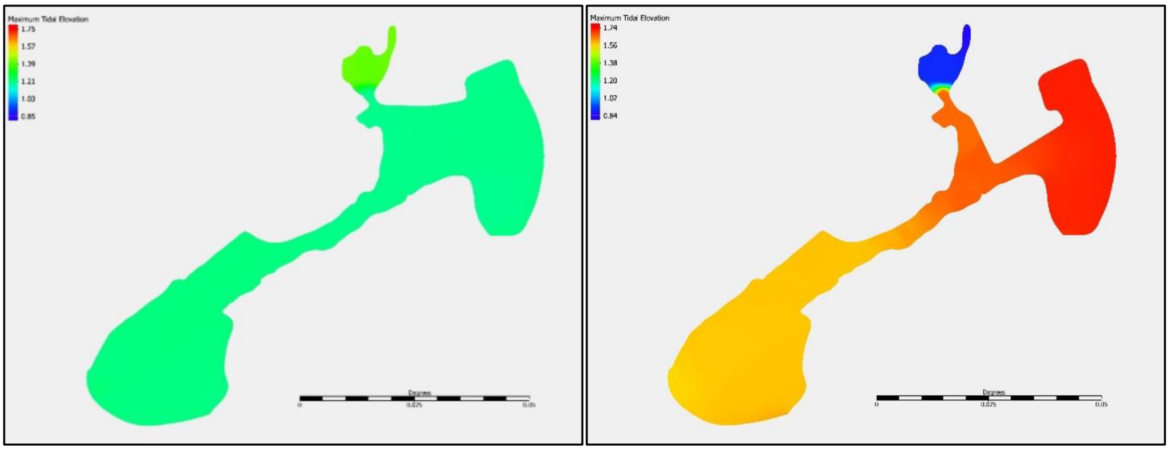


Figure 2-36: Maximum Tidal Water Elevation before (left) and after (right) the project development

Circular Patterns

The simulated Circular Patterns based on the Surface Tidal Currents vector dataset, where the flow directions of the water can be observed during a longer period. These simulations require longer computation time than the scalar or vector datasets; therefore it configured greater time steps currents, 60 minutes or more, to allow creating good constant circular patterns for the whole month. Moreover, the used simpler flow data visualization setup to allow a good interpretation.

Comparing the circular patterns between both scenarios, before and after the project development, the difference is minor, the water exchange in Cansaga Bay is weakly affected, the remaining channel is wide enough to maintain a connection to the ocean. The water circulation before the project development is flowing all around the project area arriving to the river estuary, while after the development the water circulation flows directly to the estuary which compensates the decreasing of the water circulation.

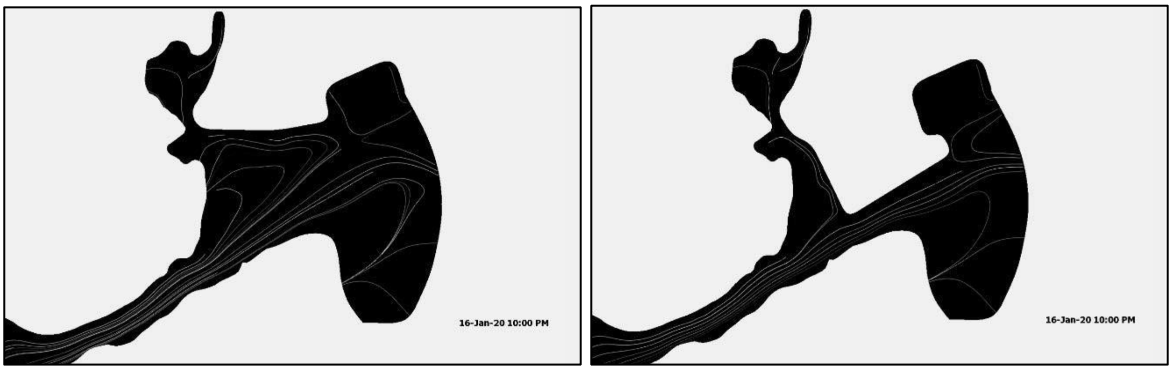


Figure 2-37: Circular Pattern simulated in January before (left) and after (right) after the project development

Tidal Prediction Cycle

The predicted tidal model from Cebu Station was compared with the ADCIRC simulated tidal models. The period and the amplitude of both graphics are very similar, however there is a small deviation produced by swell currents originating from San Bernardino Strait.

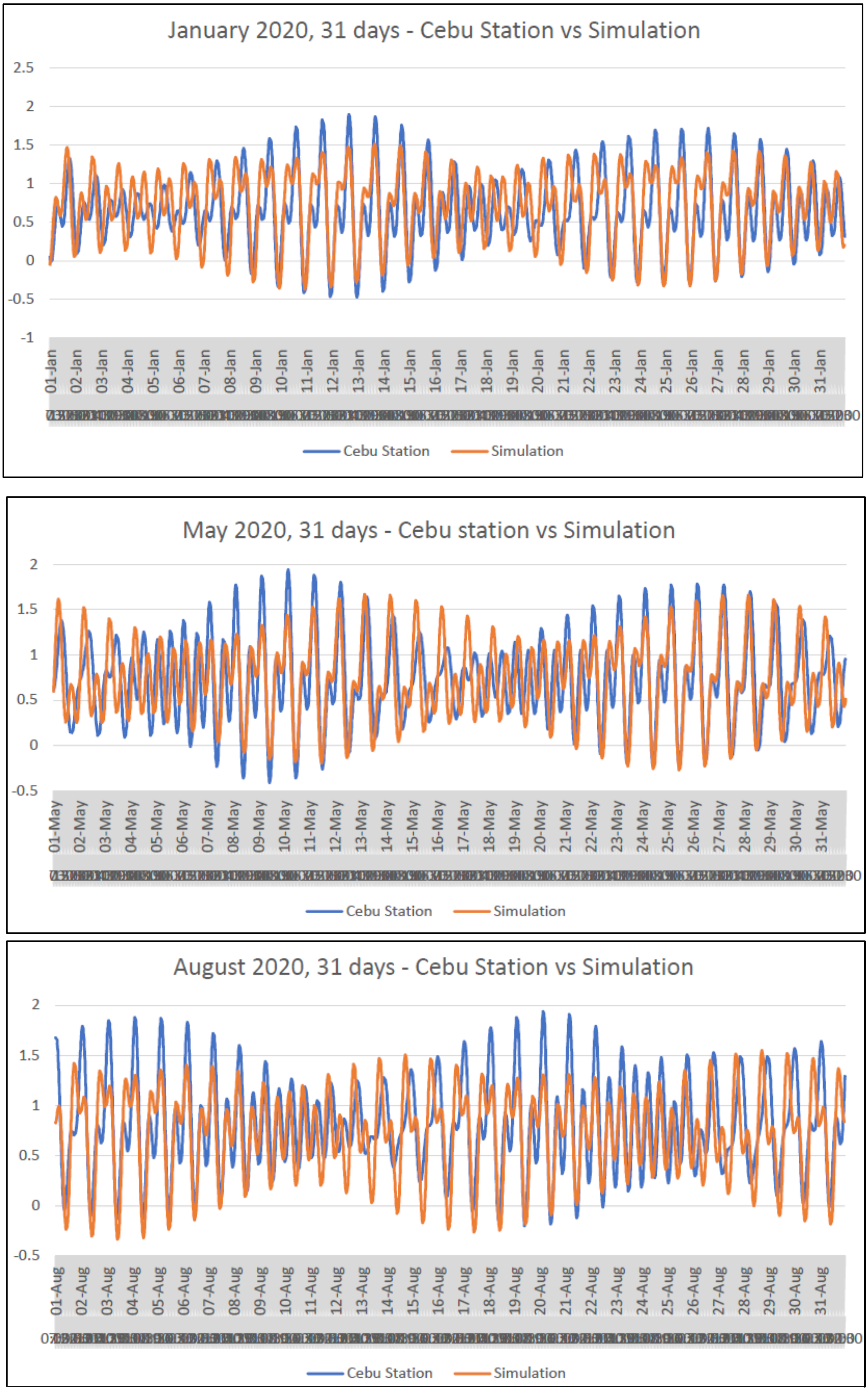


Figure 2-38: Comparison of Tidal Simulations and Cebu Station Data for the 3 Seasons

Sediment Particle Transport Modelling

Before the implementation of the land reclamation, the sediment particles originated at the perimeter of the future reclamation area were deposited to the east of the project area across the strait in Magellan Bay. However during the ongoing land reclamation we suggest frequent inspections of these areas, and a concentration of the dredging work during the incoming tides when southerly currents dominate. The majority of the released particles would be transported along the Mactan channel to the south-west.

A total of 456, 884 sediment particle packages, transported by the tidal currents derived from the ADCIRC simulations were simulated.

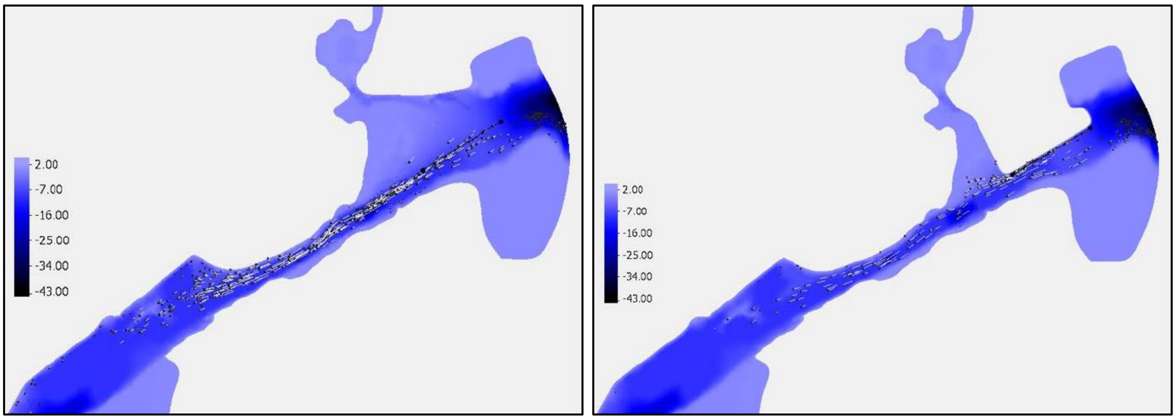


Figure 2-39: Tidal Sediment Transport Simulation before (left) and after (right) the project development

All simulations concluded that after the implementation of the land reclamation, the ocean conditions will still be qualitatively similar to the conditions pre-reclamation. This is due to the fact that the prevailing currents are aligned with the Mactan channel (north-east to south-west), and the reclamation presents a novel barrier only for water movement perpendicular to these currents. The majority of the particles released at the edge of the reclamation area will be moved along the deeper parts of the Mactan channel, and not into Cansaga Bay.

2.2.2.2. Bathymetry

The bathymetry and coastal configuration were analyzed using Navionics™ Electronic Nautical Charts for survey navigation planning with 0.5m contours resolution. The bathymetric contour lines reveal a definite coastal configuration and morphology that may influence coastal oceanography and water circulation.

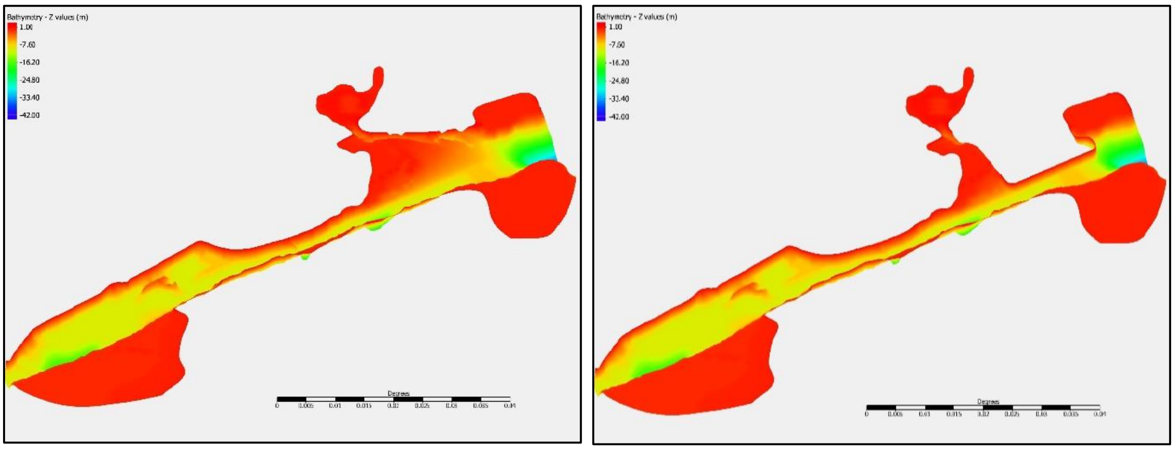


Figure 2-33: Bathymetric Map showing Before and After Project Implementation

The Project area is flood prone due to its relatively flat terrain and low elevation. The volume of run-off water during heavy and continuous downpour including sewerage must be computed properly in order to determine whether or not the proposed drainage system is wide and deep enough to accommodate the total volume of water that the Project site may contribute plus the volume of surface water from the adjoining areas.

Once the project will be implemented, the current bathymetry of the applied project area will relatively change due to the reclamation activities. To prevent affecting the adjacent coastal areas, the entire project perimeter will have silt curtains to not just to avoid siltation but as well to avoid drastic change of the existing bathymetry of Mactan Channel that might affect the water level.

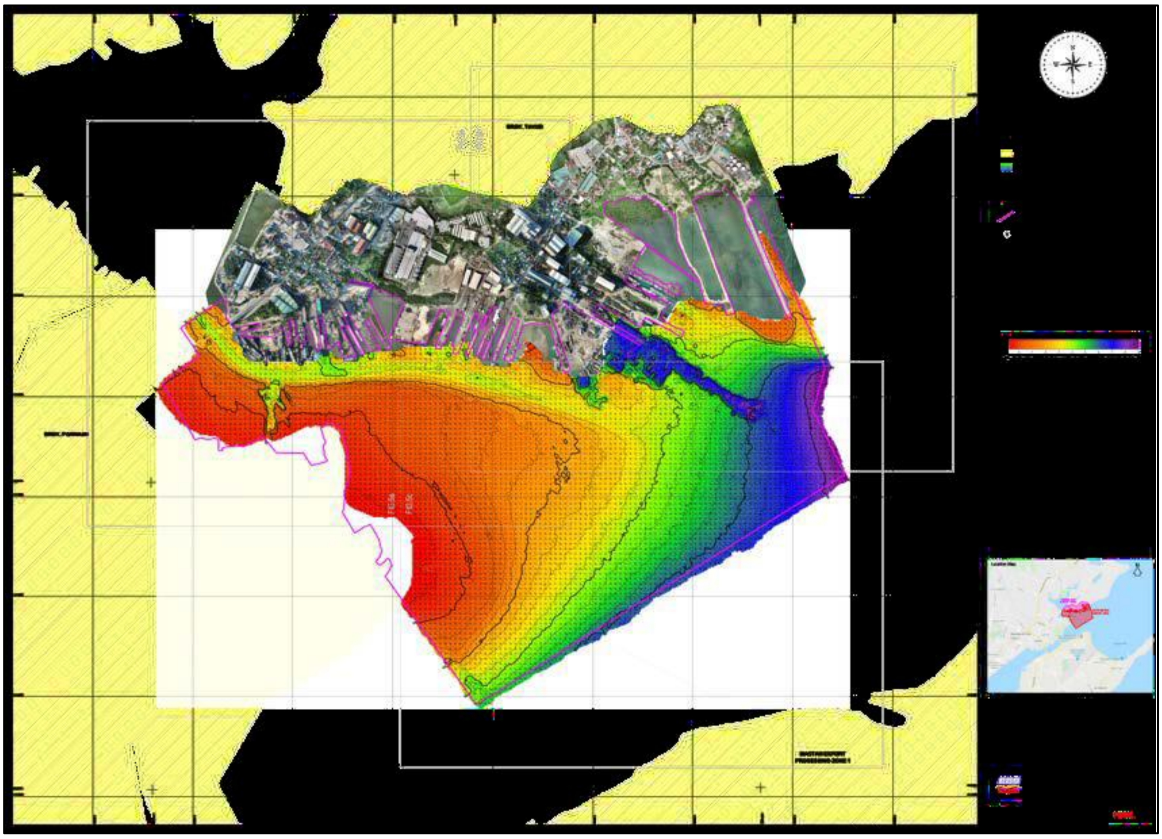


Figure 2-41: Project Area Bathymetry Mapping and UAS Land Imaging ***(Source: EGS Asia Inc.)***

2.2.3. Water Quality

The existing water quality of the coastal areas fronting and in the vicinity of the reclamation areas were described by collecting water samples at three stations at the coastal areas and determining the concentrations of water quality parameters. The sampling procedures and analyses were done according to the DENR AO 34, DOH AO 12, and the American Public Health Association's Standard Methods for the Examination of Water and Wastewater. The water quality at the stations will be determined by comparing with the Water Quality Guidelines and General Effluent Standards of 2016 (DENR Administrative Order 2016-08).

Description of Sampling Sites

A total of 2 sampling stations were established adjacent to the proposed reclamation area as described in Table 2-16 and shown in a map in Figure 2-40.

Table 2-13: Description of the Water Quality Sampling Sites

Station	Sampling Date	Geographical Coordinates
Adjacent 1	January 24, 2022 11:05 AM	N10^0 20' 40", E123^0 58' 43"
Adjacent 2	January 24, 2022 11:05 AM	N10^0 20' 50", E123^0 58' 28"

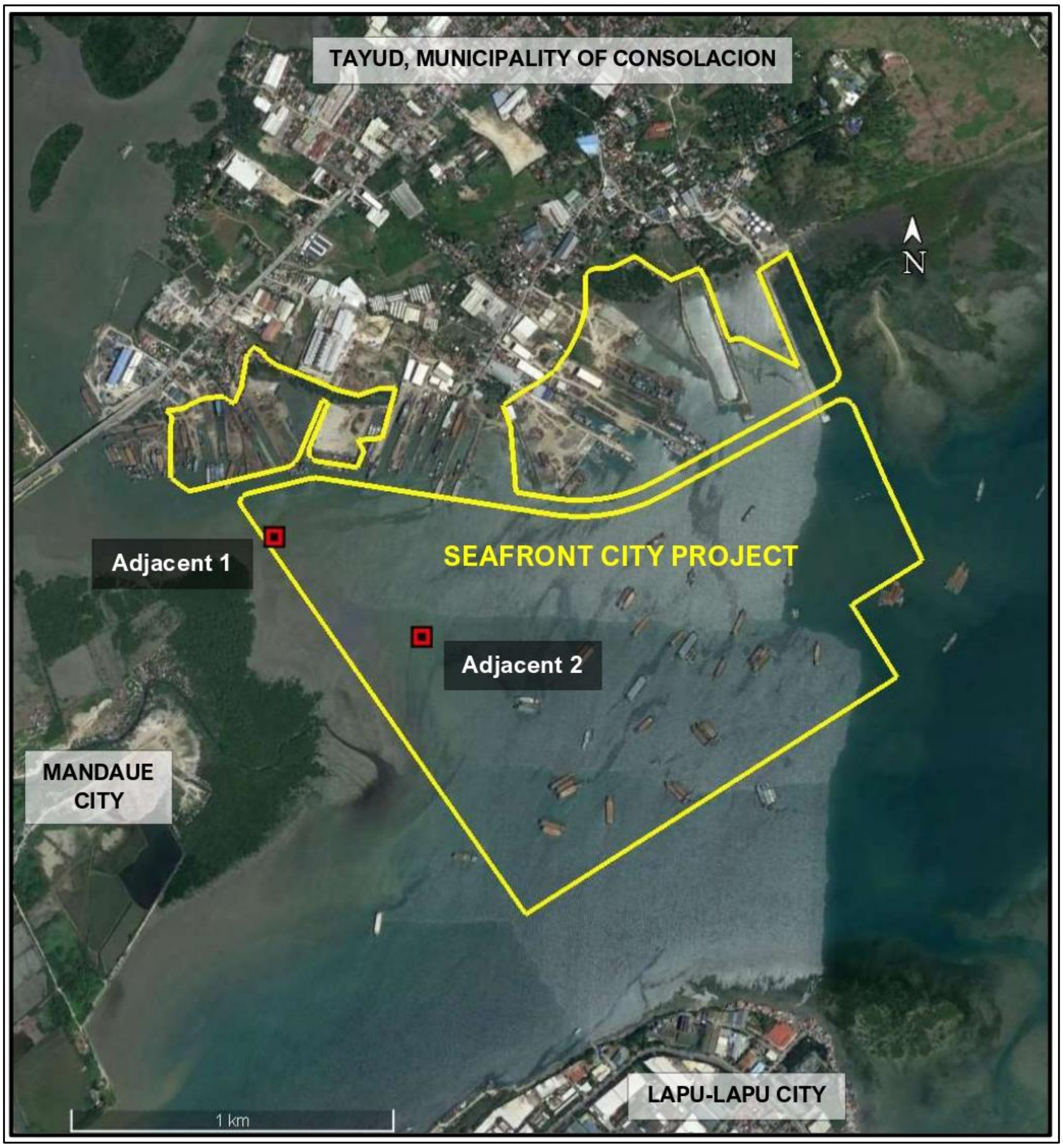


Figure 2-42: Map Showing the location of the Water Quality Sampling Sites

Water quality analytical methods used

Different test methods per water quality parameter are summarized in Table 2-17.

Table 2-14: Summary of Water Quality Methods

Parameter	Test Method
Biochemical Oxygen Demand	5210 B, 5-day BOD Test
Chemical Oxygen Demand	5220 B, Open Reflux

Total Suspended Solids	2540 D, Gravimetric
Ammonia	4500-NH3F, Phenate
Reactive Phosphate	4500-P C. Vanadomolybdophosphoric acid - Colorimetric
Chloride	4500-C B. Argentometric
Arsenic	Silver Diethyldithiocarbamate - Colorimetric
Chromium Hexavalent	3500-Cr B. Colorimetric
Fluoride	4500-F D. SPADNS – Colorimetric
Boron	4500-B C. Colorimetric
Sulfate	4500-SO_4^{2-} E. Turbidimetric
Cadmium	ICP-OES
Iron	ICP-OES
Manganese	ICP-OES
Nickel	ICP-OES
Selenium	ICP-OES
Barium	ICP-OES
Fecal Coliform	Multiple Tube Fermentation Technique

Water Quality Results

The Mactan Strait is the adjacent waterbody that can be affected by the project in terms of water quality. This waterbody has been classified by the EMB in 2016 as Class SC. The intended beneficial uses of Class SC are: 1.) Fishery Water III – For propagation and growth of fish and other aquatic resources and intended for commercial and sustenance fishing, 2.) Recreational Water Class II – For boating, fishing or similar activities, and 3.) Marshy and / or mangrove areas declared as fish and wildlife sanctuaries. The impact assessment will use the corresponding water quality standards prescribed in DENR Administrative Order 2016-08.

Table 2-15: Summary of Water Quality Results in the 2 sampling stations

Parameter	Adjacent 1	Adjacent 2	DENR Standard (Class SC)
Biochemical Oxygen Demand (mg/L)	<3*	<2**	N/A
Chemical Oxygen Demand (mg/L)	372	<11**	N/A
Total Suspended Solids (mg/L)	52	20	80
Ammonia (mg/L)	0.399	0.139	0.05
Reactive Phosphate(mg/L)	<1**	<1**	0.05
Chloride (mg/L)	24,383	22,652	N/A
Arsenic (mg/L)	0.010	0.008	0.02
Chromium Hexavalent (mg/L)	0.012	<0.005*	0.05
Fluoride (mg/L)	2.27	2.34	1.5
Boron (mg/L)	3.85	3.89	5
Sulfate (mg/L)	239.4	2,317	275
Cadmium (mg/L)	<0.001**	<0.001**	0.005

Iron (mg/L)	1.2	0.05	1.5
Manganese (mg/L)	0.06	0.004	0.4
Nickel (mg/L)	<0.003**	<0.003**	0.06
Selenium (mg/L)	<0.008**	<0.008**	0.1
Barium (mg/L)	0.02	0.01	1
Fecal Coliform (MPN/100mL)	49,000	790,000	200

***Note:** *Detection Limit; **Reporting Limit*

The sampling results showed that only the parameters ammonia, fluoride, sulfate, and fecal coliform are greater than the water quality standards. The high coliform levels are indicative of sewage discharges contaminating the marine waters represented by the sampling stations.

The high coliform is indicative of the existing land use and use of the marine waters near the sampling stations. The following are the possible sources of pollution that contributed to the high ammonia, fluoride, sulfate, and fecal coliform at sampling stations:

- Households around Cansaga Bay
- Existing solid waste disposal area
- Fishponds
- Shipyards; and
- Marine traffic

Secondary Data of Water Sampling

The water quality benchmarks for secondary data were taken in Butuanon River and Mactan Channel prescribed as Class D Waters which is primarily used for the Navigable Waters, and Class SC Waters is used for Mactan Channel, which is primarily used for Fishery Water, Recreational water and Marshy and /or mangrove areas declared as fish and wildlife sanctuaries under DAO 2016-08.

Table 2-16: Sampling Results for Butuanon River (Downstream) (JICA 2019, 4th Mactan Bridge)

	PARAMETERS	UNITS	STANDARD Class D	RESULTS
1	pH	-	6.0-9.0	7.2
2	Temperature	°C	26-30	29
3	BOD	mg/L	15	104
4	COD	mg/L	-	221
5	TSS	mg/L	110	73
6	Oil & Grease	mg/L	5.0	4
7	Salinity	g/kg	-	0.04
8	Total Phosphorous (P)	mg/L	5	1.09
9	Turbidity	NTU	-	27.9
10	Chromium (Cr)	mg/L	0.02	<0.02
11	Cadmium (Cd)	mg/L	0.005	<0.003
12	Lead (Pb)	mg/L	0.1	<0.01

Table 2-17: Sampling Results for Marine Water Quality-Mactan Channel (JICA 2019, 4th Mactan Bridge)

PARAMETERS		UNITS	STANDARD Class SC	RESULTS		
				1	2	3
1	pH	-	6.5-8.5	8.2	8.3	8.3
2	Temperature	°C	25-31	30	30	28
3	BOD	mg/L	n/a	1	<1	1
4	COD	mg/L	-	<5	<5	<5
5	TSS	mg/L	80	40	39	32
6	Oil & Grease	mg/L	3	<1	<1	<1
7	Salinity	g/kg	-	40.1	36.4	39.9
8	Total Phosphorous (P)	mg/L	0.5	0.08	0.08	0.11
9	Turbidity	NTU	-	2.68	3.96	4.93
10	Chromium (Cr)	mg/L	0.05	<0.02	<0.02	<0.02
11	Cadmium (Cd)	mg/L	0.005	<0.003	<0.003	<0.003
12	Lead (Pb)	mg/L	0.05	<0.01	<0.01	<0.01

Results shows that Butuanon River has high BOD which is aboved in the DENR Water Quality Standard for Class D. While in Mactan Channel, the parameters taken all passed the DENR Water Quality Standard for Class SC.

2.2.4. Marine Ecology

2.2.4.1. Mangrove Community

There are no published comprehensive present or historical information on the extent and distribution of mangroves for the province of Cebu (Kirit et al. 2019). However, the State of the Mangrove Summit in 2018 (Salmo et al. 2019) has compiled information from various sources and reported a total mangrove area of 2,294 hectares (Pagkalinawan & Salmo 2019) and 18 true mangrove species in the province (Garcia et al. 2019). This information was primarily from Southern Cebu (e.g. Carcar and Santander) and Northern Cebu (e.g. Daanbantayan). In addition, it is not known whether there have been previous reports for Consolacion, Mandaue, and Lapu-Lapu City in Metro Cebu.

In order to provide a background for this report, measurements of mangrove cover were derived from satellite maps. The total mangrove cover measured for the northern section of Metro Cebu was 141.6 ha (Table 19), with 51.5 ha in Consolacion, 60.9 ha in Mandaue, and 29.2 ha in Lapu-Lapu City (northern coast only). The on-site mangrove survey in the Project Area in Consolacion, Adjacent Area in Mandaue, and Control Area in Lapu- Lapu City recorded 8 species of true mangroves. Two mangrove species found during the survey were not reported for Cebu province in the available literature, namely: Avicennia alba and A. officinalis. This expands the list of mangroves in Cebu province to 20 species. All of the species listed are of Least Concern in terms of IUCN Conservation Status with the exception of Ceriops decandra, which were not present in the areas of interest (Consolacion, Mandaue, and Lapu-Lapu).

Table 2-18: Mangrove Cover Estimate based on Google Earth 2020 Satellite Image

Municipality / City	Barangay with Description	No. of polygons	Average polygon area (ha)	Mangrove area (ha)	Mangrove area vs total in municipality (%)	Mangrove area vs total in the study (%)
Consolacion	Tayud – Project Area	3	1.19	3.56	7%	3%
	Tayud – Outside Project Area	14	0.79	11.01	21%	8%
	Jugan – Outside Project	5	1.35	6.74	13%	5%
	Nangka – Outside Project	2	13.31	26.62	52%	19%
	Tugbogan – Outside Project	4	0.88	3.54	7%	2%
	Total for Outside Project Area	25	1.84	47.91	93%	34%
	Total for Consolacion	28	17.52	51.46	100%	36%
Mandaue	Pakna-an – Adjacent Area	10	4.02	40.16	66%	28%
	Lobogon – Outside Adjacent Area	3	6.90	20.71	34%	15%
	Total for Mandaue	13	4.6	60.87	100%	43%
Lapu-Lapu City	Mactan – Control Area	9	2.10	18.93	65%	13%
	Pajo – Outside Control Area	1	2.56	2.56	9%	2%
	Buaya – Outside Control Area	3	0.98	2.93	10%	2%
	Punta Engaño – Outside Control Area	4	1.20	4.79	16%	3%
	Total for Outside Control Area	4	1.20	4.79	16%	3%
	Total for Lapu-Lapu City	8	1.2	29.21	100%	21%
Total Northern Section of Metro Cebu	**Inside Project Area**	**3**	**1.19**	**3.56**		
	Outside Project Area	**46**	**7.64**	**137.99**		
	Overall	**49**	**2**	**141.55**		

Table 2-19: List and Distribution of Mangroves with Conservation Status

No.	Scientific Name	Local Name	Distribution				IUCN Status
			Consolacion (Project)	Mandaue (Adjacent)	Lapu-Lapu (Control)	Cebu Province	
1	*Acanthus ilicifolius*	Tigbau				X	LC

2	*Aegiceras corniculatum*	Saging-saging				X	LC
3	*Aegiceras floridum*	Tinduk-tindukan				X	LC
4	*Avicennia alba*	Bungalon Puti		X			LC
5	*Avicennia marina*	Bungalon	X	X	X	X	LC
6	*Avicennia officinalis*	Piapi		X			LC
7	*Bruguiera cylindrica*	Pototan Lalaki				X	LC
8	*Bruguiera gymnorhiza*	Pototan				X	LC
9	*Ceriops decandra*	Malatangal				X	NT
10	*Ceriops tagal*	Tangal				X	LC
11	*Excoecaria agallocha*	Buta-buta				X	LC
12	*Heritiera littoralis*	Dungon Late				X	LC
13	*Lumnitzeranracemosa*	Kulasi				X	LC
14	*Nypa fruticans*	Nipa/Sasa	X			X	LC
15	*Pemphis acidula*	Bantigi				X	LC
16	*Rhizophora apiculata*	Bakhaw Lalaki	X		X	X	LC
17	*Rhizophora mucronata*	Bakhaw Babae	X	X	X	X	LC
18	*Rhizophora stylosa*	Bakhaw Bato			X	X	LC
19	*Sonneratia alba*	Pagatpat	X			X	LC
20	*Xylocarpus granatum*	Tabigi				X	LC
		Total	**5**	**4**	**5**	**18**	

LC – Least Concerned, NT – Near Threatened

A satellite and map-based analysis of the historical distribution of mangroves in the northern section of Metro Cebu indicates that the historical cover was 310.6 ha in 1990 with a sharp decline to 169.4 ha in 2000 (loss of 141.2 ha) to its lowest point at 87 ha in 2010 (further loss of 82.4 ha). The significant decline in mangrove cover in the past 30 years is attributed to the increase of urban areas in the inner portions of Cansaga Bay, particularly around Mandaue and Consolacion, which replaced shallow mangrove areas with reclaimed lands for residential and commercial purposes. The conversion of mangrove forests to fish pens may have also contributed to decline of original mangrove cover in the years before 1990.

There has been a gradual recovery to 141.5 ha in 2020, gaining 54.5 ha of mangrove cover from 2010, although still 169 ha less than the historical cover in 1990 *(Source: NAMRIA, LandSat, PhilGIS, Google Earth).* The increase of mangrove cover during the last decade is significant along the western side of the estuary of Cansaga Bay, particularly in Brgy. Pakna-an, Mandaue (adjacent to the Project Area). Brgy. Pakna-an, Mandaue has the largest mangrove area in the bay with a total of 40.16 ha cover. The increase in mangrove cover is attributed to the advance of the shoreline due to man-made structures that have made it possible to trap sediments brought by the river. Over time, the sediments that accreted around these structures served as the substrate for new mangrove forests. Growth of smaller, new mangrove forests can also be identified adjacent to structures like ports and jetties inside the Project Area. On the other hand, there appears to be a large-scale loss of mangroves in the northern coast of Lapu-Lapu City in Mactan Island (Control Area), which is difficult to determine the cause/s without a separate investigation.

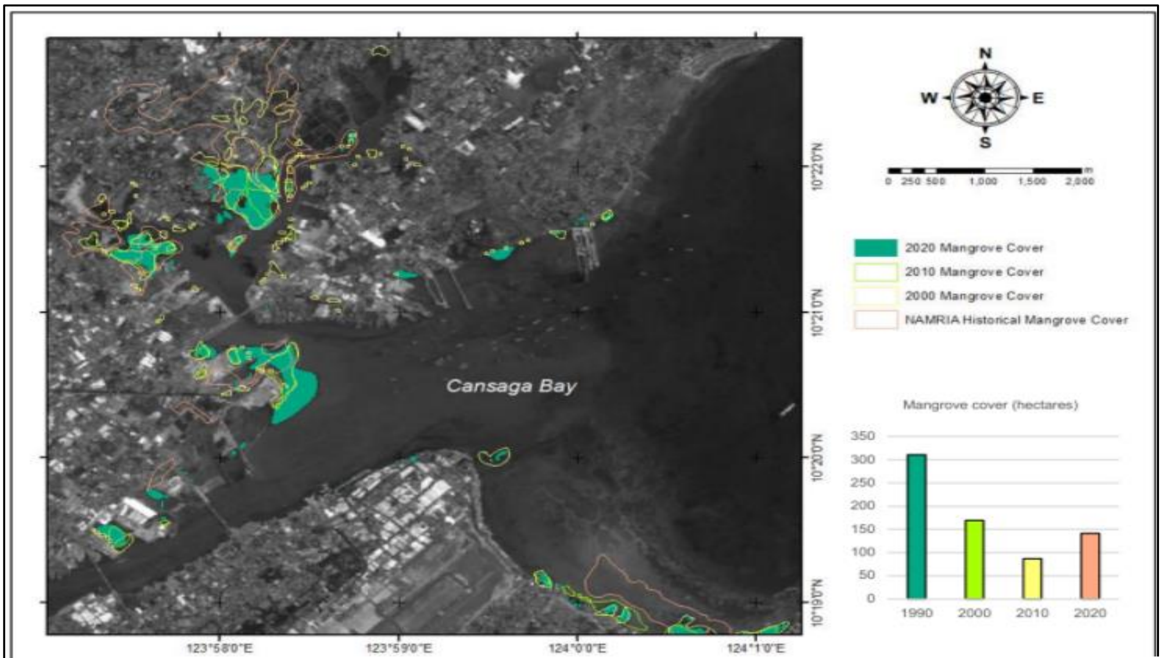


Figure 2-43: Decadal change of Mangrove Cover in Cansaga Bay

Mangrove Community Structure

A total of 7 species were recorded within the sampling plots of the Project Area (MI), Adjacent Area (MO) and Control Area (MC). A summary of the mangrove parameters is presented in Table 2-13. The Control Area had the highest species richness with 5 species, of which *Rhizophora stylosa* (Bakhaw Bato) was only sighted outside the plots. One species that is common in the estuary is *Nypa fruticans,* was not observed inside the plots. The relatively low species diversity can be attributed to the mangrove zonation and forest width. All three stations only had two mangrove zones: a seaward zone dominated by either *Sonneratia alba* or *Avicennia marina* and a less pronounced midzone with Rhizophora spp. and Avicennia spp. the width of the mangrove forest cover, as measured from the shoreline to the sea, varied from ~50 m in MI to ~400 m in MO and MC (Figure 46). In all cases, the landward mangrove zone (where Xylocarpus, Excoecaria, Heritiera, and Nypa could be found; Wycott et al. 2007) have already been developed into residential (in MO and MC), fishponds (in MO), and industrial areas (in MI).

The lack of landward mangrove zone, beach forest or any form of buffer area in the surveyed sites makes the mangrove forest vulnerable to effect of future sea level rise and limits its adaptive capacity to recover from future impacts. During the survey, the mangrove forest also appeared to have a low seedling/sapling production, except for the Control Area which had 2.1 individual sapling / seedling per m². This could translate to low regeneration capability, if not for the presence of large mature trees in both the Project Area and Adjacent Area.

Table 2-20: Summary of Mangrove Comunity Assessment Results in all Sites

Parameters	Project Area (MI)	Adjacent Area (MO)	Control Area (MC)
No. of species within plots	3	3	4
No. of species inside & outside plots	5	4	5
No. of sampling plots	5	5	9
No. of individual trees recorded	29	62	39
Tree density (n trees recorded)	7,250	12,400	4,333
Estimated total forest cover (ha)	3.56	40.16	18.93
Ave. diameter at breast height (cm)	44.7	20	41.6
Ave. basal area (m^2ha^{-1})	2,266.2	352.6	1630.6
Ave. tree height (m)	7.7	3.5	5.5
Ave. canopy width (m)	4.5	3.1	4.1
Ave. recruit (ind. Sapling/seedling per m^{-2})	0	0	2.1
Dominant species	*Sonneratia alba*	*Avicennia marina*	*Avicennia marina & Sonneratia alba*
Dominant forest type/age of mangrove forest section studied	Fringing: Secondary (<20 years)	Riverine-Fringing; Secondary (<20 years) and new (<10 years)	Fringing; Mostly old growth (>30 years)
Aboveground biomass (ton ha^{-1})	5,959	1,848	9,646

Figure 2-23 shows the width of the mangrove forest patch in the project and control site

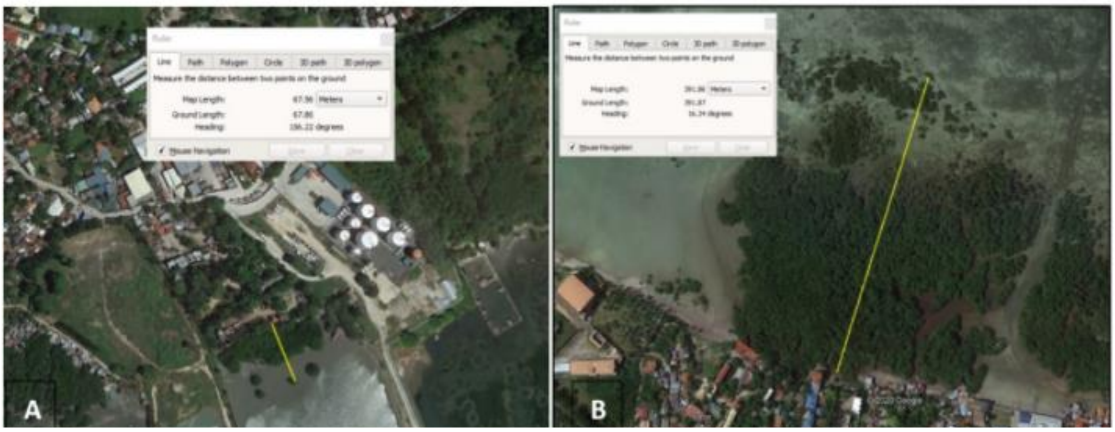


Figure 2-44: Mangrove Forest Width in Project Area and Control Area

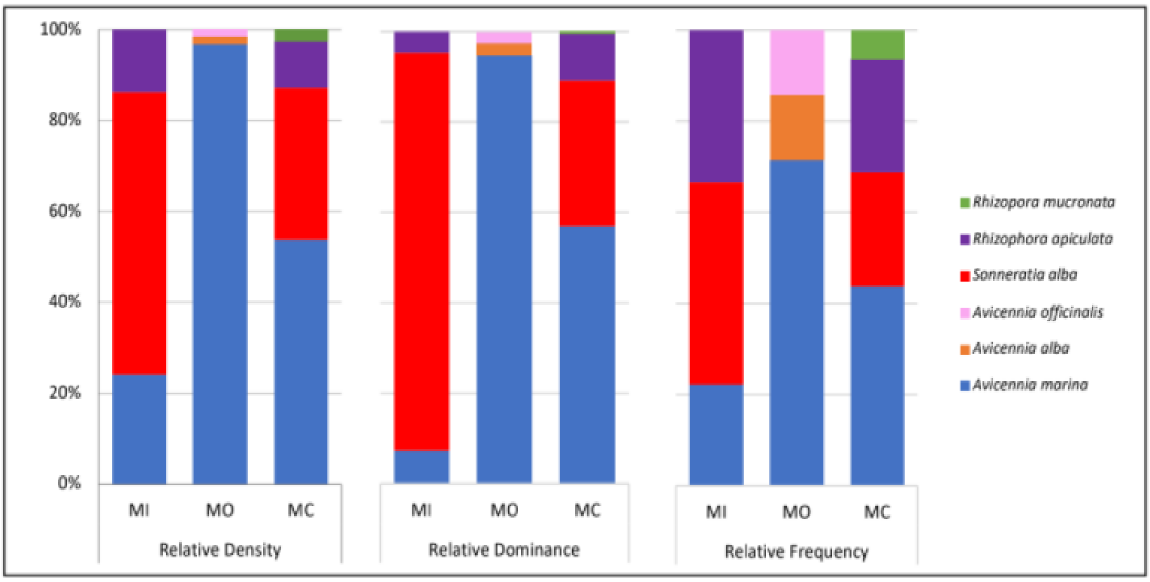


Figure 2-39: Mangrove Densisty, Dominance, and Frequency Percentage

The relative density of species per area showed that most of mangroves found in the Project Area (MI) are Sonneratia alba (62%), while most of the mangroves in both the Adjacent (MO) and Control Areas (MC) are Avicennia marina. The relative dominance of the basal area per species indicated that S. alba is again the dominant species in Project Area, contributing to about 88% of the biomass. A. marina was also again the dominant species in both the Adjacent and Control Areas in relative dominance of biomass. In terms of relative frequency (Figure 47), S. alba was present in most of the sampled plots in the Project Area (RF=44%), whereas A. marina was present in all plots in the Adjacent Area (RF=71%). In the control area (MC), A. marina was encountered in most of the sampled plots (RF=44%) while Rhizophora apiculata and S. alba was observed in one of every four plots (RF=25%). The composite score for relative dominance, density and frequency, expressed as the Importance Value (IV) indicates that S. alba is the most important species in the Project Area (most well represented in both number and size), while A. marina is the most important species in the Adjacent and Control Areas.

The species-specific above-ground (BMAG) and root (BMR) biomass in each site were calculated using allometric equation (Komiyama et al. 2005) on the field data (diameter at breast height, DBH) and species-specific wood density data (Tobias et al. 2017). The results indicate that total biomass per hectare (BMAG+BMR) was greatest in the Control Area (MC) with 9,646 ton/ha, followed by the Project Area (MI) with 5,959 ton/ha. The Adjacent Area (MO) had the least biomass per hectare with 1,848 ton/ha. As allometric calculation of biomass is a function of tree diameter, the bigger the trunk diameter (DBH), recorded for species found in the Project Area (MI) resulted to higher biomass than in the Adjacent Area (MO). In turn, the dominant trunk diameters of the mangrove forests correlate well with the estimated age of the mangrove forest sections studied.

Table 2-21: Importance Value of Mangrove Species in all sites

Site	Species	Relative Density (RD)	Relative Frequency (RF)	Relative Dominance (Rdom)	Importance Value (RD+RF+Rdom)
Project Area (MI)	*Sonneratia alba*	62.1	44.4	88.0	194.6
	Avicennia marina	24.1	22.2	7.3	53.7
	Rhizophora stylosa	13.8	33.3	4.7	51.8
Adjacent Area (MO)	*Avicennia marina*	96.8	71.4	94.8	263.0
	Avicennia alba	1.6	14.3	2.8	18.7
	Avicennia officinalis	1.6	14.3	2.4	18.3
Control Area (MC)	*Avicennia marina*	53.8	43.8	56.9	154.5
	Sonneratia alba	33.3	25	32.4	90.7
	Rhizophora stylosa	1.2	25	10.4	45.6
	Rhizophora stylosa	2.6	6.2	0.4	9.2

Importance Value

The area structure of the mangroves was evaluated by using the values of relative frequency (RFrequency), density (RDensity), and dominance (RDominance). Relative frequency of mangrove species refers to the total number of occurrence of species from the total number of transect lines or quadrats in the whole sampling area not relating to its total population. Relative density refers to the count of mangrove stands per unit area on the whole sampling area. Lastly, Relative Dominance refers to the basal area per species over the total basal area of all species. The summations of these values were added to attain the species importance value (SIV) in the entire sampling area. The SIV index per species were acquired in order to measure and identify which species were the most dominating in the whole area in terms of their density, occurrence, and basal area. For Relative frequency, all species were given with 100% condition value there was only 1 sampling station. Further, R. stylosa recorded the highest species relative density in the area (26.9), followed by A. marina (25), A. farmesiana (17.3), S. alba (16.8), N. fruticans (7.2), and R. apiculata came last (6.7). For Relative dominance, S. alba (27.6) ranked first among the species, followed by R. stylosa (27.3), A. marina (18.2), A. farmesiana (14.8), R. apiculata (12.1) in which N. fruticans (0.0) came last. Amongst all the species recorded, R. stylosa received the highest SIV with 154.2, followed by S. alba (144.4), A. marina (143.2), A. farmesiana (132.2), R. apiculata (118.8), and N. fruticans with 107.2. This confirms that R. stylosa is the principal mangrove species in the whole sampling area. Based from the results, R. stylosa ranked among the highest on both RDominance and RDensity. The successful dominance of R. stylosa and generally to the Family Rizophoraceae was due to the family's high survivability rate on wide range of ecological areas and long distance travels which enables both species to survive and germinate sporadically. In addition, the members of Rhizophoraceae also possess extensive root system (knee roots or stilt roots) which considerably contributed a lot to its adaptability and survivability.

The successful dominance of true mangrove species in the area was due to the muddy substrate that allowed the species' germinating medium to easily penetrate the substrate and germinate. Moreover, the fence surrounding the perimeter of the area and the stacked soil both aided on the slow movement of the water which settled the seeds only within the area.

2.2.4.2. Mangrove Associated-Fauna

Macro-Invertebrate Community

A number of mollusks, crustaceans, fish, and birds were observed in the mangrove areas. A total of ten species of mangrove-associated invertebrates were recorded across sites. In the Project Area (MI), the most noticeable fauna was the Telescope Snail (Telescopium telescopium), which is an abundant and edible species, and the Sulcate Swamp Snail (Terebralia sulcata). In the Adjacent Area, hermit crab (Pagurus sp.) and Mangrove Ear Snail (Casidula sp.) were common.

In the Control Area, the Mangrove Periwinkle (Littorina scabra) was the dominant gastropod. In addition, the Control Area had abundant edible bivalves, namely the Common Creepers (Rhinoclavis vertagus), Hard Clams (Meretrix sp.), Cockles (Trachycardium sp.), and Venus Clams (Gafrarium sp. and Tapes sp.). No threatened or rare species of benthic organisms were found in the three study sites.

Figure 2-46: Mangrove Associated Invertebrates Recorded in all sites

Project Area (A. Sulcate Swamp Snail *Terebralia sulcata*), Adjacent Area (B. Hermit crab Pagurus sp.; C. Mangrove Ear Snail *Casidula sp.*), and Control Area (D. Mangrove Periwinkles *Littorina scabra* and *Littorina cf. angulifera*).

Control Area. 1: Common Creeper (*Rhinoclavis vertagus*); 2: Hard Clam (*Meretrix*); 3: Cockle (*Trachycardium*); and 4–5: Venus Clams (*Gafrarium and Tapes*).

Fish Community

A total of 16 fish mangrove-associated species were also documented by diving down in the waters around the mangrove areas of each site. Only two species were found in the Project Area, which similar to the very low diversity encountered during the fish visual survey. In the Adjacent Area, only mudskippers A total of 16 fish mangrove-associated species were also documented by diving down in the waters around the mangrove areas of each site. Only two species were found in the Project Area, which similar to the very low diversity encountered during the fish visual survey. In the Adjacent Area, only mudskippers (Periophthalmus sp.) were found. In the Control Area, 13 fish species were recorded which include resident species like the Orbiculate or Polka-dot Cardinalfish (Sphaeramia orbicularis) and more mobile target species like the Great Barracuda (Sphyraena barracuda; and Blackspot Snapper (Lutjanus fulviflamma). None of these species recorded are listed as threatened or endangered in the IUCN Red List.

Table 2-22: List of Fish Species Recorded in all sites

Site	Family	Scientific Name	Common Name	Functional Group	IUCN Status
Project Area (MI)	Mugilidae	*Crenimugil sp.*	Mullet	Target	NE
	Belonidae	*Strongylura sp.*	Needlefish	Major	NE
Adjacent Area (MO)	Gobbidae	*Periophthalmus sp.*	Mudskipper	Major	NE
Control Area (MC)	Apoginidae	*Spaeramia orbicularis*	Orbiculate Cardinalfish	Major	NE
	Blennidae	*Apogon ceramensis*	Mangrove Cardinalfish	Major	NE
		Meiacanthus sp.	Fangblenny	Major	NE
	Gobiidae	*Asterropteryx semipunctata*	Starry Goby	Major	NE
		Cryptocentrus caeruleomaculatus	Blue-speckled Shrimp Goby	Major	LC
		Cryptocentrus leptocephalus	Pink-speckled Shrimp Goby	Major	NE
		Exyrias sp.	Sand Goby	Major	NE
		Oplopomus oplopomus	Spinecheek Goby	Major	NE

	Lutjanidae	*Lutjanus fulviflamma*	Blackspot Snapper	Target	LC
	Muraeidae	*Gymnothorax sp.*	Moray Eel	Target	NE
	Pomacentridae	*Chrysiptera unimaculata*	Onespot Demoiselle	Major	NE
	Siganidae	*Siganus canaliculatus*	Whitespotted Rabbit fish	Target	LC
	Sphraenidae	*Sphyraena barracuda*	Great Barracuda	Target	LC

***LC** – Least Concerned, **NE** – Near Threatened*

Figure 2-48: Images of Mangrove Associated Fishes Recorded in all sites

Orbicular Cardinalfish (Sphaeramia orbicularis) and juvenile Great Barracuda (Sphyraena barracuda) in the mangroves of the Control Area

Avi-Fauna

Five bird species were encountered during the survey of mangroves across sites. The birds observed in the Project Area were Little Egrets (*Egretta garzetta*), Mangrove Herons (*Butorides striata*), and Philippine Pied Fantails (*Rhipidura nigritorquis*), which is noteworthy given the small size of the mangrove patch. No birds were observed in the Adjacent Area at the time of the survey. Sandpipers (*Calidris sp.*) and Mangrove Kingfishers (*Todiramphus chloris*) were observed in the Control Area. None of these species recorded in the areas of interest are listed as threatened or endangered in the IUCN Red List. However, the Threatened migratory species Chinese Egret (*Egretta eulophotes*) has been previously reported in Casaga Bay, which itself harbors a rich avifauna (BirdLife International 2020).

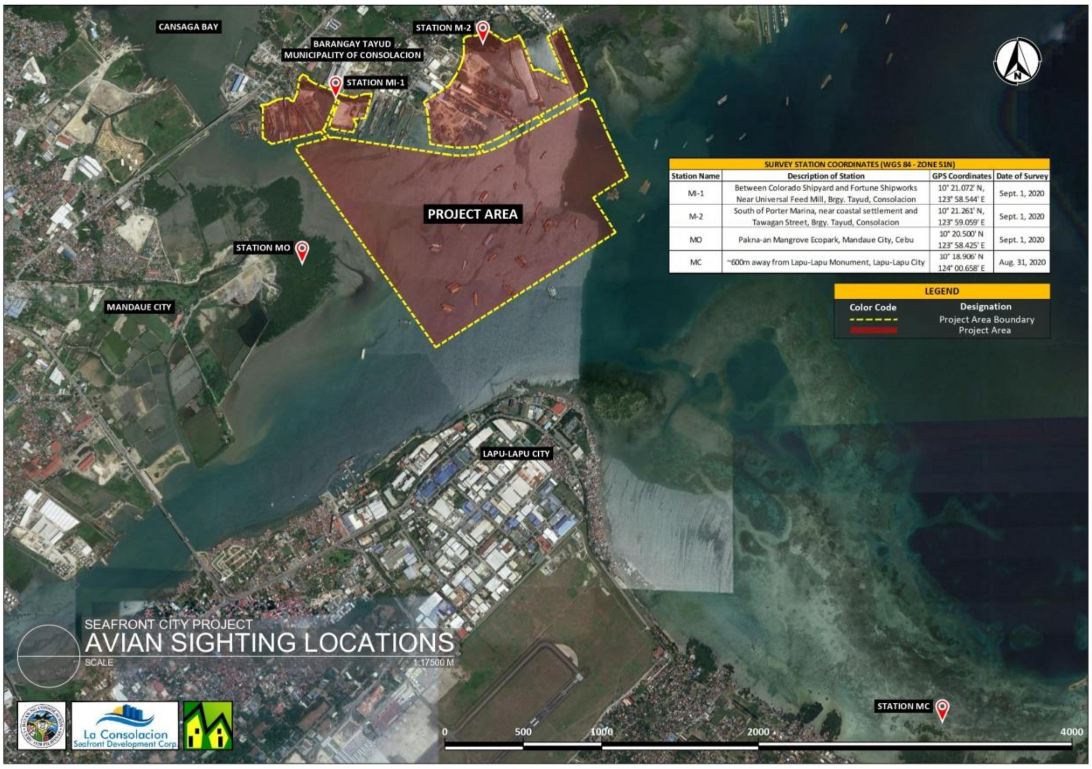


Figure 2-50: Map showing the Avian Sighting Location

2.2.4.3. Human Threats, Impacts and Management Recommendations

All of the mangrove forests in the areas of interest are bordered by human settlements on the landward peripheries. The seaward areas of the Project Area (in Brgy. Tayud, Consolacion) and the Adjacent Area (in Brgy. Pakna-an, Mandaue) have shipyards and numerous jetties as part an industrial zone. In addition, the landward section of the mangrove forest in the Adjacent Area have about 20 hectares of fishponds, about half of which appear to be abandoned having recent mangrove growth. These factors, if unmanaged, represent the major sources of threats to the mangrove forests.

However, the most noticeable direct human impacts on mangroves were the severe plastic pollution in both the Project Area (MI) and Adjacent Area (MO) close to informal settlements. The sources of plastic pollution may be from the vicinity, upstream areas, or even carried by the currents. In the case of the Project Area, the source of plastic pollution is likely to be local. In the case of the Adjacent Area, mangrove acts as catch basin of pollution (both organic and inorganic) coming from Butuanon River and its tributaries. Butuanon River passes through the upper part of Cebu City and through Mandaue City where it drains in Mactan Channel. Garbage accumulated both from Butuanon river and brought in by current through Mactan channel is likely trapped at the Adjacent Area. Plastic litter from residential sources can totally cover the mangrove forest floor, effectively suffocating mangrove pneumatophores. Plastic trapped by mangrove pneumatophores and prop roots may constitute a physical impediment affecting both the tree itself and the associated fauna, by preventing gas exchange (Curran et. al 1986) and releasing harmful chemicals absorbed by or industrially added to plastic materials (Cole et al. 2011). This observed severe plastic pollution may be the cause of death of several mangroves at the Adjacent Area. Aside for plastics pollution, there were also evidence of deliberate cutting of mangroves, particularly Avicennia marina, in the Adjacent Area and Control Area.

The impacts above may indicate a lack of effective solid waste management in the area and the lack of area protection status for the mangroves, although cutting of any mangrove tree is illegal under national laws. An immediate step to take would be to conduct massive cleanup of garbage in the mangrove areas, but the issue of garbage should be addressed in a long-term and sustainable manner at the local levels from barangay to municipalities/cities in Metro Cebu. Given the large-scale historical loss of mangroves in the areas of interest and their importance for ecosystem services (e.g. filtering pollution) and to local and migratory wildlife, all mangroves in the Project Area, Adjacent Area and Control Area should be declared as mangrove protected areas under municipal ordinance. The mangrove stands in the Project Area may be too narrow or small, with a maximum estimate of 3.56 hectares of mangrove cover, but the presence of old, natural growth stand of both hardy species of Sonneratia and Avicennia can be a good indicator of mangrove regeneration capabilities of the area, with mature trees being source for planting materials (both wildlings and seeds). Even small mangrove patches in the Project Area provide habitat for various species of birds, fish, and invertebrates, and can serve as a local “mangrove ecopark.” In the Adjacent Area (MO), 17-hectares out of the ~40-hectare mangrove area in Brgy. Pakna-an, Mandaue City has already been established as a mangrove ecopark with boardwalks, watchtower for birdwatching, and other minimal tourism infrastructures (Dimaboc 2018), which will serve both environmental conservation and ecotourism purposes. Such strategies and initiatives may be implemented to cover all mangroves in the areas of interest.

Figure 2-51: Images showing Plastic Pollution in the Mangrove Areas

Plastic pollution in the Project and Adjacent Areas (A-B); and evidence of cutting of Avicennia marina in the Adjacent and Control Areas (C-D).

2.2.4.4. Removal and Loss of Habitat / Loss of Important Species

Since portion of the project area has mangrove trees, proponent will commit to carefully implement the project without affecting the existing mangrove trees. These mangrove trees will be part of the project component, and one of its aims is to rehabilitate these mangrove trees that were malnourished and partially destroyed due to human activities. However, if unavoidable, the affected mangrove trees will be balled and transferred to other preferable locations approved by DENR where it be can recuperate and be protected. The species affected if there will be removal of mangrove trees are the species living within these mangroves such as crabs, insects, birds, mollusks, and other species.

After developing the project where it has a rainwater harvesting/artificial pond component, this will likewise serve as Mangrove Rehabilitation Area, the mangroves that were affected, balled, and transferred temporarily will be balled back to the Mangrove Rehabilitation Area within the project site for reproduction.

2.2.4.5. Abundance, Frequency and Distribution of Marine Species

2.2.4.6. Marine Survey Assessment Sampling Site Description & Methods

A marine study was conducted by a team of marine biologists from Bluenomads from August 18 to September, 2020. A total of 6 sampling stations were established (3 inside the reclamation area, 3 within the adjacent marine waters and 3 in an established control site). The primary objectives of the underwater assessment are summarized below:

1. Confirm the presence of coastal and marine ecosystems (coral reefs, seagrass beds and its associated macro-fauna);
2. Describe the baseline condition of benthos, fish, plankton within the reclamation area, adjacent to the reclamation area and the control site; and
3. Identify economically important, endemic and threatened species.

Figure 2-41 shows the location of the different underwater sampling stations.

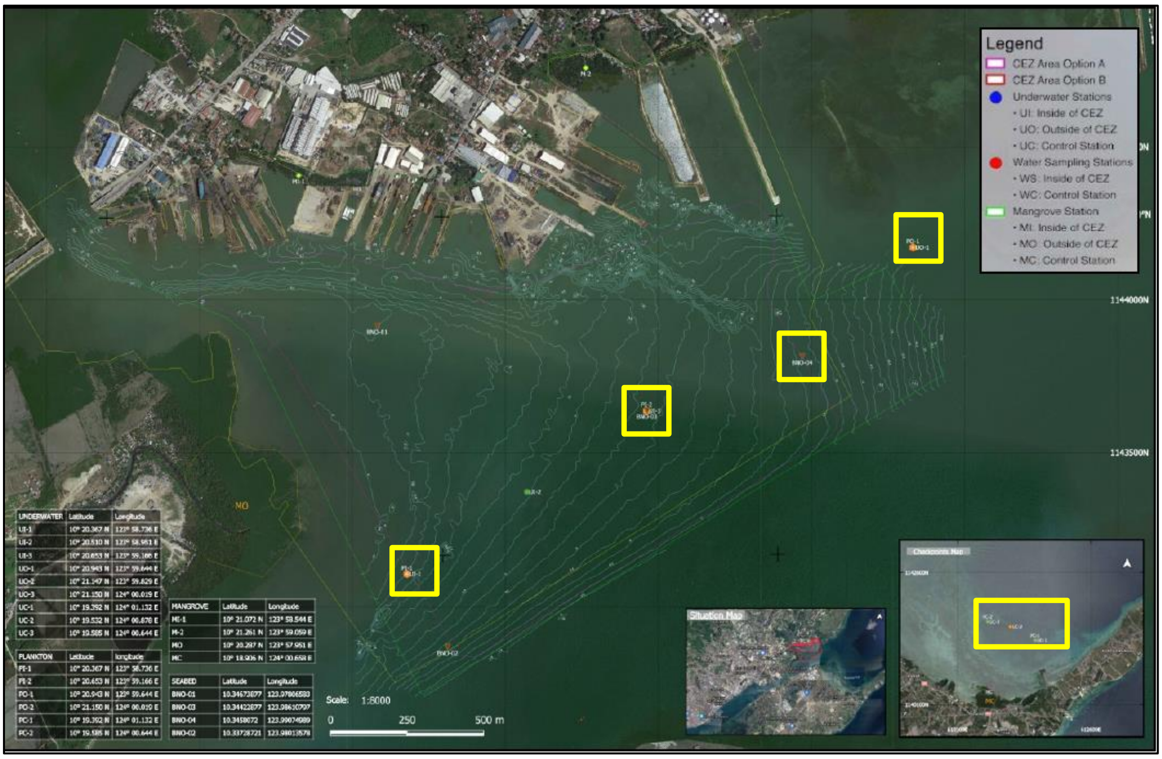


Figure 2-52: Map showing the Underwater Sampling Sites inside, adjacent and control site

Listed in Table 2-19 below is the description summary of the different sampling sites:

Table 2-23: Underwater sampling site description

Station Name	Location Descriptions of Stations	GPS Coordinates	Depth (m)
UI-1	Project Area (Brgy. Tayud). North of Magellan Channel and entry of Cansaga Bay. Mouth of Butuanon River near Paknaan Mangrove Ecopark.	10° 20.367 N, 123° 58.736 E	2.8
UI-2	Project Area (Brgy. Tayud, Consolacion). Entry point of Cansaga Bay, between cargo ships. ~1 km away from Colorado Shipyard.	10° 20.510 N, 123° 58.951 E	4.2
UI-3	Project Area. Entry point of Cansaga Bay, between cargo ships. ~1 km away from Colorado Shipyard and PKS Shipping Co.	10° 20.653 N, 123° 59.166 E	5.6
UO-1	Adjacent to Project Area. North point of Cansaga Bay, near Phoenix Petroleum jetty (~500 m away)	10° 20.943 N, 123° 59.644 E	7
UO-2	Adjacent to Project Area. North point of Cansaga Bay, ~500 m south of Porter's Marina jetty.	10° 21.147 N, 123° 59.829 E	4
UO-3	Adjacent to Project Area. North point of Cansaga Bay, ~200 m away from Porter's Marina jetty.	10° 21.150 N, 124° 00.019 E	4
UC-1	Magellan Bay. 1 km away from Kalipayan Seaside Beach and 1.4 km away from Lapu-Lapu Monument in Lapu-Lapu City.	10° 19.392 N, 124° 01.132 E	7
UC-2	Magellan Bay. 500 m away from UC-1	10° 19.532 N, 124° 00.878 E	7
UC-3	Magellan Bay. 1 km away from UC-1	10° 19.585 N, 124° 00.644 E	7

Marine Benthos

- **Project Area**

Benthic composition differed significantly among stations. The trend is clear: from entirely abiotic substrate in the Project Area to increasing live coral cover the farther away into the Adjacent and Control Areas. Corals (live hard, soft, and impacted) were completely absent in the Project Area (UI-1, UI-2, and UI-3). The sediment was comprised entirely of silt, which prevents the establishment of corals other than occasional sea pens (a soft coral) and seagrasses because of the lack of attachment areas for recruitment, limited light for photosynthesis, and sediment burial. Bacterial film also covered the silty sediment and visibility was poor at 50 cm to 2 meter range.

Coinciding with the lack of hard and stable substrates, the Project Area also had very low benthic diversity at 5 species. Not a single macroscopic invertebrate was observed during a 20-minute survey of the southernmost sampling point (UI-1), which is perhaps due to the oil spill observed and discussed above. On the two sampling sites further north (UI-2 and UI-3), the suspension-feeding seapen *Pteroeides* sp. was the dominant lifeform (n=20). There were only single observations of sea anemone, polychaete tubeworms, hermit crab (*Pagurus* sp.), and Blue Swimming Crab (*Portunus pelagicus*, a commercial/food species), reflecting the lack of complex habitats for macroinvertebrates in the area. This is in stark contrast to the diversity of the benthic composition and mobile benthic organisms found in the other two areas surveyed.

All five species are common in the Philippines and none are listed as threatened in the IUCN Red List as shown in Table 2-20.

Table 2-24: List of Macro-invertebrates recorded in the Project Area

	Family	Scientific Name	Common Name	Trophic Group	IUCN Conservation Status
1	Malacostraca	*Pagurus sp.*	Hermit Crab	Omnivore	Not evaluated
2	Malacostraca	*Portunus armatus*	Blue Swimmer Crab	Benthic Carnivore	Not evaluated
3	Anthozoa	*Actiniaria (order)*	Sea Anemone	Benthic Carnivore	Not evaluated
4	Anthozoa	*Pteroeides sp.*	Seapen	Suspension feeder	Not evaluated
5	Polychaeta	*Polychaeta (class)*	Tubeworm	Suspension feeder	Not evaluated

- **Adjacent Area**

In the Adjacent Area, the live coral cover was generally "poor" with a mean of 20.14%, although the farthest station (UO-3) had a "good" coral cover of 50% (mostly encrusting corals). The composition of inorganic substrate (33% cover) was silt (13%), sand (13%), rubble (5%), and rock (2%). The algal cover was very high with a mean of 43.6%, making it an algae-dominated reef mostly comprised of *Halimeda* sp. (18%) and *Ulva* sp. (12%), with fewer coralline algae (8%) and crustose algae (6%). *Halimeda* provides useful cryptic spaces for small invertebrates and is a major contributor to carbonate sediments of reefs (Guiry 2020). On the other hand, the abundance of the green algae such as *Ulva* sp. is an indication of organic pollution (Salas et al. 2006).

Along with the abundance and diversity of hard substrates and vegetation, the macrobenthic fauna in the area were much more abundant and biodiverse, with 21 macroinvertebrate species compared to the Project Area. The most abundant fauna were echinoderms (n=109), particularly brittlestars (n=30), Crevice Featherstar (*Comanthus parvicirrus*; n=30), False Fire Urchin (*Astropyga radiata*; n=15), Porcupine Urchin (*Diadema setosum*; n=10), Banded Urchin (*Echinothrix calamaris*; n=8), and Horned Seastar (*Protoreaster nodosus*; n=8). The presence of the suspension-feeding phyllophorid sea cucumbers, *Stolus buccalis*, is also notable. These echinoderms can thrive in disturbed habitats because of their omnivorous (e.g. sea urchins), suspension feeding (e.g. featherstar and phyllophorid), and detritus diet (e.g. brittlestar). Sea anemones (n=19) were also abundant, along with its commensal Squat Anemone Shrimp (*Thor amboinensis*; n=13). None of the species found are listed as threatened in the IUCN Red List. However, Giant Triton Snail (*Charonia tritonis*) is now a rare and protected species in the Philippines (FAO 158).

Table 2-25: List of Macro-invertebrates recorded in the Adjacent Area

	Family	Scientific Name	Common Name	Trophic Group	IUCN Status
1	Malacostraca	*Pagurus sp.*	Hermit Crab	Omnivore	NE
2	Malacostraca	*Thor amboinensis*	Squat Anemone Shrimp	Detritivore	NE
3	Malacostraca	*Stenopus hispidus*	Banded Coral Shrimp	Benthic Carnivore	NE
4	Malacostraca	*Porcellanidae*	Porcelain Crab	Suspension feeder	NE
5	Anthozoa	*Actiniaria (order)*	Sea Anemone	Benthic Carnivore	NE
6	Gastropoda	*Elysia marginata*	Sapsucking Nudibranch	Benthic Carnivore	NE
7	Gastropoda	*Chromodoris reticulatus*	Reticulated Nudibranch	Benthic Carnivore	NE
8	Gastropoda	*Goniobranchus fidelis*	Faithful Nudibranch	Benthic Carnivore	NE
9	Gastropoda	*Phyllidiella granulata*	Granulated Nudibranch	Benthic Carnivore	NE
10	Gastropoda	*Charonia tritonis*	Giant Triton Snail	Benthic Carnivore	NE
11	Bivalvia	*Ostreodae*	Oyster	Suspension feeder	NE
12	Crinoidea	*Comanthus parvicirrus*	Common Crevice Featherstar	Suspension feeder	NE
13	Echinoidea	*Echinothrix calamaris*	Banded Urchin	Omnivore	NE
14	Echinoidea	*Diadema setosum*	Porcupine Urchin	Omnivore	NE
15	Echinoidea	*Astropyga radiata*	False Fire Urchin	Omnivore	NE
16	Asteroidea	*Protoreaster nodosus*	Horned Seastar	Benthic Carnivore	NE
17	Asteroidea	*Pentaster obtusatus*	Blunt-arm Seastar	Benthic Carnivore	NE
18	Ophiuroidea	*Amphiuridae (family)*	Brittlestars	Detritivore	NE
19	Holothuroidea	*Synapta maculata*	Spotted Snake Sea Cucumber	Detritivore	NE
20	Holothuroidea	*Stolus buccalis*	Phyllophorid Sea Cucumber	Suspension feeder	NE
21	Polychaeta	*Polychaeta (class)*	Tubeworm	Suspension feeder	NE

At the Control Area, the mean live coral cover was significantly higher (39.1%) while the algal cover much less (22.5%) than in the Adjacent Area (20% coral and 44% algae) and Project Area (0% coral, 0% algae, and 100% silt). Like in the Adjacent Area, the coral cover is predominantly composed of the encrusting forms. However, unlike the Adjacent Area, the Control Area has more massive, corymbose, free-living forms, branching and tabulate *Acropora*, submassive, and foliose forms. The Control Area also had 9% impacted coral cover, comprised entirely of dead corals with algae. The composition of the inorganic substrate (mean 25% cover) was rubble (13%), sand (6%), and rocks (6%). Macroalgae comprised an important component of the benthos with a mean cover of 23%, predominantly green algae (10%) and coralline algae (10%). Other sessile invertebrates comprised 5% of the benthic cover and were comprised of sponges, tunicates, blue corals, and corallimorphs.

The area has high macroinvertebrate biodiversity with 33 recorded species. With the abundance of hard corals and the presence of massive forms, the suspension-feeding tubeworms (n=158) and spiny oysters (n=25) were the dominant macrobenthic fauna, along with detritus-feeding brittlestars (n=54). These organisms shelter in the cryptic spaces of both living and dead corals. Sea anemones (n=14), sea urchins (n=22), and sea squirts (n=18) were also common. Four species of corallivores were found: Crown-ofthorns Seastar (*Acanthaster planci*), Granular Seastar (*Choriaster granulatus*), Drupe Snail (*Drupella* sp.), and Violet Coral Snail (*Coralliophila violacea*). The presence of a coral-associated sea cucumber, *Pearsonothuria graeffei* (n=5), is also notable. The high percentage of impacted corals (mean 9%) is likely caused by high fishing pressure in the Control Area. Bottom-set net fishing, spearfishing, and gleaning (e.g. of shellfish, sea urchins, and *Dollabella* egg cases locally called "lukot") were observed during the assessment.

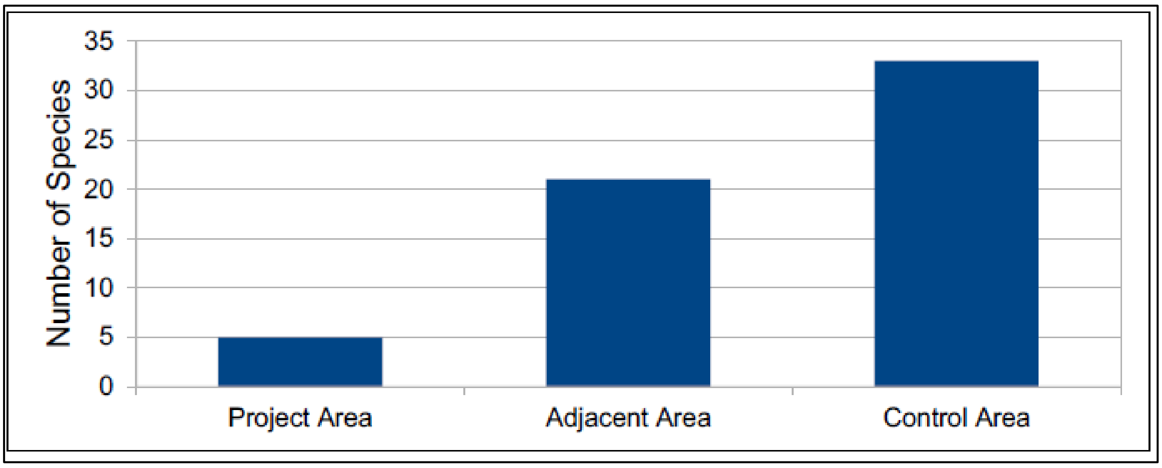


Figure 2-53: Comparison of Species Composition of Benthos in all Sites

Table 2-26: Summary of Percent Coral Cover in all Sampling Sites

Station	Percent Cover of Benthic Lifeforms / Substrate (%)							
	Live Hard Coral	Octocoral	Impacted Coral	Other Invert	Abiotic Substrate	Algae	Seagrass	Total
UI-1	0	0	0	0	100	0	0	100
UI-2	0	0	0	0	100	0	0	100
UI-3	0	0	0	0	100	0	0	100
Project Area Ave.	**0**	**0**	**0**	**0**	**100**	**0**	**0**	**100**
U0-1	6.67	0	0	0	33.33	60	0	100
U0-2	3.75	0	1.25	0	46.25	48.75	0	100
U0-3	50	6.25	1.25	0	20	22.5	0	100
Adjacent Area Ave.	**20.14**	**2.08**	**0.83**	**0.00**	**33.19**	**43.75**	**0.00**	**100**
UC-1	27.5	11.25	3.75	6.25	33.75	17.5	0	100
UC-2	52.5	6.25	8.75	7.5	11.25	13.75	0	100
UC-3	20	0	14	1	29	36	0	100
Control Area Ave.	**33.33**	**5.83**	**8.83**	**4.92**	**24.67**	**22.42**	**0.00**	**100**

Marine Fish Communities

- **Project Area**

A total of 81 fish species belonging to 22 families were recorded during the underwater surveys in the Project, Adjacent, and Control Areas. However, only 3 fish species were found inside the Project Area (Table 12) and only at the northernmost station (UI-3). These species are: Acentrogobius sp. (Figure 35) and Bathygobius sp. gobies, and the Large-toothed Cardinalfish (Cheilodipterus macrodon). Omnivore species comprise 71% while benthic carnivore species comprise 29% of the species abundance (Figure 36). All three fish species are categorized as "major" species (not "target" or "indicator") and none are listed under IUCN. The mean fish density was extremely low at only 7.8 individuals per 500 m2 and correspondingly, the fish biomass was also extremely low mean at only 0.4 kg/500 m2 (Table 13). These may be attributed both to the very low visibility of the site due to turbidity (which limits the range of observation to 2 m or less), the degraded water quality and absence epibenthic communities which are unfavorable for most fish species.

Table 2-27: Fish species observed during FVC in the Project Area

	Family	Scientific Name	Common Name	Functional Group	IUCN Status
1	*Apogonidae*	*Cheilodipterus macrodon*	Large-toothed Cardinalfish	Major	Not Evaluated
2	*Gobiidae*	*Acentrogobius sp.*	Spotted Green Goby	Major	Not Evaluated
3	*Gobiidae*	*Bathygobius sp.*	Frill-goby	Major	Not Evaluated

➢ Adjacent Area

Compared to the Project Area, the Adjacent Area had much higher fish species richness with 34 species (Table 2.41). Fish species richness ranged from 12–20 per transect in the Adjacent Area. These species have previously been reported in the Philippines, and none are listed as vulnerable, threatened and endangered under IUCN.

Mean fish density at was low at 126.7 individuals per 500 m2 and mean fish biomass was very low at only 8.9 kg per 500 m2. In terms of density per trophic group, benthic carnivores dominated (50%), followed by herbivores (19%) and detritivores (18%). The fish community was almost entirely comprised of species belonging to the "major" category (96%). There were only a few "target" species, namely Orange- dotted Tuskfish (Choerodon anchorago), Snapper (Lutjanus sp.), Freckled Grouper (Cephalopholis microprion), and Lizardfish (Synodus sp.). There was only one "indicator" species, namely Pearlscale Angelfish (Centropyge vroliki). This is perhaps due to the highly silted environment that has degraded the coral community. In terms of fish density per family, detritivorous damselfishes (e.g. Stegastes nigricans), herbivorous gobies (e.g. Cryptocentrus caeruleomaculatus), and carnivorous cardinalfishes (e.g. Ostorhinchus nanus) dominate the fish community in the Adjacent Area. In terms of biomass, detritivorous damselfishes (e.g. Stegastes nigricans) and carnivorous wrasses (e.g. Choerodon anchorago and Thalassoma lunare) dominate the area.

➢ Control Area

A total of 56 fish species were observed in the Control Area, which is much more diverse than both the Project and Adjacent Areas combined. Fish species richness were high at 20–28 species per transect. None of these species are vulnerable, threatened or endangered species under IUCN. The mean fish density at the Control Area was low at

206.7 individuals per 500 m2 but almost double that of the Adjacent Area. The mean fish biomass was also low at 60.6 kg per 500 m2 but far greater than the Project Area (0.4 kg per 500 m2) and Adjacent Area (8.9 kg per 500 m2) combined. In terms of density per trophic group, benthic carnivores dominated (50%), followed by herbivores (19%) and detritivores (18%). The fish community was almost entirely comprised of the “major” category (84%). There were six “target” species, namely Short-tail Bristletooth (Ctenochaetus cyanocheilus), Sharp-lipped Wrasse (Oxycheilinus sp.), Goatfish (Upeneus sp.), Parrotfishes (Scarus flavipectoralis and Scarus sp.), and Squarespot Fairy Basslet (Pseudanthias pleurotaenia). There were also six “indicator” species, namely Triangular Butterflyfish (Chaetodon baronessa), Eightband Butterflyfish (C. octofasciatus), Vagabond Butterflyfish (C. vagabundus), Pearlscale Angelfish (Centropyge vroliki), Yellow Angelfish (Centropyge heraldi), and Blacksaddled Toby (Canthigaster valentini). Damselfishes and wrasses dominate the fish community in terms of density and biomass.

Table 2-28: Summary of Fish Density and Biomass in all Sampling Stations

Station	Density (individuals/500 m^2)				Biomass (kg/500m^2)			
	Target	Major	Indicator	Total	Target	Major	Indicator	Total
UI-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UI-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UI-3	0.0	23.3	0.0	23.3	0.0	1.2	0.0	1.2
Project Area Mean	0.0	7.8	0.0	7.8	0.0	0.4	0.0	0.4
UO-1	0.0	166.7	0.0	166.7	0.0	10.8	0.0	10.8
UO-2	6.7	90.0	0.0	96.7	0.3	3.1	0.0	3.3
UO-3	6.7	106.7	3.3	116.7	5.2	7.5	0.1	12.7
Adjacent Area Mean	4.4	121.1	1.1	126.7	1.8	7.1	0.0	8.9
UC-1	6.7	313.3	10.0	330.0	0.2	84.3	0.2	84.7
UC-2	10.0	83.3	16.7	110.0	3.3	39.5	0.7	43.5
UC-3	36.7	123.3	20.0	180.0	10.5	42.8	0.3	53.7
Control Area Mean	17.8	173.3	15.6	206.7	4.7	55.5	0.4	60.6
Grand Total	66.7	906.7	50.0	1023.3	19.5	189.1	1.3	209.9

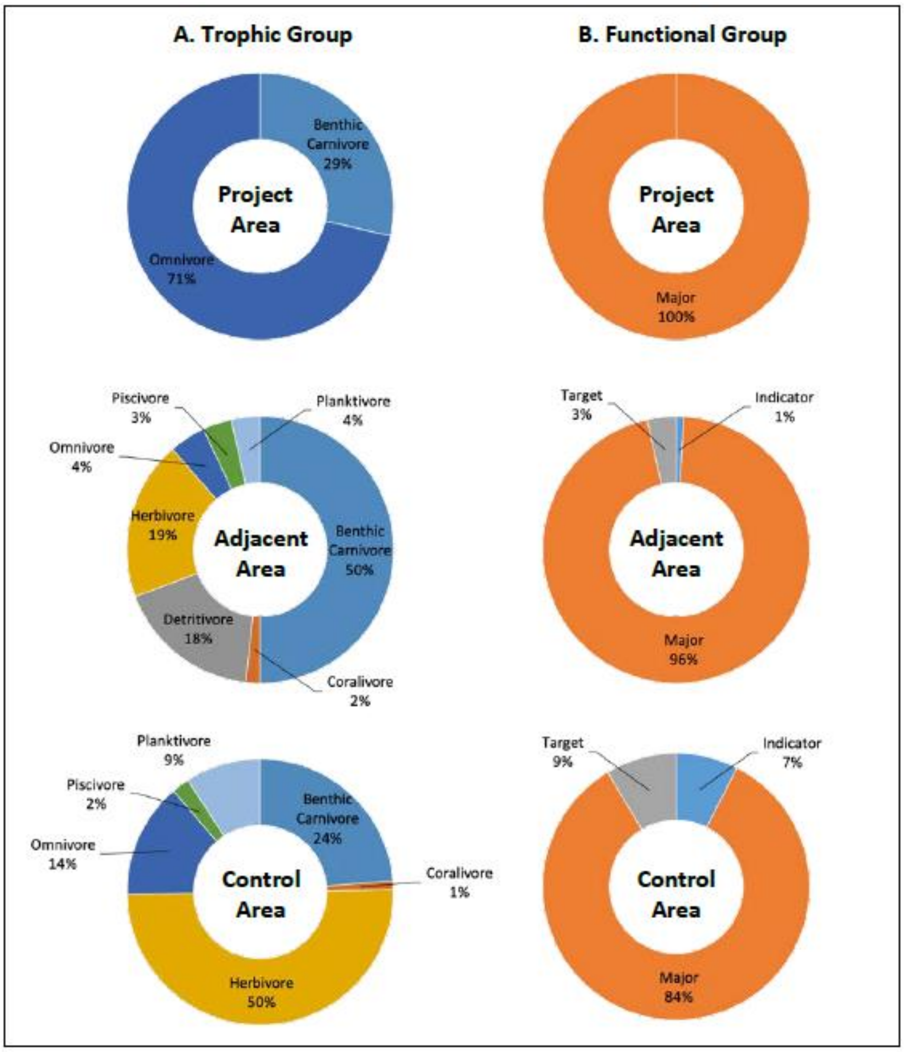


Figure 2-54: Percent Composition of fish densities per trophic level and per functional group

Marine Plankton

Zooplankton

A total of 11,125 individuals/m3 distributed among 17 zooplankton groups (in adult and larval forms) were quantified from six sampling stations in locations along the marine waters from the coastline of Consolacion and Lapu-Lapu City, Cebu. Overall, recorded zooplankton consisted 62.8% (6,988 ind/m3) of adult forms, and 37.2% (4,137 ind/m3) of larval forms from the overall total zooplankton count. The adult zooplankton forms were composed of ten groups, while the larval zooplankton forms comprised of seven groups. A large portion of the adult forms was represented by cyclopoid copepods with 2,500 ind/m3 at 22.5% composition. Larval forms were dominated by copepod nauplius and copepodites with a total of 3,475 ind/m3 at 31.2% composition, which were also the most abundant group for the whole documented zooplankton community.

The adult form groups were more dominant than the larval forms due to the high abundance of calanoids, cyclopoids, and harpacticoids, supplemented by low densities of radiolarian, amphipods, mysiids, ostracods and cladocerans. Copepods are the dominant members of zooplankton that serve as major food sources for fish and other marine life. Because of their smaller size, very high densities, fast growth rates, and more even distribution throughout the world's oceans, copepods almost certainly contribute far more to the secondary productivity of the world's oceans and grazing pressure on the phytoplankton community (Merrel & Stoeker 1998).

There were no rare or endemic zooplankton species in the area, and majority of the zooplankton groups are generally common and cosmopolitan in distribution. It is noteworthy that brachyuran zoeae or crab larvae have been recorded in the Control Area (PC-1 and PC-2) and not in the Project Area nor the Adjacent Area; though in relatively low density. These indicate a potential recruitment site of these crustaceans along the positions of sampling stations PC-1 and PC-2 of which are located at the Control Area quite distant from the Project Area. Photomicrographs of zooplankton groups recorded in the survey area.

The mean estimate of abundance of the zooplankton community was 1,854 ind/m3, recorded for all six sampling stations. In terms of spatial distribution, the highest zooplankton abundance was observed in station PI-1, which is located at the Project Area, with a density of 2,497 ind/m3, mainly due to copepod nauplius and copepodites (1,110 ind/m3). In terms of species richness, sampling station PC-1 of Control Area had the highest, harboring 13 out of the 17 representative zooplankton groups compared to the other five sampling stations.

In contrast, the lowest zooplankton abundance, at 1,420 ind/m3, was at station PC-2; while the lowest species richness, with only four groups, was at station PI-1. The low species richness in the Project Area could be due to the displacement of the plankton communities caused by turbid waters and strong currents.

Table 2-29: Zooplankton composition and abundance in the 6 sampling stations

TAXA	STATIONS						Grand Total	Rel. Abund.
	Project Area		Adjacent Area		Control Area			
	PI-1	PI-2	PO-1	PO-2	PC-1	PC-2		
Adult forms	**1,387**	**835**	**1,082**	**1,449**	**1,305**	**930**	**6,988**	**62.81**
Amphipod					82	114	196	1.76
Cladoceran			17				17	0.15
Copepod calanoid	69	350	250	154	179	82	1,084	9.74
Copepod cyclopoid	693	194	399	740	114	359	2,500	22.47
Copepod harpacticoid	624	175	300	555	310	196	2,159	19.41
Heteropod					33	98	131	1.17
Larvacean		19	83		16		119	1.07
Mysiid					65	33	98	0.88
Ostracod					49	49	98	0.88
Radiolarian		97	33		457		587	5.28
Larval forms	**1,110**	**835**	**566**	**925**	**212**	**490**	**4,137**	**37.19**
Bivalve veliger		39	33	62		16	150	1.35
Brachyuran zoea					33	147	179	1.61
Cnidarian larvae			50				50	0.45
Copepod nauplius	1,110	777	399	863	114	212	3,475	31.24
Gastropod veliger		19	17		16		52	0.47
Pluteus					49	114	163	1.47
Polychaete trochophore			67				67	0.6
Total Abundance (N)	**2,497**	**1,670**	**1,648**	**2,373**	**1,518**	**1,420**	**11,125**	**100**
Mean Abundance = 1,854								
Richness	**4**	**8**	**11**	**5**	**13**	**11**		
Mean Richness = 9								
Evenness (J')	**0.52**	**0.73**	**0.8**	**0.55**	**0.82**	**0.9**		
Diversity (H')	**1.16**	**1.52**	**1.92**	**1.34**	**2.1**	**2.15**		

As shown in Table, diversity measurements based on the Shannon-Weiner Index (H') were low (<2.0) in the Project Area and Adjacent Area, as opposed to the values (>2.0) computed in the Control Areas. Diversity index values that are greater than 2.0 indicate normal conditions for aquatic biota and the associated habitat. Values above 3.0 indicate that the habitat structure is stable and balanced, values from 1.0 to 2.0 describe a threatened condition, while values lower than 1.0 indicate pollution and degradation occurring in the habitat structure (Goncalves & Menezes 2011). In terms of evenness, the computed indices for two sampling stations (PI-1, PO-2) revealed low values (0.51–0.55) whereas the rest of the stations had relatively high values, with the highest value of 0.90 in sampling station PC-2, which indicate a balance distribution of the zooplankton community. The low evenness values in stations PI-1 and PO-2 is due to the dominance of a zooplankton group.

Overall, the zooplankton community in the Project Area and Adjacent Area are poor as indicated by a low number of taxa and diversity during the time of survey. Despite of having the highest zooplankton densities, there are, however, no rare or endangered genera or groups in the sampled zooplankton community, and all are cosmopolitan in distribution worldwide.

Phytoplankton

A total density of 143,201 cells/m3 belonging to 33 genera that were identified across all sampling stations. The phytoplankton community in the survey area is comprised of organisms from three major phytoplankton groups: Cyanophytes (blue-green algae) with two genera, Bacillariophytes (diatoms) with 21 genera, and Dinophytes (dinoflagellates) with 10 genera.

Dinoflagellates were the most abundant group with a total count of 9,207 cells/m3 accounting for 54.4% composition. They play important roles at the base of the food chain servings as sources of nutrients to larger organisms and a prey on smaller organisms such as diatoms. The large portion of the dinoflagellates was *Peridinium* sp. with total cell density of 65,637 cells/m3 accounting 45.8% of the total composition. This species is quite common, having a wide global distribution and commonly bloom-forming (Garate-Lizarraga & Muneton-Gomez 2008) but generally considered as harmless and not included in the IOCUNESCO Reference List of Harmful Microalgae (Moestrup et al. 2020). However, a dinoflagellate identified in this sampling which was included the above-mentioned list was *Dinophysis ovum*. This species is a toxic dinoflagellate capable of producing toxin associated with Diarrhetic Shellfish Poisoning (DSP) (FAO 2004). It is a cosmopolitan species with wide distribution and associated with red tide resulting to mass mortality of fish in countries like Gulf of Thailand and Seto Inland Sea in Japan (Okaichi 1967). In this sampling, however, it was recorded at low density ranging from 198–336 cells/m3 (0.07% of the total composition. Since there is an oyster farm in the estuary, although not so intensive, negative public health and economic impact is still possible if a high density *Dinophysis* bloom occur. It is therefore highly recommended to continue monitoring after the project to prevent negative public health impact brought about by possible high-density blooms of these species in other periods.

Diatoms, despite having more taxa representations than dinoflagellates, were the second most abundant phytoplankton group in terms of cell density, having a total of 52,951 cells/m3, or 37.0% composition of the community (Table 19 and Figure 41). Commonly found in warm tropical waters, diatoms provide significant influences in the overall primary productivity in such marine environments. Furthermore, these are some of the major food sources of filter-feeding shellfish, which were found along the coastal waters of the survey area. The pennate-forming diatom, *Pleurosigma* spp. was the most abundant in this group with a total density of 22,025 cells/m3, accounting for 15.4% composition of all recorded organisms. Other diatom species that contribute to the significant relative abundance were *Cylindricotheca* with 7,995 cells/m3 (5.58% of the total composition), *Nitzschia* with 6,856 cells/m3 (4.79% of the total composition), and

Rhizosolenia spp. with 3,303 cells/L (2.31% of total composition). These species can be found in marine and brackish water, while some species are also found in sediments. They play a significant role in the carbon, silica and nitrogen cycles in oligotrophic seas.

The solitary filamentous blue-green algae, *Trichodesmium* spp. had total density of 12,308 cells/m3 (8.59% composition) contributing to the total abundance of identified phytoplankton (Table 19 and Figure 42). This taxa is a quite common, but are known to form massive blooms and thus they have significant role in the marine ecosystem contributing more than 40% of all nitrogen-fixation processes occurring in the ocean (Karl 2000). Their blooms commonly occur in highly eutrophic water bodies. Photomicrographs of dominant and common phytoplankton found in the survey area.

The mean cell density of all phytoplankton in the six sampling stations was 23,867 cells/m3. In terms of spatial distribution, sampling station PI-2 had relatively the highest abundance with 40,971 cells/m3, while the highest taxa representation was in sampling stations PC-2 with 21 representations out of the total 33 documented organisms (Figure 42). These sampling stations are located at the primary Project Area (PI-1) and Control Area (PC-2) In contrast, the lowest phytoplankton density at 3,949 cells/m3 and the lowest taxa representation with 12 recorded organisms was attributed to sampling stations PC-2 and PO-2 respectively. In terms of dominance, diatoms dominated Project Area (PI-1 and PI-2) while dinoflagellates dominated in adjacent area (PO-1, PO-2) and Control Area (PC-1 and PC-2).

Table 2-11: Phytoplankton composition and abundance in the 6 sampling stations

TAXA	STATIONS						Grand Total	Rel. Abund.
	Project Area		Adjacent Area		Control Area			
	PI-1	PI-2	PO-1	PO-2	PC-1	PC-2		
Cyanobacteria	**396**	**3,703**	**1,942**	**3,362**	**2,448**	**479**	**12,330**	**8.61**
Lyngbya						22	22	0.02
Trichodesmium	396	3,703	1,942	3,362	2,448	457	12,308	8.59
Diatoms	**20,210**	**20,277**	**7,795**	**3,379**	**538**	**751**	**52,951**	**36.98**
Aulacosiera					131		131	0.09
Bacillaria		97	180			22	299	0.21
Chaetoceros		277	1,387		131		1,795	1.25
Cylindrotheca	6,539	929	277		33	218	7,995	5.58
Diploneis	2,576		555	219	8	98	3,455	2.41
Ditylium		97					97	0.07
Fragillaria	396						396	0.28
Gomphonema	793					44	836	0.58
Gyrosigma	594		97				692	0.48
Hemialus			180		106		286	0.2
Licmophora						120	120	0.08
Melosira	991	180	180	235		22	1,608	1.12
Navicula		277					277	0.19
Nitzschia	3,765	929	1,664	454		44	6,856	4.79
Odontella		97					97	0.07
Pinnularia	594	458					1,052	0.73
Pleurosigma	2,774	15,922	1,845	1,463		22	22,025	15.38
Rhabdonema						22	22	0.02
Rhizosolenia	793	458	1,012	790	131	120	3,303	2.31
Striatella						22	22	0.02
Surirella	396	555	416	219			1,586	1.11
Dinoflagellates	**5,152**	**16,990**	**16,741**	**29,269**	**7,049**	**2,720**	**77,920**	**54.41**
Akashiwo					98	22	120	0.08
Ceratium		1,110	1,207	555	1,142	392	4,405	3.08
Dinophysis	198			336	131	120	785	0.55
Diplopsalis	198	180	458	118	587	44	1,585	1.11
Goniodoma					33		33	0.02
Gonyaulax					326		326	0.23
Ornithcercus					131	44	174	0.12
Oxytoxum					98	22	120	0.08
Peridinium	4,755	14,036	14,424	26,025	4,438	1,958	65,637	45.84
Prorocentrum		1,664	652	2,236	65	120	4,737	3.31
Total Abundance	**25,758**	**40,971**	**26,477**	**36,011**	**10,035**	**3,949**	**143,201**	**100**
Mean Abundance = 23,867								
Richness	**15**	**17**	**16**	**12**	**17**	**21**		
Mean Richness = 16								
Evenness (J')	**0.81**	**0.59**	**0.64**	**0.45**	**0.61**	**0.63**		
Diversity (H')	**2.19**	**1.67**	**1.78**	**1.12**	**1.73**	**1.93**		

As shown in 2-25, diversity measurements based on the Shannon-Wiener Index were generally low (<2) except in Control Area which has a computed value of 2.12. In normal conditions for aquatic biota and the associated habitat, the resulting diversity index is more than a 2.0 value. In terms of evenness, the computed indices among the six sampling stations was moderately high in stations PI-1 and PO-2 with 0.81 and 0.88, respectively. This indicates that the phytoplankton community along the sampling stations is almost evenly distributed. The lowest computed value was revealed in station PO-2 mainly due to dominance of *Peridinium* sp. High plankton diversity in water body may indicate healthy and unpolluted conditions while dominance of only a few species may suggest otherwise (Rai et al. 2008). Phytoplankton abundance is highly variable and seasonal, but the diversity measurements in sampling stations PI-2 and PO-2 are indicative of stressful conditions caused by a disturbance which may possibly result from factors like high turbidity and eutrophication within the waters in the vicinities of the project site, which is unfavorable to the proliferation of tolerant phytoplankton organisms. For sampling station PC-2, the diversity and evenness values denote a relatively stable phytoplankton community. The overall impression from the results obtained in the phytoplankton sampling along the survey area is fair, with relatively low diversity values for most station. Furthermore, the potentially harmful genus *Dinophysis* found during the sampling period should also be noted as a possible threat to public health. The presence of these indicator organisms should be considered in a system of periodic monitoring that should be mandatory implemented in all phases of the project.

It is generally known that variation in nutrients and some physico-chemical parameters in the marine environment affects the proliferation and survival of phytoplankton, which also has a cascading effect to higher trophic levels. In this survey though, there was no correlation on the abundance, diversity and richness of phytoplankton to the level of pH, DO, concentration of nitrate and heavy metals (mercury, zinc, copper and lead) ($r<0.5$). The stations sampled had relatively uniform pH values ranging from 6.88 to 7.51, which were well within the DENR water quality standard for pH of Class SC (6.5 to 8.5). The dissolve oxygen values ranged from 5.56–7.51 mg/L which were also within the 5.0 mg/L minimum set by DENR DAO 2016-08 for Class SC waters. Lastly, the levels of tested nutrients were also very low to significantly affect the plankton community in the area. Other physico-chemical parameters not tested in this study might have an influence of the phytoplankton community and should not be ruled out.

2.2.4.7. Threat to existence and/or loss of important local species and habitat

Results of the marine study revealed potential environmental stressors in the area are industrial discharges from shipyards, and nutrient pollution from human settlement, overfishing, and fish farming. Coastal development also plays an environmentally detrimental role.

A dramatic amount of environmental stress found in the Project Area, with a near complete absence of fishes (3 species at very low densities) and benthic cover (2 species of soft corals at very low densities) and mobile invertebrates (5 species) such as sea urchins. Mangroves were reduced, polluted and showed a limited coverage perpendicular to shore, with shore-ward sections of the mangrove forest eliminated. A significantly elevated level found of nitrate and metal pollutants in the sea water, and an area of at least two square kilometers with high-density hydrocarbons (most likely heavy oil leaked from the ships docked in the shipyards).

The level of environmental stress quickly abated when moving away from the Project Area into the area immediately adjacent to it. An increase in the density and biodiversity of the benthic cover, mobile invertebrates (21 species) and fishes (20 species) has been found. The mangroves in the area immediately adjacent to the Project Area were heavily polluted (likely due to their location down-current of populated areas) and showed evidence of harvesting.

In a control site across the Mactan straitoff Mactan Island a density and biodiversity of the benthic cover, mobile invertebrates (33 species) and fishes (28 species) has been found. The reefs lacked a population of large- to medium-sized food fishes (groupers, snappers, sweetlips) but were otherwise in acceptable condition, in stark contrast to the heavily degraded marine ecosystem in the Project Area. Mangroves covered a larger distance perpendicular to shore and were noticeably cleaner. The number of mangrove tree species (3 species) was identical in the Project Area, in the adjacent and in the control area.

A survey of the fish market in Consolacion found 30 species of caught fish, with a minor overlap (6/30) with the species seen alive underwater. Severely undersized individuals dominated, and one invasive species (tilapia) was among the catch.

To conclude that primarily the shipyards, and to a lesser degree the untreated influx of human liquid waste, and fish farming along the coast of Consolacion cause massive environmental stress leading to a near-complete elimination of animal life in the most heavily affected areas, and a severe reduction of ecosystem functioning in the remainder of the area.

<u>Bufferzone from other Reclamation Project</u>

To ensure that coastal water will not be fully exhausted and developed by several reclamation projects. The Seafront City designed to have an adequate bufferzone with a minimum of 300-meter distance. The significance for the bufferzone is for the marine life ecosystem can still co-exist in the coastal water despite the developments of coastal water. Navigational area are still passable as well as passable access to Cansaga Bay.

Figure 2-55.b: Map Showing Bufferzone from other Reclamation Projects

2.2.5. Freshwater Ecology

2.2.5.1. Freshwater Assessment, Sampling Site Description and Methods

Last March 12, 2022, a group of biologists conducted the study at the two identified rivers. The results of the study will be used in doing the environmental impact assessment and analysis of the reclamation project. Among the life forms measured were benthos, fish, plankton and flora and fauna within the riparian area.

The study aimed to determine the baseline condition of the freshwater biodiversity of Cansaga River and Butuanon River. Specifically, the assessment wanted to achieve the following:

a. Describe the species composition, conservation status and diversity of macro-benthos in both rivers.

b. Describe the species composition, conservation status and diversity of fishes in both rivers.

c. Describe the species composition, abundance and diversity of plankton in both rivers.

d. Describe the species composition, conservation status and diversity of flora and fauna present within the adjacent riparian area of both rivers.

e. Determine ecologically and economically important species of benthos, fishes, planktons or flora and fauna present within both rivers and its adjacent riparian area.

f. Discuss pollution indicator species recorded in both rivers

The study was conducted at Cansaga River in Consolacion, Cebu and at Butuanon River in Mandaue City, Cebu. Both rivers drain in Cansaga Bay as shown in the image in Figure 2-44. A total of 3 sampling sites were established per river system with varying distances from the project site. The estuarine part is labeled as lower downstream; the next station is labeled as middle downstream and the third station which is farthest from the project site is labeled as upper downstream. Figure 1 shows the map of the benthos and plankton sampling sites established in the two rivers.

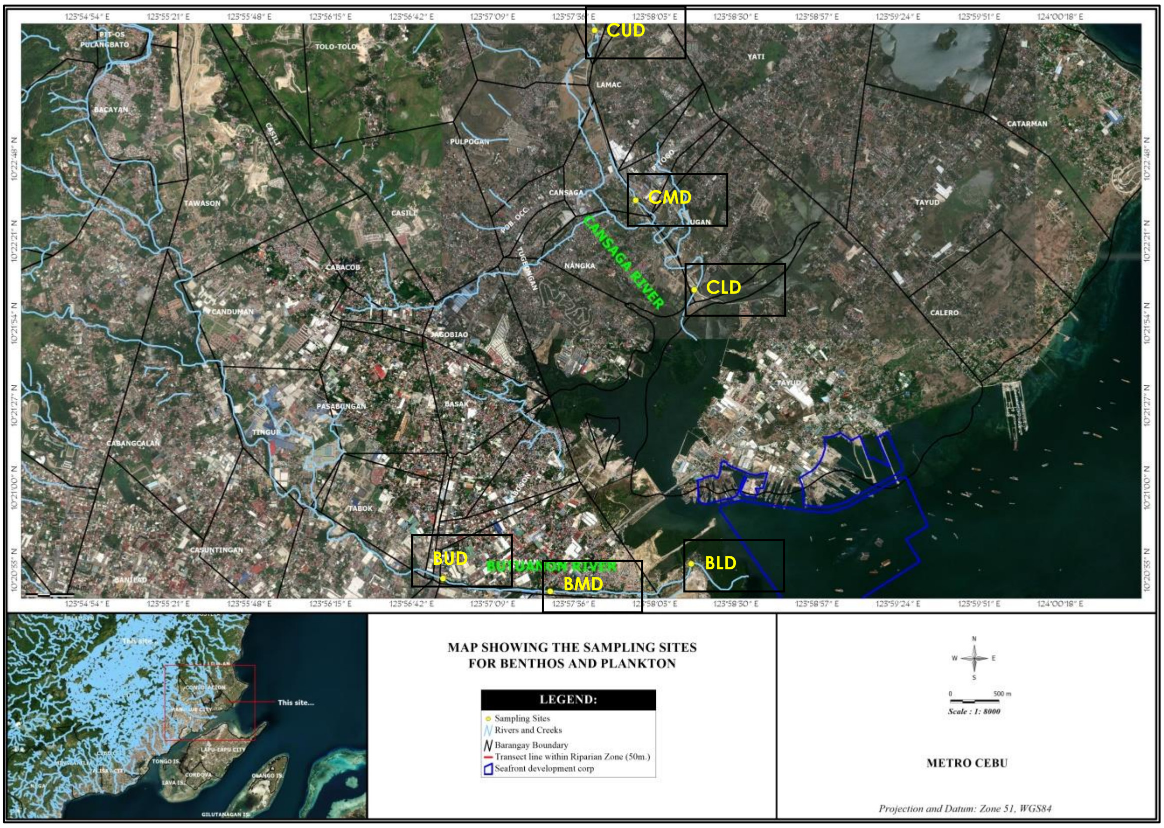


Figure 2-56: Map showing the sampling stations established in the 2 rivers

Table 2-27 shows the geographic coordinates and location description per sampling station.

Table 2-30: Summary of geographic coordinates and description per sampling station

Name of Station	Landmark / Location	Distance from the Project Site	Longitude	Latitude
Cansaga River				
1. Lower Downstream ***(CLD)***	Across PNP Regional Training Center, Camp Jesse Robredo, Brgy. Jugan, Consolacion, Cebu	1,820 m	123°58'15.0"	10°20'35.0"
2. Middle Downstream ***(CMD)***	Across SM Consolacion Beside Pitogo Bridge in Brgy. Pitogo, Consolacion, Cebu	2,960 m	123°57'28.0"	10°20'26.0"
3. Upper Downstream ***(CUD)***	Crossing of access road to Mahogany Residences in Brgy. Lamac, Consolacion, Cebu	4,600 m	123°56'52.0"	10°20'30.0"
Butuanon River				
4. Lower Downstream ***(BLD)***	Beside Dump Site in Brgy. Paknaan, Mandaue City, Cebu	570 m	123°57'42.0"	10°23'30.0"
5. Middle Downstream ***(BMD)***	Beside Mandaue Causeway Corner Ouano Ave. and Sitio Tambis, Brgy. Paknaan, Mandaue City, Cebu	1,960m	123°58'16.0"	10°22'05.0"
6. Upper Downstream ***(BUD)***	Beside Butuanon River View Deck along Corner U.N. Avenue and MC Briones St., Brgy. Paknaan, Mandaue City, Cebu	2,770m	123°57'56.0"	10°22'34.0"

In each station, 3 replicates were gathered during the sampling of plankton and benthos while a 50m transect line was laid per sampling station on both sides of the river within the riparian area to record associated flora and fauna. Each sampling station has its own physical conditions. Compared to Cansaga River, Butuanon River is more polluted because it has more adjacent industrial and residential users. It has been classified as Class D by EMB-7 or navigable waters.Photos below show the current condition of the river per sampling station.

Butuanon River Lower Downstream (BLD)

Butuanon River Middle Downstream (BMD)

Butuanon River Upper Downstream (BUD)

Cansaga River Lower Downstream (CLD)

ddle Dow

2.2.5.2. Abundance, Frequency and Distribution of Freshwater Species

Freshwater Benthos

Cansaga River

Species Composition and Diversity

A total of 8 species of freshwater macro-invertebrates belonging to 3 major groups/phyla namely: Annelids, Arthropods and Mollusk were recorded in the three sampling stations in Cansaga River. Class Insecta of the phylum Arthropoda dominated in the Upper (CUD) and Middle Downstream (CMD) portion while Class Mollusca dominated the Lower Downstream portion (CLD). It could be observed that there were more number of species at CMD (7 species) followed by CUD (6 species) while CLD had the least species (3 species). Table 2-28 below shows the list and distribution of species of the three sampling sites in Cansaga River.

Table 2-31: List of freshwater macro-invertebrate species recorded at Cansaga River

Phylum	Class / Species	CLD	CMD	CUD	IUCN Category
1. Annelida	**Clitellata**				
	Pheretima sp.	x	x		-
2. Arthropoda	**Insecta**				
	Brechmorhoga sp.		x	x	-
	Chironomus sp.		x	x	-
	Gerris sp.		x	x	-
	Pseudogrion sp.		x	x	-
	Decapoda				
	Caridina sp.		x	x	-
3. Mollusca	**Gastropoda**				
	Melanoides tuberculate	x			Not Evaluated
	Radix sp.	x	x	x	-
	No. of Species	**2**	***7***	***6***	
	Shannon diversity index H'	**0.65**	**1.29**	**0.75**	
	Esh	**0.59**	**0.66**	**0.42**	

Shannon-Wiener Diversity Index calculation yielded a value of 0.75 for CUD, 1.29 for CMD, and 0.65 for CLD. Simpson Index calculation yielded a value of 0.34 for CUD, 0.61 for Station CMD, and 0.41 for CLD. This implies that the distribution of dominant and non-dominant species is unequally distributed between the macro-invertebrate this is also supported by the low Evenness Index score, 0.33 for CUD, 0.66 for CMD, and 0.59 for CLD. This reveals that the river hosts **VERY LOW** macro-invertebrate diversity.

Species Density

Highest marcro-invertebrate density recorded was at the Upper Downstream portion with a total mean value of 25.68 indiv./2.4L. On the other hand, *Chironomus sp.* is the dominant species in both Middle and Upper Downstream area with mean densities of 20.83±2.89

indiv./2.4L and 6.94±16.67 indiv./2.4L while *Melanoides tuberculate* is the dominant species in the Lower Downstream portion of the river with mean density of 3.47±0.33 indiv./2.4L.

Chironomus is a genus of nonbiting midges in the subfamily Chironominae of the bloodworm family where in the larvae of this several species inhabit the profundal zone where they can reach relatively high densities to which was observe in the two sampling site.

The mean density of other macro-invertebrates is almost negligible with values ranging from 0.28 individuals to 3.47. This implies that the condition of Cansaga river could no longer support populations of benthic macro-invertebrates due to pollution.

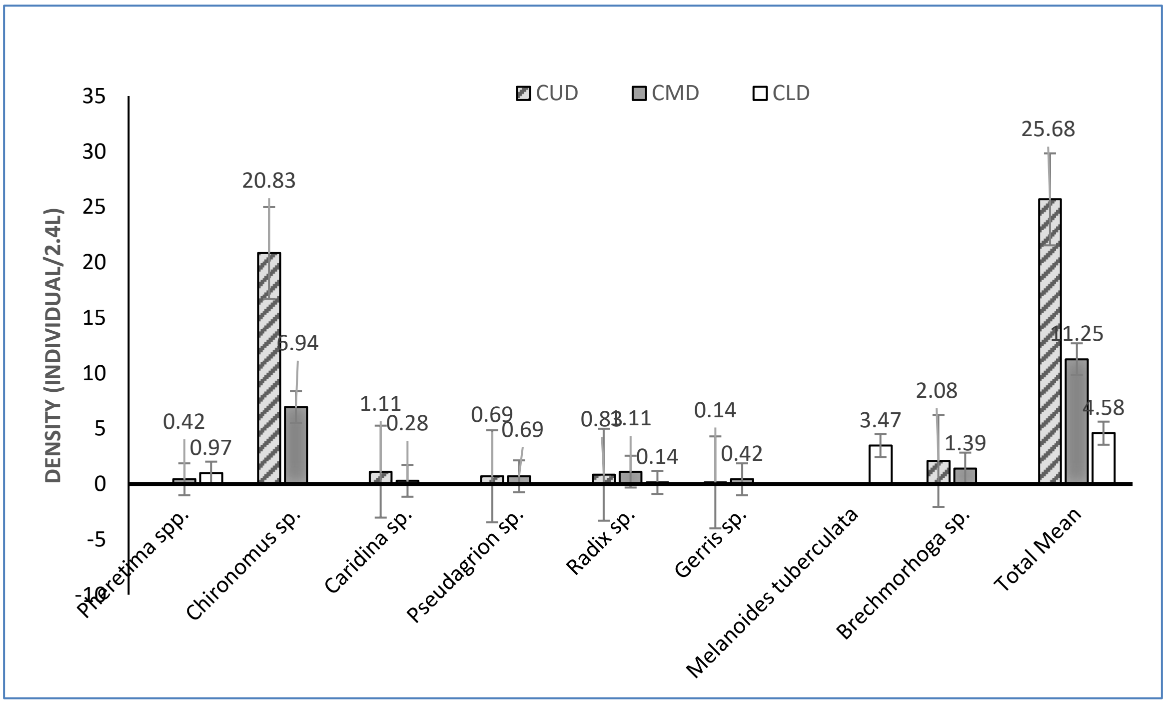


Figure 2-57: Mean macro-invertebrate density recorded in Cansaga River

Butuanon River

Species Density and Diversity

Meanwhile, a total of 7 species of freshwater macro-invertebrates belonging to 3 major groups / phyla namely: Arthropods, Annelids and Mollusks were recorded in all sampling stations in Butuanon River. Class Gastropoda (slugs and snails) dominated in all sampling sites. It could be observed that Gastropoda were more visible in the Upper downstream of the river. Table 2-29 shows the list and distribution of species in all sampling sites in Butuanon River.

Table 2-32: List of freshwater macro-invertebrate species recorded at Butuanon River

Phylum	Class/Species	BLD	BMD	BUD	IUCN Category
1. Arthropoda	**Insecta**				
	Drosophila melanogaster	x			Not Evaluated
	Corixidae	x			-
	Grylloidea		x		-
2. Annelida	**Clitellata**				
	Pheretima sp.		x		-
3. Mollusca	**Gastropoda**				
	Radix spp.	x		x	-
	Melanoides tuberculata			x	Not Evaluated
	Thiara scabra			x	Not Evaluated
	No. of species	**3**	**2**	**3**	
	Shannon diversity index H'	**0.87**	**0.67**	**0.89**	
	Esh	**0.79**	**0.97**	**0.81**	

Shannon-Wiener Diversity Index calculation yielded a value of 0.87 for Lower downstream, 0.67 Middle downstream and 0.89 in Upper downstream which implies that all of the sampling stations in the river yielded **VERY LOW** macro-invertebrate diversity. The index takes into account the number of species living in the habitat (richness) and their relative abundance (evenness).

Benthic invertebrates consume basal resources (algae, biofilms, organic matter) and thus link basal resources to higher trophic levels, including fishes. Often, benthic invertebrates are sampled in aquatic monitoring programs because they are diverse, generally sedentary, and are responsive to environmental alterations. More importantly they are good indicators of ecosystem productivity and health (Jones, 2011).

Figure 2-46 shows images of some of the documented benthic organisms in both rivers. (Complete photo documentation of macro-benthos can be found in the report's Annexes)

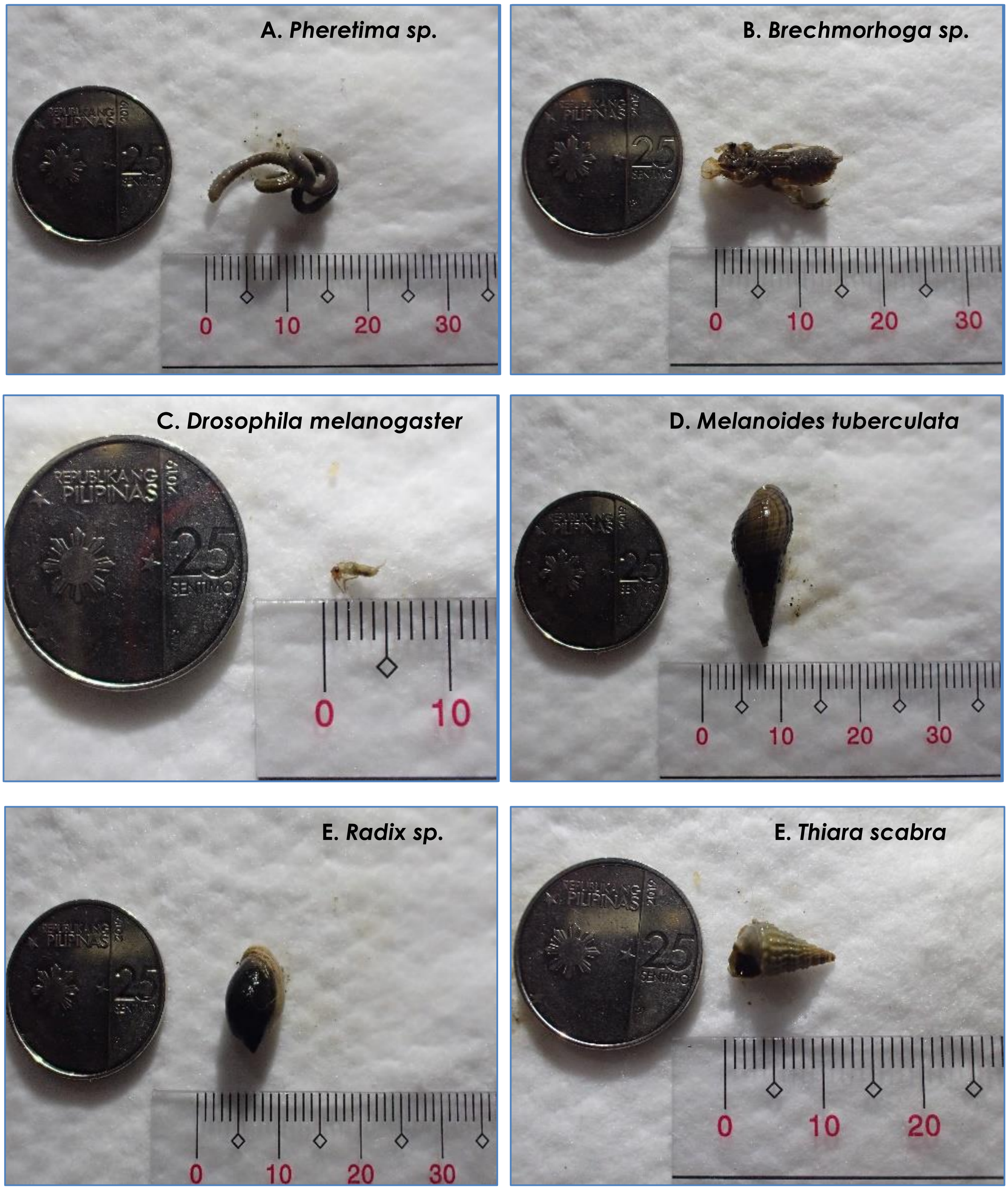


Figure 2-58: Images of some Macro-invertebrates documented in both rivers

Species Density

Highest macro-invertebrate density recorded was at Upper downstream with a total mean value of 5.0 indiv./L. The most dominant species is *Radix sp.* with a mean density value of 2.3±1.2 indiv./L and *Melanoides tuberculata* with a mean density value of 2.3±0.7 indiv./L present in the Upper downstream.

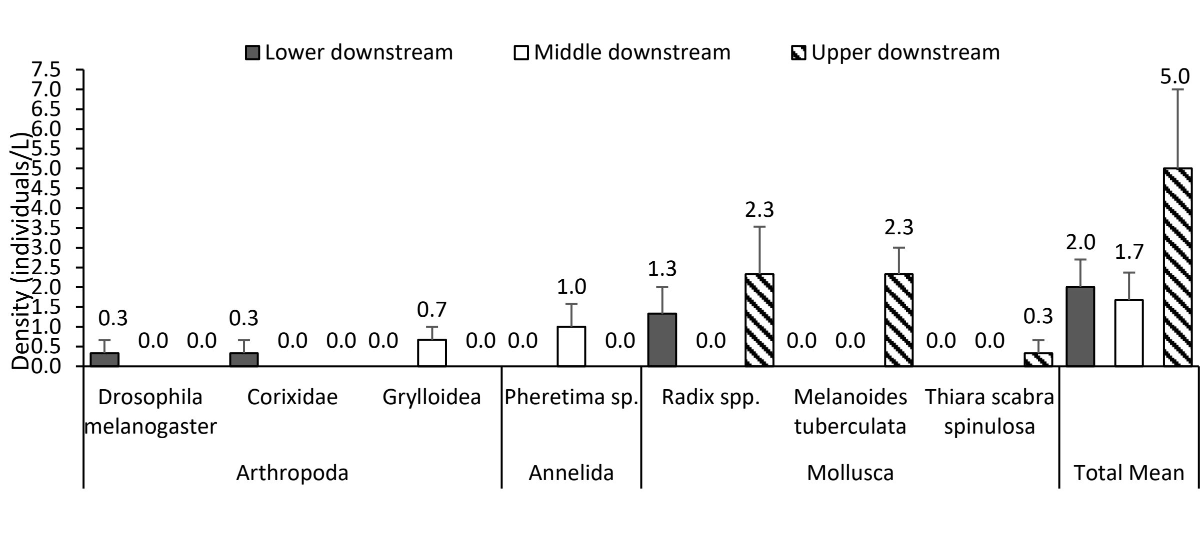


Figure 2-59: Mean macro-invertebrate density recorded in Butuanon River

Pollution Indicator Species

Using macroinvertebrate study is efficient way to monitor a river's health compared to other organism because they are extremely sensitive to their environment, widely distributed, and are economical to sampling compared to other sampling method. In this study it was observed that the dominant species in Cansaga River are *Chironomus sp.* and *Melanoides tuberculate.*

Chironomus sp. is one of the species indicator for contaminated water with high load of organic waste because of its larvae biology that can store large supply of hemoglobin in its body making reddish appearance, can store a large quantity of dissolve oxygen thus it can thrive in low oxygen environment making some of its species as indicator of mesotrophic waters (Patang *et at.* 2018).

On the other hand*, Melanoides tuberculate* is also species indicator of water pollution, this freshwater snail from Thiaridae family is a well-known species that can tolerate environments with low dissolved oxygen and high suspended particulate matters. It also has an operculum that can protect itself from drought, high salinity water, and toxic chemical in the environment making it as recommendable bioindicator of polluted ecosystem (Patang *et al.* 2018), (Mitchell *et al*. 2007).

<u>Freshwater Fish Community</u>

Species Composition and Diversity

A total of 3 species which are composed of 3 families namely Poecilidae (Livebearers), Cichidae (Tilapias) and Osphronemidae (Gouramy) were recorded in Cansaga River. Of which, all are Introduced species. No fishes were recorded in Butuanon River. Table 5 shows the list of fish species recorded in Cansaga River.

Table 2-33: List of Fish species recorded in Cansaga River

Family	Species	Status	IUCN	CUD	CMD	CLD
Poecilidae (Livebearers)	*Poecilia reticulata*	Introduced	Least Concern	x	x	x
Cichlidae (Tilapias)	*Oreochromis niloticus*	Introduced	Least Concern		x	x
Osphronemidae (Gouramy)	*Trichopodus sp.*	Introduced	Least Concern	x		
No of Species	**3**	**H'**		**0.19**	**1.6**	**0.59**
		E		**0.27**	**0.24**	**0.85**
		D		**0.09**	**0.08**	**0.45**

The dominant species in the three sampling station is the Poecilia reticulata a fish species which belongs to the family Poecilidae that inhabit fresh and brackish water and have been introduced widely and indiscriminately in many parts of the world as mosquito control agent (Araújo et al. 2009). This species is very prolific and successful in invasion of freshwater environment due to its small size high reproductive rate, and generalist nature (Ruesink 2005). In addition local accounts that piscivorous fishes like snakehead, catfish, and freshwater eel overfished in the river which supposed to be maintaining the population of *Poecilia reticulata* (Paler *et al.,* 2013).

Shannon-Wiener Diversity Index calculation yielded a value of 0.19 for Station 1, 1.6 for Station 2, and 0.59 for Station 3. Simpson Index calculation yielded a value of 0.09 for Station 1, 0.08 for Station 2, and 0.45 for Station 3 this implies that the distribution of dominant and non-dominant species is unequally distributed between the macro-invertebrate this is also support by the low Evenness Index score, 0.27 for Station 1, 0.08 for Station 2, and 0.45 for Station 3. This implies that the river hosts **VERY LOW** fish diversity.

Pollution Indicator Species

The presence of introduced freshwater fishes may represent both a symptom and cause of the decline in the river health and integrity of the native species (Kennard *et al.,* 2005). *Poecilia reticulate* the dominant species observed in the study is an indicator of a degrading river environment because of its opportunistic nature which colonize poor quality habitats that most of the freshwater species cannot survive (Araújo *et al.* 2009).

<u>Freshwater Plankton Community</u>

Cansaga River

Species Composition and Diversity

Overall, the Cansaga River sampling areas has a total of thirty-four (34) plankton species observed and recorded belonging to ten (10) Phylum and thirty-two (32) Families, wherein, one of the phyla is unranked and three unidentified family.

In terms of the species diversity per Sampling Area, the Shanon-Weiner Diversity Index fell under the category **LOW** as seen in Figure 12. Among the sampled areas, Cansaga Middle Downstream (CMD) had the highest diversity index with H'= 2.25198 and Evenness Index Esh= 0.78, followed by Cansaga Upper Downstream (CUD) with H'=2.25198 and Esh = 0.78, and then Cansaga Lower Downstream (CLD) with H'= 2.23980 and Esh = 0.81. As seen in Figure 6, the Shannon Evenness (Esh) in all sampling areas ranged from Esh = 0.78 to Esh = 0.89, thus, all the species density in sampled Stations were equitably distributed to the number of species identified in all sampling Stations. Hence, there were no dominating species observed in the sampled Stations since Shannon Evenness states that the equitability assumes a value between 0 and 1 with 1 being complete evenness.

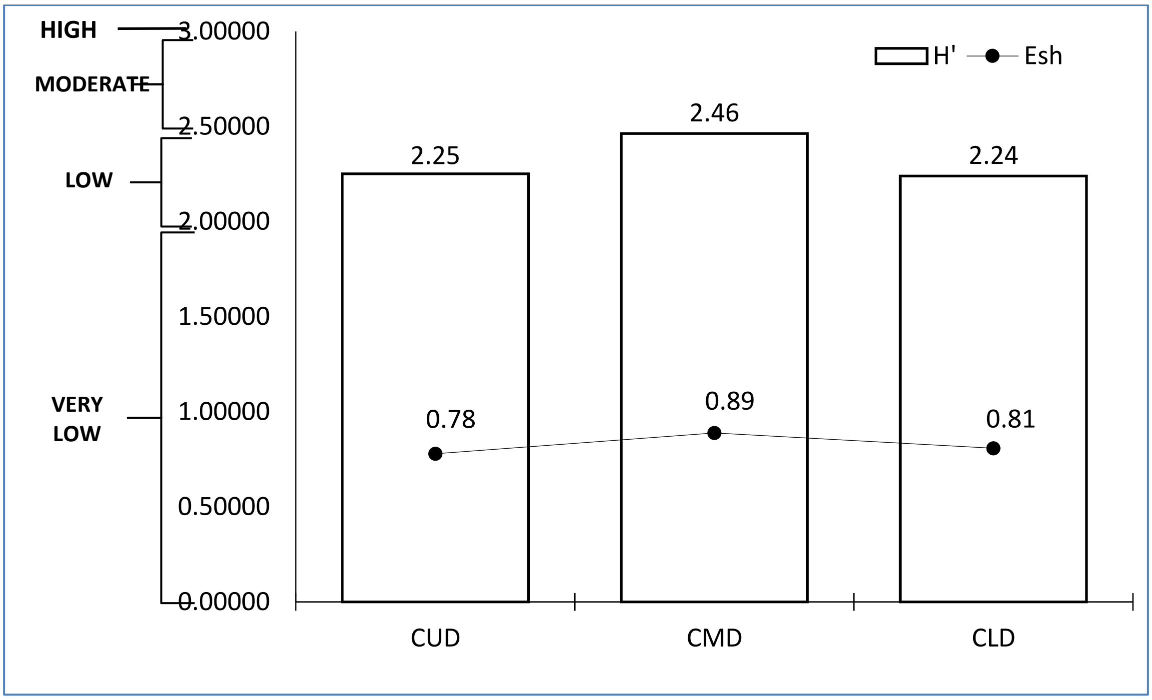


Figure 2-60: Shannon- Diversity Index and Evenness of the Plankton Community in Cansaga River

Species Density

The overall total density of plankton was 198.89 cells per mL (190 cells per mL and 8.89 cells per mL), of which, Cansaga Upper Downstream (CUD) had the highest density of 90 cells per mL, followed by Cansaga Lower Downstream (CLD) with 58.89 cells per mL, and Cansaga Middle Downstream (CMD) with 50.00 cells per mL.

The common phytoplankton species found within the three-sampling area were Planktothrix sp. (Cyanobacteria: Microcoleaceae), Prorocentrum sp. (Myzozoa: Prorocentraceae), and Thalassiosira sp. (Unranked: Thalassiosiraceae), respectively.

According to Ernst et al. (2001), Planktothrix species are capable of producing cyclic peptide toxin desmethyl microcystin-RR, which inhibits glycogen metabolism and has detrimental effects on the development of aquatic organisms. Figure 2-50 shows the mean density of plankton per species.

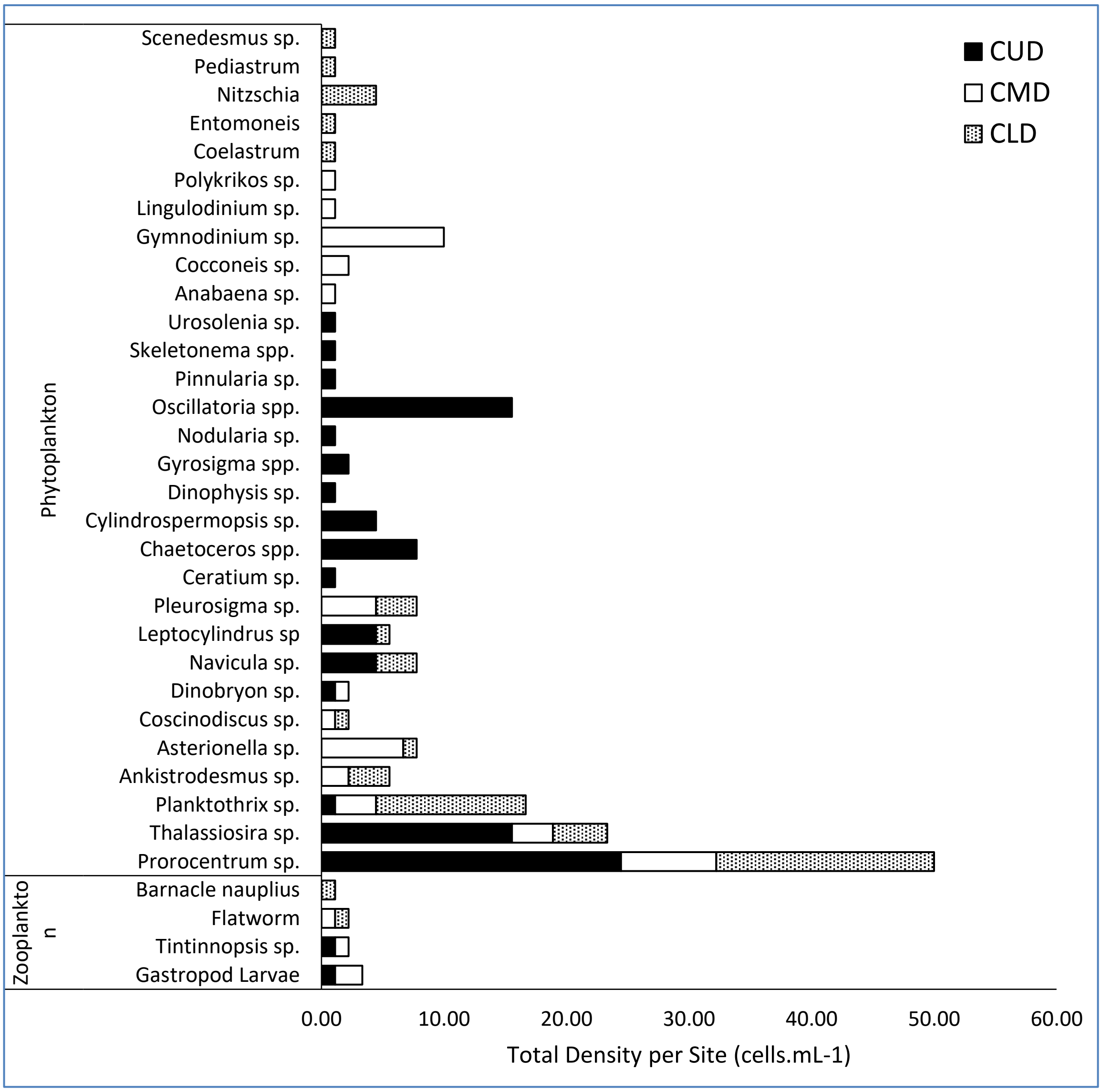


Figure 2-61: Mean Density per species of Plankton recorded in Cansaga River (cells.mL^{-1})

Butuanon River

Species Composition and Diversity

A total of 41 plankton species (38 phytoplankton species; 3 zooplankton species) under 31 families and 13 phyla were recorded in Butuanon River. Among the phyla, the phylum Cyanobacteria (11 species) and Ochrophyta (11 species) recorded the highest species richness. Cyanobacteria, commonly known as "blue-green" algae, and Ochrophyta as "diatoms," are classified as phytoplankton and are naturally present in wide arrays of water such as freshwater, marine, and brackish water (Burkholder, 2009). Zooplankton belonging to the phylum Chordata, Mollusca, and Rotifera were also recorded in the area.

The plankton population in the Butuan River falls under the **LOW AND VERY LOW** (H' ranges from 1.65 to 2.20) categories of the diversity index (Figure 13). The result is somewhat expected because the Butuanon river is listed as one of the dead rivers classified by DENR-EMB Region 7. Also, the population of plankton with respect to the number of species is not equally distributed (J' ranges from 0.58 to 0.66). Hence, there are plankton species that tend to dominate in some of the areas.

Figure 2-51 shows the diversity index and evenness per sampling station in Butuanon River.

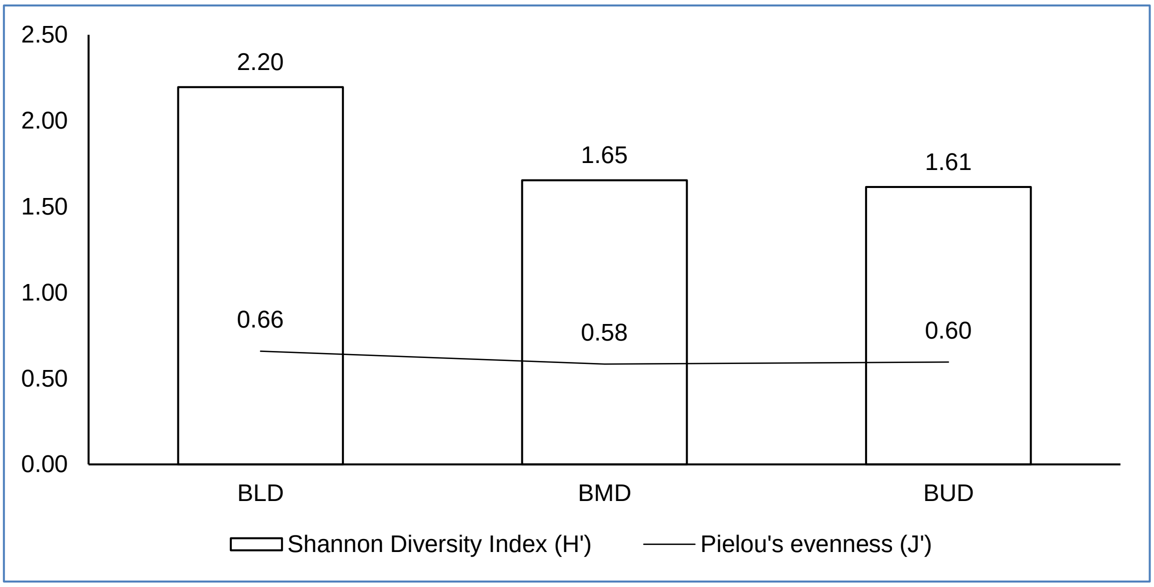


Figure 2-62: Shannon Diversity Index and Evenness of the Plankton Community in Butuanon River

Species Density

The results showed that phytoplankton generally dominates the plankton population in the Butuanon River. Chlorella ranks first among the phytoplankton species recorded. Chlorella is mainly freshwater and is particularly common in eutrophic or nutrient-rich waters (Borowitzka, 2018).

Only three species were identified for zooplankton. Rotifers are the most common freshwater zooplankton. However, results showed that Oikupleura appeared to have the highest density among zooplankton species. Although marine in nature, Oikupleura are also seen in brackish water (marinespecies.org), which explains why Oikupleura species were only seen lower downstream (see Table 7).

Overall, the lower downstream had the highest mean density among the stations. This could be attributed to the high number of species present in the area and the nutrient input from the upper stream. Figure 2-52 shows the mean density of plankton per species.

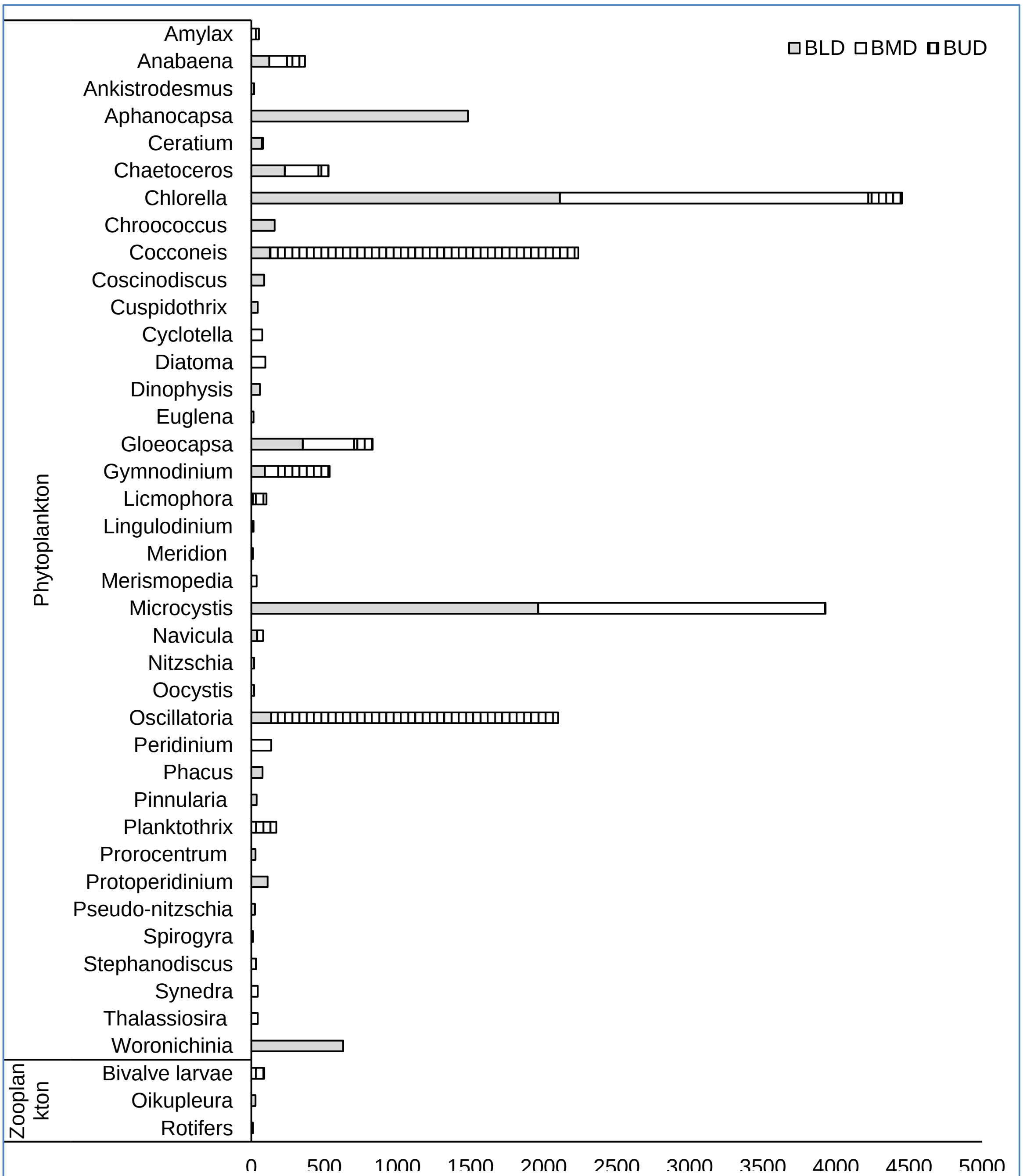


Figure 2-63: Mean Density per species of Plankton recorded in Cansaga River (cells.mL^{-1})

Cansaga River

Among the identified phytoplankton species in the Upper Downstream is the Dinophysis sp. which is a phytoplankton capable of producing okadic acid, dinophysis toxins and pectenotoxins that can inhibit protein phosphatase and can cause diarrhea (Reguera et al., 2012). It is commonly distributed in tropical and temperate regions. In addition, the phytoplankton species, Dinobryon sp. bloom can produce volatile organic compounds (VOCs) which affect water quality and can produce odors. According to Pearl (1998), phytoplankton blooming state ranges from from 104 to >106 cells.mL-1. In in case both, the Dinophysis sp. (1.11±0.27 cells.mL-1) and Dinobryon sp. (1.11±0.27 cells.mL-1) phytoplankton were not yet in blooming state.

Also recorded in the Middle Downstream of Cansaga River is the species Asterionella sp. are capable to photosynthesize and converts dissolved carbon dioxide into organic compounds (De Bruin et al., 2004 and Spaulding, 2012). However, if Asterionella sp. is overpopulated and blooms, it can cause oxygen suffocation and can produce toxins (De Bruin et al., 2004). Yet, during the sampling, the Asterionella sp. was not in bloom since 2.22±0.33 cells.mL-1. According to Pearl (1998), phytoplankton blooming state ranges from from 104 to >106 cells.mL-1. Presence of Polykrikos sp. was observed during the sampling, the said phytoplankton are capable to regulate algal blooms since they feed on toxic dinoflagellates (Gavelis et al., 2017), yet they can be toxic to certain fish species (Nagai et al., 2002).

The phytoplankton Dinobryon sp. was also observed in both upper and middle downstream of the Cansagay River sampling areas but not in bloom. As stated earlier, the Dinobryon sp. bloom can produce volatile organic compounds (VOCs) which affect water quality and can produce odors.

Another notable phytoplankton recorded was the *Scenedesmus* sp., a colonial green alga that is commonly used in experiments such as pollution studies and sewage purification process since it can provide oxygen to breakdown bacteria of organic matter that can destroy harmful substances (Britannica, n.d.).

Butuanon River

Around 42% of the plankton community in Butuanon River may contain toxins resulting in harmful blooms, while 58% of the plankton community do not. A study conducted by Pearl (1998) states that the plankton starts to bloom when it reaches 10,000 to 1,000,000 (104 to >106) cells mL-1.

The highest mean cell count mL-1 recorded for toxin-producing plankton in the Butuanon River was 3926 cells mL-1, as shown in Table 8. Species listed in Table 8 are also called pollution indicator species. Experts often analyze and monitor the density of these species to identify if the area is eutrophic or has high nutrient inputs from direct and indirect sources.

Table 2-34: List of Pollution Indicator Species causing Harmful Algal Blooms in Butuanon River

Phylum	Family	Genus	Mean no. of cells mL^{-1}
Cyanobacteria	Nostocaceae	*Anabaena*	367
Cyanobacteria	Microcystaceae	*Microsystis*	100
Cyanobacteria	Microcoleaceae	*Planktothrix*	3926
Cyanobacteria	Coelosphaeriaceae	*Woronichinia*	630
Cyanobacteria	Oscillatoriaceae	*Oscillatoria*	2100
Dinoflagellata	Gymnodiniaceae	*Gymnodinium*	1970
Dinoflagellata	Protoperidiniaceae	*Protoperidinium*	111
Myzozoa	Dinophysaceae	*Dinophysis*	59
Myzozoa	Gonyaulacaceae	*Lingulodinium*	274
Myzozoa	Peridiniaceae	*Peridinium*	137
Myzozoa	Prorocentraceae	*Prorocentrum*	30
Ochrophyta	Bacillariaceae	*Pseudo-nitzschia*	26

Results showed that the plankton community in Butuanon river would not exhibit algal blooms. However, it should be noted that these values were only applicable on the time and day of collection and will vary depending on the nutrient input from the nearby household and factories. An increase in nutrient input may potentially lead to the rise of the plankton population, causing algal bloom.

Riparian Community

Floral Species Composition and Conservation Status

Results revealed that a total of forty-nine (49) riparian vascular plants belonging to twenty (20) plant families were recorded in both rivers. Out of these species, trees were the highest recorded species in terms of growth form with thirty-two (32), followed by herbs (11), shrubs (3), and vines (3). Amongst the plant families identified, family Fabaceae was the well-represented with eight (8) recorded genera, followed by Poaceae (6) and Euphorbiaceae (3), while the remaining families have 2 to 1 genera each. Table 1 shows the species richness of the 2 assessment sites: Butuanon River and Cansaga River. Out of the 49 recorded species, Butuanon River recorded the most species with 30, while Cansaga River had twenty-nine (29). Moreover, none of the recorded species were identified as Philippine endemic. Moreover, P. inidcus and S. mahogani were the only species to be identified as Endangered and Near Threatened, respectively, in terms of conservation status. However, in terms of localized distribution, S. mahogani is considered Least Concern as the species were once the preferred subject for rehabilitation aiding the rapid multiplication of the species. Also, twenty-eight (28) plant species were distinguished on specific sampling stations. Native species refers to species that naturally thrive, endure, reproduce, or disappear wherein their distribution is not commonly static or limited to a specific location (Pereyra, 2020), hence denoting healthy ecosystems and inducing the survival of native and helthy biodiversity (Weinstein et al., 1990). Table 2-32 shows the list of all recorded plant species in both rivers.

Table 2-35: List of all recorded floral species and their conservation status

Family	Species	Local / Common Name	Butuanon River	Cansaga River	Conservation Status (IUCN, 2022)	Distribution Classification
Anacardiaceae	*Mangifera indica* L.	manga	✔		LC	Non-Native
Annonaceae	*Monoon longifolium* Sonn. B.Xue & R.M.K.Saunders	Indian tree	✔		LC	Non-Native
Acanthaceae	*Avicennia marina* (Forssk.) Vierh.	bungalon	✔	✔	LC	Native
	Ruellia tuberosa L.			✔	LC	Non-Native
Araceae	*Alocasia macrorrhizos* (L.) G.Don	biga	✔	✔	LC	Native
Araliaceae	*Polyscias nodosa* (Blume) Seem.	bingliw	✔		LC	Native
Arecaceae	*Cocos nucifera* L.	niyog	✔		LC	Native
	Corypha utan Lam.	buli	✔		LC	Native
Asteraceae	*Bidens alba*			✔	LC	Non-Native
	Chromolaena odorata Linn.	Hagonoy		✔	LC	Non-Native
Caricaceae	*Carica papaya* L.	kapayas	✔		LC	Native
Combretaceae	*Combretum indicum* (L.) De Filipps			✔	LC	Non-Native
	Terminalia catappa L.	talisay	✔	✔	LC	Native
Convolvulaceae	*Ipomeae aquatica* Forssk.	kangkong		✔	LC	Native
Cucurbitaceae	*Cucurbita maxima* Duchesne	kalabasa		✔	LC	Non-Native
Euphorbiaceae	*Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll.	alim	✔		LC	Native
	Ricinus communis L.			✔	LC	Non-Native
	Macaranga tanarius (L.) Müll.Arg.	binunga		✔	LC	Native
Fabaceae	*Delonix regia* (Boj. ex Hook.) Raf.	Fire tree	✔		LC	Non-Native

	Gliricidia sepium (Jacq.) Kunth ex Walp.	Madre de cacao	✔		LC	Non-Native
	Leucaena leucocephala (Lam.) de Wit	ipil-ipil	✔	✔	LC	Non-Native
	Millettia pinnata (L.) Panigrahi	bani		✔	LC	Native
	Mimosa pudica L.	makahiya		✔	LC	Non-Native
	Pterocarpus indicus Willd.	narra	✔		EN	Native
	Tamarindus indica L.	sambag / sampalok	✔		LC	Non-Native
	Samanea saman (Jacq.) Merr.		✔		LC	Non-Native
Lamiaceae	*Gmelina arborea* Roxb.	gmelina	✔	✔	LC	Non-Native
	Premna serratifolia L.			✔	LC	Native
Lythraceae	*Sonneratia alba* Sm.	pagatpat / piapi		✔	LC	Native
Meliaceae	*Azadirachta indica* A.Juss.	neem tree	✔		LC	Non-Native
	Melia azedarach L.	bagalunga	✔		LC	Native
	Swietenia mahagoni (L.) Jacq.	mahogany	✔		NT	Non-Native
Moraceae	*Artocarpus blancoi* Merr	antipolo		✔	LC	Native
	Artocarpus heterophyllus Lam.	nangka	✔		LC	Non-Native
	Ficus benjamina L.	balete		✔	LC	Native
	Ficus callosa Willd.	taloot	✔	✔	LC	Native
	Ficus nota (Blanco) Merr.	tubog		✔	LC	Native
	Ficus religiosa L.				LC	Native
	Ficus septica Burm.f.	lagnob	✔	✔	LC	Native
Muntingiaceae	*Muntingia calabura* L.		✔	✔	LC	Non-Native
Musaceae	*Musa acuminata* Colla	saging	✔		LC	Native
Myrtaceae	*Syzigium cumini* (L.) Skeels.	lomboy	✔		LC	Native
Poaceae	*Bambusa* sp.	kawayan	✔		LC	
	Cenchrus purpureus (Schumach.) Morrone	Napier grass	✔	✔	LC	Non-Native

	Eleusine indica (L.) Gaertn.	paragis		✔	LC	Native
	Flagellaria indica		✔	✔	LC	Native
	Paspalum conjugatum P.J. Bergius	buffalo grass		✔	LC	Non-Native
	Setaria palmifolia (J.Koenig) Stapf	palm grass		✔	LC	Native
Vitaceae	*Causonis trifolia* (L.)Mabb. & J.Wen	langingi	✔	✔	LC	Non-Native

Legend: LC = Least Concerned, EN = Endangered

Both sampling stations in Lower downstream received the lowest species richness which could be due to the higher number of households and structures present on areas adjacent to the sampling stations. Although the stations can be considered with minimal physical anthropogenic disturbance, these results on downstream sampling stations were still expected given the high amount of pollutants in the river that most plants cannot tolerate, such as household sewerage wastes. It can also be observed that the plant species recorded in upper downstream were perennial grasses (*Bambusa sp.*, *C. purpureus*) and weeds (*M. pudica*), fast-spreading non-native species (*L. leucocephala*, *S. mahogany*), mangrove species (*S. alba*, *A. marina*) and native species common along waterways that can tolerate such water stresses, stabilize stream bank, and aid in soil and water conservation (*F. religiosa*, *T. catappa, M. azedarach*). Moreover, the sampling stations were composed of thick muddy substrate mixed with sewerage from nearby households with slow water movement due to structures present beyond the sampling stations.

The Middle Downstream of Cansaga River and Upper Downstream of Butuanon River recorded the highest species richness among the sampling stations. This was due to the optimal amount of sunlight that the sampling station is receiving. Adjacent structures and expanding canopy cover of large trees in Cansaga River and tree planation composed of *P. indicus* and *S. mahogani* allow other perennial grasses and low-shade tolerant plants to germinate and survive (e.g. C. odorata) (Solofondranohatra et al., 2021). Furthermore, terrestrial and riparian ecosystems with open canopies can be predominated with perennial grasses and weeds if they primarily take over the area thus competing for space and nutrients with the other above-ground species (Casatti et al., 2009). This observation is similarly observed on both the Upper Downstream of Cansaga River and Middle Downstream of Butuanon River wherein 4 species under Poaceae were recorded covering almost 35% of the sampling station.

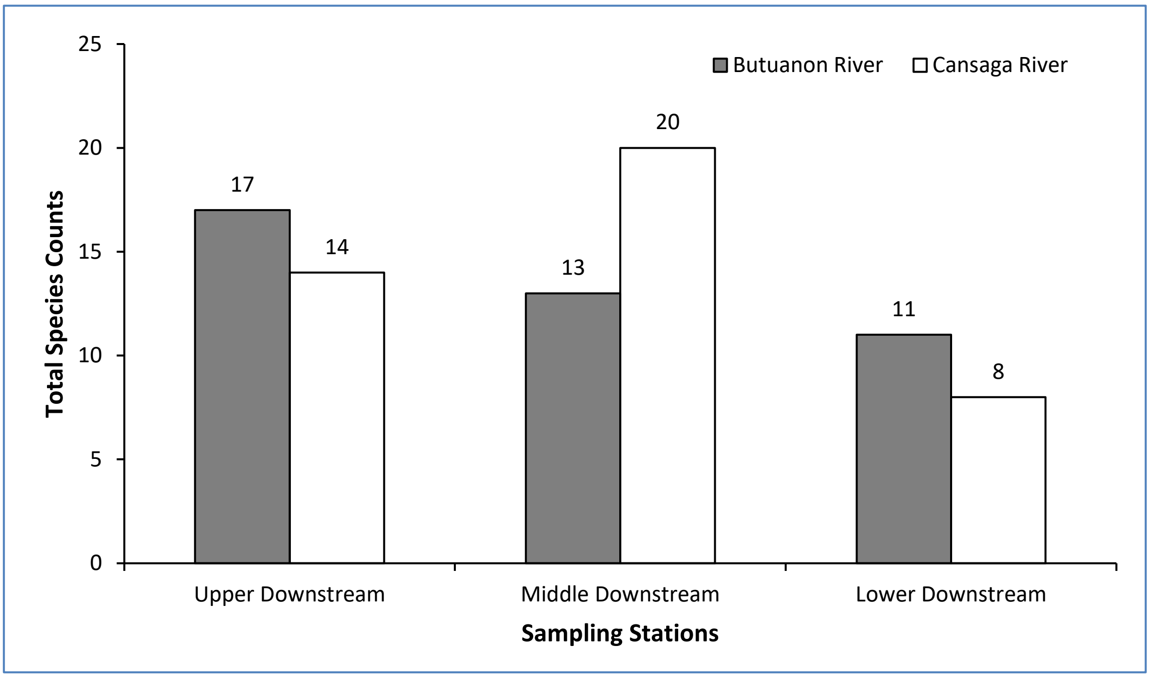


Figure 2-64: Total species count of all floral species per sampling station in both rivers

Faunal Species Composition and Conservation Status

The riparian assessment recorded a total of twenty species of vertebrates and non-vertebrate species belonging to 18 animal families. Amongst the recorded families, Family Libellulidae was the well-represented family with 2 genera of 3 species. All other families were composed of 1 genus each with 1 species each. The twenty recorded species were composed of birds (10), amphibian (1), fishes (3), and insects (6) wherein all of them were considered Least Concern in terms of conservation status. In terms of species richness, Cansaga River recorded the most species with 14, while Butuanon River only recorded 7 animal species. It must be noted that all recorded locomotive species were observed perching or foraging inside or adjacent the sampling stations.

Table 2-36: List of all recorded faunal species and their conservation status

Family	Species	Common name	Butuanon River	Cansaga River	Conservation Status
Acrididae	*Valanga sp.*	Green grasshopper		✓	Least Concern
Alcedinidae	*Todiramphus chloris*	White collared kingfisher	✓		Least Concern
Apodidae	*Collocalia esculenta*	Glossy Swiftlet	✓		Least Concern
Ardeidae	*Egretta garzetta*	Little Egret		✓	Least Concern
Bufonidae	*Rhinella marina*	Cane Toad		✓	Least Concern
Coenagrionidae	*Ischnura senegalensis*	Blue damsel fly		✓	Least Concern
Columbidae	*Geopelia striata*	Zebra Dove	✓		Least Concern
Estrildidae	*Lonchura atricapilla*	Chestnut Munia		✓	Least Concern

Laridae	*Chlidonias hybrida*	Whiskered Tern	✓		Least Concern
Libellulidae	*Neurothemis sp.*	Brown dragon fly		✓	Least Concern
	Neurothemis fluctuans	Red-black damsel fly		✓	Least Concern
	Orthetrum sp.	Green damsel fly		✓	Least Concern
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird	✓		Least Concern
Osphronemidae	*Trichopodus sp.*	Gourami		✓	Least Concern
Oxudercidae	*Periophthalmodon sp.*	Mudskipper		✓	Least Concern
Passeridae	*Passer montanus*	Eurasian Tree Sparrow	✓	✓	Least Concern
Pieridae	*Leptosia sp.*	Psyche Butterfly		✓	Least Concern
Poeciliidae	*Gambusia affinis*	Masquito fish		✓	Least Concern
Rhipiduridae	*Rhipidura nigritorquis*	Philippine Pied Fantail		✓	Least Concern
Sturnidae	*Aplonis panayensis*	Asian Glossy starling	✓		Least Concern
	TOTAL		**7**	**14**	

The Upper Downstream in Cansaga River recorded the most individuals (31) per sampling plot. Huge percentage of the total count came from the total number of recorded Mosquito fish (*G. affinis*). Numerous individuals of bio-indicators (damsel flies and dragonflies) were also recorded in the station indicating a healthy ecosystem with less to no pollutants (Catling, 2005; Hardersen, 2000; Bulánková, 1997). The presence and numbers of damselflies and dragonflies are effective bio-indictors of healthy environment especially on aquatic (e.g wetlands, riparian ecosystems) and open ecosystems (e.g grasslands), and on sewage lagoons (Catling, 2005; Bulánková, 1997).

The result of the Upper Downstream in Butuanon River was in total contrary in which zero faunal species were recorded. This was probably caused by the disturbance and noise generated from vehicles, humans, and other factors since the sampling station was adjacent to national highway and households.

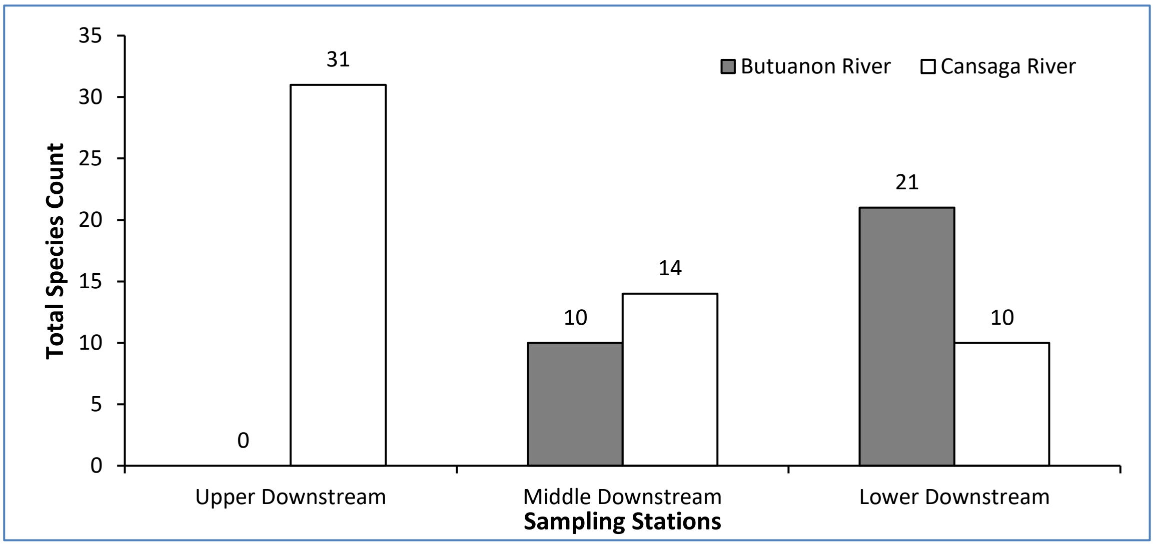


Figure 2-65: Total species count of all recorded faunal per sampling station in both rivers

2.3. THE AIR

2.3.1. Meteorology/Climatology

Change in the Local Climate, Local Temperature

Monthly Average Rainfall of the Area

The 10-year annual rainfall data taken from PAGASA Mactan showed that the rainy season in Cebu starts in late May- June to November and slightly extending until January. Wettest month is on the month of July. The remaining months from February to April are expected to be dry.

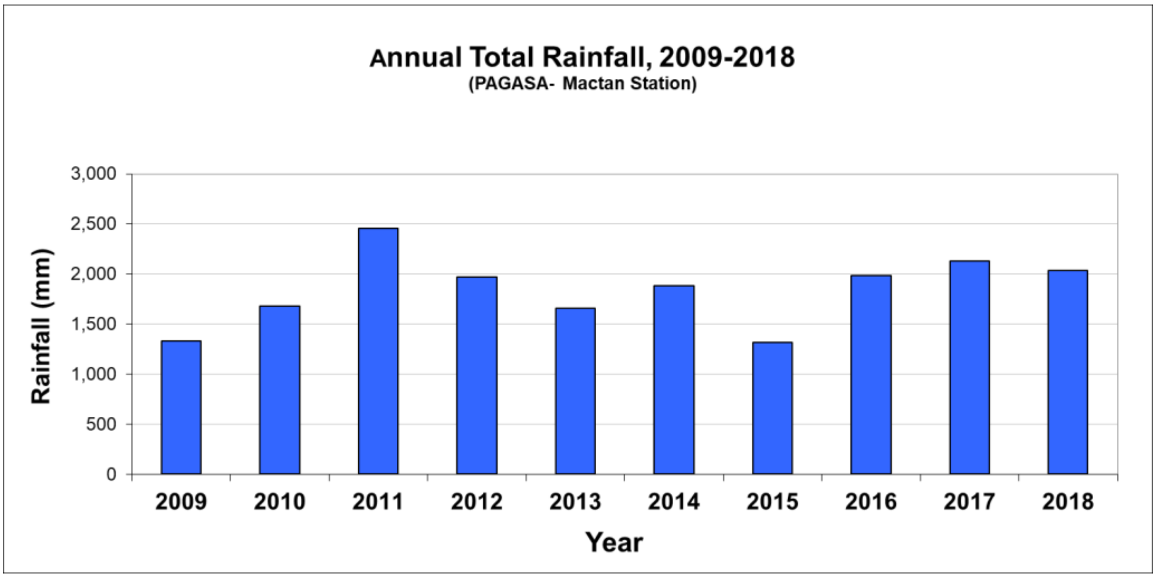


Figure 2-66: 10 Year Annual Rainfall from2009-2018 *(Source: PAGASA Mactan Station)*

Climatological Normal

Climatological normal to period averages computed for a uniform and relative long period comprising at least three (3) consecutive 10-year period. It summarizes the average values of rainfall, temperature, vapor pressure, wind speed, relative humidity, and number rainy days at the weather station. Table 1-34 below shows the data taken from the Mactan International Airport Station, where the annual rainfall of Cebu amounts to 1564.5mm.

Table 2-37: Summary of Climatological Normal in Cebu ***(Source: PAGASA Mactan Station, 2015)***

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16a)	(16b)
MONTH	RAINFALL		TEMPERATURE						VAPOR PRESS. (mbs)	RH (%)	MSLP (mbs)	WIND		CLOUD AMT. (okta)	NO. OF DAYS W/	
	AMOUNT (mm)	NO. OF RD	MAX (°C)	MIN (°C)	MEAN (°C)	DRY BULB (°C)	WET BULB (°C)	DEW POINT (°C)				DIR (16pt)	SPD (mps)		TSTM	LTNG
JAN	105.2	12	29.8	23.9	26.8	26.7	24.4	23.6	29	83	1012	NE	3	6	1	0
FEB	69.6	9	30.2	24	27.1	26.9	24.4	23.5	28.8	81	1012	NE	3	5	1	1
MAR	58.6	8	31.1	24.5	27.8	27.8	24.9	23.9	29.5	79	1012	NE	3	5	1	1
APR	48.1	6	32.3	25.4	28.8	28.9	25.6	24.5	30.5	77	1011	NE	3	4	3	2
MAY	95	10	32.8	25.8	29.3	29.3	26.1	25.1	31.6	78	1010	E	2	5	9	8
JUN	175.6	14	32.1	25.4	28.8	28.6	25.9	25	31.5	81	1010	SW	2	6	11	9
JUL	192.9	16	31.5	24.9	28.2	28	25.6	24.8	31.2	82	1009	SW	2	6	13	9
AUG	143.5	14	31.7	25	28.4	28.1	25.5	24.6	30.8	81	1009	SW	3	6	11	7
SEP	179.6	15	31.8	24.9	28.3	28.1	25.6	24.8	31.1	82	1010	SW	2	6	14	10
OCT	194.8	16	31.4	24.8	28.1	27.9	25.6	24.8	31.2	83	1010	NE	2	6	14	10
NOV	161.9	14	31	24.7	27.8	27.7	25.4	24.6	30.8	83	1010	NE	3	6	6	6
DEC	139.7	14	30.2	24.3	27.3	27.1	24.9	24.1	30	84	1011	NE	3	5	3	2
ANNUAL	**1564.5**	**146**	**31.3**	**24.8**	**28.1**	**27.9**	**25.3**	**24.4**	**30.5**	**81**	**1010**	**NE**	**3**	**6**	**87**	**65**

Climatological Extremes

Climatological extremes refer to the maximum and minimum values of weather-related data as observed and determined from and long period of data gathered by a weather station. These values include precipitation, temperature, wind speed, and sea level pressure at the weather station. These data can be requested from PAGASA at monthly or annual extremes. The data from Mactan International Airport Station. Low pressure and high wind speed indicate possible presence of a weather disturbance or a typhoon.

Table 2-38: Summary of Climatological Extremes in Cebu ***(Source: PAGASA Mactan Station, 2015)***

MONTH	TEMPERATURE (°C)				GREATEST DAILY RAINFALL (mm)		STRONGEST WINDS (mps)			SEA LEVEL PRESSURES (mbs)			
	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN	33.5	01-03-1988	19.8	01-21-1997	126.6	01-08-1999	30	NE	01-24-1975	1019.8	01-29-1998	995.3	01-24-1975
FEB	33.4	02-12-2011	20.0	02-16-2004	107.2	02-08-2012	22	E	02-18-1988	1019.8	02-01-1998	1003.8	02-18-2001
MAR	33.9	03-31-2004	20.0	03-02-2000	141.3	03-26-1982	25	SW	03-26-1982	1018.9	03-23-1998	996.0	03-26-1982
APR	35.6	04-15-1992	22.1	04-01-2003	174.0	04-04-1994	30	SW	04-04-1994	1018.1	04-05-1998	998.1	03-26-1982
MAY	37.0	05-31-2010	22.0	05-27-2007	106.0	05-27-2000	20	W	05-17-1987	1015.4	05-02-1998	1000.2	05-21-1976
JUN	36.4	06-07-2010	20.2	06-20-1997	88.0	06-05-2016	18	SW	06-25-1992	1016.5	06-07-1997	1000.5	06-29-2004
JUL	35.3	07-20-1973	20.8	07-05-1990	151.9	07-02-2016	20	SE	07-17-1998	1015.9	07-11-1979	997.9	07-03-2001
							20	SW	07-05-2015				
AUG	35.6	08-27-1998	21.1	08-19-1981	96.6	08-17-1982	25	SW	08-15-1986	1015.7	08-11-1997	1001.5	08-01-1986
SEP	35.6	09-05-2016	21.5	09-18-1972	127.0	09-26-1989	48	NE	09-02-1984	1017.5	09-22-2018	983.4	09-02-1984
OCT	34.4	10-22-1987	22.0	10-13-2009	166.1	10-28-1995	25	SW	10-28-1995	1016.8	10-05-1987	996.8	10-28-1995
NOV	33.8	11-02-1993	20.4	11-22-1998	276.1	11-12-1990	55	S	11-12-1990	1017.4	11-08-1997	971.1	11-12-1990
DEC	34.0	12-01-2006	20.0	12-28-1996	185.4	12-05-2001	42	S	12-26-1993	1018.3	12-12-2002	995.1	12-26-1993
ANNUAL	37.0	05-31-2010	19.8	01-21-1997	276.1	11-12-1990	55	S	11-12-1990	1019.8	01-29-1998	971.1	11-12-1990
										1019.8	02.01-1998		
Period of Record	1972 - 2018				1972 - 2018		1972 - 2018			1972 - 2018			

Wind Rose Diagrams

A wind rose diagram represents the frequency of winds blowing from particular directions. It uses sixteen cardinal directions. - North(N), North-northeast (NE), Northeast (NE), East-Northeast (ENE), East(E), East-southeast (ESE), Southeast (SE), South-southeast

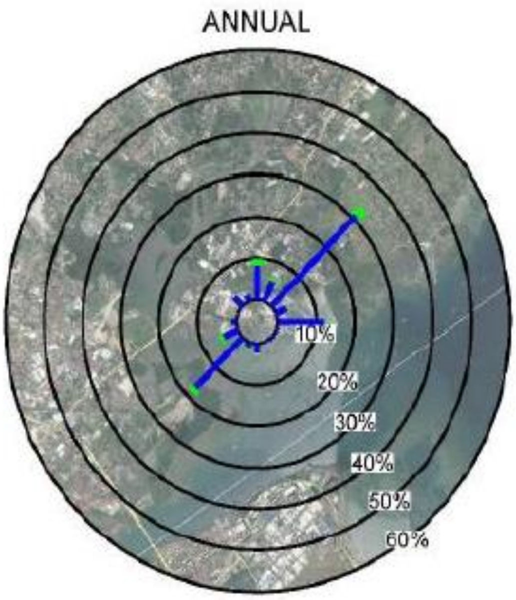
(SSE), South(S), South-southwest (SSW), Southwest (SW), West-southwest (WSW), West(W), West-northwest (WNW), Northwest (NW), and North-northwest (NNW). The Mactan Airport Wind Station of PAGASA was used to determine the wind conditions at the project site, as its exposure is expected to be similar because it is the closest station. The Annual wind rose diagram of the project site is shown in Figure 2-56.

Monsoons are characterized by a circulation of wind to certain regions, in a particular direction, with two Monsoons wind systems occurring throughout oceanic regions of Asia. In Mactan, the southwest Monsoon is felt from July to September while the Northeast Monsoon is experienced from November to May of the following year. June and October serve as the transition months. This can be seen from annual and monthly wind rose diagram of PAGASA's wind station at Mactan International Airport.

The weather due to Southwest Monsoon, locally known as Habagat, is characterized by heavy rainfall. The monsoon rainfall is a by-product of the air moving over warm equatorial ocean surface. On the other hand, Northeast Monsoon features cool and dry air from an anticyclone system.

Table 2-12: Wind Rose Color Legend (Source: PAGASA, 2015)

Color	Wind Speed Range (mps)	Description
	1 - 4	Light
	5 - 8	Moderate
	9 - 12	Moderate to Strong
	13 - 16	Strong
	17 - 24	Very Strong



Dir.	Freq. (%)	Dir.	Freq. (%)
N	9.8	S	2.4
NNE	5.9	SSW	1.6
NE	33.3	SW	18.3
ENE	3.3	WSW	4.7
E	12.5	W	1.5
ESE	0.6	WNW	0.2
SE	0.6	NW	3.0
SSE	0.3	NNW	1.5

Figure 2-67: Annual Wind Rose Diagram of the Project Site ***(Source: PAGASA – Mactan Station, 2015)***

The monthly wind rose diagram shows the variation of the wind directions over the entire year. The northeasterly winds occur during the amihan season from November to April while the southwesterly winds occur during the Habagat season from July to September. The remaining months are considered transition months between the two seasons.

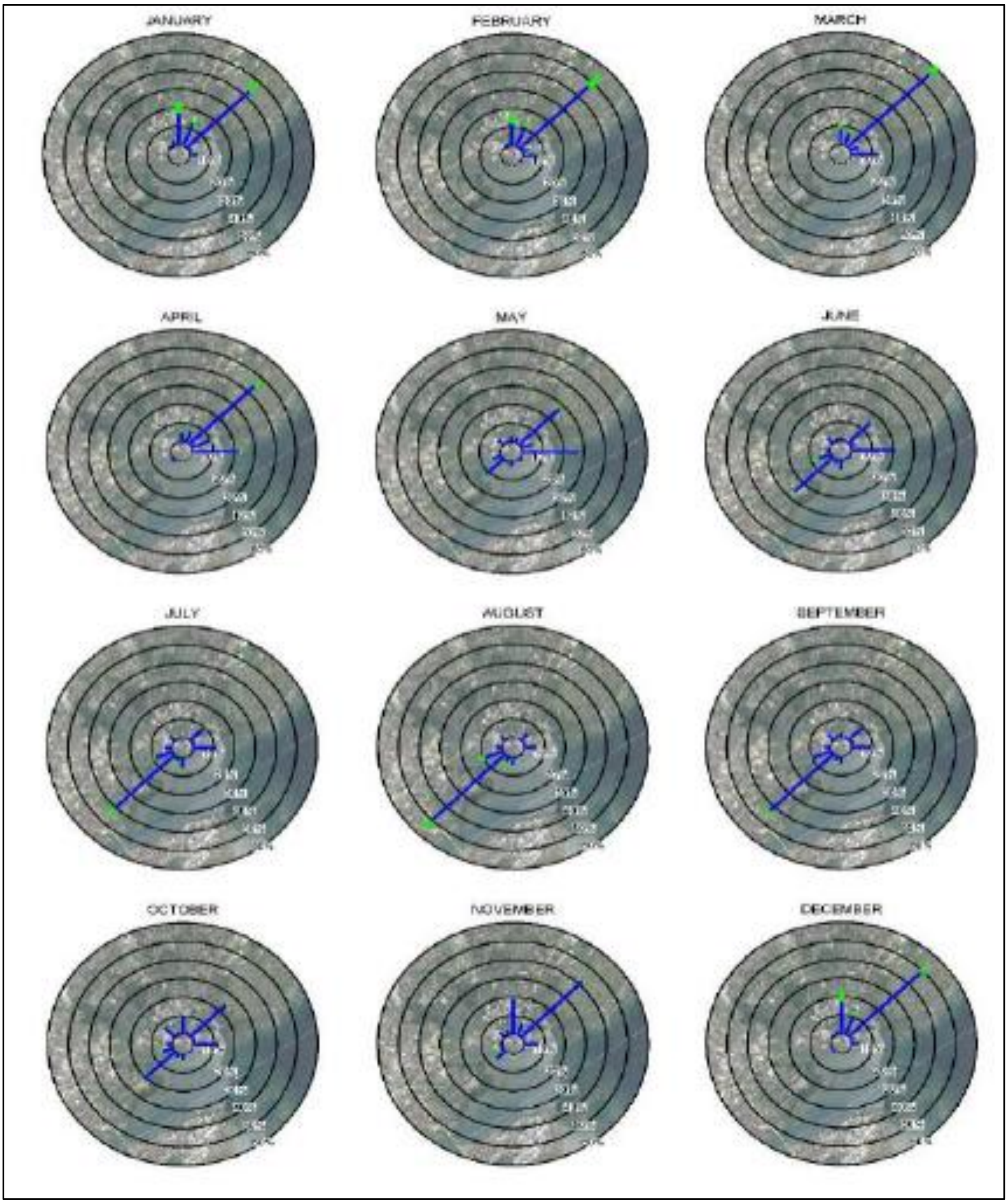


Figure 2-68: Monthly Wind Rose of the Project Site *(Source: PAGASA – Mactan Station, 2015)*

The daily temperature for the island of Cebu is relatively constant throughout the year with fluctuations ranging from between 27C to 34C. The hottest months are May to June with mean monthly temperature of 28.2C to 28.8C, while the coldest months are January and February with a mean monthly temperature ranging from 26.4C to 26.6C. The highest temperature ever recorded was 38C, while the yearly average was 30.3C. The lowest and yearly low temperatures are 18c and 25.5C respectively.

The relative humidity, which is a function of the index of moisture content in air, is quite high all throughout the year averaging 75%. The average annual relative humidity in Cebu is 79%. The highest average monthly humidity is 82% for the month of October, while the lowest average monthly humidity is 73% for the month of April (PAGASA, Mactan).

Frequency of Tropical Cyclones

Tropical cyclones or storms are not frequently experienced in Cebu Island including Mactan basically due to its strategic location being geographically covered by Leyte-Surigao Mountain ranges on the eastern side. The frequency of typhoon passage in different parts of the country is and Typhoon Incidence Map of the Philippines in Despite of this, Cebu had been hit by at least 8 disastrous typhoons as per PAGASA record from 1948–2003.

The province of Cebu normally gets typhoons once a year or none. The only recent typhoons that hardly hit Cebu are Typhoon Mike, Typhoon Fengshen (2008), Typhoon Utor (2006), Typhoon Hagibis, Typhoon Bopha (2012), Typhoon Amy, Typhoon Yolanda (2013), and just recently the super Typhoon Odette (2021).

Historical Typhoons

A tropical cyclone is caused by large temperature differences between the sea surface and the overlying atmosphere. Water vapor rises from the sea surface releasing latent heat that decreases atmospheric pressure and induces atmospheric currents that further affect the sea surface. This interaction of the seawater with the atmosphere, together with the effect of the earth's rotation, can cause the seawater to swirl into a vertex.

But in November 2013, a powerful typhoon - Typhoon Haiyan struck the province as a category 5 super typhoon. Several parts of Metro Cebu reported moderate damage as a result of strong winds brought by the storm. Northern towns of Cebu province including Bantayan Island were the worst hit, as those towns were almost totally wiped out. Nearly 100 people were reported dead after this storm.

Just recently, another super typhoon hit mostly the entire Cebu Province, the typhoon Odette which occurred last December 16, 2021 that caused massive destruction to most infrastructures in Cebu Province coupled with storm surge along the coastal areas that totally wiped out houses and beach resorts.

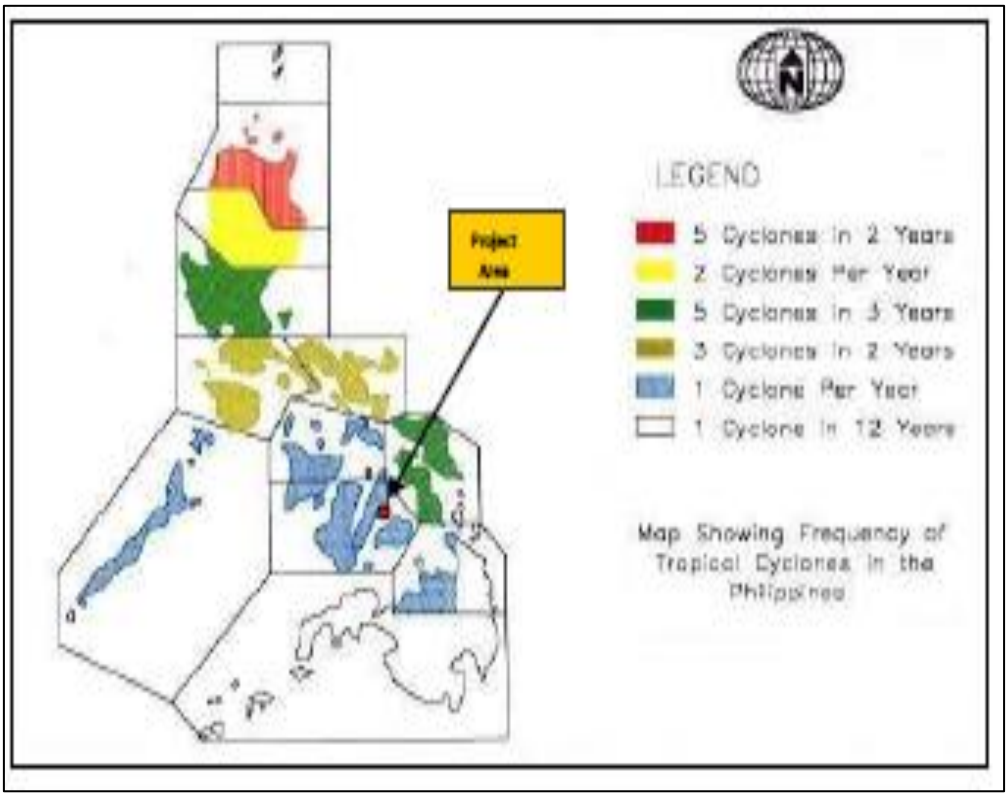


Figure 2-69: Tropical Cyclone Frequency Map of the Philippines

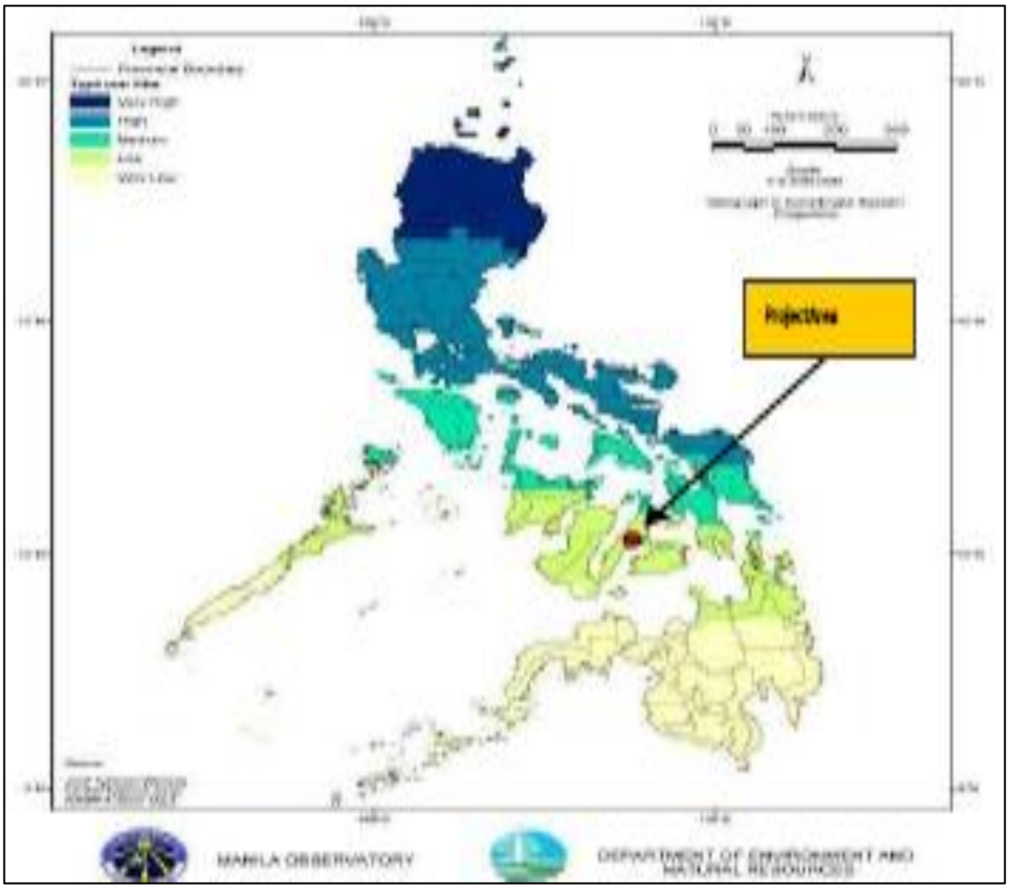


Figure 2-70: Typhoon Incidence Map of the Philippines

2.3.2. Contribution in terms of greenhouse gas emissions (or GHG mitigation potential)

2.3.2.1. Contribution to Global Greenhouse Gas

Greenhouse Gas (GHG) Emission Green Gas (GHG) Emissions from heavy construction equipment, frequent ingress and regress of the construction vehicles (e.g, trucks, front-end loaders, pavers, and other equipment) will occur from the operation of internal combustion engines, which are typically diesel-fueled.

The internationally accepted method of reporting on greenhouse gas emissions is separating emissions into scopes (WBCSD and WRI, 2004). There are three emission scopes:

Scope 1: Direct GHG Emissions

Emissions where the point of emission release is owned by the proponent, such as production of electricity, heat or steam; company owned vehicles used to transport materials, products, waste and employees; and fugitive emissions.

Scope 2: Indirect GHG Emissions

Indirect emissions associated from the purchase/import of electricity, heat or steam which is consumed by the proponent.

Scope 3: Other Indirect GHG Emissions

Indirect emissions that are a consequence of the activities of the proponent but occur from sources owned or controlled by another company or known as "sub-contractors". Examples of such are: employee business travel; transportation of products, materials, and waste; and employees commuting to and from work.

The purpose of differentiating between the scopes of emissions is to avoid the potential for double counting. Double counting occurs when two or more organizations assume responsibility for the same emissions. Reporting in line with the GHG Protocol requires that organizations report Scope 1 and Scope 2 emissions, but not Scope 3 emissions. Scope 3 emissions may be reported voluntarily.

For this proposed Project, only Scope 1 and 2 emissions are estimated. This involves GHG emissions from (diesel) fuel consumption and purchase of electricity from the grid.

2.3.2.2. Calculation Approach for Inventory

GHG emission computed was based on the GHG Protocol Corporate Standard (2001), which is broadly accepted by NGOs, businesses and governments. This has been used as the standard basis for accounting and reporting of GHG emissions. Computation for GHG emission was based on the tools and guidelines consistent with the Intergovernmental Panel on Climate Change (IPCC).

GHG emission from (diesel) fuel consumption

The development and construction phase will take approximately 33 months to complete the project. Table 2.3-4 shows the estimated diesel fuel consumption from use of mobile vehicles, heavy equipment and power generation (from generators run by diesel fuel) annually.

Construction Equipment (Heavy Equiment, vehicles)

Based on similar land development projects, the composite unit of heavy equipment (bulldozers, backhoes, loaders, flatbed truck, welding machines, jack hammer, crane, other ancillary vehicles) would have an average daily diesel consumption of 119,352.36 liters. Operating at 26 days/month at 12 months in a year, the estimated total fuel consumption per year would total 37,237,936 liters.

Naval Transport Vessel/Barges

Estimated Operating Hours per day : 18Hrs/day per unit

Estimated Fuel Consumption

Total Consumption per unit : 380 L/hr per unit

Total Consumption (2 units) : 760 L/Hr

Total Consumption / day (2 units) : 18 Hrs/day@760 L/Hr = 13,680L/day

26 days/mo@13,680 L/day = 355,680L/mo

Total Consumption / yr (2 units) 12 mos@355,680 L/mo = 4,268,160L/year

Generator Sets (2-units)

Estimated Operating time per Year : 120 days/year per unit

Estimated Consumption per day : 160L/day

Total Consumption per year : 120 days/year @160 L/day = 19,200 L/year

Total Consumption (2 units) : 2 units @ 19,200L/year = 38,400 L/year

Table 2-39: Estimated Fuel Consumption during the development and construction phase

Project Phase	Estimated Fuel Consumption (L/year)	Remarks
Fuel Consumption (mobile vehicles, heavy equipment, etc.)	37,237,936 liters	During Reclamation and Land Development
Fuel Consumption (naval vessels.)	4,268,160 liters	During Reclamation
Power generation (gensets) – stand-by units	38,400 liters	
TOTAL	**41,544,496 liters**	

An estimated total of 41,506,096 liters of diesel fuel will be consumed by the company annually during project development phase which includes an estimated consumption of 38,400 liters of diesel fuel for its standby generators (2 units) in case of power outages. Based on the computation above, the project will emit 108,016 MtCO23 to the atmosphere per year during its construction phase in which 756,110 trees are needed to offset its CO2 emissions.

GHG emission from power consumption

The proponent will likewise purchase power from the local power distributor. It is estimated that the project will purchase 5,760 MWh annually for the electrification of its facilities and utilities during the development of the project.

During the operation of estate, the proponent will likewise provide street lighting facilities that would need 745MWh annually. The proponent is currently studying options to install solar powered streetlihting system, But for purposes of GHG emmissions assessment, the estimated power requirement needed from the grid will be included.

Table 2-40: Estimated Fuel Consumption during the development and construction

Power Requirement for:	Projected demand (MWh/year)
Construction and Development	5,760
Streetlighting (during operation of the estate)	745
Total Power from Grid	**6,445**

The projected demand as shown above will be purchased from the local power distributor and this corresponds to 3,351 MtCO2 computed using the GHG emission factor of 0.52 for Luzon-Visayas grids (ADB's Philippines CTF IP Update, December 2011). As shown in Table 2-38, an estimate of 7 trees is needed to offset 1 ton of carbon dioxide over the lifetime of the tree. Ideally, to sequester the total emitted carbon dioxide emission of about 3,351

MtCO2 from purchase of electricity, a total of 23,457 trees should be planted within the duration of the project period.

The proponent will initiate environmental programs that support reforestation and carbon sink programs. It is recommended that GHG accounting and reporting be undertaken as well. GHG emission reduction programs/campaigns will be undertaken to minimize or remove unnecessary CO2 emissions.

It should be noted that the greenhouse emissions that may be contributed by the future operation of the reclamation area as an indutrial estate should undergo a different and saparate assessment, considering the type of locators that will be established in the project area.

2.3.2.3. Impacts and Mitigation

Reclamation and land development activities of the proposed project will be contributors in the deterioration of ambient air quality and increased noise levels in the area. As vehicles and equipment movement commences, it is expected that dust dispersion will be prevailent. Fuel burned to from the operation of equipment and vessels will translate to SO2 and NO2 emissions. Construction activities will also entail increased dust dispersion and noise level.

Summarized in the matrix below are the mitigating measures Summarized in the matrix below are the mitigating measures to address the projected impacts as discussed above.

To address and mitigate the emissions of greenhouse gases and increase of temperature, the project will have a component of green landscaping by planting ornamental trees and preservations of the mangrove trees within the project area. The trees will serve as natural filters of the greenhouse gases as well as reduce the temperature within the project site. Further, construction phase, there will be regular water spraying to the dust prone areas.

During the construction of the buildings, the locators will also be recommended to design their building adapting the green building initiatives not just putting up landscape components but as well as using energy-saving eco-friendly equipment and installing rainwater tank for rainwater harvesting and water recycling. Below table shows summary impacts and mitigating measures. Table 2-37 shows the potential impacts on the people and community and options for prevention, mitigation or enhancement.

Table 2-41: Summary of Impacts and Mitigation for Air Quality

Potential Hazards/Impacts	Phases				Options for Prevention or Mitigation or Enhancement
	Pre-construction	Construction	Operation	Closure	
Degradation of Air Quality					

1. Increased dust dispersion - Dust emission from mechanical disturbance during placement reclamation fill		X	X		• Delivery trucks and barges of reclamation fill should will be covered to suppressing dispersion of dust • Controlled watering of roads and access to the project and in the project area will be undertaken to desipate dust dispersion
2. Increased SO2 and NO2 Emissions - Vehicle emissions during construction activities and traffic movement (delivery trucks, fill material hauling, equipment movement) - Exhaust emission from transport vessels/barges		X	X		• all vehicles and equipment including transport vessels must be properly and regularly maintained and standard emission reduction devices should be installed in all units -progressive vegetation in the reclaimed area (parks/open spaces) must be initiated as the land development progresses. - Emission sampling will be done quarterly to be able to determine increase in emission levels particularly at alert levels. Cause/s of these will be determined and remedial measures immediately applied. Applicability and/or changes in monitoring stations will be also be regularly evaluated.
Noise Level					
- Noise from the operation of equipment during construction activities - Noise from the movement of vehicles and traffic		X	X		- Reclamation activities will well-planned, undertaken in stages in sectional areas to somehow limit noise in a smaller/manageable area. - As much as possible and practical, vehicle and equipment traffic to and from the project area will be done during allowable working hours. This includes activities

- Noise from generators as they are operated during power outages - Noise from pile and sheet driving process					that will cause excessive noise as pile driving. - Machines and equipment will be operated at low speed and or power whenever practical and switched off when not in use; - Equipment and machines that are found to generate excessive noise compared to industry standards will be removed from site and replaced - All equipment and vehicles will be serviced, properly and regularly maintained and fitted with appropriate mufflers - Community consultations will be conducted especially at sensitive receivers as residential areas. The concerned barangays and stakeholders shall be informed of schedule of operations. - Optimum traffic routes will be adopted to shorten time of exposure to noise. - Noise level monitoring will be done as frequently practicable to be able to determine increased and excessive noise levels. In these instances, cause will be determined and remedial measures immediately applied. Applicability and/or changes in monitoring stations will be also be regularly evaluated.

2.3.3. Air Quality and Noise

2.3.3.1. Air Quality

Based on the 2015 Regional Emissions inventory, the transport sector (mobile source) is the major source of pollution in Region VII. It was estimated that 10% of pollutants came from stationary sources, 77% from mobile sources, and 13% from area sources. However, ambient air quality monitoring results show that air quality in the region is in "good to fair" condition since concentrations of PM10 and TSP are within RA 8749's guideline values.

According to an inventory survey carried out in 2015 by the Environmental Management Bureau (EMB) of DENR, the source of air pollution in Central Visayas (Region VII), which includes the project site, is mainly the transportation sector. The share of such mobile sources accounts for approximately 77% of the total emissions level. This is much higher than the share of stationary sources (i.e. 10%). Nevertheless, the level of air pollution in the project area is considered generally favorable and values for PM10 and TSP have been both below the standards set under the Republic Act No. 8749.

According to Sinogaya et al. (2019), the medium value measured for NO2 over a six month period between December and June14, and that measured for SO2 over a nine month period between December and September in both Mandaue and Lapu-Lapu City are shown below. All values are below the environmental standards of the Philippines. Below are the results for air sampling conducted by JICA Survey Team for the proposed 4th Bridge Project to be located in Barangay Paknaan, Mandaue City, Cebu which is just approximately 50 to 100 meters away from the perimeter of the project site.

Table 2-42: Level of NO_2 and SO_2 in Mandaue City and Lapu-Lapu City

Sampling Point/Guideline Value in the Philippines	NO_2	SO_2
Mandaue City	15 ppb	30 ppb
Lapu-Lapu City	20 ppb	20 ppb
Guideline Value in the Philippines	80 ppb	70 ppb

Source: Sinogaya *et al.* 2019

2.3.3.2. Ambient Air

The existing ambient levels of the criteria pollutants relevant to the project were described by establishing two stations at the project site and collecting air samples. Sampling methods and analysis conformed to methods prescribed in Sec. 1(b) Rule VII Part II of the Clean Air Act IRR. The table below show the details of the sampling stations and map respectively.

Station 1 is near Cansaga Bridge and is located at N10° 21' 4.8" E123° 58' 12.48". The northwest side of this station is the Industrial Building at about 20 meters away and on its southwest side is the Mini Market (Plaza) at approximately 40 meters away from the sampling point. The northeast side of this station is the Skate Boarding Area at about 30 meters away from the sampling station. This area has north to south wind direction. This was selected as sampling point since this is a traffic congested area wherein large trucks to small vehicle are present mostly in 24 hours.

Station 2 is near Sitio Bagacay and is located at N10° 21' 4.8" E123° 59' 2.46". The northeast side of this station is the Access Road at about two meters away and on tis northwest side is the half Basketball Court at approximately 11 meters away from the sampling point. The northwest side of this station is the Residential Area at about 40 meters away from the sampling station. This area has northeast to southwest wind direction.

Figure 2-60 shows the location map of the air quality and noise sampling stations.

Figure 2-71: Map showing the ambient air and noise sampling sites

The resulting ambient air concentrations of suspended particulates (TSP and PM10), SO2, and NO2 were compared with the National Ambient Air Quality Guidelines Values (NAAQGV), Rule VII, Part II for the existing air quality at the area.

Table 2-43: Ambient Air Quality Results

Station	Date of Sampling	Location	Latitude	Longitude	TSP (µg/Ncm)	TSP (µg/Ncm)	NO_2 (ppm)	SO_2 (ppm)
A1	Jan 24-26, 2022	Near Cansaga Bridge	10° 21’ 4.8”N	123° 58’ 12.48”E	204	12	<0.01	20
A2		Near Sitio Bagacay	10° 21’ 17.88”N	123° 59’ 2.46”E	74	11	<0.01	20
National Ambient Air Quality Standards					230	150	0.08	180

2.3.3.3. Noise

The existing sound profile at the project site was determined by taking sound measurements at the ambient air quality stations using a sound meter for 24 hours in five-minute intervals. Table 2-44 and Table 2-45 shows the results of the 24 hour monitoring compared to national standard for Light Industrial Area and Residential Area respectively.

Table 2-44: Results of the 24 hour noise monitoring for Light Industrial Area

Station	Sampling Date	Location	Latitude	Longitude	Noise (dB)			
					Morning	Daytime	Evening	Night Time
N1	Jan 24, 2022	Near Cansaga Bridge	10° 21’ 4.8”N	123° 58’ 12.48”E	68	68	65	63
National Pollution Control Commission Standard for Class C (Light Industrial Area)					65	70	65	60

Table 2-45: Results of the 24 hour noise monitoring for Residential Area

Station	Sampling Date	Location	Latitude	Longitude	Noise (dB)			
					Morning	Daytime	Evening	Night Time
N2	Jan 25, 2022	Near Sitio Bagacay	10° 21’ 4.8”N	123° 59’ 2.46”E	65	69	62	60
National Pollution Control Commission Standard for Class A (Residential Area)					50	55	50	45

2.4. THE PEOPLE

2.4.1. Demography

Land Area and Composition

The region has a total space of 15,892 square kilometers accounting only 5.30% of the country's total. Negros Oriental has the largest share with 33.89%, followed by Cebu with 33.61%. See Table 2-46 shows the Provincial Composition and Land Area in Central Visayas.

Table 2-46: Provincial Composition and Land Area in Central Visayas

Province	Land Area (in sq. km.)	Land Distribution (in %)
Bohol	4,820.95	30.34
Cebu	5,342.00	33.61
Negros Oriental	5,385.53	33.89
Siquijor	343.50	2.16
Total - Region VII	15,891.98	100.00
Philippine	300,000.00	

Population

The population of Central Visayas in 2015 was recorded at 7.39 million from 5.70 million in 2000 increasing by 1.74% per year. This accounts 7.32% of the total population of the country. Cebu has the biggest population accounting 62.63% in 2015. Population land density is computed at 465.45 person per sq. kilometer - higher than the national average of 336.60. Table 2-47 shows the Population of Central Visayas (2000 – 2015).

Table 2-47: Population data of Central Visayas (2000 – 2015)

Province	Population		Share		Average Annual Growth (%)	Population Density (per sq.km.)
	2000	2015	2000	2015		
Negros Oriental	1,130,088	1,354,995	19.8	18.32	1.22	251.60
Cebu	3,356,137	4,632,359	58.81	62.63	2.17	867.16
Bohol	1,139,130	1,313,560	19.96	17.76	0.95	272.47
Siquijor	81,598	95,984	1.43	1.3	1.36	279.43
Total - Reg. 7	5,706,953	7,396,898	100	100	1.74	465.45
Philippine Total	76,498,735	100,981,437			1.87	336.60

Projected Population, Labor Force and Employment

Using a population growth of 5%, and given the population by age group, labor force participation rate (LFPR), and employment targets, the number of labor force and employment size are Projected and presented in Table 2-44.

Table 2-48: Projected Population, Labor Force and Employment for Region VII (2015-2045)

Item	2015	2020	2026	2030	2040	4050
Population	7,396,898	9,440,525	12,651,206	15,377,620	25,048,522	40,801,403
% of Pop. 14-64 years	0.59	0.59	0.60	0.60	0.61	0.61
Size of Potential LF	4,364,170	5,569,909	7,590,723	9,226,572	15,279,598	24,888,856
LFPR	0.66	0.66	0.67	0.68	0.69	0.69
Active LF	2,880,352	3,676,140	5,085,785	6,227,936	10,466,525	17,173,311
Employment Rate	0.93	0.93	0.94	0.94	0.95	0.96
Unemployed Rate	0.07	0.07	0.07	0.06	0.06	0.04
No of Employed	2,678,727	3,418,810	4,363,365	5,854,260	7,471,684	16,486,378
No of Unemployed	201,625	257,330	328,425	373,676	476,916	686,932

Table 2-49: Land Area of Metro Cebu by Component City / Municipality

Name of City / Municipality	Land Area (in sq. km)	Distribution w/in Metro Cebu (%)
Cebu City as Core Center	315.00	29.64
North of Cebu City		
Mandaue City	34.87	3.28
Consolacion	37.03	3.48
Liloan	45.92	4.32
Compostela	53.90	5.07
Danao City	107.30	10.10
Sub-total	279.02	26.25
South of Cebu City		
Talisay City	39.87	3.75
Minglanilla	65.60	6.17
Naga City	101.97	9.59
San Fernando	69.39	6.53
Carcar City	116.78	10.99
Sub-total:	393.61	37.03
Fronting Cebu City		
Lapu-lapu City	58.10	5.47
Cordova	17.15	1.61
Sub-Total	75.25	7.08
TOTAL - Metro Cebu	1,062.88	100.00
Rest of Cebu	3,880.84	
Total for Cebu Province	4,943.72	
Total for Region VII	15,487.69	
Analysis		
Share of Cebu City to Cebu Province Total (in %)	**8.12**	
Share of Cebu City to Region VII Total (in %)	**2.03**	
Share of Metro Cebu To Cebu Province Total (in %)	**21.50**	

Population and Households Size, Growth and Distribution

Metro Cebu's population was recorded at 2,849,213 in 2015 accounting 61.51% of Cebu Province total and 38.52% of Central Visayas. Population of north wing section of Cebu City covering Danao City, Compostela, Liloan, Consolacion, and Mandaue City constitute 27.98% of Metro Cebu's total net of Cebu City's population, while the south wing contributed 23.22%.

Assuming an average household size of 5 persons, total number of household in Metro Cebu is computed at 569,843 in 2015. Most of the households are found in Cebu City which accounts 32.38%.

Table 2-50: Population and HH Size, Growth and Distribution by City / Municipality

Name of City / Municipality	Population		Growth (%)	2015 % Share	2015 No of HH	Density / sq.
	2000	2015				
Cebu City as Core Center	718,821	922,611	1.68	32.38	184,522	2,929
Population North of Cebu City						
Mandaue City	259,728	362,654	2.25	12.73	72,531	10,400
Consolacion	62,298	131,528	5.11	4.62	26,306	3,552
Liloan	64,970	118,753	4.1	4.17	23,751	2,586
Compostela	31,446	47,898	2.84	1.68	9,580	889
Danao City	98,781	136,471	2.18	4.79	27,294	1,272
Sub-Total	517,223	797,304	2.93	27.98	159,461	2,858
Population South of Cebu city						
Talisay City	148,110	227,645	2.91	7.99	45,529	5,710
Minglanilla	77,268	132,135	3.64	4.64	26,427	2,014
Naga City	80,189	115,750	2.48	4.06	23,150	1,135
San Fernando	48,235	66,280	2.14	2.33	13,256	955
Carcar City	89,199	119,664	1.98	4.2	23,933	1,025
Sub-Total	443,001	661,474	2.71	23.22	132,295	1,681
Population Fronting Cebu City						
Lapu-lapu City	217,019	408,112	4.3	14.32	81,622	7,024
Cordova	34,032	59,712	3.82	2.1	11,942	3,482
Sub-Total	251,051	467,824	4.24	16.42	93,565	6,217
Total for Metro Cebu	1,930,096	2,849,213	2.63	100	569,843	2,681
Total for Cebu Province	3,356,137	4,632,359	2.17		926,472	937
Total for Region VII	3,356,137	7,396,898	1.74		1,479,380	478
Analysis						
Share of Metro Cebu to Cebu Province Total (in %)				**61.51**		
Share of Metro Cebu to Region VII Total (in %)				**38.52**		

Projected Population

As presented in the table, population of Metro Cebu is projected to increase from 3.244 million in 2020 to 6.480 million in 2050 using the growth rate below.

Table 2-51: Projected Increase of Population Rate of Metro Cebu by 2050

Interval Year	Average Annual Growth Rate
2015 Base Year Population	2,849,213
2015 to 2020	2.63 %
2021-2030	2.40 %
2031-2040	2.40 %
2041-2050	2.20 %

Table 2-52: Projected Population for Metro Cebu by City / Municipality

City / Municipality	2020	2025	2030	2035	2040	2045	2050
Core Center: Cebu City	1,050,121	1,182,331	1,331,186	1,498,782	1,687,479	1,881,451	2,097,719
North of Cebu City							
Mandaue City	412,976	464,970	523,509	589,419	663,627	739,909	824,960
Consolacion	149,878	168,748	189,993	213,913	240,845	268,530	299,396
Liloan	135,280	152,311	171,487	193,078	217,386	242,374	270,234
Compostela	54,501	61,363	69,088	77,787	87,580	97,647	108,871
Danao City	155,393	174,957	196,984	221,785	249,707	278,411	310,413
Sub-Total	908,028	1,022,349	1,151,063	1,295,982	1,459,145	1,626,871	1,813,876
Pop. South of Cebu City							
Talisay City	259,205	291,839	328,581	369,950	416,526	464,405	517,787
Minglanilla	150,527	169,478	190,816	214,839	241,888	269,692	300,693
Naga City	131,711	148,294	166,964	187,984	211,652	235,981	263,106
San Fernando	75,588	85,104	95,819	107,883	121,465	135,427	150,994
Carcar City	136,253	153,407	172,721	194,467	218,950	244,118	272,179
Sub-Total	753,284	848,122	954,901	1,075,123	1,210,481	1,349,623	1,504,759
Pop. Fronting the City							
Lapu-lapu City	464,558	523,045	588,897	663,039	746,515	832,325	927,999
Cordova	68,126	76,704	86,361	97,233	109,475	122,059	136,089
Sub-Total	532,684	599,749	675,257	760,272	855,990	954,384	1,064,089
Total for Metro Cebu	3,244,117	3,652,551	4,112,407	4,630,159	5,213,096	5,812,329	6,480,442
Total for Cebu Province	5,137,102	5,708,012	6,342,370	7,040,329	7,815,096	8,624,268	10,400,059

Source: Study Team Estimate

Projected Number of Households

Using an average of 5 persons per household, the projected number of household by Municipality and City is presented in the table.

Table 2-53: Projected Number of HH for Metro Cebu by City / Municipality

City / Municipality	2020	2025	2030	2035	2040	2045	2050
Center: Cebu City	210,024	236,466	266,237	299,756	337,496	376,290	419,544
North of Cebu City							
Mandaue City	82,595	92,994	104,702	117,884	132,725	147,982	164,992
Consolacion	29,976	33,750	37,999	42,783	48,169	53,706	59,879
Liloan	27,056	30,462	34,297	38,616	43,477	48,475	54,047
Compostela	10,900	12,273	13,818	15,557	17,516	19,529	21,774
Danao City	31,079	34,991	39,397	44,357	49,941	55,682	62,083
Sub-Total	181,606	204,470	230,213	259,196	291,829	325,374	362,775
South of Cebu City							
Talisay City	51,841	58,368	65,716	73,990	83,305	92,881	103,557
Minglanilla	30,105	33,896	38,163	42,968	48,378	53,938	60,139
Naga City	26,342	29,659	33,393	37,597	42,330	47,196	52,621
San Fernando	15,118	17,021	19,164	21,577	24,293	27,085	30,199
Carcar City	27,251	30,681	34,544	38,893	43,790	48,824	54,436
Sub-Total	150,657	169,624	190,980	215,025	242,096	269,925	300,952
Fronting the City							
Lapu-lapu City	92,912	104,609	117,779	132,608	149,303	166,465	185,600
Cordova	13,625	15,341	17,272	19,447	21,895	24,412	27,218
Sub-Total	106,537	119,950	135,051	152,054	171,198	190,877	212,818
Total for Metro Cebu	648,823	730,510	822,481	926,032	1,042,619	1,162,466	1,296,088

As of 2020 census, Consolacion had a population of 131,528 with 30,625 households. Barangay Tayud has a total population of 20,192.

Table 2-54: Top 21 most populous barangays of Consolacion (PSA, 2020)

CONSOLACION	**131,528**
Cabangahan	2,483
Cansaga	5,415
Casili	16,025
Danglag	4,235
Garing	2,615
Jugan	9,887
Lamac	9,458
Lanipga	855
Nangka	13,327
Panas	1,323
Panoypoy	1,229
Pitogo	5,278
Poblacion Occidental	5,854
Poblacion Oriental	3,314
Polog	2,097
Pulpogan	13,123
Sacsac	1,861
Tayud	20,192
Tilhaong	1,337
Tolotolo	3,156
Tugbongan	8,464

Table 2-55: Population by Barangay, Change and Growth Rage (2015-2020)

Barangay	Population percentage (2020)	Population (2020)	Population (2015)	Change (2015-2020)	Annual Population Growth Rate (2015-2020)
Cabangahan	2.06%	3,053	2,483	22.96%	4.45%
Cansaga	4.39%	6,504	5,415	20.11%	3.93%
Casili	12.57%	18,601	16,025	16.07%	3.19%
Danglag	3.05%	4,513	4,235	6.56%	1.35%
Garing	2.32%	3,431	2,615	31.20%	5.88%
Jugan	8.63%	12,774	9,887	29.20%	5.54%
Lamac	7.58%	11,221	9,458	18.64%	3.66%
Lanipga	0.61%	902	855	5.50%	1.13%
Nangka	8.79%	13,013	13,327	-2.36%	-0.50%
Panas	0.91%	1,341	1,323	1.36%	0.28%
Panoypoy	0.90%	1,339	1,229	8.95%	1.82%
Pitogo	2.90%	4,295	5,278	-18.62%	-4.25%
Poblacion Occidental	4.05%	5,988	5,854	2.29%	0.48%
Poblacion Oriental	2.13%	3,147	3,314	-5.04%	-1.08%
Polog	1.76%	2,601	2,097	24.03%	4.64%
Pulpogan	9.93%	14,700	13,123	12.02%	2.42%
Sacsac	1.67%	2,468	1,861	32.62%	6.12%
Tayud	15.68%	23,208	20,192	14.94%	2.97%
Tilhaong	1.47%	2,171	1,337	62.38%	10.74%
Tolotolo	2.75%	4,072	3,156	29.02%	5.51%
Tugbongan	5.86%	8,670	8,464	2.43%	0.51%

Barangay	Population percentag e (2020)	Population (2020)	Population (2015)	Change (2015-202 0)	Annual Population Growth Rat e (2015-2020)
Consolacion Total		**148,012**	**131,528**	**12.53%**	**2.52%**

Projected Population, Labor Force and Employment

Given below the projected population of Metro Cebu, projected population breakdown by age group, labor force participation rate (LFPR), and employment targets, the size of the labor force in Metro Cebu as well as the employment numbers.

Table 2-56: Projected Population and Employment Rate in 2050

Item	2020	2025	2030	2035	2040	2045	2050
Population	3,244,117	3,652,551	4,112,407	4,630,159	5,213,096	5,812,329	6,480,442
% of Pop. 14-64 years	0.59	0.59	0.59	0.6	0.6	0.61	0.61
Size of Potential LF	1,914,029	2,155,005	2,426,320	2,778,095	2,778,095	3,545,521	3,953,070
LFPR	0.66	0.66	0.66	0.675	0.675	0.675	0.685
Active LF	1,263,259	1,422,304	1,601,371	1,875,214	1,875,214	2,393,226	2,707,853
Employment Rate	0.93	0.93	0.94	0.94	0.94	0.95	0.96
Unemployed Rate	0.07	0.07	0.06	0.06	0.06	0.05	0.04
No of Employed	1,174,831	1,322,742	1,505,289	1,762,702	1,762,702	2,273,565	2,599,539
Sectoral Breakdown							
Service & Industry (70%)	822,382	925,919	1,053,702	1,233,891	1,233,891	1,591,496	1,819,677
Non-Industry (30%)	352,449	396,823	451,587	528,811	601,722	682,070	779,862
No of Unemployed	88,428	99,561	96,082	112,513	105,565	119,661	108,314

Source: Study Team Estimate

Economy

The early industrialization of Metro Cebu is characterized by the processing of agricultural surplus indigenous to the region dominated by copra, cereals, and marine products. Given the inherent comparative advantage of Metro Cebu, the processing of intermediate and consumption goods prospered brought about by access to large market facilitated by the presence of enterprising and experienced local traders.

Goods manufactured and traded include processed food, garments, pharmaceuticals, beverages and construction supplies. In the mid 1970's, the manufacture of native craft using raw sea shell and coconut shells and midrib proliferated with increase in export demand. This diversified to furniture making using rattan, wood, and iron as materials.

Precession engineering industries like machine shop, metal fabrication steadily grew with increase in demand brought about by an expansion in industry base. The manufacture of souvenir items, processed fruits, and bakery products blossomed with increase in demand from tourist.

In the last decade, the so called "sunrise industries" developed with the presence of enterprising, innovative, and artistic entrepreneurs supported by skilled labor force. The business community of Cebu City has vast experience in further developing the food, fashion, furniture and fun related manufactured commodities closely linked to tourism.

Sunrise industries with potential include the manufacture if ITC related equipment and high precision electronic products. Within the industry sector, construction is seen to be promising brought about by the phenomenal growth in commercial building and housing development activities. Cebu is lucky because it has a good mix of sunrise industries to thrive economically amid the country's fragile economic condition.

Most of the industrial firms operating in Metro Cebu are small and medium in size engaged in the manufacturing of food product, garment, chemical-base, handicraft, furniture, construction supply, iron works, and metal engineering, among others. Known food products famous in Cebu are dried fish, dried mangoes, and pastries.

Food processors are mostly located in Talisay, Mandaue, and south congressional district of Cebu City particularly in Barangay Labangon, Pardo, Minglanilla, and Mabolo. Handicraft making are located in Barangay Looc and Opao in Mandaue; Barangay Banilad, Minglanilla, Lahug, and Mabolo in Cebu City. Tinsmith, high precision engineering and metal fabrication are mostly located in Taboan and Martires Street near the port area. Furniture making are located in Talamban and Lahug.

Cottage type manufacturers are located in household backyard except for bakeries and tailoring shops which are found in the build-up areas. Total area occupied by the sector is difficult to determine since many of the firms are located in mixed land use areas. Proximity to labor supply, raw materials, market, and land use zoning dictates the location of these industries.

Export

Most of Cebu's exports are produced inside the economic zones. These are dominated by electronics, furniture, electrical equipment, and garment. The presence of the economic zones has substantially contributed to the growth of exports in the region. In 2005, exports from the economic zones accounted 52% of the total exports.

Table 2-57: Cebu's Top Exports

Export Products	Year 2000 Distribution by Type of Export (in %)	Export Products	Year 2005 Distribution by Type of Export (in %)
Electronics	35	Electronics	44
Furniture	9	Furniture	12
Electrical Equipment	7	Electrical Equipment	9
Vehicles, Machinery Parts	6	Other Industrial Goods	6
Other Industrial Goods	6	Garment, Wearing Apparel	6
Garment, Wearing Apparel	5	Gifts, Toys & Housewares	3
Marine Products	3	Marine Products	2
Steel, Metal Products	3	Vehicles, Machinery Parts	2
Gifts, Toys & Houseware	2	Fashion Accessories	2
Fashion Accessories	1	Steel, Metal Products	2
Others not else classified	23	Others not else classified	12
Total	100 %		100 %

Tourism

Tourism sector is a major contributor to the economic growth of Cebu. In terms of tourist arrival, tourist that visited Cebu accounts 36.37% of the total guests that visited the Visayas. The number of visitors increased from 2.48 million in 2015 to 3.45 million in 2017 increasing by 17.85% per annum.

Table 2-58: Tourism Arrival by Province

Province	Tourist Arrival			2017 Distribution (%)	Annual Growth (%)
	2015	2016	2017		
Negros Occ.	1,382,282	1,511,711	1,600,000	16.87	7.6
Negros Or.	690,000	942,542	1,173,000	12.36	30.38
Cebu	2,484,000	3,063,263	3,450,000	36.37	17.85
Bohol	1,380,000	1,767,267	2,139,000	22.55	24.5
Southern Leyte	65,750	85,400	113,250	1.19	31.34
Leyte	767,089	829,600	1,011,700	10.66	14.81
Total	6,769,121	8,199,784	9,486,950	100.00	18.38

Source: Department of Tourism, Region VII

Infrastructure

Road Network

Metro Cebu's roadways are among the countries busiest. The Natalio Bacalso Street, Cebu South Highway, and the South Coastal Road are the main thoroughfare that connects Cebu City to Talisay City and other southern municipalities of Cebu. Within the Cebu City, the main arterial roads that connect Cebu South Road to uptown barangays are Salvador Street, V. Rama Avenue, S. Osmena Boulevard, Gen Maxillom Avenue, and Gorordo Avenue.

The Banilad Road and Talamban Road that interconnects the downtown streets lead to barangays Talamban and Pit-os. Major roads that connect the southern barangays of Cebu City to Mandaue are Canduman Road, M.L. Quezon Road, and AS Fortuna Street. Cebu City is connected to the northwestern municipality of Balamban of Cebu via the Cebu Transcentral Highway.

Mactan Island is connected to Mandaue City via two bridges: the Marcelo Fernan Bridge and the Mactan - Mandaue Bridge. A third Cebu-Cordova Bridge is currently under construction. The main roads that connect Mandaue City to the northern municipalities of Cebu are Cebu North Road - Central Nautical Highway – MC Briones - Lopez Jaena and the Consolacion-Tayud-Liloan Road. See Figure 2.4 for the Major Arterial Road Network of the Project service area.

However, traffic situation in Metro Cebu in recent years has progressively deteriorated. Traffic congestion is occurring on many roads and intersections, not only during peak-hours but also during off-peak hours.

The main causes are considered as follows:

- Increase of traffic demand due to population growth,
- economic development and motorization;
- Insufficient road network and public transport services;
- Inadequate traffic management.

Figure 2-72: Major Road Network of the Project Service Area

2.4.2. Proposed Seafront City Estate

Estimated Population

Population is defined in this study as all inhabitants of Consolacion Seafront City Estate that live, work, visit, and do business in the place on a regular and non-regular basis. Regular population are those that live, work, and conduct business inside the estate on a regular 8-hour daily basis. Non-regular inhabitants are people who visit and or conduct business inside the estate on occasion. These include tourist, business clients, and other guests also termed in the report as transient population. Refer to the Population Study Document for details.

Table 2-59: 25-year Population Projection by Type for the Proposed Seafront City Estate

Year	Population by Type (High Estimate)		Total
	Regular	Transient	
2026	20,487	12,277	32,764
2027	40,975	24,554	65,529
2028	61,462	36,830	98,293
2029	81,950	49,107	131,057
2030	102,437	61,384	163,822
2031	122,925	73,661	196,586
2032	143,412	85,938	229,350
2033	145,564	87,227	232,790
2034	147,747	88,535	236,282
2035	149,963	89,863	239,826
2036	152,213	91,211	243,424
2037	154,496	92,579	247,075
2038	156,813	93,968	250,781
2039	159,165	95,378	254,543
2040	161,553	96,808	258,361
2041	163,976	98,260	262,237
2042	166,436	99,734	266,170
2043	168,932	101,230	270,163
2044	171,466	102,749	274,215
2045	174,038	104,290	278,328
2046	176,649	105,854	282,503
2047	179,299	107,442	286,741
2048	181,988	109,054	291,042
2049	184,718	110,690	295,408
2050	187,489	112,350	299,839
Average Per Year	142,246	85,239	227,485
% Distribution	62.53	37.47	100.00

Population of the estate are classified as: a) Regular Population, and; 2) Transient Population. Regular population are those residing and or employed inside the complex on a regular basis. Transient population are guests of estate residents and or clients of business establishments firms located inside the area. In this projection, it will show that projected increased number of population both from locals residing in Consolacion and transient individuals from other municipalities that will add up the possible traffic congestions in the coming years due to the project.

Employment

The Seafron City Project is one of the major project of the LGU wherein this will attract business investments within the Municipality especially within the project area after being reclaimed. The more businesses will rise, the more employment opportunity will be offered. It was estimated that from year 2026 to 2050, the project will open an estimated 120,000 employment opportunity not just from the locals but as well opportunity to the entire Province of Cebu.

Table 2-60: 25-year Employment Projection of the Proposed Seafront City Estate

Year	HIGH ASSUMPTION Population to Full Time Employment Coefficient		Estimated Full Time Employee
	Regular	Coefficient	
2026	20,487	0.90	18,438
2027	40,975	0.90	36,878
2028	61,462	0.90	55,316
2029	81,950	0.90	73,755
2030	102,437	0.90	92,193
2031	122,925	0.90	110,633
2032	143,412	0.90	129,071
2033	145,564	0.90	131,008
2034	147,747	0.90	132,972
2035	149,963	0.90	134,967
2036	152,213	0.90	136,992
2037	154,496	0.90	139,046
2038	156,813	0.90	141,132
2039	159,165	0.90	143,249
2040	161,553	0.90	145,398
2041	163,976	0.90	147,578
2042	166,436	0.90	149,792
2043	168,932	0.90	152,039
2044	171,466	0.90	154,319
2045	174,038	0.90	156,634
2046	176,649	0.90	158,984
2047	179,299	0.90	161,369
2048	181,988	0.90	163,789
2049	184,718	0.90	166,246
2050	187,489	0.90	168,740
Average Per Year	142,246		128,022

Production

The Seafront City Project will boost the economy of the LGU from 2026 to 2050. The project will produce an estimated amount of more than 160 Million per year if the the project will be implemented which will benefit not just Consolacion but the entire Cebu Province.

Table 2-61: 25-year GVA Projection of the Proposed Seafront City Estate

Year	Estimated GVA (HIGH Estimate)		GVA Total (in Php 0)
	Estate Employment Size	Labor Productivity at constant 2018 Prices to increase by 2% per year	
2026	18,438	950,000	17,516,100,000
2027	36,878	969,000	35,734,782,000
2028	55,316	988,380	54,673,228,080
2029	73,755	1,008,148	74,355,926,238
2030	92,193	1,028,311	94,803,034,721
2031	110,633	1,048,877	116,040,382,925
2032	129,071	1,069,854	138,087,164,136
2033	131,008	1,091,251	142,962,661,350
2034	132,972	1,113,076	148,007,996,650
2035	134,967	1,135,338	153,233,155,774
2036	136,992	1,158,045	158,642,859,405
2037	139,046	1,181,206	164,241,912,881
2038	141,132	1,204,830	170,040,025,903
2039	143,249	1,228,926	176,042,463,396
2040	145,398	1,253,505	182,257,094,532
2041	147,578	1,278,575	188,689,529,752
2042	149,792	1,304,146	195,350,700,520
2043	152,039	1,330,229	202,246,739,876
2044	154,319	1,356,834	209,385,256,046
2045	156,634	1,383,971	216,776,853,138
2046	158,984	1,411,650	224,429,767,762
2047	161,369	1,439,883	232,352,484,136
2048	163,789	1,468,681	240,553,741,082
2049	166,246	1,498,054	249,045,535,321
2050	168,740	1,528,015	257,837,316,403
Average Per Year	128,022		161,732,268,481

2.4.3. Generation of Local Benefits from the Project

The Project is expected to benefit the host community Barangay Tayud and its adjacent barangays and the Municipality with the estimated increase in revenues and generation of employment and entrepreunership opportunies.

The Project is envisioned to be the new commercial and business center of the Proponent, with an employment average of 128,000 workers/year in the industry and service sectors.

National government revenue by an average of Php 186.712 million per year is anticipated, and local government revenue by an average of Php 77,197 million per year. Economic production is approximated at Php 161.7 billion / year at constant 2018 prices.

The economic valuation computations are discussed in full in Chapter 1 Project Alternatives.

2.4.4. Traffic congestion

General

To prepare a 25-year projection on average annual daily traffic (AADT) with the project and assess its impact on existing road facility. Findings will serve as reference in designing the project's offsite road system for possible integration into the overall Metro Cebu Coastal Road Development Program.

The projected population for La Consolacion Seaside Estate as approved by the study team is use as demand determinant in the study. Assumptions adopted were sourced from surveys conducted with workers of MEPZ 1 and Cebu IT-Park to characterize preferred mode of transport. However, minor adjustments were made considering the policy pronouncement of government on transport modernization particularly on the PUV passenger carrying capacity.

Given data limitation, secondary information on traffic flow along Tayud Road were taken from the 2017 DPWH Publication and applied as base line information in the "without project" analysis. This was projected using economic growth indicator in tandem with on-going major projects in the vicinity. Planning standard set by industry experts on traffic saturation flow and allowable road utilization rate is use gap analysis.

Table 2-62: Average Annual Daily Traffic (AADT) Computation Model

Land Classification	Land Area		Distribution (%)
	in Sq. Meter	in Hectare	
Saleable			
Commercial	422,480	42.25	17.92
Mixed Use - Commercial	361,313	36.13	15.32
Mixed Use - Residential	163,985	16.40	6.95
Residential	204,429	20.44	8.67
Tourist and Entrepreneur	257,642	25.76	10.93
Industrial	212,041	21.20	8.99
Institutional	105,038	10.50	4.45
Total - Saleable	1,726,928	172.69	73.24
Non Saleable		-	
Utilities	89,374	8.94	3.79
Easement	64,351	6.44	2.73
Parks / Aviary	93,438	9.34	3.96
Terminal	20,018	2.00	0.85
Road network	352,257	35.23	14.94
Relocation Site	11,629	1.16	0.49
TOTAL - Non-Saleable	631,067	63.11	26.76
Total for Both	2,357,995	235.80	100.00

Size of Commuter and Mode of Transport

Commuter is assumed in this study to be equal to population and also classified as regular and transient. The size of commuter is termed in the study as Average Annual Daily Commuter (AADC).

Table 2-63: Projected Average Annual Daily Commuter (AADC) by type of Commuter

Type of Commuter	AADC by Year of Projection									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Regular	15,787	31,574	47,361	63,147	78,934	94,721	110,508	112,166	113,848	115,556
Transient	9,292	18,583	27,875	37,166	46,458	55,750	65,041	66,040	67,053	68,083
Total	25,079	50,157	75,236	100,313	125,392	150,471	175,549	178,206	180,901	183,639

Type of Commuter	AADC by Year of Projection									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Regular	117,289	119,048	120,834	122,647	124,486	126,354	128,249	130,173	132,125	134,107
Transient	69,128	70,189	71,266	72,360	73,471	74,599	75,744	76,906	78,087	79,286
Total	186,417	189,237	192,100	195,007	197,957	200,953	203,993	207,079	210,212	213,393

Type of Commuter	AADC by Year of Projection				
	2046	2047	2048	2049	2050
Regular	136,119	138,161	140,233	142,336	144,471
Transient	80,503	81,738	82,993	84,267	85,561
Total	216,622	219,899	223,226	226,603	230,032

Mode of Transport

The mode of transport used by commuter with distribution breakdown for a given period is shown below. The decline in the use of public transport in both regular and transient commuter is perceived brought about by increase in the use of private car, taxi, and motorcycle with better income and for convenience.

Table 2-64: Estimated Distribution of Mode of Transport by Commuter in the Estate

Mode of Transport	Distribution of Transport Mode Use by Regular Commuter (in %)			Distribution of Transport Mode Use by Transient Commuter (%)		
	Year 2026 - 2035	Year 2036 - 2045	Year 2046 -2050	Year 2026 - 2035	Year 2036 - 2045	Year 2046 -2050
PUV	50 %	47 %	45 %	20 %	18 %	16 %
Private Car / Taxi	20 %	22 %	24 %	60 %	62 %	64 %
Tricycle / Motorcycle	28 %	29 %	29 %	0.20	20 %	20 %
On Foot	2 %	2 %	2 %	-	-	-
Total	100 %	100 %	100 %	100 %	100 %	100 %

Number of Commuter by Mode of Transport

To compute the number of commuter by mode of transport, multiply the number of commuter with the yearly percentage distribution by mode of transport. The table below shows that the highest percentage used as mode of transportation is PUV, however, as years increased, the private car/taxi will surpass the PUV due to stability of employee's lifestyle and income that will make private cars/taxi more affordable.

Table 2-65: Projected Average Annual Daily Commuter (AADC) by Mode of Transport

Mode of Transport Use	AADC for both Regular and Transient									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
PUV	9,752	19,504	29,256	39,007	48,759	58,511	68,262	69,291	70,335	71,395
Private Car / Taxi	8,733	17,465	26,197	34,929	43,662	52,394	61,126	62,057	63,001	63,961
Tricycle / Motorcycle	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
On Foot	316	631	947	1,263	1,579	1,894	2,210	2,243	2,277	2,311
Total	25,079	50,157	75,236	100,313	125,392	150,471	175,549	178,206	180,901	183,639

Mode of Transport Use	AADC for both Regular and Transient									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
PUV	67,569	68,587	69,620	70,669	71,733	72,814	73,911	75,024	76,154	77,302
Private Car / Taxi	68,663	69,708	70,768	71,846	72,939	74,049	75,176	76,320	77,481	78,661
Tricycle / Motorcycle	47,839	48,562	49,295	50,040	50,795	51,562	52,341	53,131	53,934	54,748
On Foot	2,346	2,381	2,417	2,453	2,490	2,527	2,565	2,603	2,643	2,682
Total	186,417	189,237	192,100	195,007	197,957	200,953	203,993	207,079	210,212	213,393

Mode of Transport Use	AADC for both Regular and Transient				
	2046	2047	2048	2049	2050
PUV	74,134	75,251	76,384	77,534	78,702
Private Car / Taxi	84,190	85,471	86,771	88,092	89,432
Tricycle / Motorcycle	55,575	56,414	57,266	58,131	59,009
On Foot	2,722	2,763	2,805	2,847	2,889
Total	216,622	219,899	223,226	226,603	230,032

Table 2-66: Projected Average Annual Daily Commuter (AADC) by type of Vehicle Used

Type of Vehicle	AADC by Type of Vehicle Used (Regular and Transient)									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
A. 4 Wheel - Up Vehicle										
PUV	9,752	19,504	29,256	39,007	48,759	58,511	68,262	69,291	70,335	71,395
Private Car / Taxi	8,733	17,465	26,197	34,929	43,662	52,394	61,126	62,057	63,001	63,961
Total	18,485	36,968	55,453	73,936	92,420	110,905	129,388	131,348	133,336	135,356
B. 2 to 3 Wheel Vehicle										
Tricycle / Motorcycle	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
C. No Wheel										
On Foot	316	631	947	1,263	1,579	1,894	2,210	2,243	2,277	2,311
TOTAL	25,079	50,157	75,236	100,313	125,392	150,471	175,549	178,206	180,901	183,639

AADT Projection

Approach

To compute AADT given the average annual daily commuter, the following items are to be known: a) number of trips each commuter will take daily, and; b) number of passengers each type of vehicle will ferry per trip.

Number of Trips by Type of Vehicle

To determine the total number of trips each commuter will take daily by type of vehicle, a 2 trips per day per commuter is assumed in the study. Hence, to compute the average annual daily trips, multiplying average annual daily commuter (AADC) by type of vehicle as shown in Table 2-63 by the number of trips each commuter take per day.

Table 2-67: Average Annual Daily Trips by Type of Vehicle

Type of Vehicle	AAD Trips by Type of Vehicle									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
A. 4 Wheel-Up Veh.										
PUV										
AADC (see Table 6)	9,752	19,504	29,256	39,007	48,759	58,511	68,262	69,291	70,335	71,395
No. of Trips / Com.	2	2	2	2	2	2	2	2	2	2
Total	19,504	39,007	58,511	78,013	97,517	117,021	136,524	138,582	140,669	142,789
Private Cars / Taxi										
AADC (see Table 6)	8,733	17,465	26,197	34,929	43,662	52,394	61,126	62,057	63,001	63,961
No. of Trips / Com.	2	2	2	2	2	2	2	2	2	2
Total	17,465	34,929	52,394	69,858	87,323	104,788	122,252	124,114	126,003	127,922
Total Trips for A	36,969	73,936	110,905	147,871	184,840	221,809	258,777	262,696	266,672	270,711
B. 2 to 3 Wheel Veh.										
Tricycle / Motorcycle										
AADC (see Table 6)	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
Number of Trips	2	2	2	2	2	2	2	2	2	2
Total	12,558	25,115	37,672	50,229	62,786	75,344	87,901	89,229	90,576	91,945
Total for B	12,558	25,115	37,672	50,229	62,786	75,344	87,901	89,229	90,576	91,945
TOTAL for A & B	49,527	99,051	148,578	198,100	247,627	297,153	346,678	351,925	357,248	362,656

Type of Vehicle	AAD Trips by Type of Vehicle									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
A. 4 Wheel-Up Veh.										
PUV										
AADC (see Table 6)	67,569	68,587	69,620	70,669	71,733	72,814	73,911	75,024	76,154	77,302
No. of Trips / Day	2	2	2	2	2	2	2	2	2	2
Total AAD Trips	135,138	137,173	139,240	141,338	143,466	145,628	147,822	150,049	152,309	154,604
Private Cars / Taxi										
AADC (see Table 6).	68,663	69,708	70,768	71,846	72,939	74,049	75,176	76,320	77,481	78,661
Number of Trips	2	2	2	2	2	2	2	2	2	2
Total	137,326	139,415	141,537	143,691	145,878	148,099	150,352	152,640	154,963	157,322
Total for A	272,464	276,589	280,777	285,029	289,344	293,727	298,174	302,688	307,272	311,925
B. 2 - 3 Wheel Veh.										
Tricycle / Motorcycle										
AADC (see Table 6)	47,839	48,562	49,295	50,040	50,795	51,562	52,341	53,131	53,934	54,748
Number of Trips	2	2	2	2	2	2	2	2	2	2
Total	95,679	97,123	98,590	100,079	101,590	103,125	104,682	106,263	107,867	109,496
Total for B	95,679	97,123	98,590	100,079	101,590	103,125	104,682	106,263	107,867	109,496
TOTAL for A & B	368,142	373,712	379,367	385,108	390,935	396,852	402,856	408,951	415,139	421,422

Type of Vehicle	AAD Trips by Type of Vehicle				
	2046	2047	2048	2049	2050
A. 4 Wheel-Up Veh.					
PUV					
AADC (see Table 6)	74,134	75,251	76,384	77,534	78,702
No. of Trips / Com.	2	2	2	2	2
Total	148,268	150,501	152,767	155,068	157,403
Private Cars / Taxi					
AADC (see Table 6).	84,190	85,471	86,771	88,092	89,432
Number of Trips	2	2	2	2	2
Total	168,381	170,942	173,543	176,183	178,864
Total for A	316,649	321,443	326,310	331,251	336,268
B. 2-3 Wheel Veh.					
Tricycle / Motorcycle					
AADC (see Table 6)	55,575	56,414	57,266	58,131	59,009
Number of Trips	2	2	2	2	2
Total	111,150	112,829	114,532	116,262	118,018
Total for B	111,150	112,829	114,532	116,262	118,018
TOTAL for A & B	427,799	434,272	440,843	447,513	454,285

Passenger Ferried Per Trip by Mode of Transport

Presented in table below is the average number of passenger ferried per trip per day by mode of transport. As shown in the table, the number of passengers ferried per day is assumed to increase every ten years brought about by the mass transit modernization policy of government.

Table 2-68: Projected Average Number of Passenger Ferried per Trip by Mode of Transport

Mode of Transport	Average Passenger Ferried Per Trip by Transport Mode									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
PUV (Modern Jeepneys , Mini Bus)	25	25	25	25	25	25	25	25	25	25
Private Car / Taxi / Van	4	4	4	4	4	4	4	4	4	4
Tricycle, Motorcycle	2	2	2	2	2	2	2	2	2	2

Mode of Transport	Average Passenger Ferried Per Trip by Transport Mode									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
PUV (Modern Jeepneys , Mini Bus)	30	30	30	30	30	30	30	30	30	30
Private Car / Taxi / Van	3	3	3	3	3	3	3	3	3	3
Tricycle, Motorcycle	2	2	2	2	2	2	2	2	2	2

Mode of Transport	Ave. Passenger Ferried Per Trip				
	2046	2047	2048	2049	2050
PUV (Modern Jeepneys , Mini Bus)	35	35	35	35	35
Private Car / Taxi / Van	3	3	3	3	3
Tricycle, Motorcycle	2	2	2	2	2

Projected AADT

Projected AADT by type of vehicle is derived by dividing the average annual daily trips by type of vehicle with the average annual passengers ferried per trip by type of vehicle. Take note that the number of trips made by service vehicles owned by locators and other service provider is added in the equation assumed to be 5% of the 4 wheel and up total.

Table 2-69: Projected Average Annual Daily Traffic (AADT) by type of Vehicle by year

Type of Vehicle	AADT By Year of Projection									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
A. 4 Wheel - Up Vehicle										
PUV	780	1,560	2,340	3,121	3,901	4,681	5,461	5,543	5,627	5,712
Private Car / Taxi	4,366	8,732	13,099	17,465	21,831	26,197	30,563	31,029	31,501	31,981
Sub-Total	5,146	10,293	15,439	20,585	25,731	30,878	36,024	36,572	37,127	37,692
Srv Vehicle of Locators										
5% of Sub-Total	257	515	772	1,029	1,287	1,544	1,801	1,829	1,856	1,885
Total for A	5,404	10,807	16,211	21,614	27,018	32,422	37,825	38,400	38,984	39,577
B. 2 to 3 Wheel Vehicle										
Tricycle / Motorcycle	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
Total for B.	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
TOTAL for A & B	**11,683**	**23,365**	**35,047**	**46,729**	**58,411**	**70,094**	**81,776**	**83,015**	**84,272**	**85,549**

Type of Vehicle	AADT By Year of Projection									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
A. 4 Wheel - Up Vehicle										
PUV	4,505	4,572	4,641	4,711	4,782	4,854	4,927	5,002	5,077	5,153
Private Car / Taxi	45,775	46,472	47,179	47,897	48,626	49,366	50,117	50,880	51,654	52,441
Sub-Total	50,280	51,044	51,820	52,608	53,408	54,220	55,045	55,881	56,731	57,594
Srv Vehicle of Locators										
5% of Sub-Total	2,514	2,552	2,591	2,630	2,670	2,711	2,752	2,794	2,837	2,880
Total for A	52,794	53,596	54,411	55,239	56,079	56,931	57,797	58,676	59,568	60,474
B. 2 to 3 Wheel Vehicle										
Tricycle / Motorcycle	47,839	48,562	49,295	50,040	50,795	51,562	52,341	53,131	53,934	54,748
Total for B.	47,839	48,562	49,295	50,040	50,795	51,562	52,341	53,131	53,934	54,748
TOTAL for A & B	**100,633**	**102,158**	**103,706**	**105,278**	**106,874**	**108,494**	**110,138**	**111,807**	**113,501**	**115,222**

Type of Vehicle	AADT By Year of Projection				
	2046	2047	2048	2049	2050
A. 4 Wheel - Up Vehicle					
PUV	4,236	4,300	4,365	4,431	4,497
Private Car / Taxi	56,127	56,981	57,848	58,728	59,621
Sub-Total	60,363	61,281	62,212	63,158	64,119
Srv Vehicle of Locators					
5% of Sub-Total	3,018	3,064	3,111	3,158	3,206
Total for A	63,381	64,345	65,323	66,316	67,325
B. 2 to 3 Wheel Vehicle					
Tricycle / Motorcycle	55,575	56,414	57,266	58,131	59,009
Total for B.	55,575	56,414	57,266	58,131	59,009
TOTAL for A & B	**118,956**	**120,759**	**122,589**	**124,447**	**126,333**

Table 2-70: Projected Average Annual Daily Traffic (AADT) by type of Vehicle by year

Type of Vehicle	AADT Per Year									
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
4 - Wheel and Up	5,404	10,807	16,211	21,614	27,018	32,422	37,825	38,400	38,984	39,577
3 - Wheel and Below	6,279	12,557	18,836	25,114	31,393	37,672	43,950	44,614	45,288	45,972
Total	11,683	23,365	35,047	46,729	58,411	70,094	81,776	83,015	84,272	85,549

Type of Vehicle	AADT Per Year									
	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
4 - Wheel and Up	52,794	53,596	54,411	55,239	56,079	56,931	57,797	58,676	59,568	60,474
3 - Wheel and Below	47,839	48,562	49,295	50,040	50,795	51,562	52,341	53,131	53,934	54,748
Total	100,633	102,158	103,706	105,278	106,874	108,494	110,138	111,807	113,501	115,222

Type of Vehicle	AADT Per Year				
	2046	2047	2048	2049	2050
4 - Wheel and Up	63,381	64,345	65,323	66,316	67,325
3 - Wheel and Below	55,575	56,414	57,266	58,131	59,009
Total	118,956	120,759	122,589	124,447	126,333

Analysis on AADT Projection

AADT Distribution

The projected AADT by type of vehicle and its percentage distribution by interval year is shown below.

As presented, the share of 4-wheel and up vehicle became more dominant in the later years than the 3 wheel down type of vehicle. This is brought about by the decline in the number of commuters that takes PUV, and the decline in the number of passengers in private cars and taxis.

Table 2-71: Projected Average Annual Daily Traffic (AADT) by Interval by Type of Vehicle

Type of Vehicle	AADT by Interval Year					Distribution by Type of Vehicle (%)				
	2026	2032	2040	2045	2050	2026	2032	2040	2045	2050
4 - Wheel and Up	5,404	37,825	56,079	60,474	67,325	46.26	46.25	52.47	52.48	53.29
3 - Wheel and Below	6,279	43,950	50,795	54,748	59,009	53.74	53.75	47.53	47.52	46.71
Total	11,683	81,776	106,874	115,222	126,333	100.00	100.00	100.00	100.00	100.00

AADT Growth

Average annual growth rate (AAGR) of AADT for all type of vehicles is computed at 9.99% per year from 2026 to 2050. However, during the initial years, a high growth of 38.31% is attained due to the high entry of locators in the estate until its full occupancy in 2032. Growth thereafter stabilized relying mainly on normal increase in employment and transient guests.

Secondly, slow growth in AADT is due to the increase in average number of passengers ferried per trip from 31 in the early years to 35 in the later years.

Table 2-72: Projected Average Annual Daily Traffic (AADT) Growth Rate by Type of Vehicle

Type of Vehicle	AAGR by Inclusive Years (in %)				AAGR 2026-2050
	2026 - 2032	2032-2040	2040-2045	2045-2050	
4 - Wheel Up Vehicle	38.31	5.05	1.52	2.17	10.62
3 - Wheel Down Vehicle	38.31	1.83	1.51	1.51	9.38
Total	38.31	3.40	1.52	1.86	9.99

__Population to Traffic Ratio__

The table shows a steady decline in the population to traffic ratio from 2.15 in 2026 to 1.83 in 2050. This indicate that more vehicles will be needed to ferry the projected population of the estate adding more traffic on the road. A policy adjustment is suggested to increase the number of passengers ferried per vehicle per trip as a strategy to reduce traffic and to increase existing road capacity to accommodate more traffic.

Table 2-73: Population of Traffic Ratio

Particular	Year				
	2026	2032	2040	2045	2050
A. Population to Traffic Ratio					
Population	25,078	175,549	198,301	213,995	230,931
AADT	11,683	81,776	106,874	115,222	126,333
Ratio	2.15	2.15	1.86	1.86	1.83

Project Impact Assessment on Road Facility

__Definition of Terms__

Traffic Saturation Flow Rate (SFR) is defined as the maximum number of vehicle that can pass the stop line per unit of time under one lane with sufficient traffic demand at the intersection entrance.

It is affected by factors such as the type of road, traffic, and surrounding environment. The Highway Capacity Manual prescribed an ideal saturation flow rate of 1,900 per hour per lane per day.

"WITHOUT PROJECT" SCENARIO

A. Four-Lane Road Analysis (SFR at 1,500)

With below par current road and traffic condition of the 4-lane Tayud Highway, a low traffic saturation flow rate of 1,500 per hour per lane per day is assumed. Using the formula shown in Exhibit A below, Optimum AADT is computed at 91,800.

Using the projected Average Annual Daily (AADT) for Tayud Road without the project, the Optimum Road Utilization for Tayud Highway is achieved in year 2027. The traffic projection presented took into account the traffic to be generated by Tayud International Port to operate in 2026, operation of new housing subdivisions, and the increase in economic activity in the surroundings.

B. Four-Lane Road Analysis (SFR at 1,700)

With the completion of the 4-lane Tayud Road Expansion Project, SFR is assumed at 1,700 per hour per lane per day. Using the formula shown in Exhibit A below, Optimum AADT is computed at 104.040. Using the projected Average Annual Daily Traffic (AADT) of Tayud Road without the project, the Optimum Road Utilization is achieved in year 2029. AADT presented considered the traffic generated by the Tayud International Port to operate in 2026, operation of new housing subdivisions, and the increase in economic activity in the surroundings.

C. Four-Lane Road Analysis (SFR at 1,900)

Using the ideal saturation flow rate of 1,900 and adopting the projected Average Annual Daily (AADT) for Tayud Road without the project, the Optimum Road Utilization is achieved in year 2030. Refer to

The traffic volume presented includes traffic generated by Tayud International Port to operate in 2026, operation of new housing subdivisions in the area, and the increase in economic activity in the surrounding area.

Table 2.75 Tayud Rd. Utilization Rate Computation Table with 4 Lane Road using Various SFR (W/Out Project)

Table 2-74: Tayud Rd. Utilization Rate with 4 Lane Road using Various SFR (w/o project)

Year	Tayud Road AADT All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1,900	
	W/out Proj.	W/ Proj.		Opt. Traffic 4-Lane Rd.	Utilization Rate	Opt. Traffic 4-Lane Rd.	Utilization Rate	Opt. Traffic 4-Lane Rd.	Utilization Rate
2026	78,359	-	78,359	91,800	85.36	104,040	75.32	116,280	67.39
2027	87,762	-	87,762	91,800	95.60	104,040	84.35	116,280	75.48
2028	98,294	-	98,294	91,800	107.07	104,040	94.48	116,280	84.53
2029	110,089	-	110,089	91,800	119.92	104,040	105.81	116,280	94.68
2030	123,300	-	123,300	91,800	134.31	104,040	118.51	116,280	106.04
2031	138,096	-	138,096	91,800	150.43	104,040	132.73	116,280	118.76
2032	154,667	-	154,667	91,800	168.48	104,040	148.66	116,280	133.01
2033	162,401	-	162,401	91,800	176.91	104,040	156.09	116,280	139.66
2034	170,521	-	170,521	91,800	185.75	104,040	163.90	116,280	146.65
2035	179,047	-	179,047	91,800	195.04	104,040	172.09	116,280	153.98
2036	187,999	-	187,999	91,800	204.79	104,040	180.70	116,280	161.68
2037	197,399	-	197,399	91,800	215.03	104,040	189.73	116,280	169.76
2038	207,269	-	207,269	91,800	225.78	104,040	199.22	116,280	178.25
2039	217,632	-	217,632	91,800	237.07	104,040	209.18	116,280	187.16
2040	228,514	-	228,514	91,800	248.93	104,040	219.64	116,280	196.52
2041	235,370	-	235,370	91,800	256.39	104,040	226.23	116,280	202.42
2042	242,431	-	242,431	91,800	264.09	104,040	233.02	116,280	208.49
2043	249,704	-	249,704	91,800	272.01	104,040	240.01	116,280	214.74
2044	257,195	-	257,195	91,800	280.17	104,040	247.21	116,280	221.19
2045	264,910	-	264,910	91,800	288.57	104,040	254.62	116,280	227.82
2046	272,858	-	272,858	91,800	297.23	104,040	262.26	116,280	234.66
2047	281,044	-	281,044	91,800	306.15	104,040	270.13	116,280	241.70
2048	289,475	-	289,475	91,800	315.33	104,040	278.23	116,280	248.95
2049	298,159	-	298,159	91,800	324.79	104,040	286.58	116,280	256.41
2050	307,104	-	307,104	91,800	334.54	104,040	295.18	116,280	264.11

D. Recommendation on the Without Project Scenario

- Indorse the immediate implementation of the new 4-Lane Mandaue-Liloan Diversion Road or expand Tayud Road from 4 lane to 6 lane on or before 2027.
- Improve traffic management to achieve a high saturation flow rate of 1,900 AADT and extend the number of years to 3030 before full utilization is achieve.

"WITH PROJECT" SCENARIO

Tayud Road Utilization Rate Assessment

A. Four-Lane Road Impact Analysis

Using the following assumptions:

- Saturation Flow Rate at : a) 1,500; b) 1,700, c) 1,900
- AADT Projection from outside project
- AADT Projection from inside project

The following are concluded:

1. With SFR at 1,500, Optimum Road Utilization is achieved in year 2026.

2. With SFR at 1,700, Optimum Road Utilization is achieved in year 2027.

3. With SFR at 1,900, Optimum Road Utilization is achieved in year 2028.

Table 2-75: Tayud Rd. Utilization Rate with 4 Lane Road using Various SFR (w/ project)

Year	High AADT Estimate All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1900	
				Opt. AADT - 4-Lane Rd.	Utilization Rate	Opt. AADT - 4-Lane Rd.	Utilization Rate	Opt. AADT - 4-Lane Rd.	Utilization Rate
	W/out Proj.	W/ Proj.							
2026	78,359	11,683	90,042	91,800	98.08	104,040	86.55	116,280	77.44
2027	87,762	23,365	111,127	91,800	121.05	104,040	106.81	116,280	95.57
2028	98,294	35,047	133,341	91,800	145.25	104,040	128.16	116,280	114.67
2029	110,089	46,729	156,818	91,800	170.83	104,040	150.73	116,280	134.86
2030	123,300	58,411	181,711	91,800	197.94	104,040	174.65	116,280	156.27
2031	138,096	70,094	208,190	91,800	226.79	104,040	200.11	116,280	179.04
2032	154,667	81,776	236,443	91,800	257.56	104,040	227.26	116,280	203.34
2033	162,401	83,015	245,416	91,800	267.34	104,040	235.89	116,280	211.06
2034	170,521	84,272	254,793	91,800	277.55	104,040	244.90	116,280	219.12
2035	179,047	85,549	264,596	91,800	288.23	104,040	254.32	116,280	227.55
2036	187,999	100,633	288,632	91,800	314.41	104,040	277.42	116,280	248.22
2037	197,399	102,158	299,557	91,800	326.32	104,040	287.93	116,280	257.62
2038	207,269	103,706	310,975	91,800	338.75	104,040	298.90	116,280	267.44
2039	217,632	105,278	322,911	91,800	351.75	104,040	310.37	116,280	277.70
2040	228,514	106,874	335,388	91,800	365.35	104,040	322.36	116,280	288.43
2041	235,370	108,494	343,863	91,800	374.58	104,040	330.51	116,280	295.72
2042	242,431	110,138	352,569	91,800	384.06	104,040	338.88	116,280	303.21
2043	249,704	111,807	361,510	91,800	393.80	104,040	347.47	116,280	310.90
2044	257,195	113,501	370,696	91,800	403.81	104,040	356.30	116,280	318.80
2045	264,910	115,222	380,132	91,800	414.09	104,040	365.37	116,280	326.91
2046	272,858	118,956	391,814	91,800	426.81	104,040	376.60	116,280	336.96
2047	281,044	120,759	401,802	91,800	437.69	104,040	386.20	116,280	345.55
2048	289,475	122,589	412,064	91,800	448.87	104,040	396.06	116,280	354.37
2049	298,159	124,447	422,606	91,800	460.36	104,040	406.20	116,280	363.44
2050	307,104	126,333	433,437	91,800	472.15	104,040	416.61	116,280	372.75

B. Six-Lane Road Impact Analysis

Using the following assumptions:

- Saturation Flow Rate at : a) 1,500; b) 1,700, c) 1,900
- AADT Projection from outside project
- AADT Projection from project

The following are concluded:

1. With SFR at 1,500, Optimum Road Utilization is achieved in year 2028.

2. With SFR at 1,700, Optimum Road Utilization is achieved in year 2029.

3. With SFR at 1,900, Optimum Road Utilization is achieved in year 2030.

Table 2-76: Tayud Rd. Utilization Rate with 6 Lane Road using Various SFR (w/ project)

Year	High AADT Estimate All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1900	
				Opt. AADT - 6-Lane Rd.	Utilizatio n Rate	Opt. AADT - 6-Lane Rd.	Utilization Rate	Opt. AADT - 6-Lane Rd.	Utilization Rate
	W/out Proj.	W/ Proj.							
2026	78,359	11,683	90,042	137,700	65.39	156,060	57.70	174,420	51.62
2027	87,762	23,365	111,127	137,700	80.70	156,060	71.21	174,420	63.71
2028	98,294	35,047	133,341	137,700	96.83	156,060	85.44	174,420	76.45
2029	110,089	46,729	156,818	137,700	113.88	156,060	100.49	174,420	89.91
2030	123,300	58,411	181,711	137,700	131.96	156,060	116.44	174,420	104.18
2031	138,096	70,094	208,190	137,700	151.19	156,060	133.40	174,420	119.36
2032	154,667	81,776	236,443	137,700	171.71	156,060	151.51	174,420	135.56
2033	162,401	83,015	245,416	137,700	178.22	156,060	157.26	174,420	140.70
2034	170,521	84,272	254,793	137,700	185.03	156,060	163.27	174,420	146.08
2035	179,047	85,549	264,596	137,700	192.15	156,060	169.55	174,420	151.70
2036	187,999	100,633	288,632	137,700	209.61	156,060	184.95	174,420	165.48
2037	197,399	102,158	299,557	137,700	217.54	156,060	191.95	174,420	171.74
2038	207,269	103,706	310,975	137,700	225.84	156,060	199.27	174,420	178.29
2039	217,632	105,278	322,911	137,700	234.50	156,060	206.91	174,420	185.13
2040	228,514	106,874	335,388	137,700	243.56	156,060	214.91	174,420	192.29
2041	235,370	108,494	343,863	137,700	249.72	156,060	220.34	174,420	197.15
2042	242,431	110,138	352,569	137,700	256.04	156,060	225.92	174,420	202.14
2043	249,704	111,807	361,510	137,700	262.53	156,060	231.65	174,420	207.26
2042	242,431	110,138	352,569	137,700	256.04	156,060	225.92	174,420	202.14
2043	249,704	111,807	361,510	137,700	262.53	156,060	231.65	174,420	207.26
2044	257,195	113,501	370,696	137,700	269.21	156,060	237.53	174,420	212.53
2045	264,910	115,222	380,132	137,700	276.06	156,060	243.58	174,420	217.94
2046	272,858	118,956	391,814	137,700	284.54	156,060	251.07	174,420	224.64
2047	281,044	120,759	401,802	137,700	291.80	156,060	257.47	174,420	230.36

C. Eight-Lane Road Impact Analysis

Using the following assumptions:

- Saturation Flow Rate at : a) 1,500; b) 1,700, c) 1,900

- AADT Projection from outside project
- AADT Projection from inside project

The following are concluded:

1. With SFR at 1,500, Optimum Road Utilization is achieved in year 2030.
2. With SFR at 1,700, Optimum Road Utilization is achieved in year 2031.
3. With SFR at 1,900, Optimum Road Utilization is achieved in year 2032.

Table 2-77: Tayud Rd. Utilization Rate with 8 Lane Road using Various SFR (w/ project)

Year	AADT Estimate All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1900	
				Opt. AADT - 8-Lane Rd.	Utilization Rate	Opt. AADT - 8-Lane Rd.	Utilization Rate	Opt. AADT - 8-Lane Rd.	Utilization Rate
	Outside Proj.	Inside Proj.							
2026	78,359	11,683	90,042	183,600	49.04	208,080	43.27	232,560	38.72
2027	87,762	23,365	111,127	183,600	60.53	208,080	53.41	232,560	47.78
2028	98,294	35,047	133,341	183,600	72.63	208,080	64.08	232,560	57.34
2029	110,089	46,729	156,818	183,600	85.41	208,080	75.36	232,560	67.43
2030	123,300	58,411	181,711	183,600	98.97	208,080	87.33	232,560	78.14
2031	138,096	70,094	208,190	183,600	113.39	208,080	100.05	232,560	89.52
2032	154,667	81,776	236,443	183,600	128.78	208,080	113.63	232,560	101.67
2033	162,401	83,015	245,416	183,600	133.67	208,080	117.94	232,560	105.53
2034	170,521	84,272	254,793	183,600	138.78	208,080	122.45	232,560	109.56
2035	179,047	85,549	264,596	183,600	144.12	208,080	127.16	232,560	113.78
2036	187,999	100,633	288,632	183,600	157.21	208,080	138.71	232,560	124.11
2037	197,399	102,158	299,557	183,600	163.16	208,080	143.96	232,560	128.81
2038	207,269	103,706	310,975	183,600	169.38	208,080	149.45	232,560	133.72
2039	217,632	105,278	322,911	183,600	175.88	208,080	155.19	232,560	138.85
2040	228,514	106,874	335,388	183,600	182.67	208,080	161.18	232,560	144.22
2041	235,370	108,494	343,863	183,600	187.29	208,080	165.26	232,560	147.86
2042	242,431	110,138	352,569	183,600	192.03	208,080	169.44	232,560	151.60
2043	249,704	111,807	361,510	183,600	196.90	208,080	173.74	232,560	155.45
2044	257,195	113,501	370,696	183,600	201.90	208,080	178.15	232,560	159.40
2045	264,910	115,222	380,132	183,600	207.04	208,080	182.69	232,560	163.46
2046	272,858	118,956	391,814	183,600	213.41	208,080	188.30	232,560	168.48
2047	281,044	120,759	401,802	183,600	218.85	208,080	193.10	232,560	172.77
2048	289,475	122,589	412,064	183,600	224.44	208,080	198.03	232,560	177.19
2049	298,159	124,447	422,606	183,600	230.18	208,080	203.10	232,560	181.72
2050	307,104	126,333	433,437	183,600	236.08	208,080	208.30	232,560	186.38

D. Ten-Lane Road Impact Analysis

Using the following assumptions:

- Saturation Flow Rate at : a) 1,500; b) 1,700, c) 1,900
- AADT Projection from outside project
- AADT Projection from inside project

The following are concluded:

1. With SFR at 1,500, Optimum Road Utilization is achieved in year 2032.
2. With SFR at 1,700, Optimum Road Utilization is achieved in year 2035.
3. With SFR at 1,900, Optimum Road Utilization is achieved in year 2037.

Table 2-78: Tayud Rd. Utilization Rate with 10 Lane Road using Various SFR (w/ project)

Year	AADT Estimate All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1900	
				Opt. AADT - 10-Lane Rd.	Utilization Rate	Opt. AADT - 10-Lane Rd.	Utilization Rate	Opt. AADT - 10-Lane Rd.	Utilization Rate
	Outside Proj	Inside Proj							
2026	78,359	11,683	90,042	229,500	39.23	260,100	34.62	290,700	30.97
2027	87,762	23,365	111,127	229,500	48.42	260,100	42.72	290,700	38.23
2028	98,294	35,047	133,341	229,500	58.10	260,100	51.27	290,700	45.87
2029	110,089	46,729	156,818	229,500	68.33	260,100	60.29	290,700	53.94
2030	123,300	58,411	181,711	229,500	79.18	260,100	69.86	290,700	62.51
2031	138,096	70,094	208,190	229,500	90.71	260,100	80.04	290,700	71.62
2032	154,667	81,776	236,443	229,500	103.03	260,100	90.90	290,700	81.34
2033	162,401	83,015	245,416	229,500	106.93	260,100	94.35	290,700	84.42
2034	170,521	84,272	254,793	229,500	111.02	260,100	97.96	290,700	87.65
2035	179,047	85,549	264,596	229,500	115.29	260,100	101.73	290,700	91.02
2036	187,999	100,633	288,632	229,500	125.77	260,100	110.97	290,700	99.29
2037	197,399	102,158	299,557	229,500	130.53	260,100	115.17	290,700	103.05
2038	207,269	103,706	310,975	229,500	135.50	260,100	119.56	290,700	106.97
2039	217,632	105,278	322,911	229,500	140.70	260,100	124.15	290,700	111.08
2040	228,514	106,874	335,388	229,500	146.14	260,100	128.95	290,700	115.37
2041	235,370	108,494	343,863	229,500	149.83	260,100	132.20	290,700	118.29
2042	242,431	110,138	352,569	229,500	153.62	260,100	135.55	290,700	121.28
2043	249,704	111,807	361,510	229,500	157.52	260,100	138.99	290,700	124.36
2044	257,195	113,501	370,696	229,500	161.52	260,100	142.52	290,700	127.52
2045	264,910	115,222	380,132	229,500	165.64	260,100	146.15	290,700	130.76
2046	272,858	118,956	391,814	229,500	170.73	260,100	150.64	290,700	134.78
2047	281,044	120,759	401,802	229,500	175.08	260,100	154.48	290,700	138.22
2048	289,475	122,589	412,064	229,500	179.55	260,100	158.43	290,700	141.75
2049	298,159	124,447	422,606	229,500	184.14	260,100	162.48	290,700	145.38
2050	307,104	126,333	433,437	229,500	188.86	260,100	166.64	290,700	149.10

E. Twelve-Lane Road Impact Analysis

Using the following assumptions:

- Saturation Flow Rate at : a) 1,500; b) 1,700, c) 1,900

- AADT Projection from outside project
- AADT Projection from inside project

The following are concluded:

1. With SFR at 1,500, Optimum Road Utilization is achieved in year 2036.

2. With SFR at 1,700, Optimum Road Utilization is achieved in year 2038.

3. With SFR at 1,900, Optimum Road Utilization is achieved in year 2042.

Table 2-79: Tayud Rd. Utilization Rate with 12 Lane Road using Various SFR (w/ project)

Year	AADT Estimate All Type of Vehicle		Total	SFR: 1,500		SFR: 1,700		SFR: 1900	
				Opt. AADT - 12-Lane Rd.	Utilization Rate	Opt. AADT - 12-Lane Rd.	Utilization Rate	Opt. AADT - 12-Lane Rd.	Utilization Rate
	Outside Proj	Inside Proj							
2026	78,359	11,683	90,042	275,400	32.69	312,120	28.85	348,840	25.81
2027	87,762	23,365	111,127	275,400	40.35	312,120	35.60	348,840	31.86
2028	98,294	35,047	133,341	275,400	48.42	312,120	42.72	348,840	38.22
2029	110,089	46,729	156,818	275,400	56.94	312,120	50.24	348,840	44.95
2030	123,300	58,411	181,711	275,400	65.98	312,120	58.22	348,840	52.09
2031	138,096	70,094	208,190	275,400	75.60	312,120	66.70	348,840	59.68
2032	154,667	81,776	236,443	275,400	85.85	312,120	75.75	348,840	67.78
2033	162,401	83,015	245,416	275,400	89.11	312,120	78.63	348,840	70.35
2034	170,521	84,272	254,793	275,400	92.52	312,120	81.63	348,840	73.04
2035	179,047	85,549	264,596	275,400	96.08	312,120	84.77	348,840	75.85
2036	187,999	100,633	288,632	275,400	104.80	312,120	92.47	348,840	82.74
2037	197,399	102,158	299,557	275,400	108.77	312,120	95.98	348,840	85.87
2038	207,269	103,706	310,975	275,400	112.92	312,120	99.63	348,840	89.15
2039	217,632	105,278	322,911	275,400	117.25	312,120	103.46	348,840	92.57
2040	228,514	106,874	335,388	275,400	121.78	312,120	107.45	348,840	96.14
2041	235,370	108,494	343,863	275,400	124.86	312,120	110.17	348,840	98.57
2042	242,431	110,138	352,569	275,400	128.02	312,120	112.96	348,840	101.07
2043	249,704	111,807	361,510	275,400	131.27	312,120	115.82	348,840	103.63
2044	257,195	113,501	370,696	275,400	134.60	312,120	118.77	348,840	106.27
2045	264,910	115,222	380,132	275,400	138.03	312,120	121.79	348,840	108.97
2046	272,858	118,956	391,814	275,400	142.27	312,120	125.53	348,840	112.32
2047	281,044	120,759	401,802	275,400	145.90	312,120	128.73	348,840	115.18
2048	289,475	122,589	412,064	275,400	149.62	312,120	132.02	348,840	118.12
2049	298,159	124,447	422,606	275,400	153.45	312,120	135.40	348,840	121.15
2050	307,104	126,333	433,437	275,400	157.38	312,120	138.87	348,840	124.25
2051	313,246	128,860	442,106	275,400	160.53	312,120	141.65	348,840	126.74
2052	319,511	131,437	450,948	275,400	163.74	312,120	144.48	348,840	129.27
2053	325,901	134,066	459,967	275,400	167.02	312,120	147.37	348,840	131.86
2054	332,419	136,747	469,166	275,400	170.36	312,120	150.32	348,840	134.49
2055	339,067	139,482	478,550	275,400	173.77	312,120	153.32	348,840	137.18
2056	345,849	142,272	488,121	275,400	177.24	312,120	156.39	348,840	139.93
2057	352,766	145,117	497,883	275,400	180.79	312,120	159.52	348,840	142.73
2058	359,821	148,020	507,841	275,400	184.40	312,120	162.71	348,840	145.58
2059	367,017	150,980	517,998	275,400	188.09	312,120	165.96	348,840	148.49
2060	374,358	154,000	528,357	275,400	191.85	312,120	169.28	348,840	151.46

Tayud Road GAP Analysis

Yearly GAP Analysis

Table 2-80: 25-year Projection of Tayud Road Demand – Supply Gap Analysis

Year	Supply Per Year (in AADDT)*	Demand Per Year (in AADT)	Demand - Supply Gap (in AADT)	GAP in Terms of Lane	
				AADT Requirement / Lane / Year **	Additional Road Lanes Required***
2026	104,040	90,042	13,998	26,010	0
2027	104,040	111,127	7,087	26,010	0
2028	104,040	133,341	29,301	26,010	1
2029	104,040	156,818	52,778	26,010	2
2030	104,040	181,711	77,671	26,010	3
2031	104,040	208,190	104,150	26,010	4
2032	104,040	236,443	132,403	26,010	5
2033	104,040	245,416	141,376	26,010	5
2034	104,040	254,793	150,753	26,010	6
2035	104,040	264,596	160,556	26,010	6
2036	104,040	288,632	184,592	26,010	7
2037	104,040	299,557	195,517	26,010	8
2038	104,040	310,975	206,935	26,010	8
2039	104,040	322,911	218,871	26,010	8
2040	104,040	335,388	231,348	26,010	9
2041	104,040	343,863	239,823	26,010	9
2042	104,040	352,569	248,529	26,010	10
2043	104,040	361,510	257,470	26,010	10
2044	104,040	370,696	266,656	26,010	10
2045	104,040	380,132	276,092	26,010	11
2046	104,040	391,814	287,774	26,010	11
2047	104,040	401,802	297,762	26,010	11
2048	104,040	412,064	308,024	26,010	12
2049	104,040	422,606	318,566	26,010	12
2050	104,040	433,437	329,397	26,010	13

Interval Year Demand-Supply GAP Summary

Table 2-81: Interval Year Project Tayud Road Demand - Supply Gap Analysis

Year	Supply Per Year (in AADT) Existing 4-Tayud Road	Demand Per Year (in AADT)	Demand - Supply Gap (AADT)	GAP in Terms of Lane	
				Requirement Per Year Per Lane	Number of Additional Lanes Required

2026	104,040	90,042	(13,998)	26,010 **	-
2032	104,040	236,443	132,403	26,010	5**
2035	104,040	264,596	160,556	26,010	6
2040	104,040	335,388	231,348	26,010	9
2045	104,040	380,132	276,092	26,010	11
2050	104,040	433,437	329,397	26,010	13

The project will increase the average annual daily traffic (AADT) along Tayud Highway from 154,667 without project to 236,443 with the project upon full operation of the estate in 2032. This is an increase of 81,776 or 52.87%. The added traffic volume will exceed the maximum carrying capacity of the existing Tayud Highway estimated at 104,040 in 2029.

Traffic Congestion during Construction

Road widening of the existing Tayud Highway and or the opening of new highway to augment the exiting road system, will result to traffic obstruction and congestion.

New route has to be opened to include the upgrading of barangay roads in the vicinity to serve as temporary alternate route. A re-routing and traffic management plan needs to be developed. During reclamation activties, the filling materials will be delivered through barging. Control of numbers and schedules of barges wil be regulated by the Philippine Coastguard.

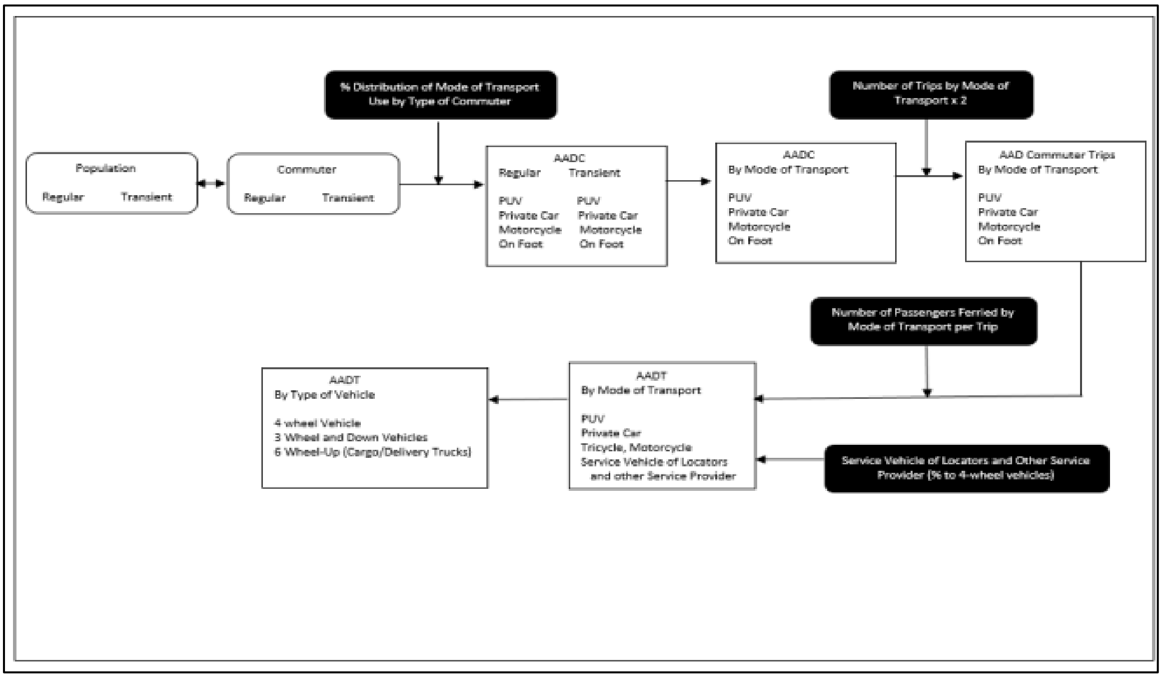
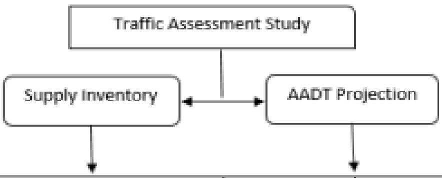


Figure 2-73: ADDT Computation Model



Year	Supply Sector (AADT)				Demand Sector (AADT)	Demand -Supply GAP (AADT)	Gap Translated in Terms Lanes	
	Existing	On Going	Pipeline	Total			Requirement / Lane / Year	Additional Number of Lanes Required
	4-Lane Rd.			(AADT)				
2026	104,040 *	none	none	104,040	90,042	-13,998	26,010**	- ***
2032	104,040	none	none	104,040	236,443	132,403	26,010	5
2035	104,040	none	none	104,040	264,596	160,556	26,010	6
2040	104,040	none	none	104,040	335,388	231,348	26,010	9
2045	104,040	none	none	104,040	380,132	276,092	26,010	11
2050	104,040	none	none	104,040	433,437	329,397	26,010	13

Exhibit A : Formula

Saturation Flow Rate / Day	1,700	1,700
No. of hour active / Day	18	18
Total	30,600	30,600
Number of Lanes	4	1
Total	122,400	30,600
Allowable Utilization Rate	0.85	0.85
Optimum AADT	104,040	26,010

Note:
* Refer to Exhibit A below column 2 to convert a 4-lane to AADT estimated at 104,040. This is assumed constant until year 2050.
** Refer to Exhibit A column 3 to compute AADT requirement per lane of road per year.
*** Number of lanes required is computed by dividing Demand-Supply Gap by AADT requirement per lane per year (Exhibit A).

Figure 2-74: Road Demand Supply Gap

During the reclamation, quarry materials will be hauled from the prospected quarry sites (6 to 8 kilometers away from the Project site) with a total volume of 575,000 cubic meters. With the use of 10 cu. m. dump trucks, it will take 52 truck trips per day to deliver the fill materials. There will also be 3,000 workers, more or less, that will be transported daily to the Project site, in two shifts. Assume 40% ride personal motorbikes or bicycles, 50% public transport (habalhabals, tricycles, jeeps), 8% shuttle bus and 2% private cars.

Existing Road Network

The main highway leading to project site is known as the Cebu North Coastal Road or locally known as Tayud Road. It is, originally, a 2-lane road but currently is being widened to a 4-lane road. Two paved roads namely, Tawagan St. and Bagakay St., and two unpaved roads will also serve as preliminary access to project site.

Figure 2-75: Existing Road Map of Project vicinity

2.4.5. Displacement of settlers/Change in Land Ownership/Displacement of Property

The Project will displace 94 families that are all to be affected by the project development.

A resettlement action plan will be formulated by the Proponent. A 1-hectare tenement complex within the Project area is included as a project component in the site development plan. There will be 11 shipyards also that will be close within the project area due to expired tenurial instruments.

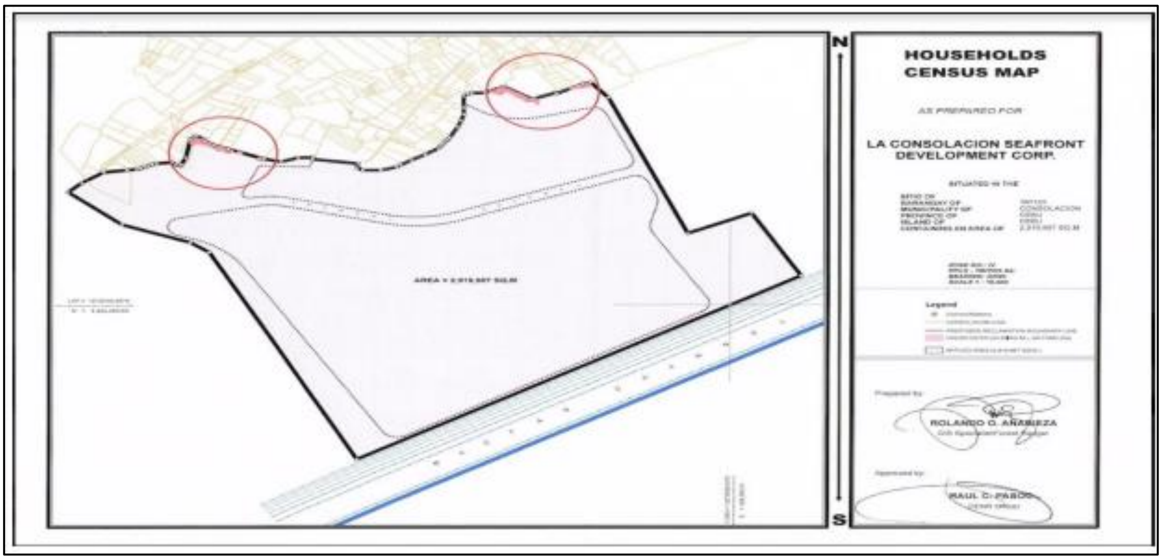


Figure 2-76: Household Census Map

Table 2-82: Inventory of Actual Occupants within Timberland Areas

INVENTORY OF ACTUAL OCCUPANTS WITHIN TIMBERLAND AREAS

	NAME	SITIO	BARANGAY	MUNICIPALITY	AGE	STATUS	ESTIMATED AREA OF LAND (SQ.M.)	YEAR OCCUPATION	WORK (MEANS OF LIVELIHOOD)	TYPE OF HOUSE	Coordinates (wgs84)	
											NORTHING	EASTING
4	Ahl Satera	Bagacay	Tayud	Consolacion	48	Married	15 sq.m	12 yrs	Tricycle Driver	Light Materials	123.9851067	10.3546233
5	Amado Agan	Bagacay	Tayud	Consolacion	62	Married	66 sq.m	14 yrs	Sari-Sari Store (Owner)	Semi Concrete	123.9846667	10.3549533
6	Annabella M. Pomento	Bagacay	Tayud	Consolacion	44	Married	12 sq.m	22 yrs	Boat Services	Light Materials	123.9851867	10.3543567
7	Arsenia Soria	Bagacay	Tayud	Consolacion	58	Widower	15 sq.m	14 yrs	Fish Vendor	Light Materials	123.9846783	10.3548783
8	Belinda Gellacone	Bagacay	Tayud	Consolacion	52	Single Mom	10 sq.m	23 yrs	Fish Vendor	Light Materials	123.9848350	10.3548233
9	Bernardo G. Judaga	Bagacay	Tayud	Consolacion	69	Married	35 sq.m	16 yrs	Vendor	Semi Concrete	123.9856917	10.3542933
10	Carmelita P. Magale	Bagacay	Tayud	Consolacion	60	Widower	40 sq.m	25yrs	Fish Vendor	Light Materials	123.9857667	10.3542267
11	Divina Magale	Bagacay	Tayud	Consolacion	32	Married	30 sq.m	13 yrs	Fish Vendor	Semi Concrete	123.9849000	10.3547650
12	Eduardo Pomento	Bagacay	Tayud	Consolacion	53	Married	10 sq.m	10 yrs	Boat Services	Light Materials	123.9853200	10.3545133
13	Fernando Aballe	Bagacay	Tayud	Consolacion	52	Married	30 sq.m	17 yrs	Boat Services	Light Materials	123.9851633	10.3543883
14	Filcisimo Lauron	Bagacay	Tayud	Consolacion	67	Married	10 sq.m	10 yrs	Construction	Light Materials	123.9844167	10.3546750
15	Gleen Abucay	Bagacay	Tayud	Consolacion	39	Married	25 sq.m	20 yrs	Welder	Semi Concrete	123.9853950	10.3545367
16	Ian Dominic Alforque	Bagacay	Tayud	Consolacion	20	Live-in	12 sq.m	5 yrs	Boat Services	Light Materials	123.9844433	10.3547467
17	Janice Jugarap	Bagacay	Tayud	Consolacion	35	Married	12 sq.m	12 yrs	Driver	Light Materials	123.9845550	10.3547500
18	Jeniel Pomento	Bagacay	Tayud	Consolacion	22	Live-in	8 sq.m	13 yrs	Laborer	Light Materials	123.9844067	10.3546617
19	Jerry Pomento Jr.	Bagacay	Tayud	Consolacion	21	Live-in	12 sq.m	5 yrs	Food Vendor	Light Materials	123.9844833	10.3546850
20	Jesel Pomento	Bagacay	Tayud	Consolacion	22	Live-in	10 sq.m	14 yrs	Casher/ KTV	Light Materials	123.9843950	10.3546583
21	Joan P. Magale	Bagacay	Tayud	Consolacion	31	Single	30 sq.m	20 yrs	Fish Vendor	Semi Concrete	123.9855983	10.3543267
22	Jocelyn Lauron	Bagacay	Tayud	Consolacion	33	Live-in	10 sq.m	10 yrs	Welder	Light Materials	123.9844100	10.3547500
23	Jovelyn Ompad	Bagacay	Tayud	Consolacion	25	Live-in	10 sq.m	4 yrs	Construction/shipyard	Light Materials	123.9845267	10.3547867
24	Juan Abucay	Bagacay	Tayud	Consolacion	64	Married	12 sq.m	16 yrs	Fishing ,Boat Seevices	Light Materials	123.9856200	10.3543233
25	Julieta Aoman	Bagacay	Tayud	Consolacion	54	Married	12 sq.m	12 yrs	Balot Vendor	Light Materials	123.9850867	10.3546300
26	Largeta Caparoso	Bagacay	Tayud	Consolacion	60	Married	25 sq.m	20 yrs	Food Vendor	Light Materials	123.9856950	10.3543250
27	Marcelino Impas	Bagacay	Tayud	Consolacion	59	Married	30 sq.m	12 yrs	Fisher Man	Light Materials	123.9848933	10.3547717
28	Mariel Pomento	Bagacay	Tayud	Consolacion	49	Married	12 sq.m	49 yrs	Fisher Man	Light Materials	123.9844467	10.3548017
29	Mario Rodrigo	Bagacay	Tayud	Consolacion	65	Married	15 sq.m	11 yrs	Pensioner	Light Materials	123.9849267	10.3547417
30	Marry Ann Aoman	Bagacay	Tayud	Consolacion	22	Live-in	15 sq.m	20 yrs	House Helper	Light Materials	123.9846617	10.3548733
31	Michelle Pomento	Bagacay	Tayud	Consolacion	25	Live-in	10 sq.m	7 yrs	Sari-Sari Store (Owner)	Light Materials	123.9844433	10.3546983
32	Nelson Torrefil	Bagacay	Tayud	Consolacion	53	Married	50 sq.m	18 yrs	Fishing ,Boat Seevices	Semi Concrete	123.9854417	10.3542300
33	Nina Pobadora	Bagacay	Tayud	Consolacion	37	Live-in	10 sq.m	10 yrs	Food Vendor	Light Materials	123.9847350	10.3548267
34	Octabio Satera	Bagacay	Tayud	Consolacion	53	Married	30 sq.m	8 yrs	Food Vendor	Light Materials	123.9851068	10.3546234
35	Rafael Rebamonte	Bagacay	Tayud	Consolacion	48	Married	10 sq.m	14 yrs	Laborer	Light Materials	123.9844033	10.3546467
36	Riche Lauron	Bagacay	Tayud	Consolacion	34	Live-in	10 sq.m	10 yrs	Welder	Light Materials	123.9844367	10.3547267
37	Ricky Balili	Bagacay	Tayud	Consolacion	32	Live-in	10 sq.m	12 yrs	Construction Worker/ IT Park	Light Materials	123.9844767	10.3547117
38	Ro-an Quimbo	Bagacay	Tayud	Consolacion	24	Live-in	8 sq.m	5 yrs	Construction/shipyard	Light Materials	123.9845133	10.3546983
39	Robert Matugena	Bagacay	Tayud	Consolacion	46	Married	20 sq.m	18 yrs	Driver Operator/ Shipyard	Semi Concrete	123.9846967	10.3548750
40	Rolando Matugena	Bagacay	Tayud	Consolacion	36	Live-in	15 sq.m	12 yrs	Warehouse Helper	Semi Concrete	123.9854700	10.3544983
41	Ronnie Lauron	Bagacay	Tayud	Consolacion	36	Live-in	10 sq.m	10 yrs	Construction	Light Materials	123.9843283	10.3545833
42	Rosalinda Pomento	Bagacay	Tayud	Consolacion	44	Married	10 sq.m	14 yrs	Laborer	Light Materials	123.9845468	10.3547100
43	Rosela Yiatam	Bagacay	Tayud	Consolacion	48	Married	20 sq.m	12 yrs	Construction	Semi Concrete	123.9850268	10.3546584
44	Sara Soria	Bagacay	Tayud	Consolacion	26	Live-in	10 sq.m	5 yrs	Food Vendor	Light Materials	123.9846783	10.3548783
45	Segundina P. Tarangia	Bagacay	Tayud	Consolacion	78	Widower	35 sq.m	6 yrs	Fishing	Semi Light Material	123.9842117	10.3547900
46	Sony Rodrigo	Bagacay	Tayud	Consolacion	39	Married	10 sq.m	6 yrs	Construction	Light Materials	123.9849367	10.3547350
47	Sophia Semensi	Bagacay	Tayud	Consolacion	47	Married	20 sq.m	14 yrs	Government Employee (J.O)	Light Materials	123.9849983	10.3546733
48	Victor Booc	Bagacay	Tayud	Consolacion	44	Married	25 sq.m	15 yrs	Fishing, Construction	Light Materials	123.9852483	10.3545583
49	Virgilio Gumba	Bangkerohan	Tayud	Consolacion	49	Married	15 sq.m	20 yrs	Shipyard Employee	Light Materials	123.9760883	10.3513250
50	Romel Alegado	Bangkerohan	Tayud	Consolacion	27	Live-in	10 sq.m	7 yrs	Shipyard Employee	Light Materials	123.9760233	10.3512467
51	Marjorie Tapil	Bangkerohan	Tayud	Consolacion	29	Live-in	8 sq.m	8 yrs	Laborer	Semi Concrete	123.9760467	10.3513000
52	Vicente Montesclaros	Bangkerohan	Tayud	Consolacion	51	Married	8 sq.m	7 yrs	Vendor	Semi Concrete	123.9760950	10.3512583
53	Elgine Hernal	Bangkerohan	Tayud	Consolacion	41	Married	20 sq.m	1 yr	Welder	Light Materials	123.9752567	10.3516883
54	Maribel Minguito	Bangkerohan	Tayud	Consolacion	44	Live-in	25 sq.m	1 yr	Welder	Light Materials	123.9753983	10.3515400
55	Sergio Baquicosa	Bangkerohan	Tayud	Consolacion	69	Married	20 sq.m	25 yrs	Sari-Sari Store (Owner)	Semi Concrete	123.9750500	10.3517433
56	Crestita Bolado	Bangkerohan	Tayud	Consolacion	52	Married	20 sq.m	2 yrs	Helper	Light Materials	123.9752150	10.3516350
57	Jason Tecson	Bangkerohan	Tayud	Consolacion	36	Married	30 sq.m	25 yrs	Engr Shiyard	Semi Concrete	123.9752150	10.3516350
58	Guillen Stephen	Bangkerohan	Tayud	Consolacion	52	Married	35 sq.m	25 yrs	Call Center	Semi Concrete	123.9748900	10.3517983
59	Edgar Guarin	Bangkerohan	Tayud	Consolacion	42	Married	20 sq.m	5 yrs	Technician	Light Materials	123.9748900	10.3517983
60	Mae Boyles	Bangkerohan	Tayud	Consolacion	41	Single	20 sq.m	21 yrs	Food Vendor	Light Materials	123.9748300	10.3517050
61	Joel Villagracia	Bangkerohan	Tayud	Consolacion	50	Live-in	12 sq.m	15 yrs	Contruction Worker	Light Materials	123.9748300	10.3517050
62	Julius Villagracia	Bangkerohan	Tayud	Consolacion	37	Live-in	12 sq.m	15 yrs	Stripper	Light Materials	123.9747917	10.3517533
63	Godoberto Bayon	Bangkerohan	Tayud	Consolacion	56	Married	35 sq.m	7 yrs	Taxi Driver	Semi Concrete	123.9747917	10.3517533
64	Joerem Villagracia	Bangkerohan	Tayud	Consolacion	24	Live-in	10 sq.m	20 yrs	Stripper	Light Materials	123.9748300	10.3517050
65	Sammy Pruclenciado	Bangkerohan	Tayud	Consolacion	51	Widow	12 sq.m	4 yrs	Taxi Driver	Light Materials	123.9748133	10.3518000
66	Maribel Salarza	Bangkerohan	Tayud	Consolacion	45	Widower	20 sq.m	20 yrs	Sari-Sari Store (Owner)	Semi Concrete	123.9746833	10.3517283
67	Dennis Nadera	Bangkerohan	Tayud	Consolacion	35	Married	20 sq.m	6 yrs	Lending Collector	Light Materials	123.9746183	10.3518317
68	Eduardo Dela Rosa	Bangkerohan	Tayud	Consolacion	45	Married	10 sq.m	16 yrs	Weaver	Light Materials	123.9746183	10.3518317
69	Rolando Retada	Bangkerohan	Tayud	Consolacion	45	Live-in	10 sq.m	14 yrs	Welder	Light Materials	123.9746367	10.3518917
70	Alberto Ocampo	Bangkerohan	Tayud	Consolacion	70	Live-in	20 sq.m	9 yrs	Habal- Habal Driver	Light Materials	123.9746367	10.3518917
71	Christopher Israel	Bangkerohan	Tayud	Consolacion	39	Married	30 sq.m	1 yr	Supervisor	Semi Concrete	123.9745050	10.3519517
72	Mauro Pacaldo	Bangkerohan	Tayud	Consolacion	31	Married	20 sq.m	3 yrs	Security Guard	Semi Concrete	123.9744617	10.3519417
73	Junior Aguipo	Bangkerohan	Tayud	Consolacion	58	Widow	40 sq.m	22 yrs	Skilled Worker	Semi Concrete	123.9744650	10.3519900
74	Regie Mahogany	Bangkerohan	Tayud	Consolacion	33	Live-in	10 sq.m	2 yrs	Constructon Worker	Light Materials	123.9744651	10.3519900
75	Noel Mahogany	Bangkerohan	Tayud	Consolacion	48	Married	20 sq.m	9 yrs	Driver	Semi Concrete	123.9744652	10.3519900
76	Mildrid Pilapil	Bangkerohan	Tayud	Consolacion	40	Single	35 sq.m	22 yrs	Sari-Sari Store (Owner)	Semi Concrete	123.9744653	10.3519900
77	Romeo Jopia	Bangkerohan	Tayud	Consolacion	63	Separated	35 sq.m	22 yrs	Casual Employee- MEPZA	Concrete	123.9744654	10.3519900
78	Eugenio Abing	Bangkerohan	Tayud	Consolacion	63	Married	20 sq.m	22 yrs	Driver	Light Materials	123.9744655	10.3519900
79	Arnel Pelayo	Bangkerohan	Tayud	Consolacion	36	Live-in	20 sq.m	8 yrs	Delivery Man	Light Materials	123.9744656	10.3519900
80	Amor Pilapil	Bangkerohan	Tayud	Consolacion	56	Single	50 sq.m	20 yrs	Batchoy Store	Semi Concrete	123.9744657	10.3519900
81	Brenda Destrisa	Bangkerohan	Tayud	Consolacion	52	Married	60 sq.m	20 yrs	Factory Worker	Light Materials	123.9744658	10.3519900
82	Ramonito Tumale	Bangkerohan	Tayud	Consolacion	41	Live-in	30 sq.m	20 yrs	Diver- Shipyard	Semi Concrete	123.9744659	10.3519900
83	Estelita Solicar	Bangkerohan	Tayud	Consolacion	52	Widower	120 sq.m	26 yrs	Laundry	Semi Concrete	123.9740300	10.3522733
84	Rufino Egay	Bangkerohan	Tayud	Consolacion	52	Married	110 sq.m	20 yrs	Diver-Fortune Shipyard	Concrete	123.9740400	10.3522734
85	Norelie Eliot	Bangkerohan	Tayud	Consolacion	32	Married	40 sq.m	20 yrs	Call Center Agent	Concrete	123.9740500	10.3522735
86	June Anthony Montejo	Bangkerohan	Tayud	Consolacion	23	Live-in	50 sq.m	10 yrs	Fort Clip Operator	Semi Concrete	123.9740600	10.3522736
87	Ralph Pomento	Bangkerohan	Tayud	Consolacion	25	Live-in	8 sq.m	5 yrs	Welder	Concrete	123.9740700	10.3522737
88	Ejiy Aguipo	Bangkerohan	Tayud	Consolacion	30	Married	10 sq.m	18 yrs	Factory Worker	Concrete	123.9740800	10.3522738
89	Rovic Pomento	Bangkerohan	Tayud	Consolacion	20	Live-in	15 sq.m	18 yrs	Factory Worker	Concrete	123.9740900	10.3522739
90	Allan Pomento	Bangkerohan	Tayud	Consolacion	50	Married	8 sq.m	18 yrs	Fisherman	Light Materials	123.9741000	10.3522740
91	Reynaldo Pomento	Bangkerohan	Tayud	Consolacion	30	Live-in	50 sq.m	18 yrs	Welder	Semi Concrete	123.9741100	10.3522741
92	Lymarzie Sotto	Bangkerohan	Tayud	Consolacion	28	Single	15 sq.m	4 yrs	House keeping	Semi Concrete	123.9741200	10.3522742
93	Gabriel Garciano	Bangkerohan	Tayud	Consolacion	31	Married	30 sq.m	12 yrs	Welder	Semi Concrete	123.9741300	10.3522743
94	Ramonito Sanchez	Bangkerohan	Tayud	Consolacion	65	Single	10 sq.m	6 yrs	Fishing	Light Materials	123.9741400	10.3522744
95	Jose Pagatpat	Bangkerohan	Tayud	Consolacion	54	Married	20 sq.m	60 yrs	Fishing	Light Materials	123.9741500	10.3522745

2.4.6. Right of Way Conflict

The Local Government Unit of Consolacion, Cebu will ensure that there will be no right of way conflict among adjacent property owners. An easement or access road going to the foreshore area will be provided as access road for the locals or fisherfolks. On the coastal area, still there will be a sufficient access for ships or sea vessels passing through Mactan Channel as well as for the ships of the adjacent shipyards outside the project area.

2.4.7. In-migration/Cultural Change

Based on the Municipality's population projection data, every year the population of the municipality is progressively increasing due to the booming of the economy in the municipality. Several factors such as increasing operation of industrial plants and commercial establishments are the main reason of the economic booming in the municipality. Due to this, the in-migration are the main reason of the increasing population within the municipality especially to the host barangay.

It was also projected that the proposed project can be an additional factor for the in-migration as projected in the population data computation conducted not just because of employment opportunities but as well as more future businesses will invest in the municipality or to the project site itself when the project will be implemented.

2.4.8. Presence of Indigenous People

There is no presence of any indigenous people within the project site or in the host barangay.

2.4.9. Project implementation's threat to public health vis-à-vis the baseline health conditions in the area

The project will not cause any direct threat to public health since project will not discharged or emit any untreated pollution that can threaten the public health. The water quality of the coastal area as adjacent water body will be regularly monitored to ensure that the project will not cause any harm to the public resulting from the development and operation of the project including to threat to the aquatic species and nearby mangroves.

During project development, the construction workers will be required to wear PPEs to ensure their safety. Several warning signs and buffers will be installed not just for the safety of workers as well as safety of any passing public near the project site.

However, for security, peace and order, and safety concerns, the following are the prevention and mitigation:

- The proponent will establish an in-house security group to secure the area.

- Proper security protocols will be established to ensure safety and security of the project area/estate and its support facilities.
- Coordination/Partnership with the LGU's, Barangay Security units, the local PNP and the PCG Regional Office will be established to strengthen security nets within the area and corresponding security and safety protocols will be established.
- Coordination/Partnership with the municipal and barangay Health units, other health institutions, the MDRR units will also be established to address Emergency response procedures.
- Standard Safety Protocols will be implemented on site as required by the DOLE. A Safety Officer will be engaged to oversee compliance and implementation of such policies. Similarly, a medical personnel, an on-site clinic, or similar measure will be adopted to make sure that immediate medical emergencies are addressed.

2.4.10. Local benefits expected from project implementation

Direct and indirect economic opportunities for local residents will result from the Project through direct labor in the construction and operation of the Project. There will be employment opportunities and some possible business opportunities and developments which will invest more in the municipality.

The following are the positive impacts that might be brough by the project:

- Enhancement of employment and livelihood opportunities
- Increased business opportunities and associated economic activities
- Increased revenue of LGUs

These are the commitments of the proponent which will be gain during project implementation:

- Prioritization will be given to qualified local manpower from the host barangays, neighboring barangays, the municipality and neighboring towns.
- Through the proponents SDP and Corporate Social Responsibility Programs, alternative programs will be implemented in line with the Barangay's Social Development Program in accordance with the Barangay's IRA.
- The locals of Consolacion will directly benefit from the project. It will earn from the shares from the sale and operation of the estate. Similarly, there will be additional earning from tax revenues from locators and other developers that will eventually be established in the estate development.

2.4.11. Threat to delivery of basic services

The Project is forecasted to benefit the local economy of Consolacion in terms of tax revenue. The project will not in any way can cause threat to delivery of basic services unless no sufficient supplies to these basic services available.

The following will be the action of the proponent to address the threat to delivery of basic services:

- Concerned water, power and telecommunication providers, health institutions and the LGU of Consolacion will be informed and engaged from the planning to ensure that requirements for these requirements are sufficient and available.
- Delivery of these services will be regularly coordinated with these agencies to ensure orderly implementation of project development details.
- Delivery of basic services will also be monitored and in coordination with concerned agencies. As necessary, partnership with health institutions, the barangay related agencies will be forged.

2.4.12. Perception Survey

Distribution of Respondents

A second perception survey was conducted last March 25-30, 2022 by the LGU of Consolacion, Cebu. A total of 3,508 respondents were interviewed coming from selected residents in the 7 Sitios of Barangay Tayud namely, Sitio Bagacay, Baha-Baha, Bangkerohan, East Binabag, Libo, Looc and Tawagan. Figure 2-65 shows the location of the respondents conducted with Perception Survey which was reflected in a map.

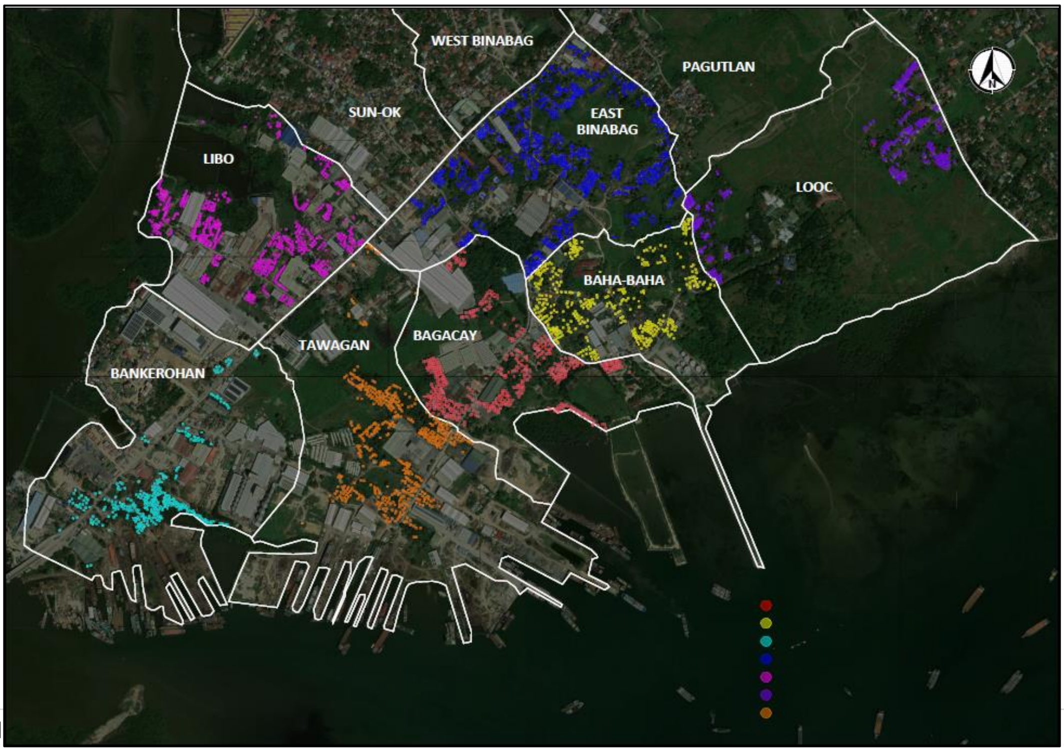


Figure 2-77: Map showing the location of the respondents of the Perception Survey

Out of the total respondents, Sitio East Binabag had the highest number of respondents with 867 followed by Sitio Tawagan with 575 and Sitio Bagacay with 523. Figure 2-67 shows the summary of the Perception Survey respondents per Sitio in Barangay Tayud, Consolacion, Cebu.

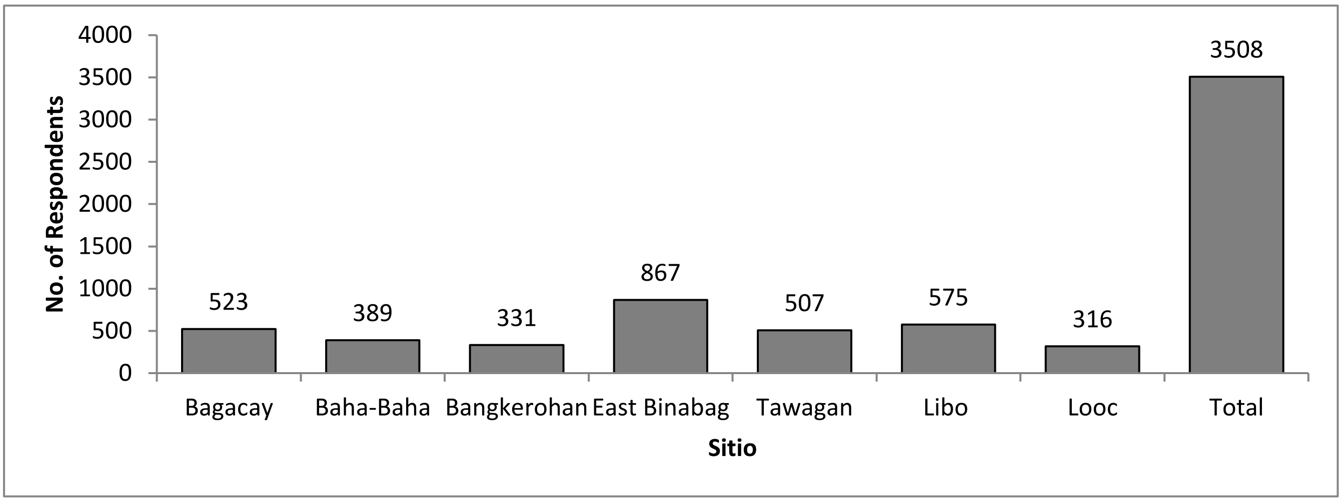


Figure 2-78: Breakdown of Perception Survey Respondents per Sitio

Awareness on the Project

Out of the initially processed data of 2,092 respondents, 1792 or 85.66% are aware of the proposed Seafront City Project of LGU Consolacion while 300 or 14.34% are not aware of the project.

Approval of the Project

Initial data processed revealed that 1,588 out of the 2,092 respondents or 76% agreed with the proposed reclamation project while 413 or 19.7% disagreed. 75 respondents did not care at all and 15 did not answer. Figure 2-67 shows the breakdown of the respondent's perception when it comes to the approval of the project.

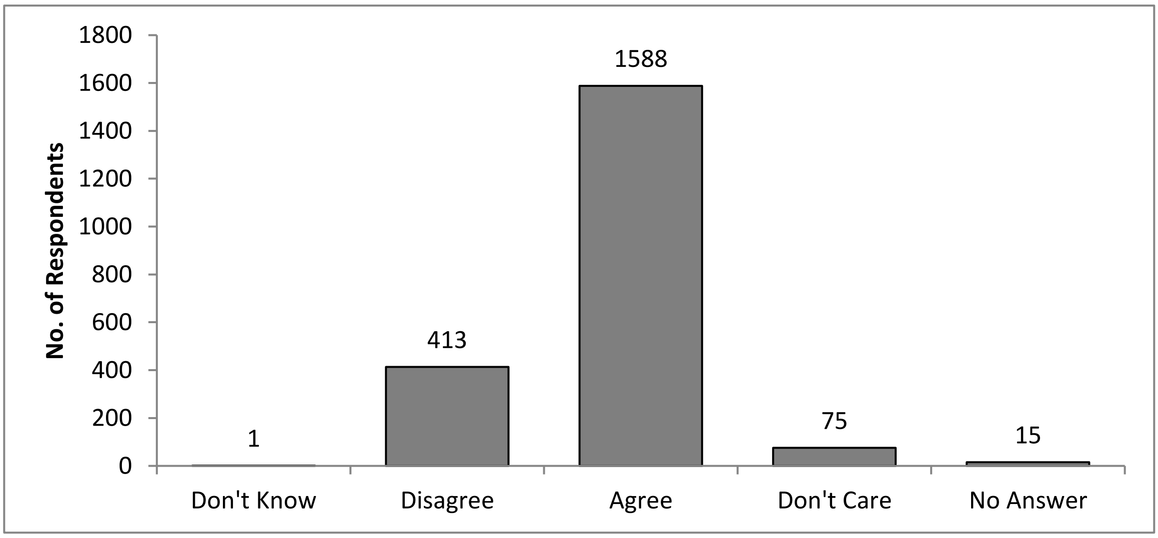


Figure 2-79: Perception on the Approval of the Project using initial data processed (n=2092)

3 ENVIRONMENTAL / ECOLOGICAL RISK ASSESSMENT

The term "risk" is not clearly delineated because the word may have two meanings. It can mean in one context a hazard or a danger of an exposure to an accident, mischance or peril. In another context, risk is interpreted more narrowly to mean the probability or chance of suffering an adverse consequence from a fortuitous event. To illustrate, "flood risk" can refer to the presence of a danger of flooding while a flood hazard to a specific probability such a flood event may occur and can be expressed in quantitative terms such as a "0.10% probability".

Environmental risk refers to actual or potential threats or adverse effects on living organisms (man, plants, animals, fish, etc.) and the environment caused by effluents, emissions, wastes, resource depletion, etc., arising out of activities involved in a project (Martin et al., 1977).

Risk assessment is a systematic method of identifying and analyzing the hazards associated with an activity and establishing a level of risk for each hazard. The hazards cannot be completely eliminated, and thus, there is a need to define and estimate an accident risk level that can be presented either in quantitative or qualitative way.

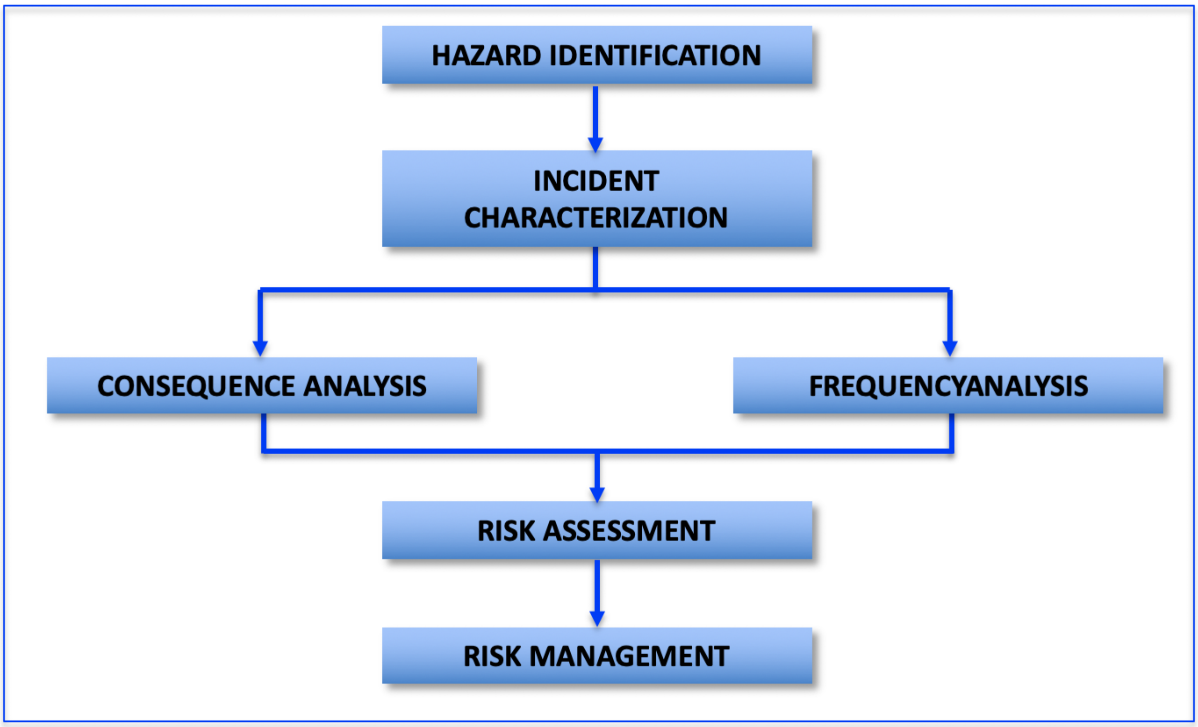


Figure 3-1: Illustration of Risk Assessment Process

Hazard identification involves the identification of all possible events or processes that could lead to disastrous or fatal incidents including potential hazards from substances, chemicals and materials (both physical and biological) used in the project process that could result in adverse effects on personnel/people and the environment. As an example for the reclamation project, "materials" could include the fills sourced from other sites, which will be examined for presence of harmful chemicals such as metals, which if present could present risk of contamination of the sea.

Consequence analysis involves the assessment of the adverse or unacceptable effects or results of an incident or episode from a project activity. When applicable, mathematical models may be employed for consequence analysis.

Frequency analysis is the estimation of the likelihood of number of occurrences of the identified hazard and/or the time occurrences of such.

Risk management refers to the overall process of prevention and reduction of the evaluated hazards, containment of the actual incident/episode, instituting response measures and the monitoring and communicating of the risks to stakeholders and project proponent/developer.

The main objective of this section is to identify and analyze hazards, the event sequences leading to hazards, the risk of hazardous events and the management of the elements of risks, which are particular to this Project relating to the coverage of the ECC being applied for.

The discussions below are based on of the Revised Procedural Manual of DAO 03-30 in particular Annex 2-7e. As stated in the RPM, an ERA, within the context of Philippine EIS System, is concerned primarily with safety risks (characterized by low probability, high consequence, accidental nature and acute effects associated and focused on human safety).

As discussed in previous sections, this EIS Report and the ECC application being made is for the reclamation works (Construction Phase of the EIS cycle) while the Operations Phase will be subject to separate requirements of the PEISS. Thus, focus is made on the creation of stable reclaimed land up to and including horizontal developments.

The ERA is focused on the movements at sea of vessels, dredging and related activities. Once the land is created, the ensuing period of at least one (1) year will no longer require the use of the vessels and dredging equipment (such as the TSHD and/or other dredgers) and will instead involve land/soil stabilization only as well as horizon development activities.

3.1 Level of Coverage of the ERA

Reference is made to Annex 2-7e of the RPM for DAO 2003-30

I. LEVELS OF COVERAGE AND SCOPING REQUIREMENTS

The requirement for the conduct of ERA shall be defined in three (3) levels:

Level 2 – for facilities that will use, manufacture, process or store hazardous materials in excess of Level 2 threshold inventory shall be required to conduct a Quantitative Risk Assessment (QRA) and prepare an Emergency/Contingency Plan based on the results of the QRA.

Level 1 – for facilities that will use, manufacture, process or store hazardous materials in excess of Level 1 threshold inventory shall be required to prepare an Emergency/Contingency Plan based on the worst-case scenario. The Plan shall be based on a Hazard Analysis study.

Risk Screening Level – specific facilities or the use of certain processes shall require the conduct of a risk screening study even if the projected or estimated inventory does not reach the threshold levels.

II. TECHNICAL GUIDELINES FOR THE CONDUCT OF ENVIRONMENTAL RISK ASSESSMENT

Determination of Risk Levels

Levels of Coverage and Requirements
Risk Screening Level.

The following activities are required to undertake a risk screening exercise:

1) Facilities for the production or processing of organic or inorganic chemicals using:
- alkylation
- amination by ammonolysis
- carbonylation
- condensation
- dehydrogenation
- esterification
- halogenation and manufacture of halogens
- hydrogenation
- hydrolysis
- oxidation
- polymerization
- sulphonation
- desulphurization, manufacture and transformation of sulphur-containing compounds
- nitration and manufacture of nitrogen-containing compounds
- manufacture of phosphorus-containing compounds
- formulation of pesticides and of pharmaceutical products.
- distillation
- extraction
- solvation

2) Installations for distillation, refining or other processing of petroleum products.
3) Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition.

4) Installations for the production or processing of energy gases, for example, LPG, LNG, SNG.
5) Installations for the dry distillation of coal or lignite.
6) Installations for the production of metals or non-metals by a wet process or by means of electrical energy.
7) Installations for the loading/unloading of hazardous materials as defined by RA 6969 (or DAO 29)

Levels 1 and Level 2 Threshold Inventory. The following threshold levels shall be used to determine whether a proposed project or undertaking shall be required to prepare a QRA and/or an emergency/contingency plan:

Table 3-1: Level 1 and Level 2 Threshold Inventory

CATEGORY	LEVEL 1 (tons)	LEVEL 2 (tons)
Explosives	10	50
Flammable substances	5,000	50,000
Highly flammable substances	50	200
Extremely flammable substances	10	50
Oxidizing substances	50	200
Toxic substances (low)	50	200
Toxic substances (medium)	10	50
Toxic substances (high)	5	20
Toxic substances (very high)	0.2	1
Toxic substances (extreme)	0.001	0.1
Unclassified (Type A)	100	500
Unclassified (Type B)	50	200

Table 3-2: Category of Hazardous Materials

Category	Definition
A. Explosives (Reactivity)	1. A substance or preparation, which creates the risk of an explosion by shock, friction, fire, or other sources of ignition.
	2. A pyrotechnic substance (or mixture of substances) designed to produce heat, light, sound, gas, or smoke or a combination of such effects through non-detonating self- sustained exothermic chemical reactions.
B. Flammable Substances (Highly flammable and extremely flammable substances)	1. Flammable substances are substances and preparations having a flash point equal to or greater than 21*C and less than or equal to 55*C, capable of supporting combustion.
	2. Highly flammable substances are substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any input of energy, or substances which have a flash point lower than 55*C and which remain liquid under pressure, where particular processing conditions, such as high pressure or high temperature, may create major-accident hazards.
	3. Extremely flammable substances are liquid substances and preparations which have a flash point lower than 0*C and the boiling point (or, in the case of a boiling range, the initial boiling point) of which at normal pressure is less than or equal to 35*C; gaseous substances and preparations which are flammable when in contact with air at ambient temperature and pressure, whether or not kept in the gaseous or liquid state under pressure; or, liquid substances or preparations maintained at a temperature above their boiling point.
C. Oxidizing substances	Substances which give rise to highly exothermic reaction when in contact with other substances, particularly flammable substances.
D. Toxic Substances	Low, medium, high, very high and extreme toxicity of substances or preparation are classified as follows:
	1. A substance shall be considered as a liquid if vapor pressure is less than 1 bar at 20*C.

	2. A substance shall be considered as a gas if vapor pressure is greater than 1 bar at 20*C.
	3. The sum of (a) and (b) as provided in Tables 2 and 3 shall determine the toxicity class as contained in Table 1.
E. Unclassified Substances	Substances or preparations that react violently with water (Type A), and substances or preparations, which release or liberate toxic gas in contact with water (Type B).

3.2 Safety Risks

Focus is herein made on "safety risks" rather than on "impacts", the latter being potential results of regular activities while the former is a result of probabilistic events.

The key aspects of risks for the reclamation/dredging (construction) phase are:

- Fire
- Explosion
- Release of toxic substances

An Environmental Risk Assessment (ERA) is required for proposed projects that will use, handle, transport, store substances that are flammable, explosive, oxidizing, or toxic. Section B of Annex 2-7e of the Revised Procedural Manual (RPM) of the DENR AO No. 30, Series of 2003 (DAO 03-30). The following facilities or installation are required to undertake a risk screening.

1. Facilities for the production or processing of organic or inorganic chemicals using:
    - Alkylation, amination by ammonolysis, carbonylation, condensation, dehydrogenation, esterification;
    - Halogenation and manufacture of halogens, hydrogenation, hydrolysis, oxidation, polymerization;
    - Sulphonation, desulphurization, manufacture and transformation of sulfur-containing compounds;
    - Nitration and manufacture of nitrogen-containing compounds;
    - Manufacture of phosphorus-containing compounds;
    - Formulation of pesticides and of pharmaceutical products; and
    - Distillation, Extraction, or Solvation.
2. Installations for distillation, refining, or processing of petroleum products
3. Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition

4. Installations for the production or processing of energy gases, for example, LPG, LNG, SNG
5. Installations for the dry distillation of coal or lignite
6. Installations for the production of metals or non-metals by a wet process or by means of electrical energy
7. Installations for the loading/unloading of hazardous materials as defined by RA 6969 (or DAO 29).

The proposed project does not fall in the above categories, though it will utilize hazardous materials or substances during construction period. During operation, the project shall prepare hazardous material management in accordance with DENR requirements.

Presented in the next sub-sections are the quantities of the identified hazardous materials, health hazard statements, the physical, chemical and environmental hazards, and proposed preventive and safety measures.

3.3 Physical, Health and Environmental Hazards of the Indicative Hazardous Substances Mixtures Diesel Fuel

Diesel Fuel is a mixture of hydrocarbons with carbon numbers in the range of C9 and higher produced by distillation of crude oil.

A. Physical Hazard

Moderately flammable liquid fuel (ignites when moderately heated). May also cause fire accidents in the event of a catastrophic failure of storage tank and piping systems, or an overfill, which can potentially escalate to a pool fire or bund fire. Exposure of diesel fuel to heat, spark, open flame and other sources of ignition, may cause vapors to ignite rapidly. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Diesel fuel vapor is heavier than air, thus may travel long distances to an ignition source and cause flashback. Runoff of liquid to sewer may also cause a fire.

B. Health Hazard

Contact of diesel fuel to eyes and skin may cause mild irritation. The major health threat of ingestion is the danger of aspiration (breathing) of liquid drops into the lung which may result in chemical pneumonia, severe lung damage, respiratory failure, and even death. It may also cause gastrointestinal disturbances like alcohol intoxication. Severe cases may result in death. Excessive exposure to diesel may cause irritations to the nose, throats, lungs and respiratory tract. Effects on the central nervous system include headaches, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death. Emissions of hazardous air pollutants such as carbon monoxide during combustion of diesel may cause unconsciousness, suffocation and death. The International Agency for Research on Cancer (IARC) and National Institute for Occupational Safety and Health classified whole diesel fuel exhaust particulates as a potential cause of lung cancer in humans.

C. Environmental Hazard

Spill of diesel forms a film on water surfaces. This will impair oxygen transfer and may result in anaerobic conditions in the body of water. Leaks may cause localized effects on aquatic organisms as it is determined to be harmful to aquatic life. Since degradation of diesel is selective, sediments can be contaminated by hydrocarbons. Diesel can contain trace amounts of short chain hydrocarbons e.g., benzene, toluene, ethylbenzene, xylene and other alkyl benzenes.

Lubrication Oil

Lubrication oil is an oily, organic liquid mixture composed of highly refined mineral oil (C15-C50). These are used for as lubricant, penetrant, to drive out moisture, to remove and to protect surfaces from corrosion.

A. Physical Hazard

Lubricating oils have combustible property. It does not ignite readily but may burn. Machinery which are insulated with lubricating oils, may also catch fire due to ignition of pressurized oil leaks, oil leaks or flowing oil.

B. Health Hazard

When undergoing combustion, a complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will evolve. In high concentrations, it may cause nasal and respiratory irritation and central nervous system effects such as headache, dizziness, and nausea. This may cause eye irritation upon contact.

C. Environmental Hazard

Accidental release of lubricating oil in the soil and water bodies will cause contamination. Lubricating oil in the soil may cause soil degradation. In large amount, this may penetrate in the ground and reach the groundwater, thus contamination will likely occur. Lubricating oil in water bodies is also undesirable. It will accumulate in the surface of the water and may be ingested by birds, animals and fish, and in large amount, may disrupt their normal body functions and likely could cause poisoning.

Paints and Thinners

Thinner is a petroleum-derived solvent used to thin oil-based paints. It is a colorless liquid and has a strong, sharp oil paint-like smell. It is not miscible with water. Paint is a solution or suspension (emulsion) of pigment, binder, mineral solvent or water and additives.

A. Physical Hazard

Thinner and paints are usually combustible. Thinner will volatilize and the vapor is heavier than air and may result in flashback. At high levels, thinners can be a fire/explosive hazard. Precautions should be taken to eliminate the build-up of explosive mixtures. Thus, heat and all ignition sources should be avoided.

B. Health Hazard

Inhalation of thinners can induce oxidative stress that may cause damage to the brain, kidney, liver, lung and reproductive system. Oil-based paints may release volatile organic compounds (VOCs) that can cause headaches, eye irritation, nausea, dizziness and fatigue. Long-term exposure can lead to more serious health problems on the central nervous system, liver and kidney damage.

C. Environmental Hazard

Volatile organic compounds (VOC) released by paints and thinners will react with the oxygen in the air to produce ground-level ozone, which interferes with the process of photosynthesis and disrupts the food chain. This will eventually result to reduced forest growth and production of crops.

3.4 Description of the hazards, both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the release of toxic substance, as applicable effects) for man and the environment posed by the release of toxic substance, as applicable.

The safety policy and emergency preparedness guidelines consistent with the regulatory requirements. Emergency Preparedness should also consider natural hazards to the infrastructures and facilities.

Table 3-3: Typical Classification of Hazardous Wastes and Relevance to Reclamation Work

Classification Under DAO 36	Proposed Revisions	Remark s
Putrescible Organic Wastes	Grease trap wastes Used or Waste Oils from operation of on board equipment	From food preparation of vessel crew Collected separately and disposed on shore or discharged to the bilge Collected separately and disposed on shore or discharged to the bilge
Inks/Dyes/Pigments, etc.	Resinous Materials	Not involved in reclamation

Containers	Waste containers previously containing hazwastes	Hazwastes involved are minimal quantities of spent lighting bulbs and computer parts
Organic Chemicals	Wastes containing halogenated chemicals	Not involved in reclamation works
Miscellaneous Wastes	Containing Pathogens	Not involved in reclamation works
Not specified	Waste electrical and electronic equipment (WEEE)	Computer system only WEEE aspect of project

Source: Public Consultation on MMT Organized by the EMB dated April 12-13, 2016 at Hotel Jen, Manila

It may be deduced from the above table that the project does not involve hazardous wastes based on present classification (DAO 36) and prospective reclassification.

3.5 Risk Management and Emergency Plan

The following presents the identified hazards of the hazardous materials and the corresponding hazard outcome and the preventive and control measures.

Storage and Handling of Diesel Fuel and Lubrication Oil

a. Hazard outcome – oil files/spills

b. Preventive and control measures

- Provide machineries with appropriate fire detection and control systems;
- Set up and implement spill and fire prevention program
- Set up secondary containment for storage of fuel oil at the site;
- Good housekeeping practices; and
- Routine inspection and maintenance of equipment

Storage and Use of Paints and Thinners

a. Hazard outcome – fire, inhalation can cause health problems; spills

b. Preventive and control measures

- Keep in tightly closed containers,
- Area should be properly ventilated,
- Set up secondary containment, and
- Keep away from heat and ignition sources

- Use of personal protective equipment

Impacts of Climate Change Increase number of dry days, ambient temperatures, and frequency of extreme temperatures

- Hazard outcome - increase risks of fire and explosion, chemical
- hazards and pollutant exposure
- Preventive and control measures - integration of climate change in the
- design, operational plans, safety programs, and Emergency Response
- Programs are recommended

Increase in intensity of tropical cyclones and rainfall during wet season

- Hazard outcome - increase risks of fire and explosion, chemical
- hazards and pollutant exposure
- Preventive and control measures -Integration of climate change in the
- design, operational plans, safety programs, and Emergency Response
- Programs
- Note that the presentations of hazards below pertain to construction of the project.
- During operation, the operator of the Seafront City Project shall prepare hazardous material management plan.

3.5 Physical Risks- Failure of Structure which could endanger life, property and/or the environment

• Description of conditions, events and "trigger", which could be significant in bringing about identified physical risks
• Description & assessment of the possible accident scenarios posing risk to the environment
• Description of the hazards both immediate (acute effects) and delayed (chronic effects) for man and the environment posed by the failure of structure, as applicable

The "failure of structure" referred to in this Phase is the collapse of the reclaimed land. There will be no vertical structures to be constructed during this Phase.

Although highly unlikely because of engineering and design interventions, use of internationally-accepted construction technology and methodology, the use of sound fill materials and rocks and the employ of proven Contractor, a discussion are nevertheless made on this potential physical risk.

The environment that will be at risk is the Direct Impact Area of the project, i.e., the boundaries of the landform including the islands.

The immediate remedial activity is to deploy silt curtains to the boundaries of the landform to prevent dispersal of silt. Temporary containment structures, e.g. sheet piles or armor rocks will be imbedded to prevent dispersal of other heavier materials from the collapsed landform.

Table 3-4: Summary Matrix of Physical Risks

Activities	Physical Risks	Probability of Incident	Prevention/Control Measures
Dredging	Accidents to Construction Personnel	Nil to insignificant	• Safety Training of Construction Crews • Safe worthy equipment
Filling	Accidents to Construction Personnel	Nil to insignificant	• Safety Training of Construction Crews • Safe worthy equipment
Operation of Heavy Equipment	Accidents to Construction Personnel	Nil to insignificant	• Safety Training of Construction Crews
Activities	Physical Risks	Probability of Incident	Prevention/Control Measures
			• Safe worthy equipment

It is thus concluded that there exists no significant safety risks, further since the activities are confined to the reclamation area and away from population centers there are no societal risks associated.

4.6 Risks During the Horizontal Development Works

The horizontal development works are included in the scope of the "construction phase" and include the following activities which will be undertaken at the reclaimed land.

- Road Construction
- Construction of Drainage System
- Installation of electrical power and water distribution system

Physical risks, i.e. to construction workers are deemed as the major considerations during these works. This is because of the use of heavy equipment during the above-cited works.

Assessment and Recommendations

During the horizontal development activities, the major risks are those associated to accidents and safety. These may however, be minimized or prevented through the following:

- Training of construction workers and equipment operators;
- Use of personnel safety equipment;
- Regular maintenance of heavy equipment; and
- Compliance with the engineering design and the applicable construction codes

4 IMPACTS MANAGEMENT PLAN

The Environmental Management Plan (EMP) is designed to reduce environmental stress that the Project may bring about to the environment. The Plan also features the benefits of the Project implementation.

The following explanatory notes are deemed relevant to the formulation of the EMP for the following reasons:

- The paradigm that an EIS/ECC is a “Planning Tool” and not a Permit is expounded.
- This emphasis is useful when seeking the LONOs from the various agencies to impress on them that they can still exercise their respective mandates even if the ECC shall have been secured.
- It also impresses on the PRA, which has the mandate to issue the NTP to allow project implementation that it can still prescribe other requirements during the conduct of the Design and Engineering Details (DED).
- Equally important, in cases of challenges from the Court, this explanation will serve as an important basis for any court intervention.
- Similarly, when/should challenges or issues arise in the future concerning the ECC, this discussion will become relevant.
- For Reclamation Projects, the EMP also referred to as Impacts Management Plan (IMP) declared in the EIS Report are further validated by government authorities post ECC in contrast with other ECPs whereby project implementation may immediately proceed after the securing of their ECCs.

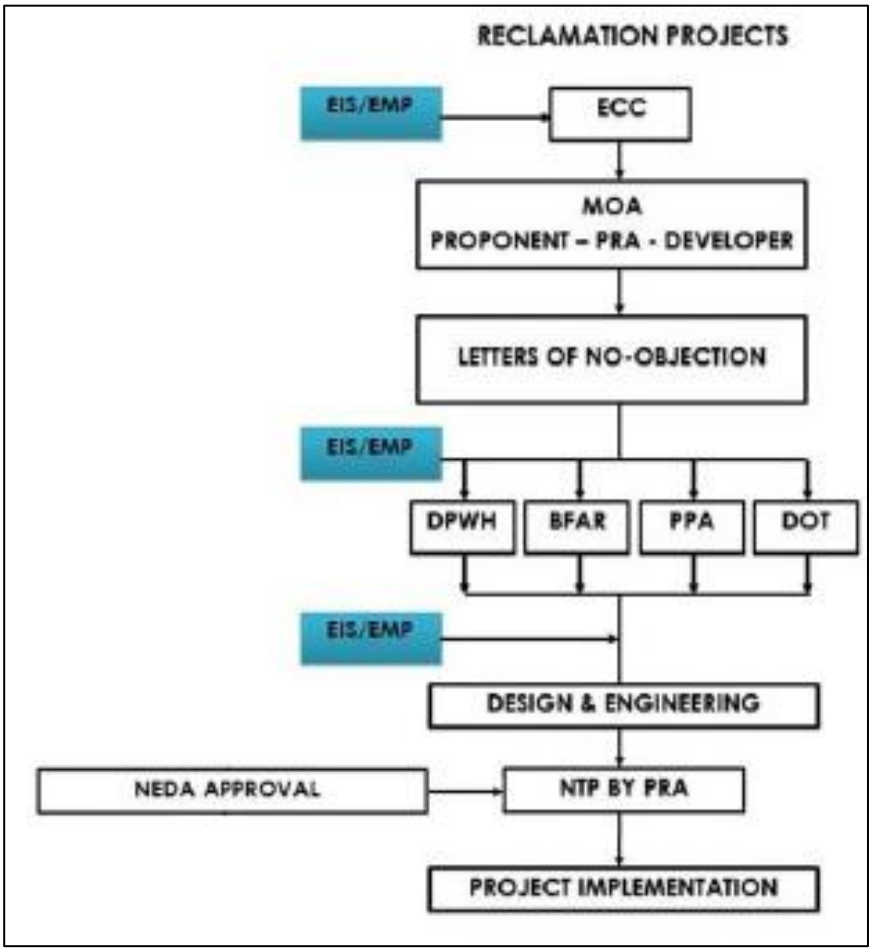


Figure 4-1: Post ECC Implementation of the EMP

The above notes and Figure 4-1 imply the following:

- The EIS Report and the ECC are only planning tools. Environmental protection is more firmly assured in the activities post ECC such as the conduct of Detailed Engineering Design (DED).
- For other ECPs, projects may be implemented (i.e. construction could start) after securing of the ECC, undertaking an internal (by the Proponent) DED and securing construction permits from authorities.
- In the case of Reclamation Projects, there are still 2 levels of approvals prior to actual construction works. These involve: (1) the validation of the IMP prior to the signing of a MOA involving the project the developer; and (2) another stage which is the securing of Letters of No Objection (LONO) from concerned agencies. Thus, environmental protection is planned in the EIS/ECC and further enhanced post ECC by agencies other than the DENR/EMB.
- Even after the securing of an ECC, changes may be imposed on the master plan for a reclamation project. e.g. the case of the reclamation project in Municipality of

Consolacion whereby the configuration of the reclamation was changed to allow for better water circulation.

- Another key point is that a Multi Partite Monitoring Team (MMT) is to be organized post ECC. The MMT will further add to additional requirements for the EMP.

Impacts, Mitigating Measures and the EMP

The Environmental Management Plan (EMP) is summarized in the table below as derived from the assessment of environmental impacts. This focuses on the major impacts wherein mitigating measures are required.

Moreover, the issues and concerns raised during the Public Scoping, a key aspect of the Public Participation activity under DAO 2017-15 are incorporated in the EMP. The impact analysis and proposed mitigation/management measures cover the Land, Water, Air and People modules.

Table 4-1: Environmental Management Plan

Project Phase/Environmental Aspect	Environmental Component Likely to be Affected	Potential Impact Residual Effects (When applicable)	Options for Prevention or Mitigation or Enhancement	Efficiency of Measures	Responsibility Entity	Cost	Guarantee/Financial Arrangements
I. Pre-Construction Phase							
Actual survey works and baseline data gathering such as Geotechnical Survey, Marine Study, Water and Air Sampling, and IEC. There are no residual impacts on the environment.							
II. Construction Phase							
Dredging Works Activity							
Removal of unwanted seabeds and silt	Water Quality	Water pollution brought about by silt disturbance within the project area/sedimentation that might affect the Mactan channel as well as the ajacent nearby freshwater body such as Cansaga Bay and other freshwater tributaries	-Installation of silt curtains and other silt management measures shall be placed in appropriate location depending on the waves and current -Establishing bufferzones where the silt curtains will be installed as protection for adjacent areas, important nearby corals outside the project site as preparation for the	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards outside the silt curtain area.	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	MOA among Consortium; ECC commitment

		Disturbing the oil spill found in the area during dredging activities	project implementation. - Location of the silt curtain must be placed based on the tidal current location which is areas facing to the Mactan Channel. - Oil spill in the sediments will be remediated, dredged, and removed from the area to avoid dispersing pollution into the water area. Contaminated sediments will be relocated first in a safe area then a 3rd party hauler and treater will be contracted for treatment prior disposal. - Careful removal, relocation, and disposal of heavy				

		Potential loss of soft bottom fauna due to removal of sediment in the project area	metal polluted sediment in the Project Area. Conduct water quality monitoring before, during and after the project. - Removed silt will be collected and will be use as part of the filling materials or will be use for other purposes such as compactment materials for construction purposes. -Documentation and regular monitoring of soft sediment fauna and other possible ecological coastal water resources.				
	People	Loss of livelihood of the fisherfolks	• Affected fisherfolks will be assisted by the LGU for alternate job employment offer.	100% Compliance to livelihood and Social Development Program	MMT Members And Proponent Self-	Php 200,000.0 0	MOA among Consortium; ECC commitment

			However, for those who will remain as fisherfolks, they will still be assisted by the LGU by provision of more appropriate fishing gears to organized fishers to enable them to fish further offshore where stocks of abundant fishes will be found. The LGU has also an existing Fisher's code wherein the fisherfolks in the municipality are supported with their livelihood. Though the project area is not a fishing ground, proponent will still allocate an area where there will still sufficiently access to the coastal area as docking area for the boats of the fisherfolks bound to		Monitorin g		

		Impact of closed down shipbuilding/shipyard operations	their fishing grounds. There will be support for the establishment and maintenance of no-take Marine Protected Areas in the Adjacent or Control Area as consideration to help conserve the environment and increase fishery yields through spill over effects. A regular monitoring will be conducted to ensure that the project development will have no negative effects to the nearby fishing grounds. -Affected employees from the closed-down operations of the shipyards/shipbuilding operations will be				

			assisted by the LGU for other alternative employment offers. The affected shipyards will ne be assisted by the LGU for possible relocation sites and there will be programs also offered by the LGU that help the affected shipyard covert their project that will jive into the development and operation of the Seafront City Project				
	Water Resources	Disturbance of coastal water resources such as corals, fishes, etc. Alteration of benthic and fish community structure in the adjacent area.	There will be no corals that will be affected within the project area. If there will be any corals that might be carried away from other location to the project site due to strong current, the affected corals/fishes within	100% Compliance to Aquatic Life Preservation/Protection	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	MOA among Consortium; ECC commitment

			the project area will be transferred/relocated to a secured deeper location where it will not be disturbed by human activities and away from passing ships/ship anchorage area. To ensure no current-carried corals within the project area, there will be regular on-site monitoring of the benthic and fish community in the adjacent area in every phase of the project development in coordination with DENR and BFAR and formulation of a management and sustainability plan to conserve the area. Installation of a well-designed,				

			science based artificial reef system that can increase rugosity on the newly created coastline.				
		Planktons advection to water current disturbance	Recovery of Planktons will depend on the biogeochemical cycling of many elements, through carbon fixation and phosphorous exportation. Proponent will conduct regular monitoring of plankton community.				
Transport of dredged material to disposal site	Water Quality	Water pollution due to accidental spillage of dredged materials	The hauler shall ensure that vessels used for transporting are in good condition to prevent dredged materials from leaking or spilling.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards outside the silt curtain area.	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	MOA among Consortium; ECC commitment

			Coordinate MARINA on standard protocols or guidelines of proper handling in transporting/barging of sediments or dredged materials in coastal waters.				
Dumping of dredged material to disposal site (Inland)	Soil and water quality	Soil and water Pollution due to disposal of dredged materials	There will be temporary relocation sites for the unwanted seabed dredged materials from the project site. The perimeter of the relocation sites will be enclosed with fence and the stockpile area of the dredged materials will be installed with high density polyethylene (HDPE) liner and/or clay to prevent soil and water (ground and surface) contamination and	No soil contamination and Allowable Ambient Criteria due to disposal of dredged materials	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	MOA among Consortium; ECC commitment

			zero discharge. A 3rd party contractor will be hired for the proper removal, relocation, treatment, and disposal of unwanted and hazardous materials from the seabed within the project area.				
Dredging of filling material for reclamation	Water Quality	Water pollution due to dredged filled materials that might affect the Mactan channel as well as the ajacent nearby freshwater body such as Cansaga Bay and other freshwater tributaries. Additional turbidity and siltation in Adjacent Area. Accretion of sediments on mangrove roots in the Project Area	Installation of silt curtains and other silt management measures shall be placed in appropriate location depending on the waves and current. Conduct regular ecological and water quality monitoring of adjacent and control areas as monitoring stations to ensure no exceedances of DENR water quality standards and destruction of the	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards	MMT Members And Proponent's Self-Monitoring	Php 200,000.00	MOA among Consortium; ECC commitment

		and Adjacent Areas. Increased siltation and sediment loading in the Adjacent areas.	ecological coastal water resources.				
Barging of fill materials for reclamation	Water Quality	Water Pollution due to accidental spillage of dredged materials during barging Increase of suspended solids affecting the settlement of marine species in the dredging and reclamation areas. Traffic congestion/disturbances on marine navigational area of Mactan Channel.	Provision of containment facility to prevent spillage such as oil spill booms, absorbent pads, etc. to contain and extract oil spill in the coastal water. Provision of control measures when transporting filling materials to avoid oil spill. Coordinate MARINA on the traffic regulations on coastal waters or navigational area. Implement traffic management plan in accordance to	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards 100% No proliferation of suspended solids	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	MOA among Consortium; ECC commitment

			MARINA'a guidelines/protocols .				
Reclamation Activity							
Construction of containment structures Installation of sand bags/containment wall system along certain areas along the perimeter of the project area	Water Quality	Water pollution/ Increase turbidity of adjacent areas due to Infrastructure /Construction Activities of adjacent areas that might affect the Mactan channel as well as the ajacent nearby freshwater body such as Cansaga Bay and other freshwater tributaries.	•Installation of a silt curtain/Silt management measures 50m away from the working area, surrounding the area to be filled with reclamation materials and in the revetment structures area. - Location of the silt curtain must be placed based on the tidal current location which is areas facing to the Mactan Channel. •Provision of geotextile membrane on the containment structures throughout the	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards	MMT Members And Proponent's Self-Monitoring	Php 500,000.00	MOA among Consortium; ECC commitment

			perimeters of the project area.				
	Water Quality	Water quality degradation of Cansaga Bay. Contamination with hazardous materials.	Conduct of periodic monitoring of water quality and the occurrence of freshwater fish (i.e., abundance, species richness and biomass). All hazardous construction materials and hazardous wastes to be generated such as used oil will be contained properly in an enclosed facility in a considerable distance away from the construction zone to prevent accidents and pollution in the Project and Adjacent Areas. Rigid policies against disposal of oil waste and marine	100% No freshwater quality degradation and loss of freshwater species particularly Ylang Ylang River	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	MOA among Consortium; ECC commitment

			water bilge water should be implemented, as with all relevant marine pollution prevention protocols of DENR EMB and MARINA.				
	Water-Change in current pattern and wave action	Fish larvae and other marine species migrating to nearby mangrove areas	Sustainability of mangrove protection and conservation thru preparation of mangrove conservation plan	100% No cutting of mangroves	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	MOA among Consortium; ECC commitment
	Hazard/Safety	Tsunami/Storm surges/Flooding of Tayud, Adjacen City of Mandaue and Lapu-lapu	Strictly implement the recommendation of the EGGAR report	100% No flooding and permanent defense against tsunami/storm surge	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	MOA among Consortium; ECC commitment
	People	Decrease of fish catch production of affected fishermen	There will be no fishefolks that will be displaced within the project area, however, there might be fishing grounds nearby the project area that	100% sustained the income of affected fishermen	MMT Members And Proponent's Self-Monitoring	Php 500,000.00	MOA among Consortium; ECC commitment

			might be affected if project development will cause environmental impact. To ensure prevention of negative impacts to the fish catch production, religious implementation of mitigating measures will be followed. However, proponent still prepared a supplementary livelihood program or social development program for fisherfolks that will be affected. Installation of a well designed, science based artificial reef system can help increase rugosity (attachment surfaces of corals)				

			on the newly created coastline.				
		Health and Safety due to exposure to Construction Hazard	Implement wearing of PPE's at all times when inside the project site. Sufficient precautionary warning signs will be installed in every construction working stations and hazard prone areas to ensure safety of the workers. A readily available emergency health safety kits should be present with onsite medical personnel or physician in case of accidents or emergencies.	100% Compliant to PPEs and Zero accident	MMT Members And Proponent's Self-Monitoring	Php 200,000.00	MOA among Consortium; ECC commitment
		Employment	Priority to qualified local hirees	100% Compliance to SDP in terms of local employment	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	MOA among Consortium; ECC commitment

Possible Vegetation Removal/Destruction (Mangrove)	Land/Water	Loss of important species/Loss of Habitat. Physical damage to mangrove trees and roots in the project area and adjacent area.	Install buffer zone to ensure the that the mangrove trees will not be affected. Construction and reclamation activities should be restricted within a buffer area around the mangroves. A 50 meter bufferzone distance away from the construction and reclamation acitivities will be established to prevent damage to mangrove roots which is one of the main environmental protection measures prioritized by the project proponent. The mangrove area will serve as mangrove rehabilitation area to enhance the existing mangrove trees. The project	100% Compliance to SDP	MMT Members And Proponent's Self-Monitoring	Php 200,000.00	MOA among Consortium; ECC commitment

			will be designed to have a mangrove preservation/rehabilitation area with continuous open access of coastal water where it can still flow to the mangrove areas. The mangrove areas will also serve as rainwater harvesting area. Establish also a living shoreline. It is a natural way of approach for shoreline protection and is done by placing natural materials like plants, stone, and sand. This provides the first line of defense for incoming swells and wakes. By mimicking the physical properties of natural habitats, it increases				

			biodiversity. This living shoreline will be positioned in front of the sheet piles. There are no fishponds within the project area or adjacent to the mangrove areas but only existing shipyards structures. The abandonment and demolition of these structures will be carefully done to avoid destruction of mangroves and other adjacent areas. Hazardous wastes from the demolished structures will be carefully contained to be hauled by 3rd party hauler and treater.				
Filling the project area with reclamation	Water Quality	Water pollution /Increase turbidity due to filling	Installation of a silt curtain/silt management	Allowable Ambient Criteria or 100%	MMT Members	Php 200,000.00	EIS / ECC Commitment

materials '- Delivery of filling and other construction materials through barges		materials near reclamation areas	measures 50m away from the working area, surrounding the area to be filled with reclamation materials and in the revetment structures area. Silt curtains shall be removed after all necessary components and materials are in place inside the revetment sections.	Compliant to RA 9275 and DAO 2016-08 standards"	And Proponent 's Self-Monitorin g		
		Increase in sedimentation outside the project area	Provision of permeable geotextile membrane to prevent sediments during high and low tide outside the project area. Several silt traps will be installed to ensure prevention of sedimentation.	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards	MMT Members And Proponent 's Self-Monitorin g	Php 300,000.0 0	EIS / ECC Commitment
		Shoreline change leading to	Designate buffer zones to areas that				

		increased vulnerability to coastal flooding. Local increase in mangrove cover in some areas introduced by accretion in adjacent man made structures.	are prone to coastal flooding. An adequate drainage system will be constructed with several catch basins and rainwater lagoon to address possible flooding issues. The mangrove areas that will be rehabilitated and converted as mangrove ecopark can trigger increase of mangrove cover with the help of the man-made enhancement measures such as rainwater lagoon to cultivate the existing mangrove trees.				
Hauling of filling materials	Air (noise)	Noise generation	Use of efficient silencers on equipment and other noise dissipating device on	100% Compliant with Noise Standards	MMT Members And Proponent 's Self-	Php 50,000.00	EIS / ECC Commitment

			all equipment to be used. Avoid use of heavy machinery during night hours. Observe allowable work hours to limit noise. There will be installation of temporary noise barriers/buffer zone to the areas near residential houses to suppress noise.		Monitoring		
	Air (Quality)	Dust pollution due to vehicle movements: - Along the road leading to the reclamation area - Within the project area activities	Sprinkling of water using water tanker at least four times a day along all possible roads leading to the reclamation area (as shown in an indicative haul route map in the EIS), especially during dry season. Covering all loaded trucks properly/fully using tarpaulin	100% Compliant to RA 8749 in terms of air quality standards	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	EIS / ECC Commitment

			throughout the hauling period. •All trucks shall be road-worthy.				
Land Development							
Compaction/Soil stabilization of the project area	Land	Liquefaction due to improper compaction Seabed/underwater ground vibrations/shaking due to intensive	Geotechnical analysis of materials to determine the possible liquefaction and other geological hazards of the project area to ensure a proper design for mitigation measures such as strengthening the foundation structures, the type of filling materials appropriate to be used, and etc. based on the EGGAR report recommendations. Conduct thorough EGGAR to determine if there are no large voids or faults that might trigger	100 % No liquefaction	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	EIS / ECC Commitment

		drilling for soil stabilization or foundation works	intensive underground shaking that might cause tsunamis. The "g" values should be considered by the Structural Engineers in engineering design to determine potential hazard of an earthquake occurring during the life of a structure. The project area facing the coastal area will be built with high wave deflectors in case if storm surge or tsunamis.				
	Water Hazard	Flooding due to insufficient drainage network and existing low-laying elevation of the project site as per geohazard assessment and	Proper Engineering design for adequate drainage network with water catchment and rainwater tanks to address flooding problems. Implement	100% No flooding	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	EIS / ECC Commitment

		PAGASA rainfall data.	bufferzones to areas of hugh vulnerability to flooding. Critical facilities or equipment should be positioned away from the inundation prone areas.				
	Water Quality	Increase sedimentation fluxes	Stabilization or reclaimed areas through vegetation cover enrichment/enhance ment Per EGGAR recommendation, since the project will require substantial backfilling activity to elevate the offshore areas, retaining walls are to be constructed around the perimeter of the project site. The sea walls or any other structures will protect the filling material so it will	100% No further siltation/sediment ation will occur	MMT Members And Proponent 's Self-Monitorin g	Php 500,000.0 0	EIS / ECC Commitment

			not be easily eroded by waves to the sea during strong winds and storms.				
	Air (Quality)	Noise pollution due to heavy equipment operation	Use of efficient silencers on equipment and other noise dissipating device on all equipment to be used. Install buffer zone surrounding the project area to minimize noise. Observe allowable work hours to limit noise.	100% Compliant to Noise Standards	MMT Members And Proponent 's Self-Monitorin g	Php 100,000.0 0	EIS / ECC Commitment
		Dust pollution due to heavy equipment operation including transport vessels	Sprinkling of water using water tanker at least four times a day within the project area especially during dry season. Transport vessels/barges shall	100% Compliant to RA 8749 in terms of air quality standards"	MMT Members And Proponent 's Self-Monitorin g	Php 50,000.00	EIS / ECC Commitment

			be fully and properly covered and load secured throughout the hauling period.				
Construction of horizontal structures such as follows: A. Road networks B. Drainage system (sewage and sewerage system) C. Water distribution D. Centralized wastewater treatment facility E. Power and telecommunication lines	Land	Land pollution due to indiscriminate /improper dumping of solid wastes and toxic substances	Ensure that its contractors shall practice onsite segregation and establish storage facility of the following: 1. Construction debris such as used drum, used tires, wood cuttings, iron bar cuttings, etc. 2. Hazardous wastes such as used oil, busted lamps, oily/contaminated rags, etc. will be contained in an enclosed facility intended for hazardous/special storage facility. The above waste materials shall be hauled and disposed of by a DENR	100% compliance with the following: • RA 9003 • DAO 1992-29 and DAO 2013-22 and its Revised Procedural Manual	MMT Members And Proponent's Self-Monitoring	Php 2,000,000.00	EIS / ECC Commitment

			accredited hauler and treater. The hazardous waste facility should be placed in a considerable distance away from the construction zone to prevent accidents and pollution in the Project and Adjacent Areas. Rigid policies against disposal of oil waste and marine water bilge water should be implemented, as with all relevant marine pollution prevention protocols of DENR EMB and MARINA. Composting facility will be provided to process biodegradable waste. Compost materials shall be				

			used for greening activities. 3. Installation of MRF for proper solid waste segregation In terms of foundation structures, it is therefore important for the project proponent to carefully consider the engineering properties of the fill materials to be used. Foundation of structures should be designed as not to exceed the bearing capacity of the soil. Static and dynamic loads must also be considered in the foundation design.				
	Land/Water	Generation of untreated/ improper disposal of domestic wastewater	Personnel stationed at the reclaimed land will be provided with on-site portable toilets and	Zero discharge of domestic waste to Bacoor Bay.	MMT Members And Proponent's Self-	Php 1,000,000.00	EIS / ECC Commitment

			washrooms during project implementation. Collection and disposal will be done by a DENR accredited hazardous waste hauler and treater. The proponent will install a centralized wastewater treatment facility with a capacity of 15,000 m3/day for treatment of domestic sewerage as preparation for project operation for small locators who cannot install their own STP. The capacity of the wastewater is based on projected water demand of the project during operation phase		Monitorin g		

			from year 1 of the project operation to year 20. Further, most locators who will invest in the project will be required to put up their own wastewater treatment facility. Treated wastewater will be recycled for watering the landscape area or greeneries. The proponent will also encourage the locators to implement dual piping system wherein treated wastewater from the STP will be recycled back to be used as water for toilet flusing purposes. Effluent from the wastewater treatment facility				

			will have regular sampling or monitoring to ensure it passed the DENR effluent water quality standards. Sludge from the wastewater treatment facility will be hauled and further treated by a 3rd party treater.				
	Water Quality	Water Pollution due to increase of storm water run-offs surrounding the areas	Adequate drainage system with settling ponds or settling basins to capture silts prior outfall as standard requirement by the DPWH. The settling basins will be permanently attached to the drainage system to served as permanent mitigating measures for silts in the run-off water even during operation	Allowable Ambient Criteria or 100% Compliant to RA 9275 and DAO 2016-08 standards"	MMT Members And Proponent 's Self-Monitoring	Php 500,000.00	EIS / ECC Commitment

			phase wherein there will be several vertical construction activities of the future locators. Sewage and sewerage systems shall have dual piping (going to the wastewater treatment facility and for redistribution). Provision of storm water collection system. There will be also a secondary containment for fuel oil and chemical storage tanks in a considerable distance away from the construction area.				

	Air (Quality)	Dust pollution emanating from open areas	Sprinkling of water along all possible routes leading to the reclamation area, at least four times a day, especially during dry season. Open areas should be covered with greeneries such as grass, shrubs, etc.	100% compliance with RA 8749 in terms of air quality standards	MMT Members And Proponent's Self-Monitoring	Php 100,000.00	EIS / ECC Commitment
	People	Health and Safety due to exposure to Construction Hazard	Implement wearing of PPE's at all times when inside the project site. Sufficient precautionary warning signs will be installed in every construction working stations and hazard prone areas to ensure safety of the workers. A readily available emergency health safety kits should be present with onsite medical personnel	100% compliance to PPEs and Zero accident	MMT Members And Proponent's Self-Monitoring	Php 200,000.00	MOA among Consortium; ECC commitment

			or physician in case of accidents or emergencies.				
		Employment	Priority to qualified local hirees	100% compliance to SDP in terms of local employment	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	MOA among Consortium; ECC commitment
III. Abandonment Phase							
Dismantling of equipment, clean-up, cessation of construction activities	People	Reduction and eventual termination of employment	Promote alternative livelihood at early stage of project operation. Pay employees termination pay and other payment mandated by laws.	100% compliance with SDP	MMT Members And Proponent's Self-Monitoring	Php 1,000,000.00	EIS / ECC Commitment

5 SOCIAL DEVELOPMENT FRAMEWORK (SDP) AND IEC FRAMEWORK

The SDP framework is based on the sustainable development and self-reliance approaches. Its goal is to empower communities and stakeholders to undertake sustainable development efforts even after the decommissioning of the project. The full benefits of the project should be able to trickle down to the most disadvantaged and vulnerable sectors of affected communities. The participation of these vulnerable sectors (youth, women, elderly, persons with disability, fishermen, farmers, small traders and enterprise owners, etc.) as partners of development activities in the affected Barangay should be ensured from planning, implementation to evaluation of identified projects.

The SDP should be able to complement the existing Municipal Development Plans and consider their basic priorities identified by the LGUs, and more importantly, the project impact and stakeholders' concerns and issues.

The Indicative Social Development Plan (ISDP) was done through consultation with the decision makers of the project affected barangay , the Barangay Chairperson of Local Government Units (LGUs) and the Government agencies such as, the, MSWD, MHO and the representatives of the proponent.

The objective was to:

- Identify the basic needs and welfare of the community as basis for the framework of social development program plan of the project affected by the project.
- Prepare an indicative and sustainable plan based on the government requirement pursuant to the DENR DAO 2003-30, Municipality and Barangay's Development Plan and the mandated corporate responsibility of the proponent.
- Mandated development programs as required by DILG in the Internal Revenue Allotments (IRA)
- Establish a working relation with proponent and the various community stakeholders with the goal of improving the quality of life of the project affected communities by enabling them to becoming self-reliant.

The ISDP also provides an opportunity for identifying the following:

- Addressing key socio-economic issues and concerns by the various stakeholders, including those that were raised during the public scoping;
- Identifying and designing the recommended measures in response to the issues and concerns that were raised;
- Identifying the lead agency or organization responsible in implementing the measures; and

- Setting of timelines to implement these measures consistent with the plans and programs of the lead government agencies.
- It is expected that in the long term, the economic benefits from tax revenues, the funds from the mandated services of the inter-agencies and the socio-economic benefits from the project operation will be the main sources of funds to sustain the implementation of the Social Development Plan that the proponent will support in concurrence with the concern LGUs and surrounding communities.

Table 5-1: Social Development Framework

CONCERN	Responsible Community Member / Beneficiary	Government Agency/ Nongovernment Agency and Services	PROPONENT	Indicative Timeline	Source of Fund
Gender Responsive Livelihood / Employment (Men, Women, Youth and elderly)					
Skills training	-Barangay kagawad for livelihood - Qualified Project Affected Men, Women, Youth and Elderly - BFARMC/ qualified affected fisherfolks	LGU – Planning and Development Coordinator MSWD MAO TESDA	Community Relations	Preconstruction Construction Operation	LGU
Health and Safety					
IEC on safety for employees IEC on safety for residents DRRM and Emergency Response	-Barangay Kagawad for Health -Barangay Health Workers -Project Affected Community	LGU MHO/RHU Barangay Disaster Management	Community Relations	Preconstruction Construction Operation	LGU
Environment and Sanitation					
	-Barangay Kagawad for Environment	MHO/RHU MENRO Solid Waste Management Health and	Community Relations/ Environmental Unit	Preconstruction Construction Operation	LGU

	-Project Affected Community	Sanitation program			
Peace and Order					
Entry of migrant workers	-Barangay Kagawad for Peace and order -Project Affected Community	LGU PNP	Community Relations/Environmental Unit	Preconstruction Construction Operation	LGU
Affected Fisherfolks					
Loss of livelihood/source of income	-Affected fisher folks within the area -Qualified identified workers within the area who will be affected by the project. - Affected employees of shipyard/shipbuilding operators that will be closed-down	MSWD MAO	Community Relations	Pre-construction Construction Operation	LGU

Information, Education and Communication (IEC)

The Information, education and communication framework is meant to bridge the proponents and the host communities through various media. The basic objective is to promote awareness and understanding among the residents of host communities on the different programs the proponent is doing for them. This will build confidence and will promote better understanding and harmony between the two parties.

The Information, Education, and Communication Plan of the company shall focus on the project information dissemination, predicted impacts of reclamation activities to the environment particularly to the people and their inherent resources, the benefits that the community and the people may derive from such operation, and the cost and benefit analysis of the operations with regard to environmental protection, and the future of local folks after the abandonment of the project.

The IEC will focus on the following: employment, marine ecology, water quality, noise, emergency response procedures, and the ECC conditions. The program will be handled by a Community Organizer or Officer. He or she will organize local meetings and reach out the community to convey the proponent's programs for the community. Table 5-2 shows the IEC Framework to be used in the project.

Table 5-2: IEC Framework

NEEDS	IMPLEMENTATION	COMMUNITY IMPLEMENTATION PLAN (Strategies)	GOVERNMENT/ NON-GOVERNMENT AGENCY SERVICES	PROPONENT	COST ESTIMATE
❑ **Municipality of Consolacion** **Barangay Tayud** Full Information about: ❑ The EIA process ❑ The operation of a Reclamation project ❑ The consequential impacts on the residents of the community and their mitigation measures ❑ The benefits of the Project on their Socio-cultural/economic and bio-physical environment of the affected residents as they address the major issues of: air and water Pollution using Information, Communication and Information ❑ Full information on the decommissioning plan of	**Before project implementation and during Project Operations**	1. Primer/ Brochure (print media) This strategy is effective in explaining in detail the subject matter, done in a simplified manner and in the language of the people. This strategy likewise, uses illustrations to further clarify the processes that is to be done. A. The EIA process illustrated and simplified in the language of the affected community written in English & Bisaya B. The Reclamation Project: This shall contain: ❑ the project description, project time frame, project facilities, management of Social and Environmental impacts, potential project benefits a graphic illustration about the process of reclamation plant operation. ❑ the process of Environmental Impact Assessment, roles and responsibilities of stakeholders ○ The Social Development and Management ○ Gender Responsive Livelihood and Credit Facilities ○ Education and Recreation	**1. Municipal & Barangay Information Officer.** **2. Elementary and High School Students** **3. Barangay Committee on Education and Culture** **4. Sangguniang Kabataan Barangay** **5. EMB-DENR** **6. PRA** 7. DOT – Provincial and Municipal 8. BFAR	**• LGU** **Community Relation Officer** **• LGU** **• Corporate Communication** **• LGU** **Community Relation Officer**	PhP 50M (for the entirety of the Project)
the project.		○ Health and Safety ○ Environment and Sanitation R.A.9003, R.A.9729 Climate Change ○ Peace and order and Spiritual ❑ On the residents who will be affected by the Reclamation activities showing their right to complain for violations of ECC conditions. ❑ Consultations and Focused Group Discussions (These are face to face encounters where participants and facilitators of knowledge and skills develop strategies to respond to the needs of the communities in the context of what is appropriate for their capabilities and resources) ❑ Using the interpersonal approach Community Relations Officer maintain regular consultations with the barangays for an open dialogue on the issues, problems and concerns related to the implementation and sustainability of the project. (Multi-partite Monitoring Team) ❑ Group discussion of the sectoral groups which will be affected by the LGU Activities the legal processes with the application of priority job placement, and other benefits ❑ Workshops on Solid Waste		**LGU** **Community Relation Officer** **LGU** **Corporate Communication**	

NEEDS	IMPLEMENTATION	COMMUNITY IMPLEMENTATION PLAN (Strategies)	GOVERNMENT/ NON-GOVERNMENT AGENCY SERVICES	PROPONENT	COST ESTIMATE
		Management and Preparation of IEC materials ▫ Workshops on Coastal Resource Management in coordination with the BFAR, Municipal and Provincial Tourism Board, through workshops (interpersonal) and tarpaulin signage in strategic areas of the project site and identified possible indirect impact areas (intrapersonal) e.g. Cebu Province ▫ Workshop on Climate Change & community Disaster Risk Reduction Management 3. **Posters and Wall Comics** ▫ A graphic illustration of information on " What the Reclamation project?" and the rationale of the project in the context of their life-ways ▫ A graphic illustration on Community – based Coastal Resource Management ▫ A location of the area identified as Tourism site indicated as indirect area affected by the project ▫ Community-Based Solid Waste Management and information about DENR R.A.9003 and DAO 2004-1 ▫ Community-Bsed Climate Change Management / Disaster Risk Management . CDRMC / BDRMC .		LGU Community Relation Officer	
		▫ **Cell phone Patch Consultation** ➢ Using the Cell Phone feed-back mechanism through the BARANGAY COUNCILS in all project affected barangays. ▫ **Barangay Forum (e.g. FGD) and phone Patch up** This strategy enables the Company to discuss the progress of the project with key-persons of the company/resource persons weekly. This also encourages multi-sectoral interest groups to ask questions through phone patches .			

5.1. Social Development Plan for Affected Shipyard Owners

This Social Development Plan is specifically formulated for the purpose of paving a way for the transition of the shipyard industry in Consolacion to a new phase of development in the foreshore and offshore area of the municipality in accordance with Ordinance No. 6 series of 2019 otherwise known as "AN ORDINANCE DECLARING THE FORESHORE, OFFSHORE AND SEA WITHIN THE MUNICIPAL TERRITORIAL LIMITS FROM THE BOUNDARY OF LILOAN AND MANDAUE CITY WATERS INTO AN INTERNATIONAL INVESTMENT, TOURISM, COMMERCIAL, RESIDENTIAL AND ECONOMIC HUB OF THE MUNICIPALITY OF CONSOLACION" *(Attached as Annex)*.

Such transition is anchored on the need for Consolacion to attract additional foreign and local investments in order to sustainably energize its economic growth being the gateway to the north as the tri-cities of Cebu is trying, as it should rightly so, to decongest. It is also an aggressive response to the Build Build Build Program, a key element of the 10-Point

Socioeconomic Agenda of the government, which aims among others to "accelerate annual infrastructure spending to account for 5% of GDP, with Public-Private Partnerships playing a key role." Executive Order 27 (s. 2017) directs all government agencies, including LGUs, to implement the Socioeconomic Agenda of the national government.

This program is supported by Ordinance No. 8, series of 2012, otherwise known as the "LOCAL INVESTMENT INCENTIVE ORDINANCE OF THE MUNICIPALITY OF CONSOLACION" *(Attached as Annex)* and Ordinance No. 04, series of 2013, otherwise known as "GUIDELINES FOR THE ISSUANCE OF ENDORSEMENT FOR THE APPLICATION OF INFORMATION TECHNOLOGY PARKS/CENTER WITH THE PHILIPPINE ECONOMIC ZONE AUTHORITY (PEZA) IN THE MUNICIPALITY OF CONSOLACION" *(Attached as Annex").*

Goals

a. Administer a smooth transition for affected businesses

b. Leverage economic opportunities

c. Provide an appropriate climate for career transition and outplacement

d. Attract more investment

Strategies

1. In a meeting held with the shipyard owners last January 6, 2021, the leadership of Consolacion LGU informed the former that the Seafront City Project will be soon be implemented and that the municipality needed their support. It was part of the over-all thrust that the affected businesses in the project area will be welcomed to join in the development so that they can maximize the benefit of the project. As such, Consolacion LGU is poised to enter into negotiations with the affected companies for the purpose of consolidating their interests with that of the proposed project. Consolacion LGU is of the belief that the transition can be laid out properly and with ease in view of the variable that the Seafront City Project will be phased according to the development schedule which provides that the first one to be developed is Lot 1, coupled with the fact that the area where the shipyards are operating now will represent the share of the government. These would mean that there is ample time for the shipyard for such transition and that they will be negotiating solely with the government in view of the proximity of the government's share of the whole development to their properties.

2. Even as the Seafront City Project is still in the stage of obtaining the necessary permits in order for it to proceed, it is worth noting that the foreshore and offshore areas of Consolacion is no longer viable for the continued existence of the shipyard industry in view of the passage of Ordinance No. 6, series of 2019. As such, the same businesses that will be affected are encouraged to shift from their current

business structure to ones that will jibe with the proposed project. Otherwise, Consolacion LGU is providing them with alternative sites *(Attached as ANNEX "D")* where they can continue with their existing industry. Consolacion LGU believes that the proposed project is one that will provide a more productive economic enterprise for the affected companies in view of the diversity of its opportunities for business.

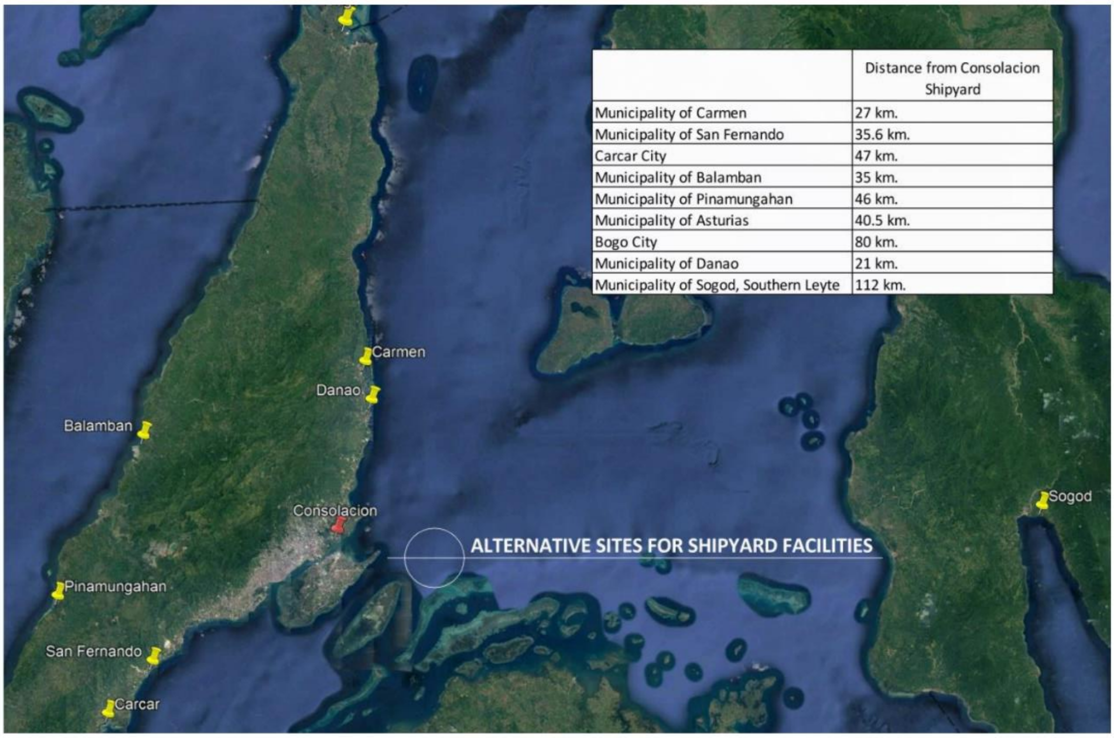
3. In order to mitigate the impact that the proposed project will have on the affected workers of the shipyards, the following programs will be introduced:

    - Provide displaced employees with invaluable counsel easing the stress and emotions accompanied with the loss of a job;
    - Help the laid-off employees find work quicker;
    - Consider the laid-off employees as priority in the hiring of workers for the proposed project.

4. For purposes of creating a competitive climate in the project area, Consolacion LGU is encouraging other companies to invest in Seafront City with the following strategies:

    - Create and/or animate business groups, like chambers of commerce, to promote activities for local businesses where the action organization focuses on attracting business to the community;
    - Offer grants to SMEs and cooperatives;
    - Attract young people by revitalizing and/or showcasing more cultural attractions, such as a community theater, an art gallery, and nightlife;
    - Organize events that celebrate the various cultures representing Consolacion.

Alternative Sites for Shipyard Facilities



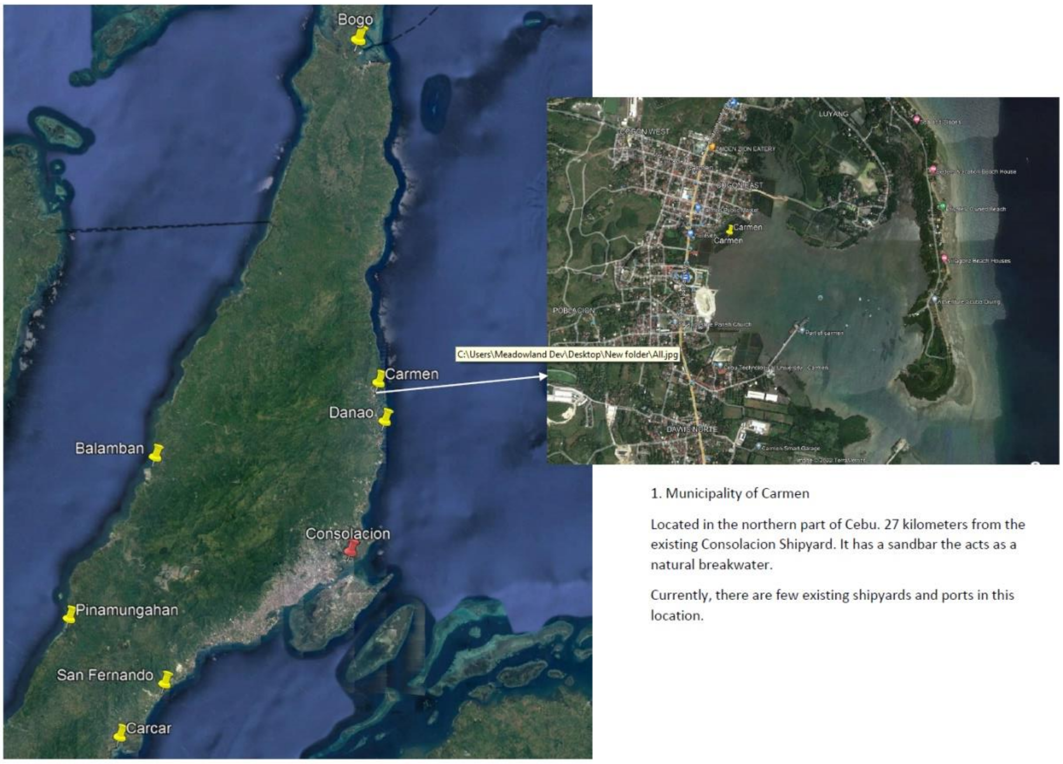


Figure 5-1: Alternative Sites for Shipyard Facilities

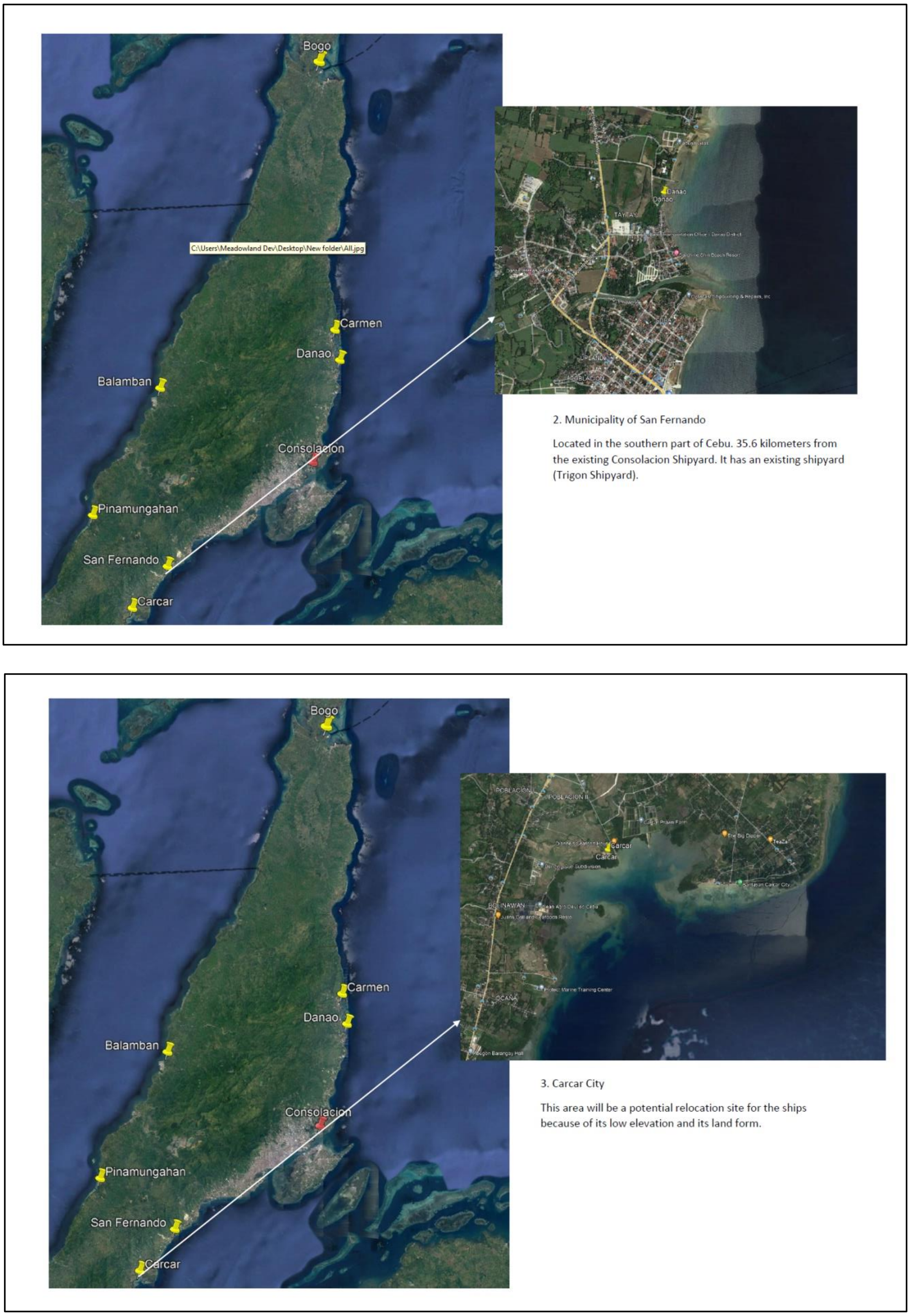
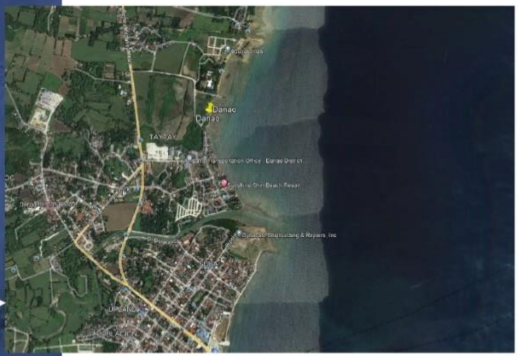
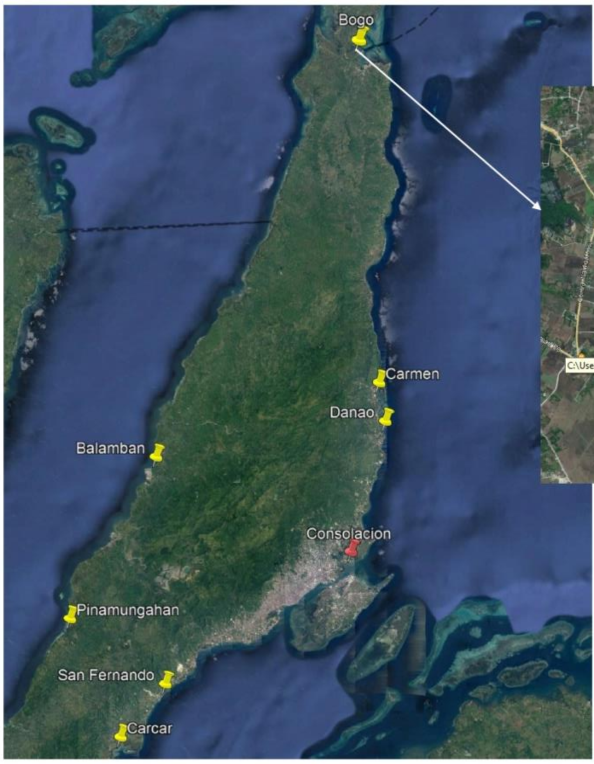


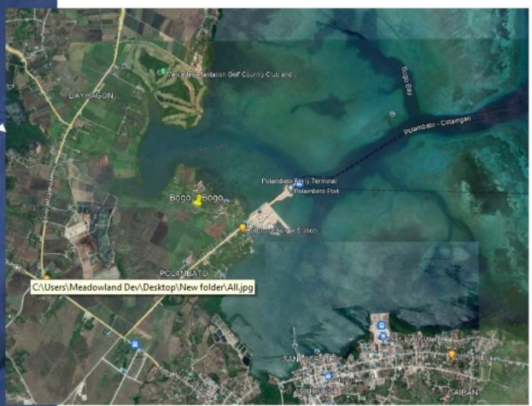
Figure 5-2: Alternative Sites for Shipyard Facilities



4. Municipality of Danao

This relocation site will be the nearest to the shipyard in Consolacion. It is near Dynacast Shipbuilding & Repairs, Inc.





5. Bogo City

This relocation site will be near the Port of Bogo. 80 kilometers from Consolacion shipyards.

6 ENVIRONMENTAL COMPLIANCE MONITORING

Self-Monitoring Plan

Provided in Table 6-1 is the Environmental Monitoring Plan (EMoP) with Environmental Quality Performance Levels (EQPLs) consistent with Annex 2-20 of the RPM for DAO 2003-30.

From this the definition of EQPL-Environmental Quality Performance Level is as follows:

- Alert or Red Flag: early warning
- Action Level: point where management measures must be employed so as not to reach the regulated threshold or limit level, or to reduce deterioration of affected environmental component to pre-impact or optimum environmental quality
- Limit Level: regulated threshold of pollutant (standard that must not be exceeded); point where emergency response measures must be employed to reduce pollutants to lower than standard limit.

6.1. Self-Monitoring Plan (SMP)

The proposed SMP as shown in Table 6-1 using the recommended format in Annex 2-20 of RPM DAO 2003-30.

The final SMP (with inputs from the MMT if required) will be formulated after the ECC has been issued. The more detailed SMP will establish the final Environmental Quality Performance Levels (EQPL) for monitoring, budget, accountability, stakeholder participation, complaints management, communication and reporting, environmental impact event/action response plan, audit program and schedule for baseline monitoring and preparation of the environmental management audit manual.

Initially, the SMP shall have the following objectives:

- Ensure that all emissions and effluents or discharges from the Project comply with DENR Rules and Regulations which include but not limited to RA 8749 (Clean Air Act) and PD 984 (Pollution Control Law), PD 1586, RA 6969;
- Validate the changes in the various environmental media (impact monitoring) as discussed in the impact assessment;
- Provide early warning information of unacceptable environmental conditions; and
- Encourage stakeholder participation.

These EQPLs are initial values. Final thresholds for management limits, action, and alert levels will be determined from monitoring data and concurred by the MMT members, EMB and the Municipality of Consolacion. The salient point of Table 6-1 is that Alert and Action EQPLs were only assigned to parameters that can be controlled by the project during construction and operation phases. The proponent will strictly monitor the lower values (ALERT and ACTION) as indicators to take action so that the LIMIT value will not be reached.

Table 5-3: Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts Per Envit'l Sector	Parameter to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL MANAGEMENT SCHEME					
			Method	Frequency	Location			EQPL RANGE			MANAGEMENT MEASURE		
								ALERT	ACTION	LIMIT	ALERT	ACTION	LIMIT
PRE-CONSTRUCTION PHASE													
Not relevant, survey works and securing of clearances from Government Agencies, and IEC													
CONSTRUCTION PHASE													
WATER													
Construction of containment structures Filling of Materials Transport of Materials	Water Pollution	TSS	Grab Sampling per DAO 2016-08 Water Quality Guidelines and General Effluent Standards	Quarterly	8 Stations - 2 stations per side elevation/direction (N, S, W, E)	PCO/ MMT	Part of the monitoring fund of MMT PhP 400k	>35 mg/L	>40 mg/L	>45 mg/L	Conduct investigation on the possible causes of exceedances as per standard Incident Accident Notification, Investigation and Reporting Procedure	Conduct investigation on the possible causes of exceedances as per standard Incident Accident Notification, Investigation and Reporting Procedure. Retesting to verify the exceedances.	-Remove oil from the Oil-Water Separator using oil sorbent pads. - Conduct retesting to confirm result of action. Hire a 3rd party environme ntal monitoring team to conduct the testing to validate results. If exceedance persist operation in the area of concern will be temporarily stopped unless the exceedance is corrected.
		O & G						>1.5 mg/L	>1.8 mg/L	>1.9 mg/L			
		Color						7.2 & >8.2	<7.1 & >8.3	7 & >8.4			
		Temperature						No significant effect					
		BOD						2.6°C rise	2.8°C rise	3.0°C rise			
		Cadmium						>15 mg/L	>20 mg/L	>25 mg/L			
		Lead						0.001 mg/L	0.002 mg/L	0.0025 mg/L			
		Mercury						0.007 mg/L	0.002 mg/L	0.009 mg/L			

		Chromium							0.0007 mg/L	0.0008 mg/L	0.001 mg/L			
		Total Coliform							0.03 mg/L	0.04 mg/L	0.045 mg/L			
		Fecal Coliform							70 MPN/100mL	80 MPN/100mL	90 MPN/100mL			
		COD							>80 mg/L	>90 mg/L	>100 mg/L			
		Surfactants							0.2 mg/L	0.25	0.28 mg/L			
		Ammonia							0.03 mg/L	0.04 mg/L	0.05 mg/L			
		Nitrate							15 mg/L	17 mg/L	19 mg/L			
		Phospahte							0.35 mg/L	0.4 mg/L	0.45 mg/L			
		Sulfate							235 mg/L	240 mg/L	245 mg/L			
		Cyanide							0.015 mg/L	0.017 mg/L	0.019 mg/L			
		Arsenic							0.007 mg/L	0.008 mg/L	0.009 mg/L			
		Copper							0.01 mg/L	0.015 mg/L	0.018 mg/L			
		Flouride							1mg/L	1.2 mg/L	1.4 mg/L			
		Iron							1mg/L	1.2 mg/L	1.4 mg/L			

		Zinc							0.035 mg/L	0.04 mg/L	0.009 mg/L			
	Marine life disturbance	Inventory of Corals, fishes, and etc.	Marine life assessment	Semi Annual	Semi Annual	PCO in coordination with DENR CDD	Part of the monitoring fund of MMT PhP 100k		40% loss	60% loss	80% loss	Conduct investigation	Implement emergency contingency measures such as rehabilitation of damage corals and its relocation	Suspension of operation to conduct massive rehabilitation of coastal waters
	Loss of Mangrove Trees	Inventory of Mangrove Trees	Mangrove assessment	Semi Annual	Semi Annual	PCO in coordination with DENR CENRO	Part of the monitoring fund of MMT PhP 100k		40% loss	60% loss	80% loss	Conduct investigation	Implement emergency contingency measures such as rehabilitation of damage mangroves	Suspension of operation to conduct massive rehabilitation and close containment
AIR														
	Noise generation	Noise (Decibels dBA)	Portable Noise sampler NPCC Class C	Semi Annual	Semi Annual	PCO	Part of the monitoring fund of MMT PhP 10k	Daytime - 60dB Night time - 55dB	Daytime - 65 Night time - 58	Daytime - 70 Night time - 60	Survey sampling station verify complaints as per Noise Level Monitoring and Measurement Procedure. Check the	If source of noise is from the site, inform the PM to provide mitigation measures. Conduct noise monitoring to verify if level is already w/in limits. If source of noise is not from the area, inform the MMT regarding possible source for MMT's	If source of noise is from the site, inform the PM to provide mitigation measures. Conduct noise monitoring to verify if level is already w/in limits. If source of noise is not from the area, inform the MMT regarding possible source for	Stoppage of operation until noise issues are completely addressed

											sound level using sound meter. Determine possible cause	investigation & coord w LGU.	MMT's investigation & coord w LGU.	
Hauling of filling Materials	Degradation of air quality Dust pollution due to vehicle movements	SO2 (µg/Ncm)	DENR AO 2000-81, Rule XXVI, Sec.1	Quarterly	2 Quarterly	PCO/ MMT	Part of the monitoring fund of MMT PhP 100k	290 (1hr)	305 (1 hr)	340 (1 hr)	Check weather condition during sampling and if location is downwind of the area. Check possible source of pollution including external factors.	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said stations & hire 3rd party sampling firm to confirm. Adjust the unit's operation per operating manual.	Check weather condition during sampling and if location is downwind of the area. Conduct site visit at said stations & hire a 3rd party sampling firm to confirm. Adjust the unit's operation per operating manual. Temporarily stop certain aspect of operation unless the problem has been resolved. If the source is not from site, coordinate with LGU, DENR & MMT for	Stoppage of operation until air quality already within the DENR Air Quality Standard
		NO2 (µg/Ncm)						220 (1hr)	235 (1 hr)	260 (1 hr)				
		PM10 (µg/Ncm)						220 (1hr)	235 (1 hr)	200 (1 hr)				
		TSP (µg/Ncm)						255 (1hr)	235 (1 hr)	300 (1 hr)				

													appropriate action.	
Compaction/Soil stabilization of the project area	Noise pollution due to heavy equipment operation Dust pollution due to heavy equipment operation including transport vessels	same as noise generation entries above Same as degradation of air quality entries above												
LAND														
Construction of horizontal structures	Land pollution due to solid wastes and toxic substances	Volume of solid wastes	Visual	Weekly	On site	PCO	Monitoring will be through visual count weekly of the number of garbage cans/containers picked up and coordinated to Cavite Solid Waste Management Office.	40% full containement of Solidwates in the MRF and Hazardous Waste Storage Facility	60% full containement of Solidwates in the MRF and Hazardous Waste Storage Facility	80% full containement of Solidwates in the MRF and Hazardous Waste Storage Facility	Regular monitoring of hauling	Corrdinate additional 3rd party hauler and treater	Additional MRF and Hazardous waste storage facilty	

PEOPLE														
Construction	Hiring	Employment of local qualified residents	Contractor records	Construction period	Reclamation/construction sit	MMT	Included in Operation Cost	Negative feedback to the Proponent	Formal complaint by the workers	Formal complaint by the workers	Formal complaint by the workers	Complain to DOLE	Review the protocol and reconsider the complaint if applicable	
	Exposure of employees and the local community to construction activities	Safe personhours, injury, near miss and other safety performance indices Health stats	Incident reporting, survey, include in the H&S Plan	Annually	Reclamation/construction site	MMT	Part of the monitoring fund of MMT	No affected employee, injury, near misses and minor accidents.	One affected employee, injury, near misses and minor accidents.	Major acciden t s such as fires, explosion, etc.	Re-training of the workers on safety. Investigate.	inspect the area of most accidents. Monitor.	Safety audit on site by 3rd Party	
	Residents	Health, Income	Surveys, medical examinations included in the H&S Plan, payment record, key informant interviews	Annually	DIAs and IIAs	ComRel Officer	ComRel Officer	Increased level of sickness per survey	Increased level of sickness per survey	All complaints lodged by residents	Talk with the locals to check their stand & to property address it.	Intensify IEC and ComRel	Conduct FGDs if needed	

6.2. Multi-Partite Monitoring Team (MMT)

Based on DAO 2017-15 in compliance to the ECC during the implementation of the project, it is imperative to ensure the implementation of Environmental Management Plan (EMP).

The MMT is to be composed of representative(s) from the concerned local environmental Non-Government Organization (NGO), PAGASA, DPWH, BFAR, PRA, and other concerned government agencies, which shall be organized consistent with DAO 2017-15 and DAO 2018-18. The MMT shall primarily oversee and report to EMB Central Office, the proponents' compliance with its commitment and EMP/EMMoP as contained in the EIS documents.

The MMT is recommendatory to EMB. MMTs have the primary responsibility of validation of Proponent's environmental performance, with the following specific functions:

Per DAO 2003-30:

1. Validate project compliance with the conditions stipulated in the ECC and the EMP;
2. Validate Proponent's conduct of self-monitoring;
3. Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the Proponent and EMB recommended measures to address the complaint;
4. Prepare, integrate and disseminate simplified validation reports to community stakeholders;
5. Make regular and timely submission of MMT Reports based on the EMB-prescribed format.

Per DAO 2017-15:

6. Continue to serve as a venue for promoting greater stakeholder vigilance and providing appropriate check and balance mechanisms in monitoring project impacts as well as a venue for empowering the communities in taking responsibility for environmental protection.
7. Conduct quarterly ocular site visit to validate the proponent's compliance with the ECC conditions and the EMoP including the requirement to conduct self-monitoring and submit corresponding reports regularly.
8. Discuss findings with the proponent.
9. May observe sampling activities conducted by the project proponent.

10. Prepare and submit report to EMB-CO and EMB-RO concerned using EMB-prescribed format.

11. Institute an environmental emergency and complaints receiving and management mechanism, which shall include systems for transmitting recommendations for necessary regulatory action to EMB in a timely manner to prevent adverse environmental impacts. The preliminary and proposed list of stakeholder members of the MMT shall be the basis of selection and proposed role.

Section 16.2 of DAO 2017-15:

12. "The project proponents and EMB-DENR shall no longer be member of the MMT. The EMB-DENR shall provide oversight guidance to the MMT and consider its reports and recommendations in its impact and compliance evaluation. It shall conduct regular performance audit of the MMTs. The project proponent shall provide funds for the MMT activities based on the Annual Work and Financial approved by the EMB."

The above is a subject of challenge from some private sector and current members of the MMT.

Section 15.4 of DAO 2017-15:

13. "In case that in this Environmentally Critical Project (ECP), the significant environmental impacts do not persist after construction phase or whose impacts could be regulated through the regular monitoring activities conducted by other government agencies, the MMT shall be terminated upon certification of completion by the lead government agency."

6.3. Environmental Guarantee Fund

A readily available and replenishable Environmental Guarantee Fund (EGF) to cover the following expenses:

1. For further environmental assessments, compensations and/or indemnification for whatever damages to life and property that may be caused by the project;

2. Rehabilitation and/or restoration of areas affected by the project's implementation; and

3. Abandonment/decommissioning of the project facilities related to the prevention of possible negative impacts; and as a source of fund for contingency and clean-up activities.

A replenishable Environmental Monitoring Fund (EMF) shall likewise be established to cover all costs attendant to the operation of the MMT.

Proposed Amounts:

1. Proposed EGF trust fund- Php 50,000,000 (estimate)
2. Proposed EGF cash fund- Php 50,000,000 (estimate)
3. Proposed EMF cash fund- Php 10,000,000 (estimate)

The above will be discussed with the MMT upon its formation. It may be expected that the Proponent -LGU will also need to discuss this with the prospective private sector developer.

Note no.2 above is expected to be deliberated during the formation of the MMT for this Project.

Basis of the estimate

Annex 3-6 of the Revised Procedural Manual provides the guidelines for the determination of the EGF and is summarized hereunder. There is no explicit provision under DAO 2003-30 requiring valuation of potential impacts that may arise as a result of changes in the use of natural and environmental resources. Procedures for arriving at such estimates in a more rational and systematic manner will have to be based on experiences that shall have been generated on Philippine examples and other developing countries. In the absence of such information, more recent experiences of projects of similar nature with provisions for EGF may be utilized.

The amount and mechanics of the EGF, EMF and the establishment of the MMT shall be determined by the EMB Central Office and the proponent in consultation with the EMB Region 7 Office through a Memorandum of Agreement (MOA), which shall be submitted to this Office one (1) year prior to project construction.

It should take into consideration the following factors in determining the appropriate amount for specific projects:

- The EIS committed programs
- The degree of environmental risk involved (based on number and extent of potential damage)
- Valuation of resources that would most likely to be affected
- The proponent’s ability to provide funds for the EGF

At the end of the project life, a sufficient amount should be left from the EGF to ensure that rehabilitation, restoration, decommissioning, or abandonment shall be adequately financed. Such amount may be increased during the project life span to insure that the balance shall be sufficient for the abandonment phase. In such case, the EGF Committee may require an adjustment of such amount to cover inflation and other factors. The required submission to the DENR-EMB of the project's Abandonment Plan shall have a corresponding fund commitment subject to the approval of the DENR or the lead government agency with direct approving authority on the Abandonment/Decommissioning Plan of the project.

7 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

In general, the port operator will be responsible for the formulation of emergency response policies during the operation of the port. The emergency response for the reclamation project generally aims to provide a response mechanism for any marine accident, which may involve risk to life or the environment. The emergency response policy and procedure for the project should consider and cover the following:

- Regulatory Framework/Legal Basis
- Identification, definition, and categorization of emergencies
- Composition, organization, roles and responsibilities of the Emergency Response Team
- Incident Management
- Marine Incidents
- Land Side Incidents
- Hazardous Materials Incident
- Safety during an Incident
- Post-Incident Evaluation

Policies on HSE

Inasmuch as the direct responsibility for Health, Safety and Environmental concerns rest on the Dredging/Reclamation Contractor, a judicious selection process for the Contractor will necessarily be made. The formal award of the Contract cannot be made until after the securing of an ECC. However, provided below are basic policies and guidelines on HSE of an international reclamation practitioner.

7.1 General

All vessels working / sailing for the project have to comply with the local and international maritime requirements or protocol such as that prescribed by the Philippine Coast Guard and under the MARPOL.

Some of the requirements are:

- Communication procedures with Port Authorities;
- Anchoring;

- Towing;
- Speed limitation within port; etc.

All vessels / barges must have valid harbor craft license or equivalent. Official inspections on the vessel regarding its construction and required safety appliances must be carried as per regulations.

Prior to commencement of operations, all relevant notices (e.g. Notifications to Mariners; Port Marine Notices) shall be provided to the Master, who will verify them for implementation.

7.2 Responsibilities and Duties

All personnel are responsible for the safety of themselves and those they work with. They have a duty to take action to prevent accidents at all times, in accordance with accountability for HSE.

The Master of a vessel is responsible for the safety of the vessel and all those on board at all times. He has the authority to decide whether any operations affecting the vessel should proceed or be terminated, and should question any instructions issued to him that create a hazard to the vessel and all those on board.

Emergency response on an ISM certified vessel takes place in accordance with the Master Roll. The Master Roll shall show the duties assigned to the different members of the ship's crew.

Onboard HSE Inductions

All personnel joining the vessel for the first time or who have not been on board within the previous 6 months will be required to undergo HSE induction training ('Information at recruitment' resp. 'Familiarization') from the Captain or Chief Engineer.

Training shall include but not be limited to aspects of living and working on board a vessel or barge:

- Layout of the vessel;
- Housekeeping rules;
- Muster Stations;
- Emergency Alarms;
- Safety Equipment;
- PPE;

- Emergency Escape Routes;
- HSE Management; and
- Environmental Awareness.

Signed function descriptions and records of familiarization / information at recruitment shall be available onboard.

After boarding a vessel, visitors shall report to the Master who shall give a small induction on the particular dangers and rules on the vessel. Visitors shall always be guided during visits on deck.

Site Basic Safety Rules

The vessels shall make the necessary communication, depending on the type and operations of the vessel, with other vessels and/or with the Radio Room by means of the VHF channel that has been set up for the project.

Approaching or leaving a jetty or another vessel shall be done at a low speed, avoiding high waves and thus allowing safe boarding. Life jackets of the inflatable type or work vest type shall be worn in following situations:

- when boarding / deboarding a vessel / jetty;
- when working near or over the sides of a vessel;
- when there is a danger of falling into the water; and
- when working on other locations as specified by the supervisor or safety officer.

Other rules include:

- Reference is made to the specific SWP for PPE;
- Standards for housekeeping on the vessel (e.g. deck, galley, accommodation, etc.) shall be followed;
- The crew shall be competent and shall be made familiar with various emergency situations and hazardous applications through toolbox meetings and drills;
- Regular inspections shall be held by the Master, Safety Officer or Chief Engineer. The inspection and the frequency shall depend on the type of vessel;
- Mooring to other vessels or to jetties shall be done safely and with correct and sound mooring ropes;
- Fishing is not allowed on site;
- Smoking is only permitted in designated smoking areas;
- Drugs are not permitted on board. Persons taking medication are to advise the medic of their medical condition and show the prescription drugs they are taking; and

- All crew shall be in possession of a valid medical fitness certificate, correct seaman's book and correct STCW95 certificates for the function they have.

During periods of rough weather the following rules are to be observed:

• Crew shall not work in external areas of the vessel unaccompanied.

• Watertight closures are to be secured and shall be kept clear of obstructions.

• Watertight doors shall always be secured after passing through them (this should be observed in good weather conditions also).

• On vessels with low freeboard working decks such as anchor handlers and tugs where decks are easily awash the following precautions will be taken: personnel shall not work in external areas of the vessel unaccompanied; and personnel working on external decks shall wear a work vest.

8 ABANDONMENT / DECOMISSIONING / REHABILITATION POLICIES & GENERIC GUIDELINES

Statement on Proponent’s policies and generic procedures for Rehabilitation/ Decommissioning/Abandonment will be submitted post-ECC, within a timeframe specified in the ECC.

This will be submitted post-ECC, within a timeframe specified in the ECC. Abandonment/decommissioning may not be undertaken until after approval of the EMB of the submitted plans, which may include: a. Environmental Site Assessment to determine contaminants left by the construction; b. the monitoring of any residual effects and c. legal commitments, if any.

The proposed project is only intended for reclamation works and horizontal development, thus, decommissioning is only perceived as cessation of works in reclaimed land, which will be prepared before vertical development (construction of buildings etc.,) or the establishment of the locators, which is not included in this ECC application. Once this Environmental Site Assessment (ESA) shall have been contemplated, it will be the responsibility of the proponent to coordinate with the EMB for the latter’s guidelines on what are the needed activities including more in-depth monitoring as well as the decommissioning procedure.

The activities to be undertaken for the cessation of reclaimed land are:

- Sampling test for water to ensure that there are no leak oil and greases and more importantly metallic contamination and other substances that can affect the existing water quality of Mactan Channel.
- General demobilization of equipment.
- In terms of alternatives for the future use of abandoned area, there will be no area to be abandoned, hence, this is not needed;
- Rehabilitation/ restoration plans, if any the project is consistent with the long-term zoning and land use development, noting that the proposed project is the LGU itself.

General Abandonment/Decommissioning Scenario

Procedures for the decommissioning of the project components

Demobilization during post construction will be conducted by the contractors as per Provincial Government requirements, which include all activities and costs for transport of all construction equipment used, all excess materials, disassembly and transport of temporary facilities used during construction, removal and disposal of all construction debris and general clean-up of construction site. The project components are largely the reclaimed land including the infrastructures therein constructed e.g. roads open spaces, viaduct, drainage culverts, electrical and water lines, etc.

Transport/disposal of equipment and other materials used in the operation

The equipment and other materials used in the reclamation and dredging works would have been returned or claimed back by the contractors. Remediation of contaminated soil and water resources due to spills and leakage of chemicals and other materials used in the operation will be conducted.

Maintenance and Enhancement

The reclaimed land itself and the operations phase of the project have no lifespan, hence, a continuing proper maintenance, enhancement and upgrading will be done to ensure high standard of the developed areas that is environmentally compliant, structurally-sound and safe. Structures will be assessed and monitored regularly to ensure the sustained integrity of the project development.

Alternatives for the future use of abandoned area

The proponent can bid out the project to private sectors for their use; subject to the policies and approval of PRA and the NEDA.

Consistency with long term zoning and land use development plan of the municipality

The project is consistent with the long term zoning and land use development, noting that the proposed project is the LGU itself.

Focus on the Decommissioning/Rehabilitation and Restoration Activities

Focus will be made on the 235.8 hectares landform created for Seafront City Project.

Moreover, attention will be also be made on the rehabilitation and restoration needs, if any, for any residual impacts on the nearby fishing structures and on the fishing grounds. Damage if any to the marine ecology will have to be compensated for including the rehabilitation of such damage.

9 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

Apart from the monitoring team to be established by the proponent, the contractor shall also appoint a full–time Pollution Control-Environmental Officer/Health and Safety Officer. He/She will be responsible for the formulation and implementation of environmental conservation and environmental protection/health/safety programs. The implementation of the entire environmental management and monitoring program shall fall under his/her direct supervision. He/She will be reporting to the site manager. All procedures shall be institutionalized upon approval of the same. The contractor shall comply with all requirements under the terms and conditions set out in the permits or certifications obtained by the proponent and in compliance with the provisions of the contract and applicable local environmental laws and regulations.

The PCO/EO/HSO will be responsible for:

- Formulation and implementation of environmental conservation plans;
- Implementation of environmental impact and management procedures;
- Timely submission of Self-Monitoring and related reports;
- Coordination with the Multi-Partite Monitoring Team (MMT);
- Health/safety programs and community programs during project operation
- Compliance with all regulations imposed by the DENR, the MGB and other concerned agencies (e.g. LGU, PCG-Regional Office, Cebu Provincial Port Authority-CPPA, Cebu Provincial Reclamation Authority-CPRA).
- Implementation of the Demobilization Plan.

The Pollution Control Officer (PCO) is tasked to:

➢ Proper and regular monitoring of water quality, compliance to all permit conditions, and all sampling and monitoring activities are done in accordance to the required methodologies;

➢ Regular submission of compliance reports;

➢ Conduct spot and regular audit procedures to ensure implementation of established environmental management protocols and impact management plans;

➢ Report on the efficiency of environmental management measures and assist the management in implementing corresponding mitigating measures as required;

The HSO is tasked to:

- ➢ Ensure that comprehensive Health and Safety protocols are in place and implemented. Such policies shall be complied with not only by the proponent but also by all contractors and personnel involved in the project.
- ➢ Conduct regular safety trainings and audits similar to environmental audits for all its personnel, directly hired and contracted.
- ➢ Coordinate with the Philippine Coast Guard Regional Office (PCGRO) and/or other concerned agencies for auditing purposes and training as required.
- ➢ Ensure conduct of health examinations for all personnel prior to engagement and on a periodic during the duration of the of the project.

The CRO on the other hand shall have the following functions:

- ➢ Maintain constant communication and establish positive relationship with concerned government agencies (e.g. DENR, LGU, PCGRO, CPRA, etc.) and stakeholder groups to address environmental concerns and implemnet environment-related programs in coordination with the PCO and the EO;
- ➢ Implement a regular and intensive information, education and communication (IEC) program to promote Corporate Social Responsibility advocacies in environmental protection and other social development programs (SDP);

Additional manpower will be needed for the implementation of the Social Development Programs and Environmental Protection and Management projects.

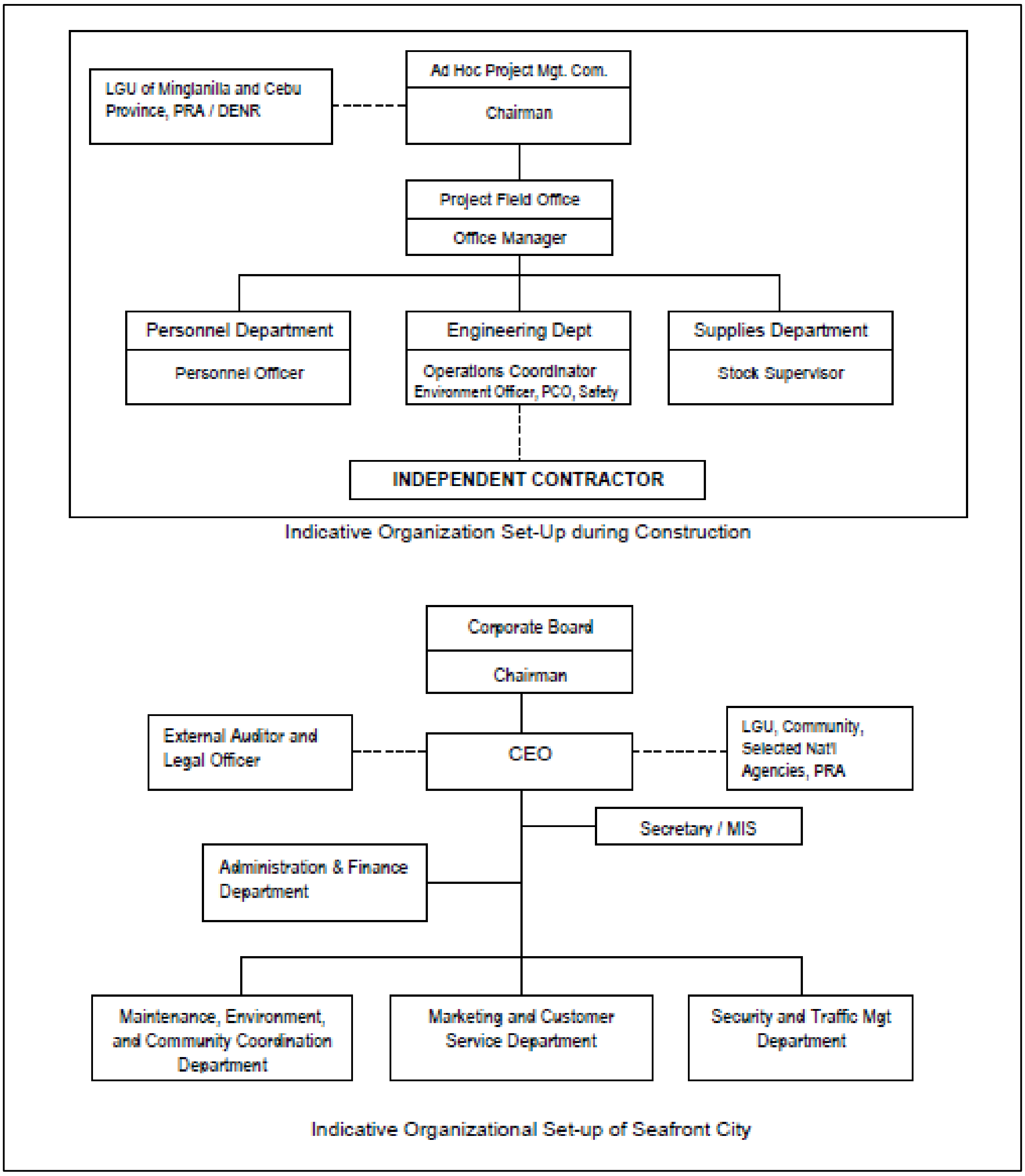


Figure 9-1: Indicative Organizational Set-Up

Framework on Grievance Mechanism

In general terms a "grievance mechanism" is a formal, legal or non-legal complaint process that can be used by individuals, workers, communities and/or civil society organizations that are being negatively affected by certain business activities and operations.

Grievance Procedures for Reclamation Projects

Inasmuch as an LGU is the Project Proponent for reclamation projects, the Grievance Mechanism is lodged in the LGU set up.

Following procedures are based from the Local Government Code (Reference :RA 7160)

- The MPDO will be responsible for receiving the complaints and grievances regarding the proposed reclamation project which relate to environmental, social and economic aspects (e.g. employment and livelihood). Following are the general procedures:
- The said Office will first verify the nature, correctness as well as the rationale for the complaints.
- Only formal complaints will be formally entertained.
- When verified, this Office will refer the complaints to the concerned unit or subcommittee of the LGU, e.g. the environmental, employment, senior citizen, gender, peace and order, etc. unit or subcommittee.
- The sub-committee will conduct an investigation or inquiry on the complaint and will call a face-to-face meeting with the complainant(s).
- The sub-committee will endorse the complaints and grievances to the Environment & Social Concerns Office or other unit(s) for advice and assistance.
- During the community meetings prior to the reclamation activities, the channels for complaints and grievances and related procedures shall be announced/publicized to the public including the PAFs in the form of hand-outs like pamphlets brochures/ leaflets.
- After the community meetings, all concerned institutions, including Barangay, LGU, PMO-GNP I, shall use the same hand-outs to explain the grievance redress procedures to those who come to them for filing their concerns.

Grievances from the PAFs related to the reclamation implementation or any related issues to the project will be handled, free of monetary charge, through negotiations and are aimed to have consensus decision following standard procedures.

Amicable and non-confrontational atmosphere will be observed during meetings and in the resolutions of complaints.

A timeline shall be set by the MPDO/CPDO for amicable resolutions of complaints. The complainants shall have the prerogative of elevating their complaints to the courts as they see fit.