ROYAL CROWN-GROUNDPORT AND PARTNERS CORPORATION

Draft Environmental Impact Statement (EIS) Report

Proposed Busuanga River Dredging Project

Municipality of Rizal and San Jose

Oriental Mindoro

December 2023

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Table ES-1. Project Fact Sheet

Name of Project	**Busuanga River Dredging Project**		
Project Location	Barangays Adela and San Pedro, Municipality of Rizal and Barangays San Agustin and Central, Municipality of San Jose, Occidental Mindoro		
Project Category & Type (based on Annex A of MC 2014-005)	Category C. Environmental Mitigation; Disaster Risk Reduction; Climate Change Adaptation		
Project Area	Project Area (Onshore)		538.29 ha
	River Dredging Area (inside onshore project area)		175.69 ha
	River length (dredging area) STA. 1+050 TO STA. 9+000		7.95 km
	STA. 0+950 TO STA. 3+550		2.60 km
	TOTAL		10.55 km
	Dredging Area (Navigation Zone)		70.82 ha
	Support facilities (inside onshore project area)		1.5 ha
Extraction Rate	River (m^3/annum)	STA. 1+050 TO STA. 9+000	3,876,537.17
		STA. 0+950 TO STA. 3+550	6,62148.85
		TOTAL	4,538,686.02
	Navigation Zone (m^3)	1st 6 months of operation	2,536,078.67
Project Cost	River and Navigational zone - **PhP 603,310,000**		
Major Project Components	1. River dredging zone 2. Navigation lane dredging 3. Buffer zone (easement) 4. Stockpile area and other support facilities 5. Handling and transport of dredged materials 6. Cost recovery through sale of dredged materials 7. Office, staging area, stockpile area and other support facilities		
Project Proponent	**Royal Crown-Groundport and Partners Corporation** Contact Person: Mr. David Dela Cruz Position: President Tel No.: 0906 519957 Email Address: davidcdelacruz@yahoo.com 12-1C 12F, EGI Rufino Towers, Buendia Ave. corner Taft Ave., Pasay City,		
EIA Preparer	**Royal Crown In-house Consultants and employees** Contact Person: Ms. Celina Flor Cura Tel No.: 0928 5182884 Email Address: celinacura@gmail.com		

ES.1.1 SUMMARY OF PROJECT DESCRIPTION BASED ON DREDGING MASTER PLAN

The proposed project is the dredging works along the lower reaches of Busuanga River in barangays Adela and San Pedro, Municipality of Rizal and barangays San Agustin and Central, Municipality of San Jose, all within the Province of Occidental Mindoro. This area and vicinity are likewise the study area.

According to MIMAROPA Regional Development Plan 2011-2016, the major hotspot areas in the region in terms of flooding hazard are the provinces of Occidental Mindoro, Oriental Mindoro, and Marinduque, which includes the municipalities of Rizal and San Jose where the Busuanga River is located. Based on a study prepared by JICA on Nationwide Flood Risk Assessment and the Flood Mitigation Plan in the country, the Magbando River Basin where the Busuanga River flows, approximately 18 square kilometers of land area were inundated with 1.5 meters of flooding which may affect the 44,000 individuals residing in the area.

The Busuanga River is one of the river tributaries supplying water for drinking and irrigation for the citizens of municipalities of Rizal and San Jose, Occidental Mindoro. Perennial flooding and landslides continue to persist within the area which leads to river siltation. With the steady rise of population in the area and impacts of climate change, the apparent siltation along the stretch of the river poses a threat to the safety of the locals and economy. It is therefore vital to take action to prevent this threat and to promote economic growth and development within the locality.

The dredging project is aimed towards alleviating the flooding within the basin through river restoration, increasing the capacity of discharge flowing and to minimize the amount of silt accumulated in the river stretch and river mouth without cost to the government.

The dredging operations shall be done by simple, straightforward dredging and haul out of dredged materials. This process will be repetitive until the maximum desired riverbed elevation and pilot channel width as per approved Dredging Master Plan (DMP) are attained. It should be noted that the design river elevation differs for every section or river station.

A Cutter Suction Dredger (CSD) shall be used to initially break up a navigation channel at the delta towards the river mouth and then to the silting / catchment basin, and to remove the surplus deposits at the dredging channel.

Conventional land-based dredgers such as the excavators (in backhoe mode) and dump trucks will be used in tandem for upstream dredging or in the shallow river sections where dredging by CSD is not feasible.

The dredging activities will strictly follow the detailed engineering design plans for the dredging project duly approved by the DPWH Region 4B and will start from downstream and progress upstream. There will be no on-site processing. Moreover, no spoil area is required under the Project because all of the dredged materials will be transported by a belt conveyor to the dump ship and transported to the mother vessel that is anchored offshore.

The CSD will first be used from the offshore dredging area towards the river mouth. The vessel will pump the sand from the dredging segment area and will be loaded directly to the loading barges through an extended hose from the dredging mechanism.

At the point where the CSD cannot navigate the channel because of lack of depth, conventional mechanical dredging will be used. Backhoes will be used to extract the sand from the river and will be loaded onto the dump trucks. These trucks will then transport the sand to the main stockpiling area. This process will be done repeatedly. The CSD and mechanical dredging will be done simultaneously. The CSD will be stationed in the river mouth moving towards the inner part of the river while mechanical dredging operations will be conducted from the other end (upstream) of the dredging zone moving towards the sea.

The proposed project area covers approximately and **538.29 hectares** for the onshore area and **70.82 hectares** for the offshore area (navigation zone) for a total of **609.11 hectares**. Within the onshore project area is the river dredging basin stretching 10.55-line km in **175.69 hectares**. The stockpile area shall occupy 1 hectare inside the project area.

Project Area (onshore)	538.29
Project Area (offshore) Navigation Zone	70.82
TOTAL PROJECT AREA	**609.11**

Inside the onshore project area is the River Dredging Zone which covers 175.69 ha along 10.55 line km divided into 2 sections as bellow:

Section 1 - Main Channel (Sta 1+050 to Sta 9+000)
Section 2 - Branch (Sta 0+950 to Sta 3+550)

Hydraulic Design Data
The baseline velocity for the 3 sections of the river are as follows:

Section 1 Main Downstream:

Drainage Area	=	530.07 km^2
Velocity	=	1.59 m/sec
Peak Discharge	=	1,205.90 m^3/sec

Section 1 Junction:

Drainage Area	=	508.60 km^2
Velocity	=	2.85 m/sec
Peak Discharge	=	1,972.33 m^3/sec

Section 2 Branch:

Drainage Area	=	530.07 km^2
Velocity	=	1.68 m/sec
Peak Discharge	=	936.10 m^3/sec

Length and Width of River within the Project Area
The existing length of the river from end to end of the project/dredging area is 10.55 km measured along the dominant flow section. Once the dredging channel is established and excavated, the length shall be 10.3 km. The design channel width ranges from 100 to 300 meters.

Projected Width of the River After Dredging Operations
The existing riverbanks, and therefore the width of the river will essentially remain the same. However, the portion with water or the active channel shall be constricted within the dredging zone as it shall be deepened and unblocked so as to guide the water to favor that route. The design channel top width (pilot dredging channel) shall range from 100 to 300 meters.

Resource and Extraction Rate
Based on the Approved Dredging Master Plan, the computed volume of aggregates that needs to be extracted within the entire river dredging area to handle a storm with 100-year average return interval without overbanking / flooding is at least 4,538,686.02 m^3. Since there will be continuous replenishment of sediments from upstream, these replenished materials within the dredging zone needs to be extracted as well in order to maintain the designed width of dredging channel and riverbed elevation (depth). This is broken down into the main channel (STA. 1+050 TO STA. 9+000) @ 3,876,537.17 m^3 and the branch (STA. 0+950 TO STA. 3+550) @ 662148.85 m^3

For the offshore area, the estimated volume of sand and gravel materials to be dredged is 2,536,078.67 m^3 to be extracted for the first 6 months of the project operation.

Please note that the volume to be extracted per section of the river shall always be in accordance with the approved dredging plan, be it the initial removal or the maintenance phase wherein newly-deposited materials are to be removed again for an efficient flood control operation to take effect.

ES 2.0 PROCESS DOCUMENTATION

The scope for this EIS preparation was decided among the Project Proponent, EIA Team, DENR-EMB R4B and EIA Review Committee (EIARC) members during the Technical Scoping on June 20, 2022, following the guidelines set in the EIS scoping and screening form for dredging projects. This checklist is provided as **Annex ES-1.**

The Busuanga River Dredging Project falls under Category C. “Environmental Mitigation; Disaster Risk Reduction; Climate Change Adaptation, per EMB Memorandum Circular 2014-005.

This EIA essentially follows the DENR procedural guidelines under DAO 2003-30 (Phil. EIS System), DENR MC 2010-14 and EMB MC 2011-005. The potential positive and negative impacts, hazards and risks that could occur during the various phases of the project are discussed together with the options for mitigation measures.

ES.2.1 EIA TEAM

The table showing the list of EIA Preparers is provided below.

Table ES-2. EIA Team Composition

Name	Field of Expertise	EMB Registry No.
Ms. Celina Flor Cura	Team Leader /Project Coordinator	-
Mr. Aaron Dela Cruz	Assistant Team Leader / EMP / Noise	-
For. Benjamin R. Cuevas	Terrestrial Ecology Specialist	IPCO-072
Benjamin S. Francisco	Marine and Freshwater Ecology	IPCO-038
Michael Chester Francisco	Fisheries	IPCO-040
Angelie Faye Nicolas	Sociology Module	IPCO-259
Rogerio Espiritu Jr.	Oceanography	-

The accountability statements of the proponent and the preparer are in **Annex ES-2**.

ES.2.2 EIA SCHEDULE

The following are the activities and corresponding schedule that were conducted for this study.

Table ES-3. EIA Study Schedule

Activity	Date
Secondary Data Researches	April 11-May 13, 2022; October-November 2023
Reconnaissance Site Survey	May 15, 2022
Bathymetric Survey	July 13-23, 2021 & October 9, 2023
Terrestrial Ecology Baseline Assessment	October 9, 2023
Oceanographic Studies (field survey)	October 9, 2023
Water Quality Sampling	May 16-17, 2023 and October 10, 2023
Marine Ecology Baseline Assessment	October 16-17, 2023
Freshwater Ecology Baseline Assessment	October 16-17, 2023
Air Quality and Noise Sampling	October 9, 2023
SOCIAL PREPARATION UNDERTAKEN	
Perception Survey	October 18, 2023 (Brgys. Adela & San Pedro); November 9-10, 2023 (Brgys San Agustin & Central)
Public Scoping via Key informant Interview (KII) and Focus Group Discussion (FGD)	May 16-20, 2022
Public Consultation (and site inspection)	Sept 14-15, 2023
Focus Group Discussions/KII to augment public consultation	October 9, 2023

The Technical Scoping Checklist is provided in **Annex ES-1** while the Public Participation Documents are presented in **Annex ES-3**.

ES.2.3 EIA METHODOLOGIES

The EIA study was done to organize the technical components of the project as well as to identify the specific requirements of the proposed mining project by considering the environmental, economic, social, and institutional factors. All necessary requirements were documented through primary and secondary data gathering, scientific analyses and recommendations based on actual approaches were used to complement the study. The following are the sampling/assessment methodologies employed by the EIA team for the study:

Table ES-4. EIA Methodology

Module / Section	Baseline	Methodology
LAND		
Land Use Classification	**Secondary data:** Comprehensive Land Use Plans or Ecological Profiles of municipalities of Rizal and San Jose; Provincial Development and Physical Framework Plan of the Province of Occidental Mindoro; geoportal.gov.ph; NAMRIA; HazardHunterPh; KII **Primary data**: ocular inspection	Assessment of compatibility of the proposed project in the land use classification
Geologic Hazards	Official Seismic Hazard Assessment Report from PHIVOLCS; secondary data on geology and geohazards from PHIVOLCS, MGB and UP Project NOAH	Identify and assess project impact
WATER		
Hydrology / Hydrogeology	**Secondary data:** Existing drainage system; Climate, historical flooding and storm surge occurrences from PAGASA Project NOAH, Rizal and San Jose LGU; and flood hazard map from MGB. **Primary data:** Streamflow measurements	Identify and assess project impact on the change in drainage morphology, local drainage and resulting effects of flooding. Numerical flood modeling included in the Detailed Engineering Study
Water Quality	**Primary data:** actual sampling in 5 stations. **Parameters Considered** pH; BOD_5; Oil and Grease; TSS; and Fecal/Total Coliform	Standard Methods for Water Quality Sampling and Monitoring – grab sampling. Water Body Classification: DENR Class C; DAO 2016-08; Analytical Methods: by ELARSI Laboratory, recognized by DENR
Freshwater Water Ecology	**Primary data:** Field survey conducted to identify and assess project impact in terms of threats to existence/and or loss of species, abundance frequency and distribution species and include discussions on overall impact to freshwater ecology. Interviews with Barangay Officials and fishermen	Fish biota - opportunistic observations in river pools, KII & catch observations of fishers Macro-invertebrates – actual specimen collection Planktons - core sampling in random stations along 100-m transect walks in shallow portions of the river. Composition, abundance and density of phytoplankton communities determined using standard methodologies particularly the Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics.
Marine	**Primary data:** Field survey conducted to assess the abundance / density / distribution of ecologically and economically important species, benthic planktons, corals reefs, algae, seaweeds, sea grasses. Additional interviews were carried out with fishers encountered during actual fishing documentation in the estuary	Transect, manta tow and spot dives surveys, marine resource characterization
AIR		
Ambient Air Quality	**Primary data:** sampling in 2 stations	**Methodology:** AQI) of Plume Labs
Ambient Noise	**Primary data:** daytime noise sampling in 7 stations	**Methodology:** use of Digital Lutron® Model SL-4013 non-integrating type 2 sound level meter
PEOPLE		
Demographic Profile / Baseline	**Primary data:** Conduct of Perception Survey, Public Scoping, KIIs **Secondary data:** CLUPs of the municipalities of Rizal and San Jose and PSA 2020 Population Census	

ES.2.4 PUBLIC PARTICIPATION ACTIVITIES

1. Perception Survey

On October 9 to 13, 2023, a perception survey was conducted in barangays Adela and San Pedro in Rizal and barangays San Agustin and Central in San Jose. This was conducted to gather data on the residents' perceptions of the current state of their community and to identify the community's needs and concerns, as well as to assess their level of awareness and understanding of the project's objectives and potential impact on their daily lives. The most common issues raised include flooding, expected benefits, livelihood and employment.

The results of the surveys covering barangays Adela and San Pedro, Municipality of Rizal and Barangays San Agustin and Central, Municipality of San Jose, which host the project area are presented in **Annex ES-3**. The sample Perception Survey Form, on the other hand, is presented in **Annex ES-4**.

2. Public Scoping

The Public Scoping was held on May 16-19, 2022 in various offices of the pertinent stakeholders of the Project. The proponents and EIA Team were joined by the barangay officials representing each barangay in the project area. This collaborative effort aimed to foster open dialogue and engagement with the stakeholders present during the scoping. The scoping was done through separate meetings with government offices, line agencies and barangay LGUs.

The objective of the conducted Public Scoping Activity is to ensure that the Environmental Impact Assessment (EIA) will address the relevant issues and concerns of the stakeholders and that it will be consistent with the Philippine Environmental Impact Statement System (PEISS).

In general, the stakeholders expressed their support for the project although there are some concerns or requests/suggestions that they expressed. They also provided important information regarding the project area.

The complete Public Scoping Report is provided in **Annex ES-3**. It is noted that details on the project were preliminary and not yet firm during the conduct of Public Scoping Activity.

3. Public Consultation

The public hearing and site inspection for the ECC Application of Royal Crown-Groundport and Partners Corporation, proponent for the Busuanga River Dredging Project were conducted on September 6 and 7, 2023.

The Public Hearing conducted on September 6, 2023, at the Barangay Hall Gymnasium of Barangay Adela, Rizal, Occidental Mindoro, was a significant event facilitated by representatives from the Environmental Management Bureau (EMB) in the MIMAROPA region. This gathering served as a platform for various stakeholders to engage in discussions and deliberations concerning the Busuanga River Dredging Project. The Project Proponent Representative, Ms. Celina Cura, demonstrated the Company's commitment to community engagement and feedback collection. Also presented were the details of the project giving emphasis on the results of the environmental and social assessment and the corresponding potential impacts management, underlining the importance of transparency in the environmental assessment process.

This community engagement activity was also participated by 102 individuals (48 Male and 54 Female), the Barangay Adela LGU officials and residents, LGU of Rizal, DENR and EMB-R4B representatives.

There was no direct objection to the issuance of the ECC to the Proponent, nevertheless, concerns were raised. The key concerns of the stakeholders include: possible benefits/livelihood opportunities for locals; contingency plans in case of loss of livelihood; flooding and soil erosion; security of residents; dimensions of dredging and area limits or boundaries; and assurance that the Proponent will adhere to and fulfill its commitments.

The Proponent committed that they will comply with all the necessary permits and other requirements and will support the community through the MMT. On the other hand, the barangay officers and other participants expressed their support to the Proponent and committed to join the MMT that will be created.

The complete Public Consultation Report is provided in **Annex ES-3.**

ES 3.0 EIA Summary

Summary of Alternatives Considered
In terms of siting options, the lower reaches of Busuanga River was designated by the Inter-Agency Committee (IAC) as an exclusive dredging zone for river restoration. For the process technology, dredging by cutter suction dredger (CSD) in tandem with land-based backhoe and truck were deemed the most suitable for the site.

ES.3.1 DISCUSSION ON NO PROJECT OPTION

The "no project" option means that the dredging project will not push through, and that no dredging activity will take place along Busuanga River. Thus, it means to allow siltation/sedimentation to accumulate until the riverbed is completely choked, for the flooding and destruction of agricultural crops to continue, and for the risks to life and property to continue.

Moreover, the surrounding communities of Busuanga River (barangays Adela and San Pedro, Municipality of Rizal and Barangays San Agustin and Central, Municipality of San Jose) will be continually exposed to flooding risks affecting their health, lives, properties and safety. This will further affect the economy of the area as flood hazards will discourage investment of businesses and other employment opportunities in the area.

The high volume of sediment transported from the watershed catchment of Busuanga River to the sea will continue, the excessive sediment accumulation in the riverbed will increase which may result to further convulsion of the rivers, and as extreme rainfall volume in extreme Tropical Storms will become more frequent, government expenditures for disaster preparedness, rescue, relief, and repair of flood-damaged structure will increase. To do nothing is not a wise option when there are alternatives being offered at no obligation to the Government.

ES.3.2 ECOLOGICAL PROFILE AND CARRYING CAPACITY OF THE PROPOSED PROJECT SITE

Summary of Baseline Characterization

Water Quality
The pH level of groundwater and freshwater samples did not exceed the allowable limit for Class A and Class C, respectively. Marine water pH exceeded the allowable range for Class SC water. Elevated coliform counts were detected mostly in all sampling stations. Slight temperature increase was presented in the collected groundwater sample. In general, all remaining parameters measured for groundwater, freshwater and marine water samples are within their prescribed limits as compared to their respective DAO 2016-08 and DAO 2021-19 standards.

Salt water intrusion was detected in the groundwater. It is only used for domestic purposes and only during the rainy season because saltwater intrusion is high during the dry months.

Marine Ecology
Marine ecology baseline assessment was conducted in the impact area of the proposed Busuanga River Navigation Zone on 16-17 October 2023. The survey employed standard scientific survey methods for coastal resources prescribed in English et. al (1997) focusing on finding and describing

important, fragile coastal habitats and associated ecological niches in the coastal shelf fronting the Busuanga River Estuary.

The survey team completed 10 broad area manta tows, 6 spot dives with scuba for benthic and seabed characterization, plankton community sampling and macro-invertebrate survey. Spot dives were undertaken in lieu of coral line intercept transect in as much as the impact area is devoid of corals and similar resources. Sandy seabed, with no elements of coral habitat was catalogued in all the manta tows and spot dives. The shelf area in front of the estuary hosts little macro-invertebrate of significant value except for 3 species of gastropods and a bivalve utilized as a popular seafood.

Fishers declared that some 30 fish food species are targeted by local fishing boats in fishing ground offshore of the estuary, employing hook and line, gill nets and troll lines. The CPUE is low.

The principal issues arising from the dredging project include enhanced sandy substrate intrusion into the coastal seabed, increase seawater turbidity, alteration of benthic habitats of fish, among others. All of these issues can affect fish feeding, reproduction and recruitment over the long term if the issues are not effectively addressed through efficient mitigating measures. The fundamental mitigating strategy is to prevent sediment streams from spilling into the coastal shelf through various control measures at source.

Freshwater Ecology

Freshwater ecology baseline assessment was conducted on 16-17 October 2023. Three (3) stations were subjected to determination of fish biota, macro-invertebrates and plankton community structure. For fish species composition and macro-invertebrate community, actual fishing and actual gleaning were conducted to determine real-time, *in-situ* catch composition and rates. Actual fishing and information from key informants revealed the presence of 16 species of fish and 3 species of crustaceans in the Busuanga River, mostly in the estuary and downstream sections. The midstream and upstream sections of the project site are populated mostly of mature gobies (Gobidae), freshwater shrimp (*Nematopaleomon tenuepsis*) and tilapia. None of the species in the river are endemic or are rated in the IUCN as endangered or vulnerable. Actual gleaning for macro invertebrates yielded 7 species that included the rare red racer nerith *Vittina waigiensis* and the lucrative geloina *Polymesoda erosa.* Abundance of the macro-invertebrates was considered high. In plankton community, no diatoms with biotoxin nature (*Nitzchia and Fragilaria)* in bloom proportion were discerned in the analysis. No significant fishing activities were witnessed in the river. Sand quarrying, on the other hand, was extensive in the upstream section. The dredging of the river can result to enhanced sediment spills in the estuary and coastal shelf but no corals are located in the shelf. Sediment sequestration measures need to be established in the estuary in order to reduce sand and silt invasion into the coastal waters.

Carrying Capacity

The Busuanga River watershed has an area of 530.07 km^2. The proposed dredging cross section to be dredged has 100 meters and 200 meters bottom width, 1V:2H side slope and 3-meter depth.

The results of the hydrologic analysis employing both hydrologic modelling and extreme value analysis in the determination of the design discharges for the 100-yr return periods for each of the dredging sections show that the computed 24-hour rainfall totals to 182.04 mm, with peak at 13th hour at 84.29 mm (46.30%). Without any loss, the excess rain that will be converted to runoff is equivalent to the rainfall amount.

Moreover, the stream velocity at the main channel is 1.59 m/sec; at the junction is 2.85 m/sec and at the branch is 1.68 m/sec. The corresponding peak discharges are 1,205.90 m^3/sec, 1,972.33 m^3/sec and 936.10 m^3/sec, respectively

These peak discharges were simulated using the steady state 1-dimensional flow of the HEC-RAS program. Comparison of the resulting water surface profiles for the "without" and "with" dredging project show that there is a decrease in riverbed and water levels along the length of the dredged channel.

Using 2D – unsteady flow inundation models were used with the aid of the HEC-RAS Version 5.0.7 software, the simulated flood scenario implementing the proposed flood control measure (dredging) is presented to denote the possible improvement in the flooding situation in the project area. In this analysis, a 10m-deep cut was introduced along the main channel. The resulting 100-yr flow hydrograph was used as the upstream boundary while the downstream boundary condition was still set to a stage hydrograph with a value of 2m.

It can be seen that after the proposed dredging project, the flooding within the Busuanga River Basin will be mostly contained within the pilot dredging channel, thus, resulting in a significant reduction in flooded areas.

For the sediment transport analysis, a 1D HEC-Ras analysis was applied. Results show that minimal deposition can be expected along the upper portion of the Busuanga River. Deposition starts midway and continues to persist toward the mouth of the channel. The sudden drop along Station 3+600 is the result of the flow being redirected towards the formed tributary channel, which then leads down to the mouth at Station 9+050. When plotted with the invert change along the channel, it can be seen that the sediments were indeed deposited in the portions where velocity dropped, thus, validating the relation of flow velocity to the riverbed fluctuation. Moreover, velocity drop should also be expected downstream where the river channel merges to the sea. The channel elevation changes continuously due to erosion and aggradation along the riverbed. One factor that contributes to this fluctuation is the sudden change in the width and elevation of the target cross sections. This affects the flow velocity along the channel, which in turn determines whether the sediment particles will be deposited or eroded. As the flow velocity decreases, particles tend to deposit. Inversely, this means that the sediments tend to be eroded as the flow velocity increases.

At peak discharge, the sediment concentration along the river averages 1,760.02 mg/L. The estimated sediment transport capacity during the peak discharge is found to be about 104,432.4 tonnes/day for the main channel of Busuanga River, and about 1,746.93 tonnes/day for its tributary.

Lastly, the depth of scour (ds) using the Blench formula ranged from 3.24m to 4.22m while for the Fruchert formula, the depth of scour (Y) ranged from 4.60m to 5.81m.

Terrestrial Ecology

Terrestrial Flora

A total of 460 number of individuals belonging to seed plants (Angiosperm) that includes monocots and dicots comprising the taxonomic group of 39 morpho-species belonging to 39 genera and 16 were recorded in-situ. The midstream area has the highest abundance with 174 individuals representing 30 species with 30 genera and 13 families. The downstream and upstream sections have 166 and 120 individuals, respectively. There 5 plant form or habit consisting of trees, shrubs, vines, grasses, and herbs. The most speciosae (having several species) belongs to trees and shrubs with 10 species apiece, followed by grasses (8), herbs (7), and vines (4).

The species with the highest relative density belongs to Carabao grass (*Paspalum conjugatum* P. J. Berguis) with 12.39% (57 individuals) while the species having the highest relative dominance include Datiles (*Muntingia calabura* L.) of Muntingiaceae with 71.17% followed by Agoho (*Casuarina equisetifolia* L.), and Alagau (*Premna odorata* Blanco) and Gmelina (*Gmelina arborea* Roxb. ex Sm. in Rees), with 5.49% and 1.37% respectively. Overall, the species to have the highest importance value (IV) include Datiles with 75.94% followed by Agoho and Carabao grass with 24.24% and 16.62%, respectively. On biodiversity index, the Shannon-Wiener Biodiversity Index (H') is "moderate" at 2.7804 and Pielou's Evenness Index J' is "very high" at 0.8779 *(Fernando Biodiversity Scale and Evenness Index)*. The midstream area recorded a biodiversity index at 3.0842 ("high") and evenness index at 0.9068 ("very high") followed the upstream area with 2.7095 ("moderate") and 0.8504 ("very high") while sampled plots in the downstream area registered 2.5476 ("moderate") and 0.8766 ("very high"). On conservation status, all recorded flora species were cited as Least Concern under IUCN and not included in the list under DENR AO 2017-11. Moreover, 13 species or 33.33% of the 39 species are native and are among the notable species that are restricted to the Philippines. The remaining 26 species or 66.67% are considered naturalized, introduced or exotic.

Terrestrial Fauna

For the terrestrial fauna (wildlife), the assessment conducted at the downstream, midstream, and upstream areas of the project site yielded 184 individuals belonging to 33 species of avifauna representing 29 genera and 23 families. The midstream area has the highest abundance with 83 individuals representing 20 species with 19 genera and 16 families. The downstream section has 55 individuals while the upstream area has 46.

Among the avifauna species observed, Eurasian Tree Sparrow (*Passer montanus* Linnaeus, 1758) has the highest relative abundance with 24.46% (45 individuals) followed by Chestnut Munia (*Lonchura atricapilla* Vieillot, 1807) with 11.96% (22 individuals) and Cattle Egret (*Bubulcus ibis* Linnaeus, 1758) with 8.70% (16 individuals). In terms of conservation status, all recorded fauna species are classified as LC under IUCN and not included in the list following the DENR AO 2019-09. On endemicity, majority of the fauna species are residents (72.73%) while the migrants are 21.21% and the endemics has 6.06%. Lastly, the study area has **moderate** biodiversity index with H' = 2.9437 and evenness index with J' = 0.8133 *(Fernando et al. 1998).* This also implies that the abundance of dominant species is evenly distributed in the area.

ES.3.3 SUMMARY OF THE ENVIRONMENTAL MANAGEMENT GOALS AND INDICATOR LIMITS ON WATER QUALITY

The proposed project is primarily aimed to restore and enhance the conveyance capacity of Busuanga River in order to minimize the perennially damaging floods of the adjacent areas at no cost to the government. For all that, there are still potential adverse impacts in the process of performing the project activities. Accordingly, environmental management goals are set to mitigate such impacts on land, water and people.

The proposed project will not generate unwanted dredged materials since all extracted materials shall be loaded directly to the barge. Hence, unwanted dredged materials to be disposed of are not expected. If ever, the disposal of such unwanted spoils shall be by reuse, i.e., use them in areas where it is needed as preliminary dump piles or supplemental filling or be donated to government and non-government organizations needing it.

In the case of resuspended silt during dredging due to disturbance of the riverbed, this may be prevented with the installation of silt curtains around the dredging area to trap any dispersed silt.

For marine and freshwater ecology, the Project aims to restore the river, and thereafter maintain the integrity and resilience of the ecosystem through prevention of sediment streams and rehabilitation of dredged areas though greening and waste management. The long term objective of improving the water environment is to enhance growth, reproduction and recruitment of fish and crustaceans and restore aesthetic quality. It is the management goal to ensure that dredging activities will not permanently impair the already highly-stressed freshwater ecology and that the existing fauna can be safely trans-located in undisturbed portions of the river to ensure that a new starter population is embedded.

On people, the dredging operations may possibly impact on the accessibility of locals into the river and their adjacent farmlands and/or homes. Nevertheless, the dredging operations shall be done in small portions of the dredging zone at every single time. This means that there will always be sufficient access for the residents. Furthermore, there will be no displacement of settlers as there are no existing dwelling units within the river.

No significant fishing activities were witnessed in the river. The few sustenance fishers will only avoid the localized dredging site in the river but can fish in most sections without disturbance. The project will support re-stocking of foodfish in suitable sections of the river. In the marine environment, dredging will not affect or disrupt fishing operations, including set gears. If ever, the Project will address dislocation of traditional nearshore fishing operations due to potential limitations brought about sediment streams in nearshore waters in a manner that will help fishers improve fishing practices offshore. This will include support for the establishment of fish aggregating devices in adjoining offshore fishing grounds. Fishing operations are not permanent in one fishing site and fishers normally search for productive catching grounds from time to time, especially during peak months. There are no permanently set fishing gears near the estuary. Although the sustenance fishers are likely to be able to continue with their activities without hindrance, Royal Crown shall target livelihood and Fish Aggregating Device (FAD) for the fishers in its SDP.

Notwithstanding the adverse impacts, a multitude of local socioeconomic benefits shall be brought about by the Project including but not limited to the following: enhancement of employment and livelihood opportunities; increased business opportunities and associated economic activities; and increased revenue of LGUs.

The main impacts on water quality are: siltation and potential water pollution from untreated wastes and oil or oily residues. These could be temporary or permanent, significant or not significant depending on the nature of the existing quality of receptors. First and foremost, this is a River Restoration Project, it is expected that its direct effect shall be the improvement of the carrying capacity of Busuanga River, thereby lessening flood hazard susceptibility and its ill-effects to life, property and agricultural yield. Other impacts include: water quality degradation due to blanketing of sediment/silt from highly turbid waters emanating from dredging site (this in turn, could lead to degradation of freshwater and marine ecology); noise associated with dredging, loading, unloading and sorting/stockpiling operations; and beneficial effects to locals in terms of employment opportunities, SDP implementation, and lesser exposure to flood hazards. The table below lists the impacts, mitigating measures, and the target efficiency.

The following table is a summary of key impacts and the corresponding options for mitigation.

Table ES-5. Key Significant Impacts of the Project

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
CONSTRUCTION / DEVELOPMENT PHASE –			
NONE	No major construction works will be done since the support facilities (base camp) will be rented. Hence, no impacts are foreseen		
OPERATIONS PHASE			
Installation of slope protection; Opening of navigation zone and river mouth; Dredging Stockpiling or Hauling Ship Loading Vessel/s Operation Refueling Operation of other facilities	**LAND**		
	Possible conflict with existing land use; encroachment in environmentally critical areas; and impact in existing land tenure issue/s	Consultation with land tenants that will be affected by dredging activities. Give just compensation; Good housekeeping.	Complaints avoided or properly and promptly settled.
	Generation of domestic solid wastes	Respective waste management facilities for all operating units; Improvement of segregation methods and recycling facility; River clean-up drives; and IEC on ecological solid waste management	Zero Dumping; 100% compliant with RA 9003; and DAO 1992-29 and DAO 201322 including its Revised Procedural Manual
	Generation of toxic and hazardous waste wastes	Sorting, labeling and monitoring of hazardous wastes with bund wall and oil-water separator at the storage facility; Provision of oil spill kit and fire extinguisher; Collection, transportation and treatment of generated hazardous waste materials by a DENR accredited transporter and TSD facility	Zero Dumping; 100% compliant with RA 9003; and DAO 1992-29 and DAO 201322 including its Revised Procedural Manual
	WATER & LAND: Geohazards		
	Potential inducement of riverbank erosion	Maintaining slope stability of riverbanks by proper engineering measures; Adequate drainage control; Easement of at least 20 meters between bank and dredging operations; Maintain 1:4 height to base ratio for bank slope; The channel cutting will be strictly limited in the depth and other specifications as stipulated in the detailed engineering plan.	Zero riverbank erosion due to dredging
	Improvement in flood drainage containment capacity of lower Busuanga River leading to improvement in farm yield	IEC to inform locals about the perceived & planned enhancement of the river Installation and proper maintenance of drainage system.	Enhancement
	WATER		

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
	Change in drainage morphology	Maintain a central pilot channel to guide stream flow; Silt curtains to be installed will be strategically installed (when possible) to lessen the transport of silt-laden water.	Enhancement of heavily-choked Busuanga River
	Riverbed deepened and water surface lowered - lessens flooding susceptibility	Maintain a central pilot channel; Strictly follow/stick to approved Dredging Plan.	Enhancement
	Disruption in water circulation pattern, littoral current, and coastal erosion/deposition	Stick to DPWH-approved Dredging Plan; Employ geo-engineering technologies.	Enhancement of heavily-choked Busuanga River
	Increase in background water quality levels due to resuspension of sediments. Overflowing of heavily-silted water into crop lands that can damage soil fertility.	Installation of silt curtains; If silt curtains and other containment enclosures are not possible, limit the dredging during periods of calm winds or low tides; Follow engineering and environmental plans stringently; Maintain a central pilot channel; Stick to approved Dredging Plan; Periodic water quality monitoring; Cover stockpiles of dredged materials if hauling is not yet available.	100 % compliant to RA 9275 and DAO 2016-08 standards
	Inadvertent spill of ship bilge, ballast water, fuel, oily residues, domestic wastewaters from vessel operations	Onboard bilge management; Ballast water management; Proper maintenance and regular inspection of vehicles and equipment; Provision of facilities for recovery of leaks and storage in drums; Proper training of vehicle operators especially on spill prevention and containment; Designation of a motor pool for refueling and maintenance works; Refueling by latch-lock between dispenser & receiving fuel tank; Prepare belt oil skimmer for oil spill emergency; Implement Oil (& grease) Spill Contingency Plan; No bilge water disposal at sea; Use of portable septic tanks in all facilities; Waste minimization, recycling and re-use including motor pool spoils; Proper handling and storage of petroleum products utilized by equipment, machineries and continuous checking / visual observation of leaks;	100% compliant to RA 9275 and DAO 2016-08 standards
	Potential increase in BOD & coliform level of water bodies from domestic wastewater and equipment.	Temporary facilities (“portalets”) for workers onboard the vessels; Strictly impose proper waste disposal and sanitation/good housekeeping practices; Prevention of disposal of untreated wastewater to river/sea; Regular Water Quality Monitoring	Zero discharge of untreated domestic wastewater to the river/bay.

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
	Siltation loading in coastal waters – leading to potential disturbance and alteration of the seabed and benthic substrate hosting fish, macro-invertebrates and crustaceans	Contain erosion at source and entrap fugitive sediments thru provision of silt curtains and sediment filters around estuary and around coral reef; Mangrove planting in foreshore areas; Compensate any substantiated loss of income from fishing due to project; Loss of gear efficiency of stationary gears due to sediment streams will be replaced.	100% compliant to Approved Dredging Plan
	Potential loss of sandy demersal fish habitat; Migration of fish; Physical damage to macro-invertebrate habitats	Translocate/ re-stock suitable bivalve populations in the inter-tidal area; Formulation of a Fisheries Improvement Plan	100% compliant to Approved Dredging Plan
	AIR AND NOISE		
	Air pollution due to GHG emissions from burning of fossil fuel for the dredger, vehicles, generator and other equipment	Regular Preventive Maintenance System (PMS) for al vessels; Vessels fully compliant with international standards; Use of low Sulphur content fuel; Use of turbo charging engines for efficient combustion to minimize the generation of criteria pollutants; Install mufflers and scrubbers at the exhaust pipe to capture pollutants (particulates and gasses); and Install filter in the exhaust pipe.	100% Compliant to RA 8749
	Increase in ambient noise level	Regular preventive maintenance of vessels/vehicles/equipment; Choose less noisy equipment or cover noisy equipment with noise reducing sheets; Enclosure of equipment emitting high level noise; Use alternative power source for cooling system such as solar power; If possible, plant trees at the banks to act as buffer; Proper scheduling of dredging and hauling; Imposition of speed limits for land vehicles along access roads (30 kph maximum); Periodic monitoring of noise level during operating hours.	100% Compliant with Noise Standards
	PEOPLE		
	Improved safety due to lesser flooding problems as a result of dredging	IEC to inform locals about the perceived & planned enhancement of the river	An enhancement feature
	Public health and safety issues related to project implementation	Provide health clinic manned by a doctor, nurse and health workers; Provision and maintenance of signages demarcating buffer zone; Facilitate trainings for Project-related Disaster Risk Reduction Management in the Barangays.	100% Compliant to DOLE OSH Standards;

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
	Physical injuries arising from accidents	Wearing of PPEs for all workers while at the project premises; Conduct regular safety trainings and drills; Conduct basic medical check-up for newly-hired workers; Provide warning and safety signs where needed; Daily toolbox meeting; and Implement Emergency Response Plan and Health and Safety Management Plan.	100% Compliant to DOLE OSH Standards; 100% Compliant to Phil. Coast Guard & MARINA Standards
	Equipment and personnel safety during rainy season	Use amphibious dredger; Define quick shelter route in event of strong rain; Conduct emergency drills; Set up barometer and anemometer at site; Assign somebody to monitor weather and provide all-weather communication equipment with all operators; and Provide training for adaptation of working procedures and protocol under all weather conditions.	100% Compliant to DOLE OSH Standards; 100% Compliant to Phil. Coast Guard & MARINA Standards
	Uncontrolled developments around the project site	Coordinate with Barangay LGU regarding developments to discourage building of permanent structures due to flood hazard.	100% compliance to Local Government Code
	Spread of epidemic (i.e., virus)	Rigidly implement all protocols implemented by the government at all times; Provide insurance/compensation benefits to workers when there is a known epidemic.	100% Compliant to COVID guidelines
	LIVELIHOOD: Displacement of sustenance fishers in the river and estuary.	Translocate/ re-stock suitable bivalve populations in the intertidal area; Formulation of a Fisheries and other Livelihood Improvement Plan (part of SDP); Provide the affected local people with supplemental livelihood training; Replace dislocated fishing gears; and Pursue crab and fish replenishment in nearshore sandy shoals and private fish hatcheries.	100% Compliant to livelihood and Fish Aggregating Device (FAD);
	Threat to stability of foundation of the gabions (FCs) of DPWH.	Provide scour protection for FCs if very proximal; Maintain a minimum of 50m distance from FCs for dredging operations or upgrade engineering protection for the FCs if Dredging Master Plan dictates shorter distance.	100% compliance to DPWH standards and the approved Dredging Plan
Hiring of workers	Employment and livelihood opportunities for local people and entrepreneurs	Prioritize locals in hiring of workers if skills are available locally; Partner with the LGU for the implementation of the Social Development Program; Provide employees' wages and benefits as prescribed by law; Generation of livelihood opportunities by allowing local entrepreneurs to provide support services to the project and its workers.	100% Compliant to SDP and the Local Government Code in terms of local employment

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
	In-migration might cause health and safety issues, social conflicts, peace and order, and introduction of other social evils.	Prioritize locals in hiring; Establish and maintain strict hiring policy for migrant workers and orient them properly upon or before arrival; Coordination with the Barangay LGU to ensure only authorized establishments are able to operate in the area.	100% Compliant to SDP and the Local Government Code in terms of local employment
Dredging activities, Hiring of workers	Discrimination of women in the workplace and security issues to women and children	Promote equal protection or treatment to women and children as part of the gender and development initiatives; Implement flexible and gender-sensitive employment and equal opportunities for the elderly, men, women, and youth that are not employed; Assist the women in capability-building and/or skills training; Uphold fundamental human rights by never discriminating against others based on their legally-protected traits.	100% Compliant to SDP and the Local Government Code in terms of local employment
SDP implementation & payment of taxes and other fees.	Delivery of supplemental basic social services to local people	Partner with the LGU for the implementation of the SDP; pay all taxes and fees diligently.	at least 100% Compliant to SDP
DECOMMISIONING AND ABANDONMENT PHASE			
Dismantling and removal of equipment and structures	Generation of solid waste from dismantling of structures. Potential stockpiling of wastes at riverbanks	Implement ecological solid waste management system; Ensure proper disposal of all solid wastes before leaving the site.	100% compliant with RA 9003
	Generation of hazardous waste from dismantling of structures.	Implement hazardous waste management system to acceptable standards; Commission a DENR-accredited 3rd Party Contractor to haul out all waste materials and dispose only to approved Treatment, Storage and Disposal (TSD) facility.	100% compliant with DAO 1992-29 and DAO 201322
	Collapse of riverbanks or damage to gabions &/or other FCs	Provision of engineering mitigation measures to portions of riverbanks when absolutely necessary (in coordination with DPWH); Project site to be inspected by concerned government agencies & LGUs before Proponent turns over the site to the LGU. Reforestation of riparian zone (along riverbanks) whenever applicable, with indigenous species.	100% compliant with DPWH guidelines
	Increase in turbidity due to sediment resuspension	Maintain sediment barrier until TSS values are below the limit for Class C/ Class SC	100 % compliant to RA 9275 and DAO 2016-08 standards
	Potential spill of oil, lubricants or wastewater	Commission an accredited 3rd Party Contractor to haul out and/or treat all liquid wastes (especially used oils/lubricants and its containers).	100% compliant to RA 9275 and DAO 2016-08 standards

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Target Performance/ Efficiency
	Re-establishing riparian vegetative cover in the project area	The planting of trees/vegetative cover at riverbanks for the duration of the project shall have grown and improved the area by the time of decommissioning.	An enhancement
	Return and/or increase in population of fish and other water species due to restoration of habitat	An enhancement	An enhancement
	GHG and particulate emissions from equipment	Provide catalytic converters and particulate filters for petroleum-fueled equipment; Construct at site a concrete platform with lip, surfaces lightly dipping to an oil collection sump with oil and grease separator unit. Collected used oil and fuel storage should be on concrete flooring with containment lip in case of spillage; and Used oil should be hauled out only by DENR accredited waste handler and treater.	100% Compliant to RA 8749
	Cessation of employment and loss of business opportunities for locals.	Ensure capability training as part of employment benefits to help them become employable after life of project; Provide assistance in job seeking; Prepare the communities through capability building and assistance in the development of alternative sustainable livelihood; and Implement satisfactory retrenchment package.	100% compliant to DOLE Labor Code
	Accidents due to collapse of riverbanks or damage to gabions or FCs	Provision of engineering mitigation measures to portions of riverbanks when necessary (in coordination with DPWH); Project site will be inspected by concerned government agencies & LGUs before Proponent turns over the site to the LGU.	100% compliance to DPWH guidelines and to Approved Dredging Plan

SECTION 1. PROJECT DESCRIPTION

INTRODUCTION

The proposed Busuanga River Dredging Project is located in barangays Adela and San Pedro, Municipality of Rizal and barangays San Agustin and Central, both in Occidental Mindoro. It is to be implemented by the Joint Venture of Royal Crown--Groundport and Partners Corporation (RC-GPC) in coordination with the Provincial Government and the Department of Public Works and Highways, Region IVB.

According to the MIMAROPA Regional Development Plan 2011-2016, the major hotspot areas in the region in terms of flooding hazard are the provinces of Occidental Mindoro, Oriental Mindoro, and Marinduque, which includes the municipalities of Rizal and San Jose where the Busuanga River is located. Based on a study prepared by JICA on Nationwide Flood Risk Assessment and the Flood Mitigation Plan in the country, the Magbando River Basin where the Busuanga River flows, approximately 18 square kilometers of land area were inundated with 1.5 meters of flooding, which may affect the 44,000 individuals residing in the area.

Busuanga River is one of the major drainage systems supplying water for drinking and irrigation for the residents of the municipalities of Rizal and San Jose, Province of Occidental Mindoro. The area is beset by perennial flooding leading to heavy damages to the surrounding agricultural areas and built-up areas. As such, human intervention through flood control measures is a must. This continuing issue has set in motion the coordinated efforts and mandates of the Provincial Government of Occidental Mindoro, Department of Public Works and Highways (DPWH), Department of Environment and Natural Resources (DENR) (including the Mines and Geosciences Bureau), Department of Interior and Local Government (DILG), and Department of Transportation (DOTr) in accordance with the provisions of DAO-2020-12 and in relation with their Joint Memorandum Circular (JMC) No. 1, Series of 2019. River dredging was identified as a safety measure that can reduce water levels in flooding events. With the involvement of the MGB, it determined strategic zones as River Dredging Zones (RDZs), wherein dredging shall be conducted to help alleviate flood hazards for exposed communities. In MGB 4B's report entitled "Field Assessment Report on the Identified River Dredging Zones in Occidental Mindoro", the lower reaches of Busuanga River was among the delineated River Dredging Zones (RDZs). This RDZ was then awarded to the JV of RC-GPC as the private partner for a collaborative flood control through dredging project.

The proposed dredging project is aimed to increase the capacity of discharge flowing and to minimize amount of silt accumulated in the river stretch and river mouth of Busuanga River in order to improve alleviate the flooding within the basin.

Similar to other municipalities in the province, the economy of the municipalities of Rizal and San Jose are largely dependent on agriculture. Such dependence is constantly besieged with several issues especially the decreasing farm output brought about by increased siltation, erosion of fertile soil and flooding. When the river sediments are deposited to adjacent agricultural areas the soil fertility is adversely affected. Most importantly, flooding directly poses risks to property, livelihood and lives.

The Joint Venture of Royal Crown--Groundport and Partners Corporation is a consortium of various companies. It is a professional construction, dredging and construction/dredging management company. The partners are: Royal Crown Monarch Construction and Supplies Corp.; Groundport Inc.; Tarlac 3G Construction and Development Corp; St. Gerrard Construction Gen. Contractor and Development Corp.; and MMMD Phil Resources and Development Corp. The more relevant projects that they have individually engaged in is the contracting of government infrastructure projects as well as commercial construction projects. The JV consortium was purposely and specifically built to help governments create solutions for complex engineering and dredging scenarios. It works by creating a solution to dredge and rehabilitate the river and properly utilize the dredged materials for the benefit of the partner province and the organization itself. **Annex 1-A** shows the Securities and Exchange Commission (SEC) registration of the organization.

Flood control is part of the government's responsibilities. With the issuance of the DPWH Department Order 139, the Government provides guidelines for private sector participation in the delivery of flood control services, similar to the principle of harnessing private sector participation in the provision and operation of important basic services such as water, road infrastructures, and telecommunications. The Provincial Government has the power to vet interested private companies that are applying as the Dredging Contractor. The DPWH has the mandate to establish exclusive River Dredging Zones with the recommendation of the Provincial Government thru its Provincial Government Environment and Natural Resources Office (PGENRO) and MGB. It shall also be the one to issue the Dredging Clearance to the Proponent/qualified person who will conduct dredging with commercial utilization.

The means of the Private Sector partner (RC-GPC) to continue the operation and assist in the sustained provision of flood control services is cost recovery through the commercial disposition of the dredged materials, following applicable government guidelines.

1.1 PROJECT LOCATION AND AREA

1.1.1 Map Showing Sitio, Barangay, Municipality, Province, Region Boundaries, Vicinity, Proposed Buffers Surrounding the Area and Primary & Secondary Impact Areas

1.1.1.1 Location

The proposed project is located along Busuanga River (**Figures 1-1** to **1-3**).

The Busuanga River Dredging Project is located in the island of Occidental Mindoro. The project area is located between the municipalities of Rizal (Barangays Adela and San Pedro) and San Jose (Barangays San Agustin and Central), Occidental Mindoro. The river basically acts as a boundary for both municipalities. The two municipalities are connected by the Busuanga Bridge. No sensitive ecosystems may be affected or likely to be affected by the dredging operations because the areas considered to be critical are distant from the Project site. The focus of the project is river restoration through dredging within the delineated limits of the RDZ plus the navigation zone to allow passage of the dredging vessel.

The Busuanga RDZ displays heavy siltation that hampers free flow of surface water, thus, necessitating extraction of the surplus sediments. Water depths vary between 0.1 and 8 meters, revealing a nearly level lowland gradient with ongoing sediment accumulation. Dredging these alluvial sediments offers alleviation of inundation in adjacent/ nearby agricultural lands.

The survey area is located in the southern part of Mindoro Occidental, which is geographically situated between 12°25' N and 120°59' E. It is bounded in the north by the municipality of Calintaan in Occidental Mindoro; to the east by the municipalities of Bulalacao and Mansalay in Oriental Mindoro; to the south by the municipality of Magsaysay in Occidental Mindoro, and to the west by the Mindoro Strait.

Occidental Mindoro occupies the western section of Mindoro Island, including outlying islands in the northwest, located in northwestern most part of Region IV-B or MIMAROPA directly south of Region IV-A. General land surface features in the province are mountains, rivers, hills, valleys, wide plains and some small freshwater lakes. The high mountains can be found along the provincial boundary with Oriental Mindoro. Mountain ranges converge on the two central peaks, Mt. Halcon in the north and Mt. Baco in the south. The northern part of the province has relatively fewer plains, while the southern parts have wider flatlands. Most of the plains are cultivated fields, with few remaining untouched forests. Significant hilly areas that are mostly grassed over are in Santa Cruz in the north, and in San Jose and Magsaysay in the south.

The following maps illustrate the project location in relation to regional, provincial, municipal and barangay boundaries. (**Figures 1-4** to **1-6**). **Figure 1-7** is the vicinity map showing nearest houses and other landmarks in the area.

1.1.1.2 Project Area vis-à-vis the Dredging Basin and Buffer Zone

Project Area
The entire Project Area is composed of the onshore and offshore areas. It is located in the lower reaches of Busuanga River approximately 1.95 km downstream of Busuanga Bridge to the river mouth encompassing 10.55 line km of river channel covering **538.29 hectares** plus the navigation zone fronting the river dredging zone covering **70.82 hectares** for a total of **609.11 hectares**.

Project Area (onshore)	538.29
Project Area (offshore) Navigation Zone	70.82
TOTAL PROJECT AREA	**609.11**

Inside the project area are the river dredging zone, navigation channel and buffer zone as discussed below.

River Dredging Basin
The dredging basin is inside the project area in the middle portion of the river channel from:

Section 1 Main Channel:	Sta 1+050 to Sta 9+000	(7.95 line km)
Section 2 Branch:	Sta 0+950 to Sta 3+550	(2.60 line km)
		10.55 line km

It has a total area of **175.69 hectares**.

Navigation Channel
In accordance with the DAO 2020-12, Section 4: Prescribed Dredging Method, all dredging activities shall be initially conducted at the deltas of heavily-silted river channels for a period of six (6) months. This is aimed to restore the natural state and flow of the river with consideration of the constant sand replenishment and to create navigational channels and providing more depth for the passage of dredging vessel/s that will implement flood control measures into the delineated River Dredging Zone (RDZ). Dredged materials in this portion shall likewise be available for commercial disposition.

The clearing of the passage starting from the river delta is the first phase of the proposed project. This extends the deltas allowing access of the large Cutter Suction Dredger. Furthermore, dredging the opening of the river mouth and delta will accommodate the natural transport of sediments from upstream and ultimately drain to the sea without obstructions.

As shown in **Figure 1-3**, this starts from the shoreline going seaward with an area of **70.82 ha.** It shall encompass the two river mouths of Busuanga River.

Buffer Zone
This is the easement from the river dredging zone to the edge of the project area and/or the river regime.

The proposed navigation zone (delta dredging zone), river dredging basin and the buffer zones surrounding the project area are presented in **Figure 1-7**.

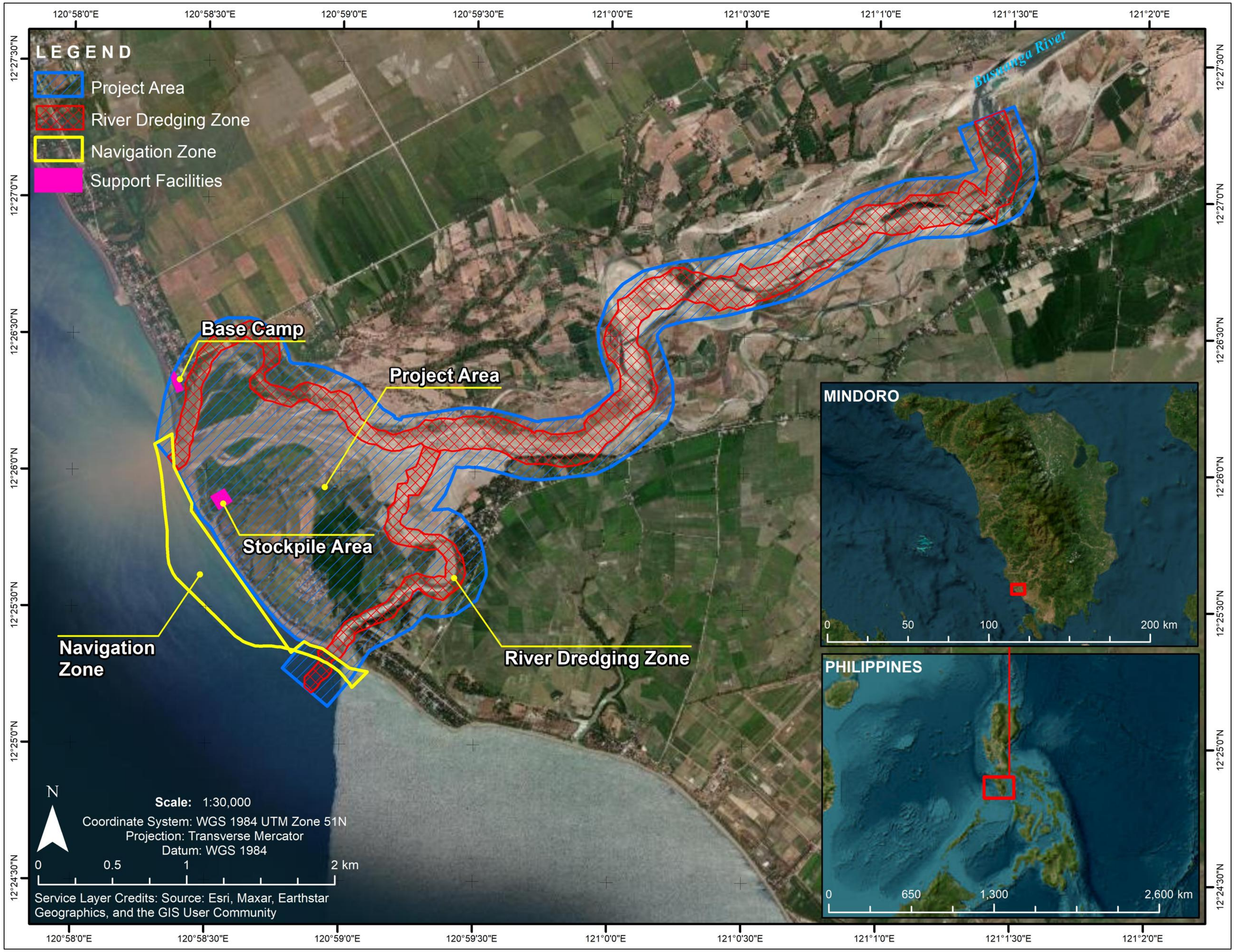


Figure 1-1. Busuanga River Dredging Project Location Map on Google Earth Image

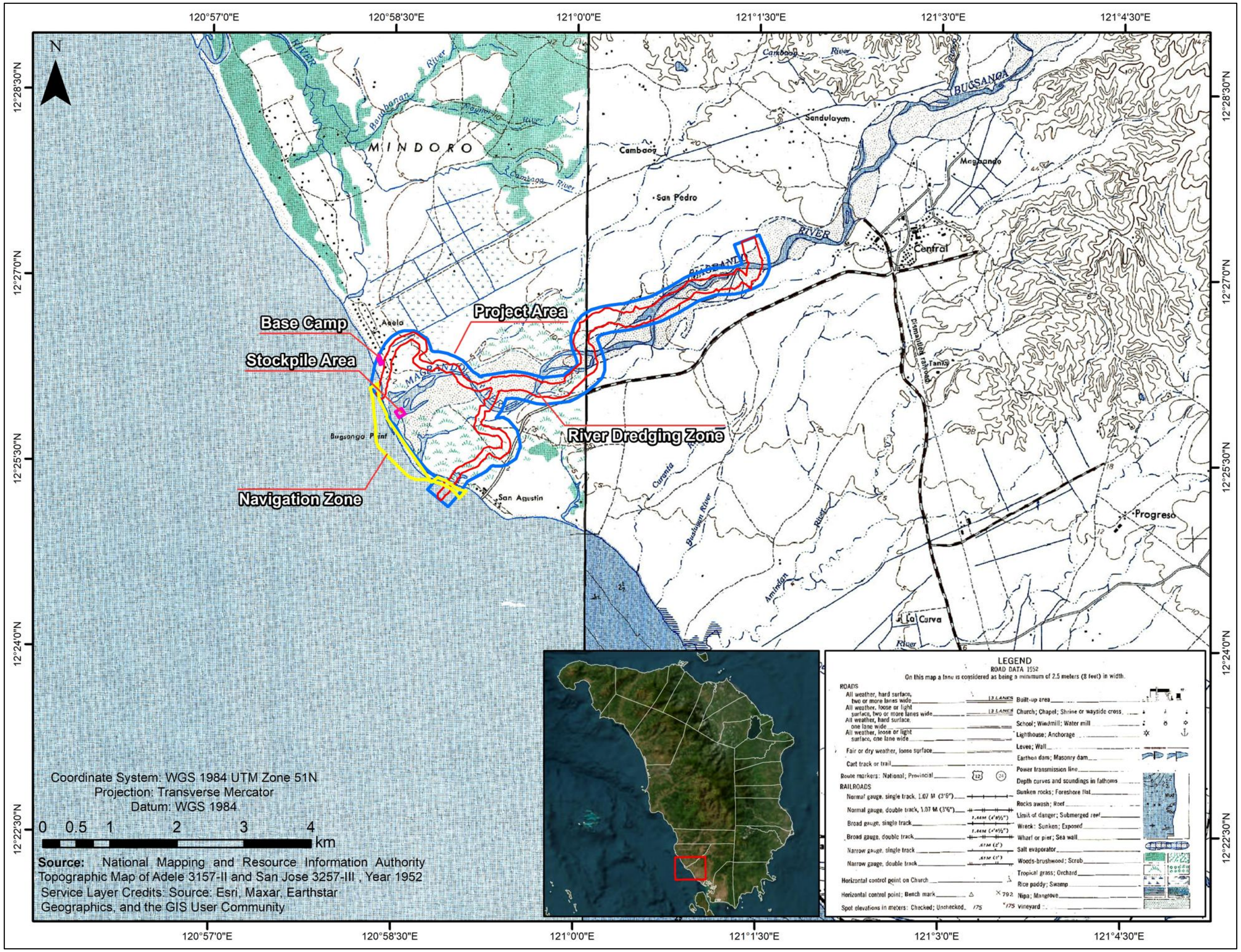
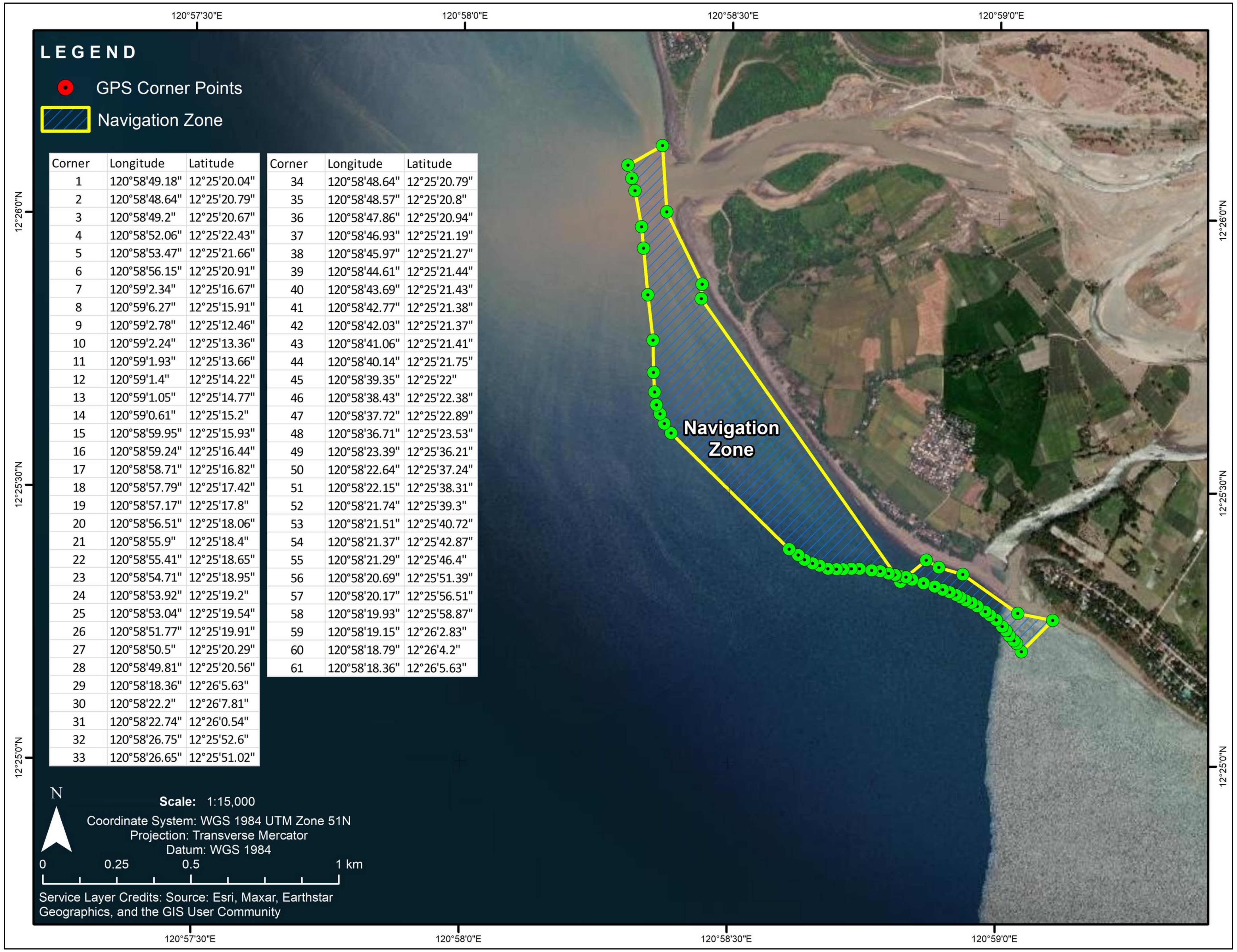


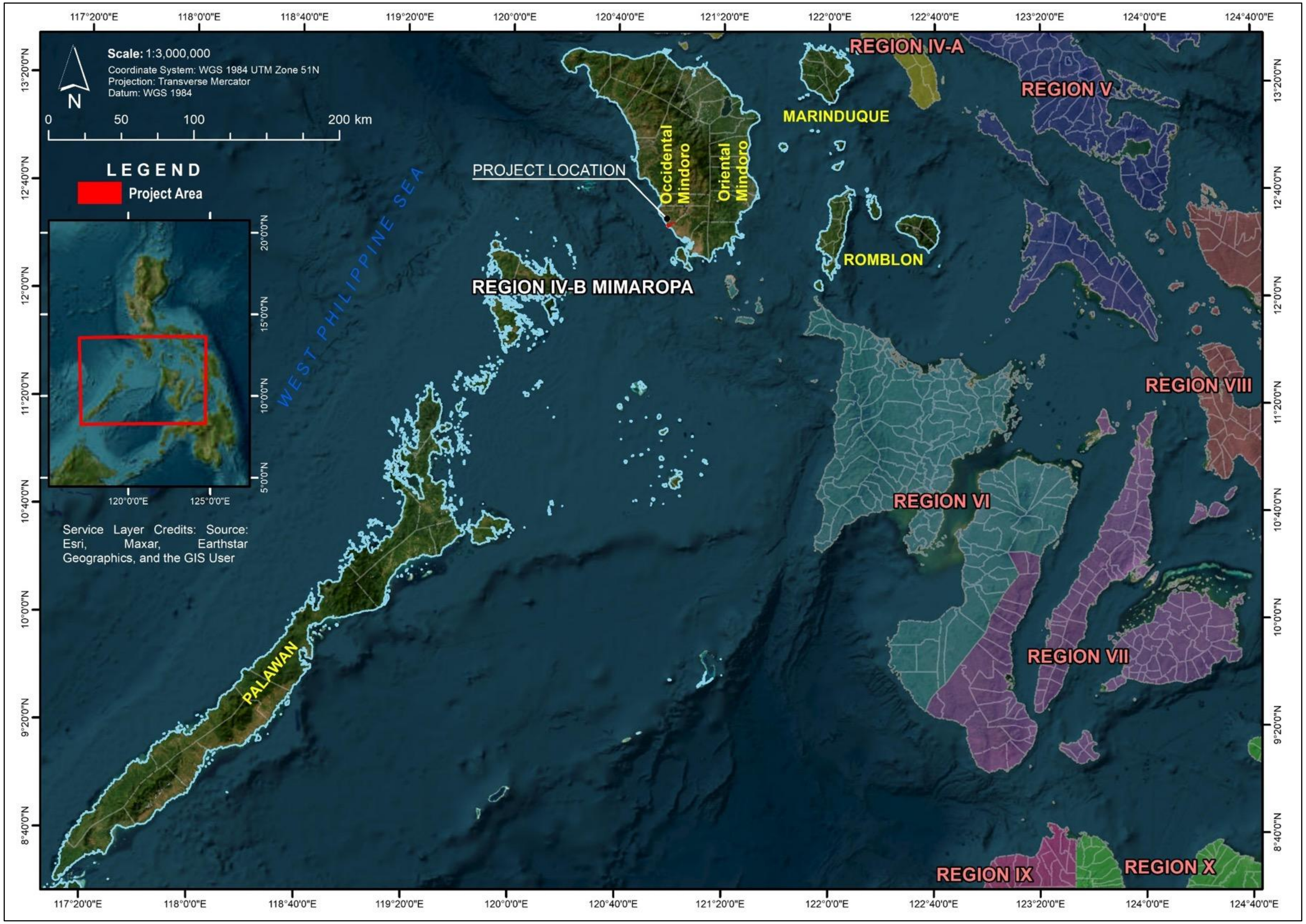
Figure 1-2. Busuanga River Dredging Project Location Map on NAMRIA Basemap



Corner	Longitude	Latitude
1	120°58'49.18"	12°25'20.04"
2	120°58'48.64"	12°25'20.79"
3	120°58'49.2"	12°25'20.67"
4	120°58'52.06"	12°25'22.43"
5	120°58'53.47"	12°25'21.66"
6	120°58'56.15"	12°25'20.91"
7	120°59'2.34"	12°25'16.67"
8	120°59'6.27"	12°25'15.91"
9	120°59'2.78"	12°25'12.46"
10	120°59'2.24"	12°25'13.36"
11	120°59'1.93"	12°25'13.66"
12	120°59'1.4"	12°25'14.22"
13	120°59'1.05"	12°25'14.77"
14	120°59'0.61"	12°25'15.2"
15	120°58'59.95"	12°25'15.93"
16	120°58'59.24"	12°25'16.44"
17	120°58'58.71"	12°25'16.82"
18	120°58'57.79"	12°25'17.42"
19	120°58'57.17"	12°25'17.8"
20	120°58'56.51"	12°25'18.06"
21	120°58'55.9"	12°25'18.4"
22	120°58'55.41"	12°25'18.65"
23	120°58'54.71"	12°25'18.95"
24	120°58'53.92"	12°25'19.2"
25	120°58'53.04"	12°25'19.54"
26	120°58'51.77"	12°25'19.91"
27	120°58'50.5"	12°25'20.29"
28	120°58'49.81"	12°25'20.56"
29	120°58'18.36"	12°26'5.63"
30	120°58'22.2"	12°26'7.81"
31	120°58'22.74"	12°26'0.54"
32	120°58'26.75"	12°25'52.6"
33	120°58'26.65"	12°25'51.02"

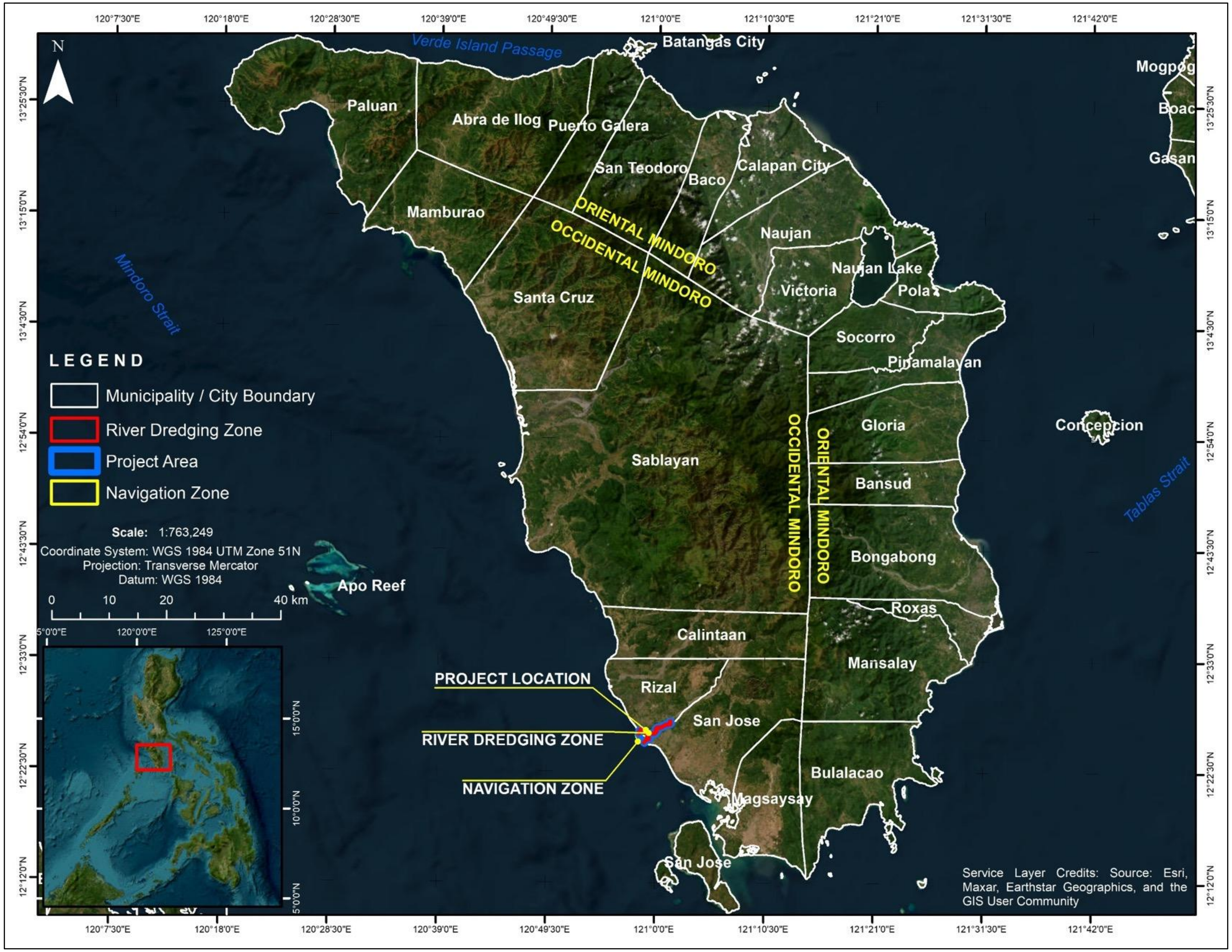
Corner	Longitude	Latitude
34	120°58'48.64"	12°25'20.79"
35	120°58'48.57"	12°25'20.8"
36	120°58'47.86"	12°25'20.94"
37	120°58'46.93"	12°25'21.19"
38	120°58'45.97"	12°25'21.27"
39	120°58'44.61"	12°25'21.44"
40	120°58'43.69"	12°25'21.43"
41	120°58'42.77"	12°25'21.38"
42	120°58'42.03"	12°25'21.37"
43	120°58'41.06"	12°25'21.41"
44	120°58'40.14"	12°25'21.75"
45	120°58'39.35"	12°25'22"
46	120°58'38.43"	12°25'22.38"
47	120°58'37.72"	12°25'22.89"
48	120°58'36.71"	12°25'23.53"
49	120°58'23.39"	12°25'36.21"
50	120°58'22.64"	12°25'37.24"
51	120°58'22.15"	12°25'38.31"
52	120°58'21.74"	12°25'39.3"
53	120°58'21.51"	12°25'40.72"
54	120°58'21.37"	12°25'42.87"
55	120°58'21.29"	12°25'46.4"
56	120°58'20.69"	12°25'51.39"
57	120°58'20.17"	12°25'56.51"
58	120°58'19.93"	12°25'58.87"
59	120°58'19.15"	12°26'2.83"
60	120°58'18.79"	12°26'4.2"
61	120°58'18.36"	12°26'5.63"

Figure 1-3. Busuanga River Dredging Project Location Map of Proposed Navigation Zone



Source: PSA

Figure 1-4. Project Location Map Showing Regional and Provincial Boundaries



Source: PSA

Figure 1-5. Project Location Map Showing Municipal Boundaries

Figure 1-6. Project Location Map Showing Barangay Boundaries

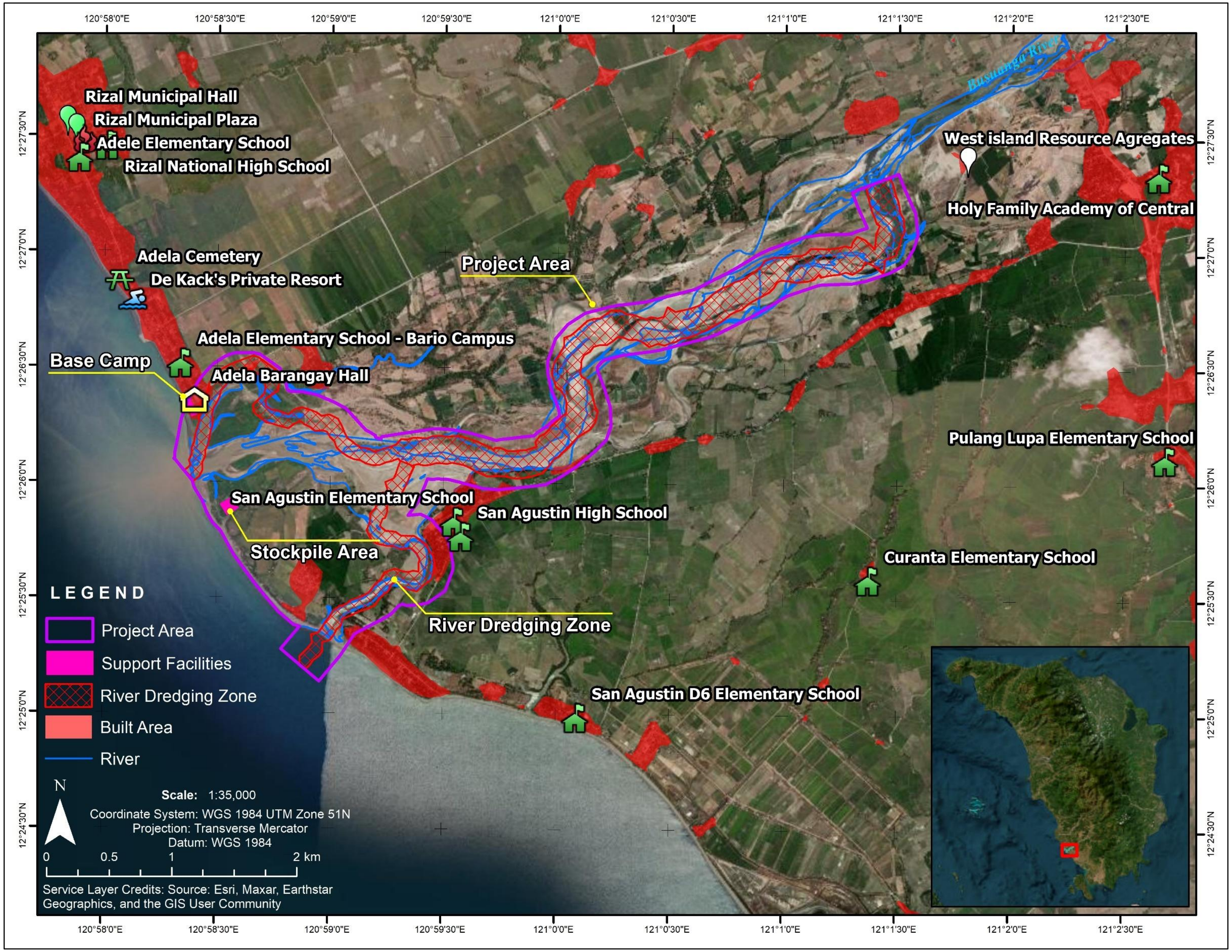


Figure 1-7. Vicinity Map of Project Area

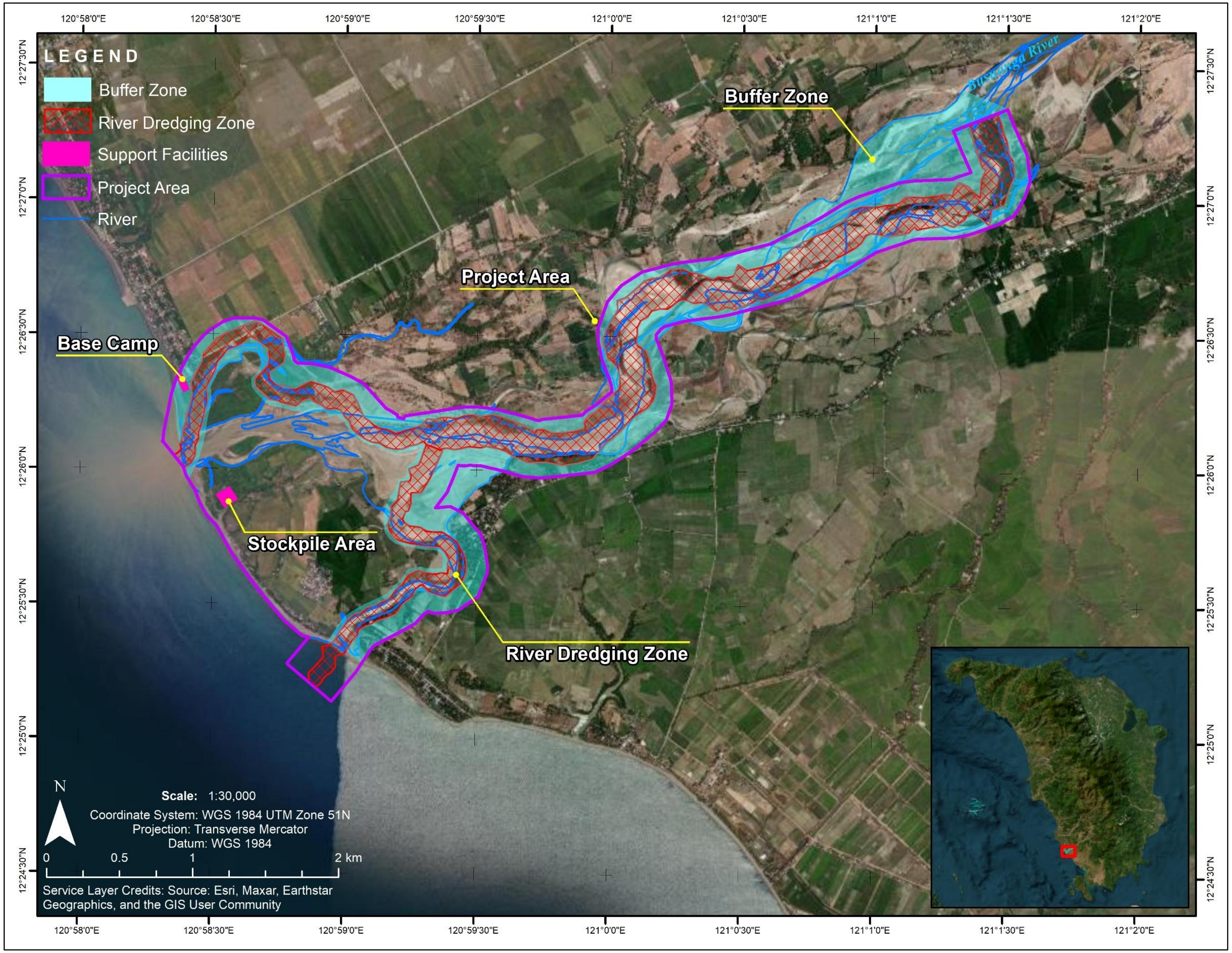


Figure 1-8. Location Map Showing Project Area, River Dredging Basin, Support Facilities and Buffer Zones

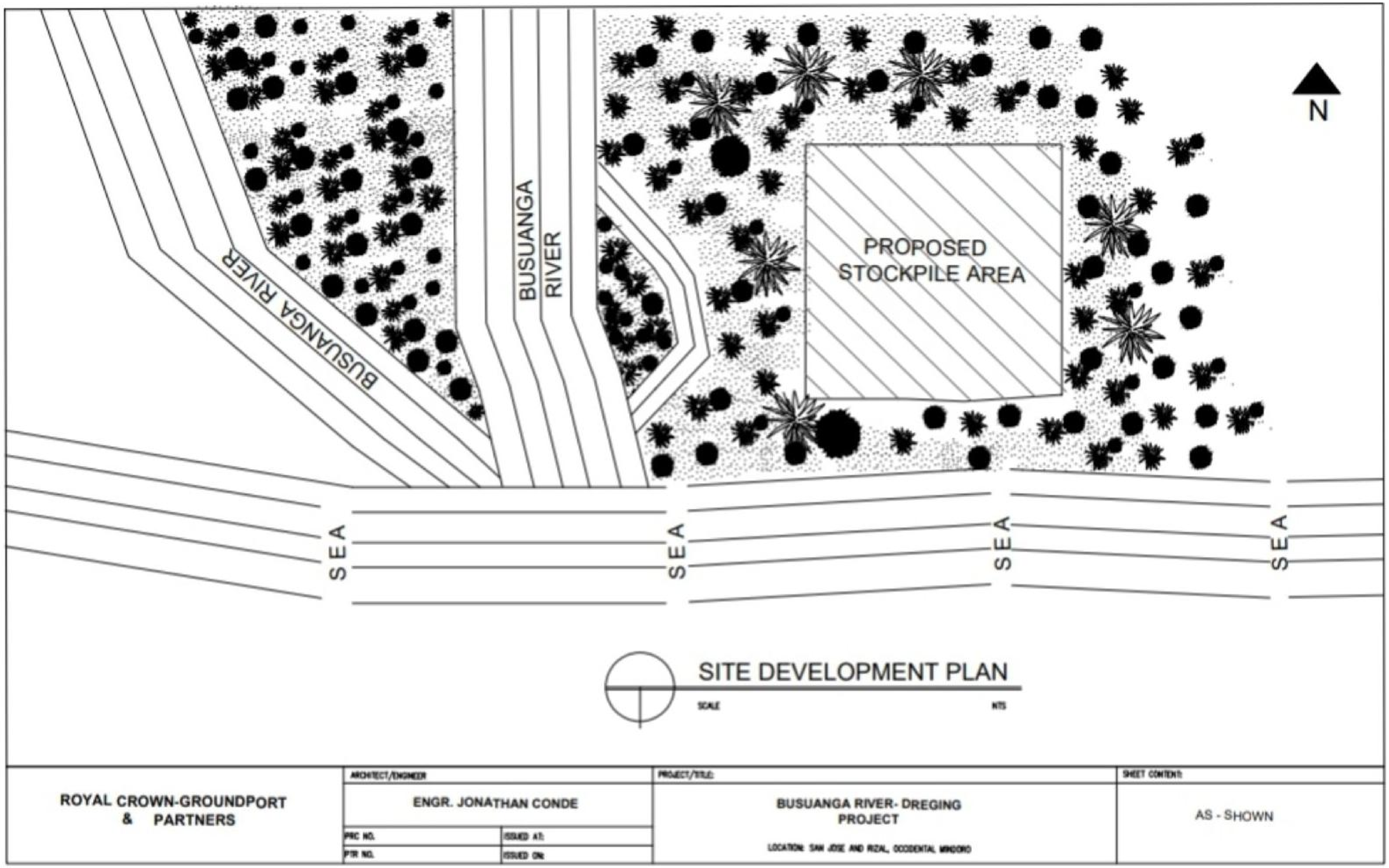


*Figure 1-9.	Indicative Site Development Plan of Support Facilities*

1.1.1.3 Primary and Secondary Impact Areas

The primary project impact areas for land and water are: the project area (onshore), which is the 538.29-ha area downstream of the bridge to the river mouth of Busuanga River defined by coordinates in **Table 1-1** within barangays Adela and San Pedro, Rizal and barangays San Agustin and Central, San Jose; the 70.82 ha area of the river delta for navigation zone; and the 1.5 ha area for stockpile and camp, office and other support facilities. These areas will be the primary receptor of changes due to Project activities. (**Figures 1-10** and **1-11**) In addition, primary impact areas for water is considered for the following: where water quality is projected to be affected or where considerable turbidity from dredging operations would occur (coastal waters up to 500m from shore and from edge of navigation zone); and where streamflow and sediment transport would likely be affected (Sta 9+000 of channel up to 3km upstream of Busuanga River). See **Figure 1-11**. In terms of the People Sector, the primary impact area includes the residents within the floodplains in immediate vicinity of the 4 barangays mentioned above as they will be the primary beneficiaries of the SDP and the first priority in local hiring. Also to be directly impacted are the local sustenance fisherfolks, nearby residential areas, farmers of the adjacent rice fields/agricultural areas, and other users of river water as they will be affected in any changes in freshwater quality and/or quantity. The productivity of sustenance fishing will likely be affected as the fish population in the area adapts to the physical and ecological alterations of the river. Likewise, changes in turbidity of river water may temporarily affect the fertility of the rice fields in case of spill overs, which is usually the normal case in the area. (**Figure 1-12**)

On the other hand, the secondary impact areas for land include the Busuanga River floodplains farther from the project area in barangays Adela and San Pedro, Municipality of Rizal and barangays San Agustin and Central, Municipality of San Jose. These areas will eventually experience reduction in the frequency, extent and depth of flooding over time, as the Project effectively de-clogs the highly-choked alluvial channels of Busuanga River and the flood drainage of the river will gradually improve. The impacts in these areas are considered secondary as these will only manifest after sufficient river sediments have been dredged and effects of the flood management measure is perceptible (**Figure 1-10**).

The LGUs of Rizal and San Jose can be regarded as secondary impact area in terms of people, as they will be the recipient of taxes, royalties, and permit fees to be generated from the project. Ultimately, both municipalities and their residents shall benefit from the projects of the LGUs brought about by increased revenues. They may also benefit from either SDP or Corporate Social Responsibility programs of the proponent. (**Figure 1-12**)

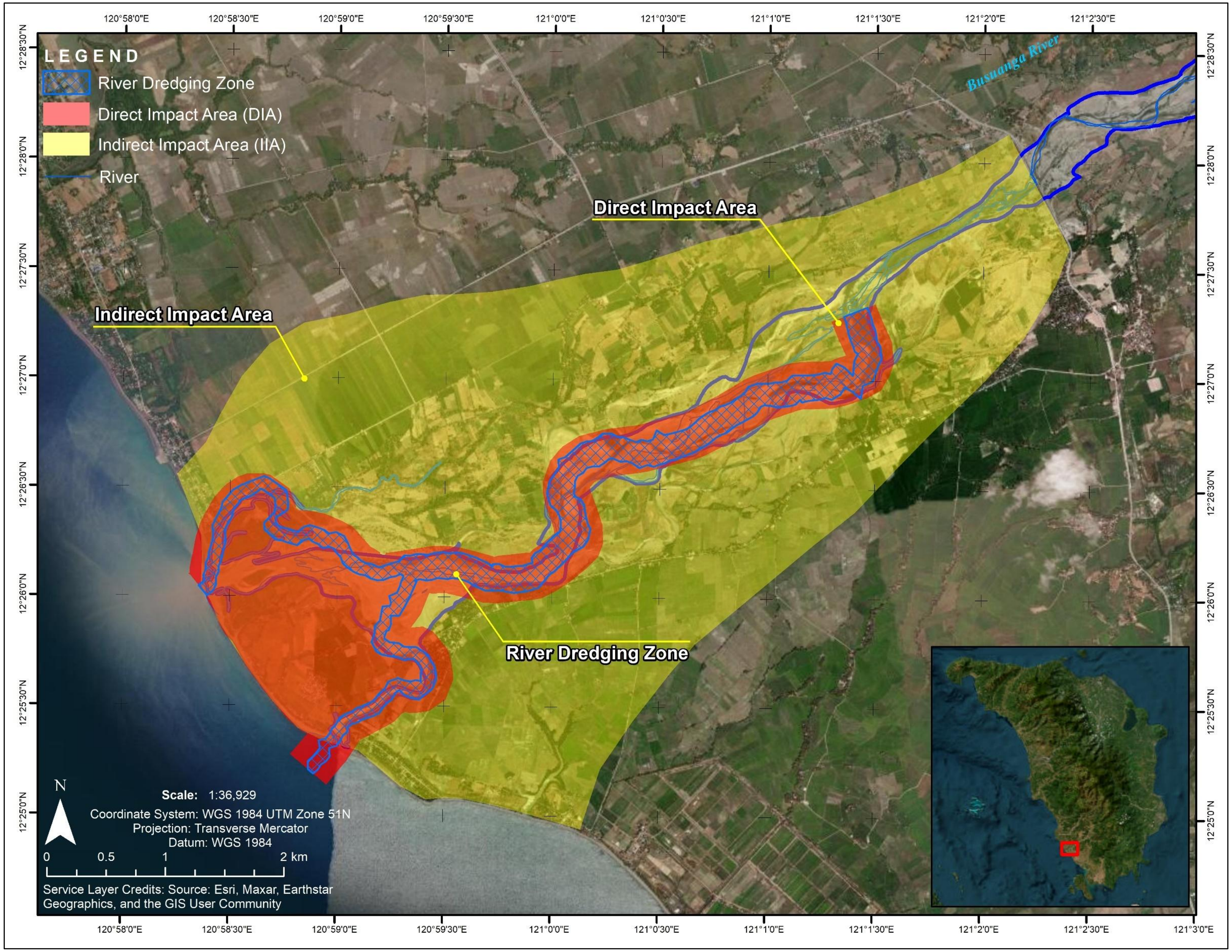


Figure 1-10. Map Showing Primary and Secondary Impact Areas – Land

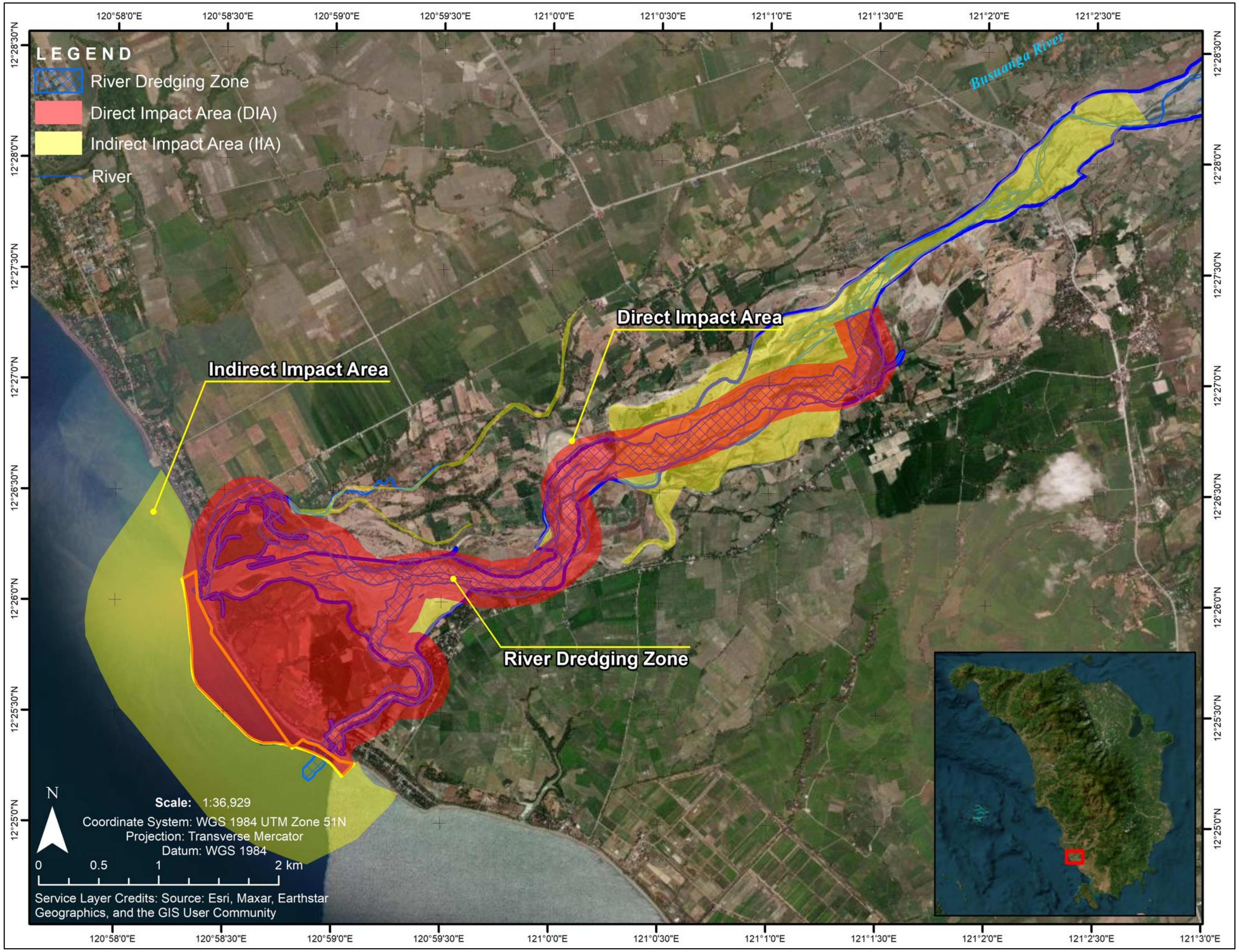


Figure 1-11. Map Showing Primary and Secondary Impact Areas – Water

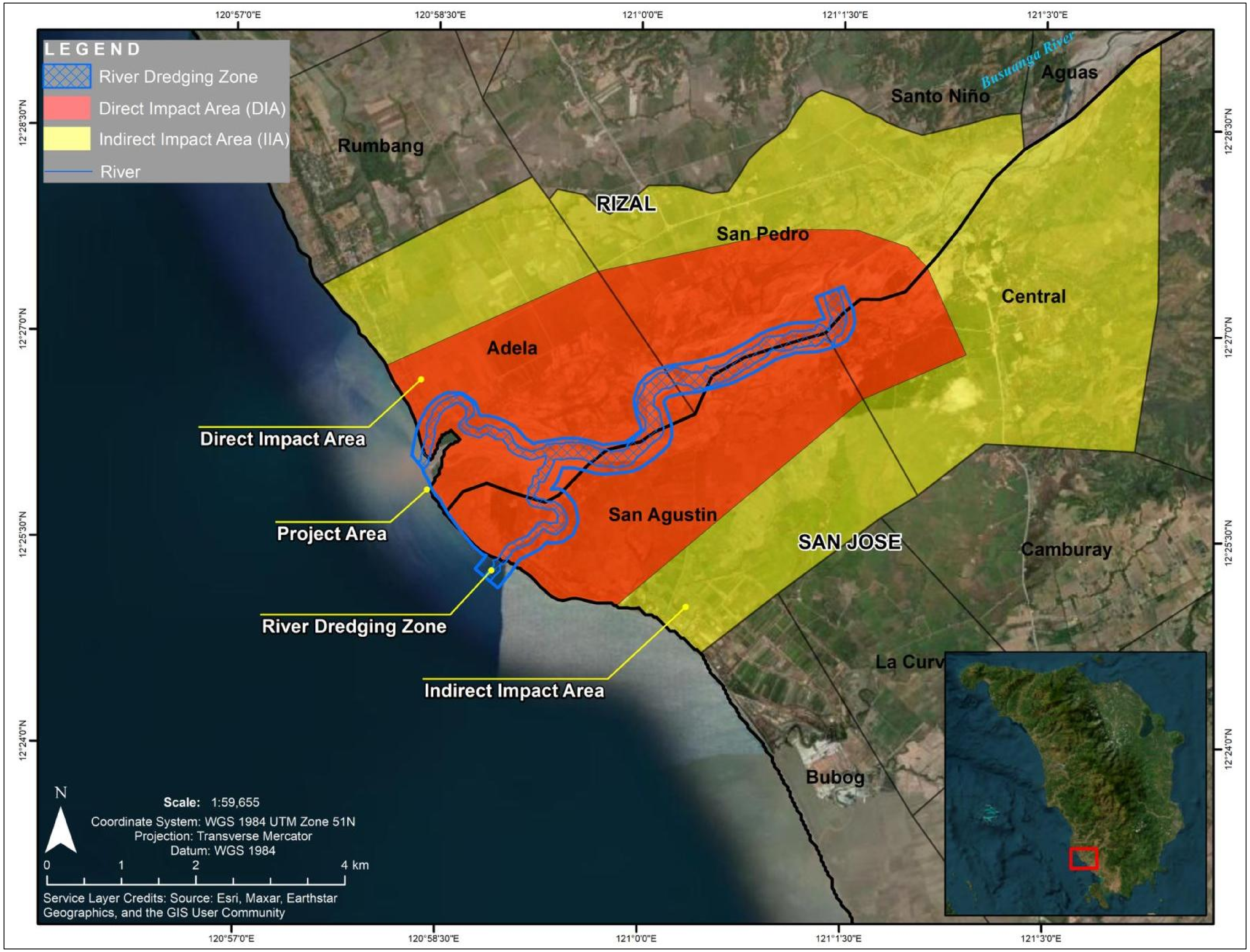


Figure 1-12. Map Showing Primary and Secondary Impact Areas – People

1.1.2 Geographic Coordinates

The project area boundaries as defined in accordance with the Dredging Master Plan (**Annex 1-B**) and the Detailed Engineering Studies (**Annex 2-A**), are confined within the following geographic coordinates.

Table 1-1. Geographical Coordinates of the Project Site (WGS 84)

Point	Longitude	Latitude	Point	Longitude	Latitude
ONSHORE – RIVER AREA			37	120°58'39.61"	12°26'33.51"
1	120°58'47.21"	12°25'16.57"	38	120°58'41.22"	12°26'33.13"
2	120°58'48.27"	12°25'17.82"	39	120°58'46.50"	12°26'29.49"
3	120°58'49.33"	12°25'19.07"	40	120°58'48.12"	12°26'25.67"
4	120°58'50.39"	12°25'20.32"	41	120°58'48.44"	12°26'24.08"
5	120°58'51.45"	12°25'21.57"	42	120°58'49.15"	12°26'23.55"
6	120°58'52.19"	12°25'22.45"	43	120°58'49.91"	12°26'23.50"
7	120°58'50.49"	12°25'22.93"	44	120°58'50.81"	12°26'23.49"
8	120°58'46.40"	12°25'26.35"	45	120°58'52.46"	12°26'23.43"
9	120°58'40.81"	12°25'32.85"	46	120°58'56.39"	12°26'22.67"
10	120°58'34.72"	12°25'40.79"	47	120°58'57.92"	12°26'22.04"
11	120°58'31.03"	12°25'47.31"	48	120°58'59.44"	12°26'21.41"
12	120°58'28.91"	12°25'49.36"	49	120°59'00.97"	12°26'20.78"
13	120°58'27.28"	12°25'52.17"	50	120°59'04.10"	12°26'19.14"
14	120°58'26.13"	12°25'55.05"	51	120°59'05.96"	12°26'17.26"
15	120°58'24.01"	12°25'58.41"	52	120°59'07.07"	12°26'16.06"
16	120°58'23.45"	12°26'00.25"	53	120°59'08.18"	12°26'14.85"
17	120°58'18.88"	12°26'05.73"	54	120°59'09.13"	12°26'13.83"
18	120°58'18.63"	12°26'05.83"	55	120°59'09.28"	12°26'13.64"
19	120°58'18.63"	12°26'06.03"	56	120°59'10.54"	12°26'12.98"
20	120°58'18.80"	12°26'06.14"	57	120°59'11.95"	12°26'12.13"
21	120°58'18.87"	12°26'07.64"	58	120°59'12.00"	12°26'11.69"
22	120°58'19.23"	12°26'09.69"	59	120°59'13.36"	12°26'11.27"
23	120°58'19.57"	12°26'11.28"	60	120°59'13.63"	12°26'11.94"
24	120°58'19.90"	12°26'12.79"	61	120°59'15.27"	12°26'12.19"
25	120°58'20.13"	12°26'14.16"	62	120°59'16.91"	12°26'12.44"
26	120°58'20.51"	12°26'16.27"	63	120°59'18.54"	12°26'12.69"
27	120°58'21.17"	12°26'18.33"	64	120°59'20.15"	12°26'12.94"
28	120°58'21.82"	12°26'20.18"	65	120°59'21.78"	12°26'13.19"
29	120°58'22.89"	12°26'22.33"	66	120°59'23.41"	12°26'13.45"
30	120°58'23.67"	12°26'23.77"	67	120°59'25.05"	12°26'13.71"
31	120°58'24.68"	12°26'25.54"	68	120°59'26.79"	12°26'13.98"
32	120°58'25.61"	12°26'27.01"	69	120°59'29.62"	12°26'14.02"
33	120°58'27.86"	12°26'29.59"	70	120°59'31.27"	12°26'13.96"
34	120°58'29.10"	12°26'30.67"	71	120°59'34.12"	12°26'13.59"
35	120°58'32.10"	12°26'32.60"	72	120°59'35.74"	12°26'13.24"
36	120°58'34.51"	12°26'33.45"	73	120°59'37.35"	12°26'12.88"

Point	Longitude	Latitude
74	120°59'39.22"	12°26'12.41"
75	120°59'40.82"	12°26'11.99"
76	120°59'42.42"	12°26'11.57"
77	120°59'43.29"	12°26'11.26"
78	120°59'44.02"	12°26'11.15"
79	120°59'44.93"	12°26'11.42"
80	120°59'46.58"	12°26'11.59"
81	120°59'48.09"	12°26'11.74"
82	120°59'49.73"	12°26'11.93"
83	120°59'51.38"	12°26'12.13"
84	120°59'53.02"	12°26'12.32"
85	120°59'53.25"	12°26'12.32"
86	120°59'53.91"	12°26'12.40"
87	120°59'54.63"	12°26'13.21"
88	120°59'56.02"	12°26'14.10"
89	120°59'57.16"	12°26'14.84"
90	120°59'58.06"	12°26'15.59"
91	120°59'59.33"	12°26'16.63"
92	121°00'59.66"	12°26'17.67"
93	121°00'39.92"	12°26'19.11"
94	120°59'59.90"	12°26'20.66"
95	120°59'59.46"	12°26'21.75"
96	120°59'58.85"	12°26'23.26"
97	120°59'58.24"	12°26'24.78"
98	120°59'57.42"	12°26'28.58"
99	120°59'57.38"	12°26'30.21"
100	120°59'57.33"	12°26'31.84"
101	120°59'59.39"	12°26'37.71"
102	121°00'00.47"	12°26'38.95"
103	121°00'01.54"	12°26'40.19"
104	121°00'02.61"	12°26'41.43"
105	121°00'07.26"	12°26'44.41"
106	121°00'08.86"	12°26'44.83"
107	121°00'10.46"	12°26'45.25"
108	121°00'12.06"	12°26'45.68"
109	121°00'13.65"	12°26'46.10"
110	121°00'16.16"	12°26'46.56"
111	121°00'17.80"	12°26'46.77"
112	121°00'19.44"	12°26'46.97"
113	121°00'21.08"	12°26'47.18"
114	121°00'22.72"	12°26'47.39"
115	121°00'23.50"	12°26'47.51"

Point	Longitude	Latitude
116	121°00'25.10"	12°26'47.92"
117	121°00'26.70"	12°26'48.34"
118	121°00'28.30"	12°26'48.76"
119	121°00'29.90"	12°26'49.18"
120	121°00'31.50"	12°26'49.59"
121	121°00'33.10"	12°26'50.01"
122	121°00'34.70"	12°26'50.43"
123	121°00'36.30"	12°26'50.84"
124	121°00'36.50"	12°26'50.94"
125	121°00'37.97"	12°26'51.68"
126	121°00'39.44"	12°26'52.43"
127	121°00'40.91"	12°26'53.17"
128	121°00'42.38"	12°26'53.92"
129	121°00'43.85"	12°26'54.66"
130	121°00'45.33"	12°26'55.41"
131	121°00'46.34"	12°26'55.99"
132	121°00'47.75"	12°26'56.84"
133	121°00'49.17"	12°26'57.69"
134	121°00'50.58"	12°26'58.53"
135	121°00'51.99"	12°26'59.38"
136	121°00'53.40"	12°27'00.23"
137	121°00'56.19"	12°27'01.51"
138	121°00'57.75"	12°27'02.04"
139	121°00'59.32"	12°27'02.57"
140	121°001'0.88"	12°27'03.10"
141	121°01'2.45"	12°27'03.63"
142	121°01'04.01"	12°27'04.16"
143	121°010'5.68"	12°27'04.72"
144	121°01'09.11"	12°27'05.17"
145	121°01'10.76"	12°27'05.24"
146	121°01'12.42"	12°27'05.30"
147	121°01'14.07"	12°27'05.37"
148	121°01'15.72"	12°27'05.44"
149	121°01'17.05"	12°27'05.50"
150	121°01'17.38"	12°27'05.50"
151	121°01'18.61"	12°27'06.05"
152	121°01'20.17"	12°27'06.59"
153	121°01'21.71"	12°27'07.08"
154	121°01'21.02"	12°27'08.55"
155	121°01'20.33"	12°27'10.03"
156	121°01'19.64"	12°27'11.51"
157	121°01'18.86"	12°27'13.31"

Point	Longitude	Latitude
158	121°01'18.25"	12°27'14.82"
159	121°01'17.63"	12°27'16.33"
160	121°01'29.94"	12°27'21.15"
161	121°01'30.55"	12°27'19.64"
162	121°01'31.16"	12°27'18.13"
163	121°01'31.68"	12°27'16.94"
164	121°01'32.37"	12°27'15.46"
165	121°01'33.06"	12°27'13.98"
166	121°01'33.75"	12°27'12.50"
167	121°01'34.44"	12°27'11.02"
168	121°01'35.16"	12°27'05.27"
169	121°01'34.51"	12°27'03.19"
170	121°01'33.99"	12°27'01.64"
171	121°01'31.57"	12°26'57.51"
172	121°01'27.70"	12°26'55.40"
173	121°01'26.14"	12°26'54.86"
174	121°01'24.58"	12°26'54.32"
175	121°01'23.02"	12°26'53.77"
176	121°01'21.46"	12°26'53.23"
177	121°01'17.93"	12°26'52.50"
178	121°01'16.27"	12°26'52.43"
179	121°01'14.62"	12°26'52.37"
180	121°01'12.96"	12°26'52.30"
181	121°01'11.31"	12°26'52.23"
182	121°01'09.66"	12°26'52.17"
183	121°01'08.33"	12°26'51.86"
184	121°01'06.76"	12°26'51.33"
185	121°01'05.20"	12°26'50.80"
186	121°01'03.63"	12°26'50.27"
187	121°01'02.07"	12°26'49.74"
188	121°01'00.50"	12°26'49.21"
189	121°01'00.30"	12°26'49.12"
190	121°00'58.89"	12°26'48.27"
191	121°00'57.48"	12°26'47.42"
192	121°00'56.06"	12°26'46.58"
193	121°00'54.65"	12°26'45.73"
194	121°00'53.24"	12°26'44.88"
195	121°00'51.39"	12°26'43.84"
196	121°00'42.56"	12°26'39.37"
197	121°00'39.69"	12°26'38.26"
198	121°00'28.49"	12°26'35.35"
199	121°00'26.89"	12°26'34.93"

Point	Longitude	Latitude
200	121°00'24.42"	12°26'34.48"
201	121°00'17.85"	12°26'33.65"
202	121°00'17.10"	12°26'33.53"
203	121°00'15.50"	12°26'33.11"
204	121°00'12.30"	12°26'32.26"
205	121°00'11.63"	12°26'31.77"
206	121°00'10.56"	12°26'30.53"
207	121°00'10.54"	12°26'29.58"
208	121°00'11.16"	12°26'28.07"
209	121°00'12.52"	12°26'24.61"
210	121°00'13.02"	12°26'23.06"
211	121°00'13.52"	12°26'21.51"
212	121°00'14.02"	12°26'19.96"
213	121°00'14.24"	12°26'15.06"
214	121°00'12.94"	12°26'11.39"
215	121°00'10.36"	12°26'08.74"
216	121°00'09.09"	12°26'07.69"
217	121°00'06.55"	12°26'05.60"
218	121°00'04.90"	12°26'04.27"
219	121°00'03.28"	12°26'03.22"
220	121°00'01.90"	12°26'02.33"
221	121°00'00.51"	12°26'01.44"
222	120°59'0570"	12°25'59.74"
223	120°59'54.60"	12°25'59.40"
224	120°59'44.60"	12°25'58.31"
225	120°59'40.59"	12°25'58.58"
226	120°59'34.46"	12°26'00.18"
227	120°59'32.85"	12°26'00.54"
228	120°59'31.23"	12°26'00.89"
229	120°59'30.81"	12°26'00.95"
230	120°59'29.16"	12°26'01.01"
231	120°59'28.68"	12°26'01.10"
232	120°59'27.15"	12°26'00.86"
233	120°59'25.80"	12°26'01.03"
234	120°59'25.19"	12°25'59.52"
235	120°59'24.57"	12°25'58.01"
236	120°59'23.96"	12°25'56.50"
237	120°59'23.35"	12°25'54.99"
238	120°59'20.70"	12°25'51.49"
239	120°59'24.11"	12°25'51.81"
240	120°59'26.92"	12°25'50.45"
241	120°59'31.10"	12°25'45.64"

Point	Longitude	Latitude
242	120°59'31.60"	12°25'43.97"
243	120°59'32.06"	12°25'42.40"
244	120°59'32.69"	12°25'38.63"
245	120°59'32.63"	12°25'37.22"
246	120°59'30.58"	12°25'31.82"
247	120°59'26.06"	12°25'28.72"
248	120°59'23.66"	12°25'28.25"
249	120°59'20.53"	12°25'28.03"
250	120°59'19.30"	12°25'28.43"
251	120°59'18.88"	12°25'28.11"
252	120°59'18.35"	12°25'27.92"
253	120°59'16.31"	12°25'25.70"
254	120°59'13.99"	12°25'24.37"
255	120°59'08.22"	12°25'21.35"
256	120°59'06.76"	12°25'20.58"
257	120°59'05.85"	12°25'19.22"
258	120°59'02.97"	12°25'14.89"
259	120°59'01.62"	12°25'13.25"
260	120°58'57.38"	12°25'08.25"
261	120°58'47.21"	12°25'16.57"
OFFSHORE - NAVIGATION ZONE		
1	120°58'49.18"	12°25'20.04"
2	120°58'48.64"	12°25'20.79"
3	120°58'49.20"	12°25'20.67"
4	120°58'52.06"	12°25'22.43"
5	120°58'53.47"	12°25'21.66"
6	120°58'56.15"	12°25'20.91"
7	120°59'02.34"	12°25'16.67"
8	120°59'06.27"	12°25'15.91"
9	120°59'02.78"	12°25'12.46"
10	120°59'02.24"	12°25'13.36"
11	120°59'01.93"	12°25'13.66"
12	120°59'01.40"	12°25'14.22"
13	120°59'01.05"	12°25'14.77"
14	120°59'00.61"	12°25'15.20"
15	120°58'59.95"	12°25'15.93"
16	120°58'59.24"	12°25'16.44"
17	120°58'58.71"	12°25'16.82"
18	120°58'57.79"	12°25'17.42"
19	120°58'57.17"	12°25'17.80"
20	120°58'56.51"	12°25'18.06"

Point	Longitude	Latitude
21	120°58'55.90"	12°25'18.40"
22	120°58'55.41"	12°25'18.65"
23	120°58'54.71"	12°25'18.95"
24	120°58'53.92"	12°25'19.20"
25	120°58'53.04"	12°25'19.54"
26	120°58'51.77"	12°25'19.91"
27	120°58'50.50"	12°25'20.29"
28	120°58'49.81"	12°25'20.56"
29	120°58'18.36"	12°26'05.63"
30	120°58'22.20"	12°26'07.81"
31	120°58'22.74"	12°26'00.54"
32	120°58'26.75"	12°25'52.60"
33	120°58'26.65"	12°25'51.02"
34	120°58'48.64"	12°25'20.79"
35	120°58'48.57"	12°25'20.80"
36	120°58'47.86"	12°25'20.94"
37	120°58'46.93"	12°25'21.19"
38	120°58'45.97"	12°25'21.27"
39	120°58'44.61"	12°25'21.44"
40	120°58'43.69"	12°25'21.43"
41	120°58'42.77"	12°25'21.38"
42	120°58'42.03"	12°25'21.37"
43	120°58'41.06"	12°25'21.41"
44	120°58'40.14"	12°25'21.75"
45	120°58'39.35"	12°25'22.00"
46	120°58'38.43"	12°25'22.38"
47	120°58'37.72"	12°25'22.89"
48	120°58'36.71"	12°25'23.53"
49	120°58'23.39"	12°25'36.21"
50	120°58'22.64"	12°25'37.24"
51	120°58'22.15"	12°25'38.31"
52	120°58'21.74"	12°25'39.30"
53	120°58'21.51"	12°25'40.72"
54	120°58'21.37"	12°25'42.87"
55	120°58'21.29"	12°25'46.40"
56	120°58'20.69"	12°25'51.39"
57	120°58'20.17"	12°25'56.51"
58	120°58'19.93"	12°25'58.87"
59	120°58'19.15"	12°26'02.83"
60	120°58'18.79"	12°26'04.20"
61	120°58'18.36"	12°26'05.63"

The River Dredging Zone is divided into two sections: Section 1 Main Channel starts at Sta. 1+050 and ends at Sta. 9+000; Section 2 Branch starts at Sta. 0+950 and ends at Sta. 3+550, with a total of 10.55 km in length.

1.1.3 Description of the Vicinity and Accessibility of the Project Site

The immediate vicinity of the project site is generally sparsely inhabited except for a few house clusters/ built-up areas that are located very near the riverbanks. The nearest house clusters are two in Brgy. Adela, Rizal (adjacent to northern limits of project area near the coast and 140m east of the main channel RDZ), and three in Brgy. San Agustin, San Jose (2 are adjacent/SE of the RDZ branch and 1 is 150 to 250 to the north of the branch or inside the "island"). See **Figure 1-7**.

The nearest vital infrastructures are Busuanga Bridge (1.95 km) and the various (at least 6) flood-control structures (FCs) within the vicinity of the project area,

The nearest critical facilities are: Adela Brgy. Hall (57 m NW of RDZ) Adela Elementary School Barrio Campus (270m) and San Agustin Elem School (29m). Other critical facilities are in relatively safe distances from the project site such as: Rizal National Highschool (2.024 km N); Adela Elementary School (2.079 km N); Rizal Municipal Hall (2.285 km N), San Pedro Elem School (2.42 km N); Sto. Niño Elem School (1.39 km N); Holy Family (2 km E); Pulanglupa Elem School (2.6 km SE); and Curanta Elem School (2.35 km SE).

The land surrounding the proposed project area is mainly agricultural (**Figure 2.2.1-1**).

Accessibility
Occidental Mindoro lies 15 kilometers from the southwest coast of Luzon and is accessible by sea and air.

The Municipalities of Rizal and San Jose are accessible by sea from Batangas, Manila and Visayan Islands and by land from north and south sections of the province. Alternative routes may be through Batangas-Abra de Ilog-Rizal-San Jose and Batangas-Calapan City-San-Jose-Rizal.

San Jose can likewise be reached by air through private aircrafts or commercial flights from Manila, which are available from Sunday to Friday and travel time is around one hour.

The nearest existing major road (National Highway) to the proposed project site is the Mindoro West Coastal Road (MWCR). The site can be accessed through tertiary roads connecting to the main road. Furthermore, the San Jose Port is located about 15 km from the Project site. The land-based vehicles and equipment shall be stationed at the main camp.

For the sea- /water-based dredging activities, a dredging vessel will travel to the dredging site. It will conduct the needed dredging activities and extract the river sediments. A small barge shall carry/ship off the dredged materials to the mother vessel, which is anchored offshore.

1.2 DEVELOPMENT FRAMEWORK

1.2.1 Need for the Project at the National, Regional and Local Levels

The National Government, through the DENR and DPWH as lead agencies, has been continuing its efforts to address and help alleviate perennial flooding problems all over the country by means of its Flood Control Projects (FCPs) that include River Restoration thru Dredging. This seeks to protect and restore to their natural state and water flow the heavily silted river channels. The DENR is making it possible for LGUs to undertake dredging and river restoration projects without spending taxpayers' money thru DAO No. 2020-07. The private contractors shall cover all expenses of dredging operations in RDZs. The proposed project is in line with this thrust of the government from the national to the local levels.

In terms of flooding risk, the Province of Occidental Mindoro, which include the towns of Rizal and San Jose, where the Busuanga River is situated, are among the key hotspot locations in the region.

According to a JICA research on the nation's flood risk assessment and flood mitigation plan, approximately 18 square kilometers of land were flooded with a depth of 1.5 meters of water in the Magbando River Basin, where the Busuanga River runs. This will potentially harm the people who live there. The Busuanga River supplies water and irrigation for local residents who have agricultural needs in the towns of Rizal and San Jose.

The Busuanga River is reportedly flooded for an extended period of time, as is common during typhoons and the monsoon season. The deteriorating forest cover of watersheds, high erosion rates, heavy siltation, and narrow river sections resulting in bottlenecks in the downstream stretch of the river all contribute to the basin's flooding problem. Furthermore, the lands adjacent to the river are eroded, and tons of discharge sediments were poured into the river, causing it to become heavily silted. This situation has a significant impact on the residents' lives as well as the local and national economies. There are also islet formations in the middle of the river, which change the flow direction, causing continuous erosion along the riverbanks and a heavily-silted river. The mouth of the Busuanga River in San Jose and Rizal, Occidental Mindoro, has already been obstructed by numerous islets by about half.

Moreover, siltation in the river poses a threat to the safety of the inhabitants and the local economy. Given the area's steadily increasing population and the effects of climate change, it is crucial to take action to stop this threat and foster local economic growth and development.

The main objective of the Busuanga River Dredging Project is river restoration wherein the carrying capacity of the river shall be increased thereby preventing/mitigating inundation of excess runoff to the adjacent floodplains. The project will not only reduce the level of floodwaters in the Busuanga River, but it will also serve as a river training project, reducing the impact of floodwaters on existing riverbanks and structures.

Dredging can be beneficial to the environment because it will remove sediments, improving water quality and aid in the restoration of the health of aquatic ecosystems. The dredging of the Busuanga River ensures clear passage through its channel. In the current state of Busuanga River, dredging is deemed essential in maintaining the river's natural flow and reducing the risk of a disaster in the surrounding communities that experience recurring flooding during rainy seasons. Moreover, bank erosion can be lessened if the river flow is redirected to a deeper, more defined central channel, which is the pilot dredging zone.

This project can also help increase the hydraulic capacity of irrigation systems that rely on the Busuanga River for irrigation water supply, provide more depth for the passage and easy navigation of fishing boats, and remove contaminated sediments caused by anthropogenic activities in and around the vicinity.

The benefits to the National Government from this Project include saving of government funds intended for dredging activities for FCPs. The money saved can be used in other government projects such as infrastructure, and will therefore lead to further development.

More importantly, the repetitive damages caused by flooding shall be lessened leading to improved agricultural productivity The high government expenditures in disaster management, relief, rescue and infrastructure repair shall be lessened considerably, hence, can be used in other projects. With improved government infrastructure projects, the economic productivity will also improve and create more jobs and increase household income and ultimately reduce poverty. While this Project may not bring about immediate improvements, private sector participation in the delivery of basic services will enable the government to utilize its limited resources for other development purposes, while providing an important basic service which impacts on public safety, agricultural productivity, avoidance of losses to the economy from damage to infrastructure and private property due to regular flooding.

Furthermore, this Project can contribute to the sand and gravel supply chain, which will help reduce its soaring market price. The fast-paced infrastructure and commercial development across the country has raised the demand for aggregates.

1.2.2 Socioeconomic Benefits

This is primarily a Flood Mitigation Project and therefore, the flooding susceptibility in the area will lessen significantly after some time. This means there will be less damages to life and property. The government will spend less in repairing infrastructure and providing relief to the affected families, hence, they can realign their budget to developmental projects instead. Less flooding will also mean less siltation to agricultural lands, which suggests lesser degradation of soil fertility that would translate to increase in agricultural productivity/income.

If properly implemented, new projects and investments, especially in rural areas, have the potential to bring about socioeconomic development to the area. The proposed project will promote the welfare of its host communities from the barangay to the provincial levels, especially in terms of employment and livelihood.

With the tax revenues that the Provincial and Municipal LGUs will be receiving from the project, they can increase budget/spending on the delivery of basic services. This may also facilitate partial funding of developmental projects that will propel socioeconomic growth.

With the proposed project, there will be opportunities for employment, local business growth, increased government revenues (through local and national taxes and permitting fees), and Social Development Program to the host community. Brisk business opportunities for the local suppliers around the area will come during the construction and operation phases of the project.

The proposed project will generate additional jobs as it will require manpower during construction and operation phases. The proponent shall prioritize the hiring of qualified residents of the host barangays and perhaps other nearby barangays. Any gender shall be welcome in applying for these positions, as the management will not be prejudiced against certain gender and sexuality. Indigenous People near the cited municipalities can also apply as long as they have the needed skills/expertise for the job. In turn, the increase in employment opportunities will translate to increased buying capacity of the local workers, which will eventually promote down-the-line benefits in terms of increased sales or opportunities for local businesses.

The economic structure in the municipality is divided into two sectors, the industrial sector, and the agricultural sector, where they are engaged in aquaculture and small farming. Busuanga River is known to be a source of water supply for irrigation system. If the dredging operation is pushed through, there will be more water supply for the citizen’s farms and thus, their income from will increase.

Moreover, a smooth and fast-moving river can serve as an alternative mode of transportation, increasing commerce and easing the movement of goods and services between and among localities, in addition to ensuring the safety of the lives of the residents in the area. Furthermore, tourism programs can be developed along the river's stretch when it is already clean and suitable for developing a variety of activities.

1.3 ALTERNATIVES

Dredging is a beneficial process that can be applied to the environment as it will remove and de-clog or clear sediments thereby improving water quality and flow and aid in the restoration of the health of aquatic ecosystems/river ecology. The dredging and desilting of Busuanga River will improve the drainage of rainwater and upland water sources, minimizing flood damages thereby improving the quality of life, capacity and flow in the surrounding communities of the river. With this, no alternative was considered since the selected dredging approach is in immediate need for mitigation and environmental enhancement to address the flooding problem.

The probable impacts during operation of the dredging and desilting project includes possible generation of noise from equipment and employees during operating hours, oil leaks from vessels or equipment, minimal emissions and sediment plumes, Nevertheless these can be minimized by applying proper mitigation and continuous monitoring all though out the dredging operation.

For technology and design, RC-GPC shall use a Cutter Suction Dredger for the deeper portions of the river delta. On the inner sections of the river, a conventional mechanical dredging using backhoes/excavators in tandem with dump trucks will be used.

1.3.1 Site Selection

The need for dredging as a flood mitigating measure is the primary concern in site selection. The other parameters considered in the selection of the site include: presence of economically-viable aggregate deposits; land use and classification; low population density; accessibility by land and sea; social acceptability; and manageability of potential environmental impacts.

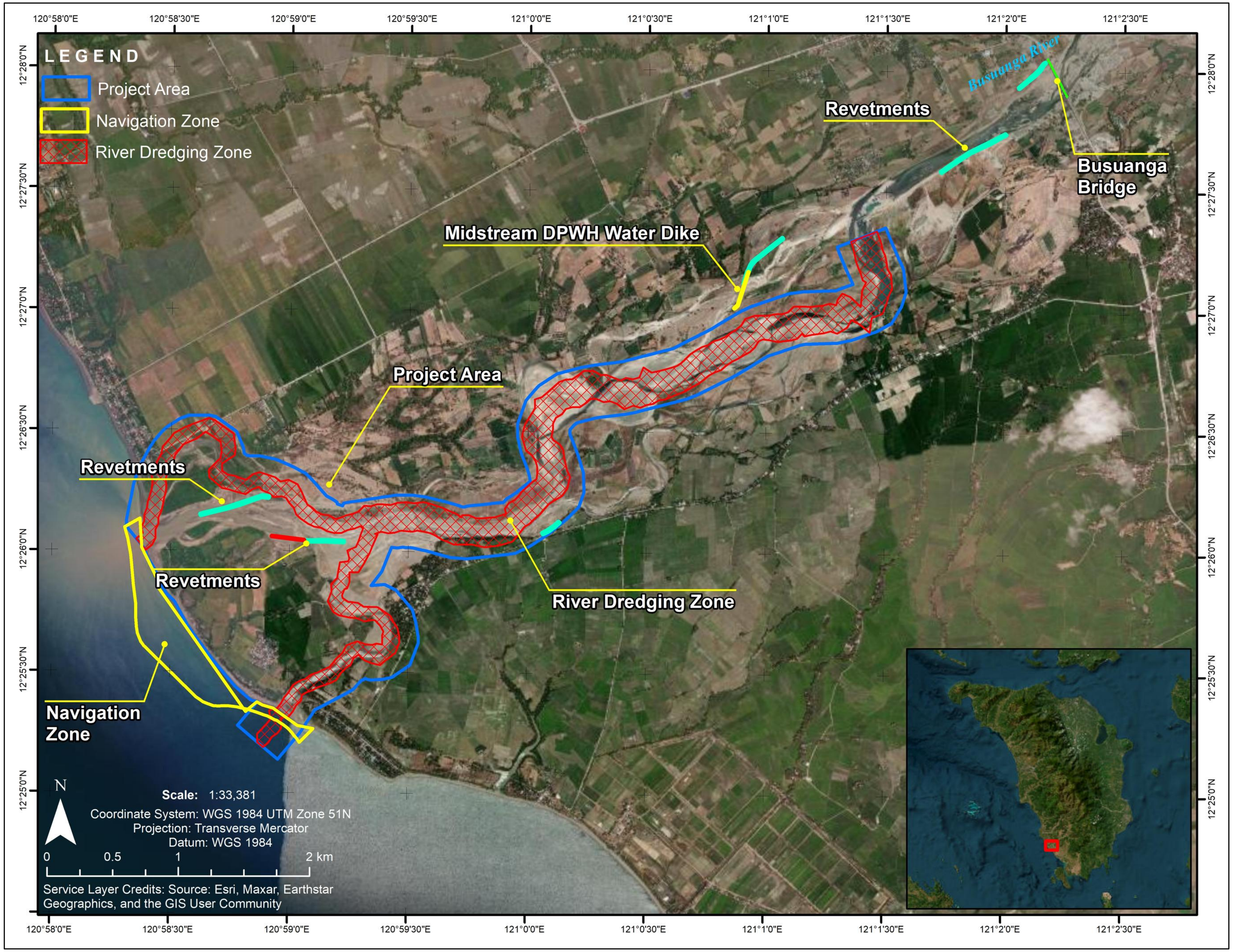
The IAC has previously worked on the delineation of RDZs in Occidental Mindoro. The whole stretch of Busuanga River was among the recommended areas of MGB 4B for river dredging zones as described in its assessment report entitled “Field Assessment Report on the Identified River Dredging Zones in Occidental Mindoro” (See **Figure 1-16**). In turn, the DPWH delineated the exact limits of the dredging zone based on the hydrological and engineering studies conducted. Based on the results of this study, the Dredging Master Plan (DMP) was crafted and subsequently approved. The dredging operations of the selected private partner is strictly limited within the bounds of the DMP.

The delineated RDZs were then opened to the public for application as partners/dredging operators. RC-GPC submitted a dredging proposal for the Busuanga RDZ and consequently approved. Aside from various parameters considered in selecting the site, it is noted that there is a multitude of other interested parties and it is the sole discretion of the Provincial Government to select which contractor is to be awarded a specific RDZ.

1.3.2 Technology and Design

The IAC on River Restoration/Flood Control (FC) has already established the RDZs of the Province, which means that controlled and sustainable dredging has already been selected as a preferred methodology for the program. One obvious reason is that it will not involve government expenditure.

Infrastructure-based FCs and other mitigating measures will continue to be implemented by the DPWH in conjunction with dredging. Within the project area and vicinity, there are 5 existing gabion dikes so far. Please refer to **Figure 1-13** below.



Source: DPWH DEO Occidental Mindoro, Google Earth

Figure 1-13. Project Location vis-à-vis the DPWH Flood Control Structures and Busuanga Bridge

Equipment

The dredging equipment can be classified as either mechanical or hydraulic. Mechanical dredgers lift the materials by means of diggers or buckets; while hydraulic dredgers pick up the materials by means of suction pipes and pumps.

In the choice of dredging equipment, the most environmentally-sound machinery/vessel is obviously the best option. There are a lot of dredgers that can be used for this project. The Cutter Suction Dredger was chosen as this type of machine produces more output and seems to be applicable with the type of sand present and the conditions in the proposed dredging area. Mechanical dredging will also be done for the shallow part of the river. This can be done with the use of backhoe and dump truck tandems to transport the extracts.

A. Mechanical Dredgers
Mechanical dredgers remove loose soft or hard materials by way of digging or cutting using a dipper or bucket of some type and usually operate with loading barges (or dump trucks) that are filled with the excavated material. Excavation works will be done by using a bucket in various forms. The effectiveness of this operation depends on the power that is channeled to the bucket / blade as well as the shape of the outskirts / blade bucket stuck on the ground. The types of mechanical dredgers include the following:

Grab Dredger – essentially derrick mounted on a barge and equipped with a wire-mounted bucket of the type deemed most appropriate for the materials to be dug. The barge is usually equipped with 2 spuds forward and 1 spud aft, the latter spud for advancing the dredge. When dredging, the bucket is dropped through the water in an open position and digs into the bottom material, closed, removing material from the bottom, and then raised and emptied. The bucket capacity ranges from 0.8 to 13 m^3, and the operating depth is limited to 40m.

Dipper Dredger – power shovel with considerable digging power. Like the grab, its barge has 3 spuds. The bucket capacity is normally about 4 to 6.5 m^3 and the operation depth is up to 15m.

Bucket Dredger – consists of endless chain of buckets. The top of the chain is thrust into the underwater deposit so that each bucket digs its own load and carries it to surface. It operates on wires by swinging parallel to the work face, and advances on a lead wire while being held in position by stem wires. The productivity ranges from 10-1,000 m^3/h, each of the buckets' capacity is usually 0.2-0.8 m^3.

B. Hydraulic Suction Dredgers
Hydraulic suction dredgers can be classified according to the means of disposal/unloading of the dredged materials into hopper (trailing suction), pipeline (cutterhead), and sidecasting dredgers.

Trailing Suction or Hopper Dredger (TSHD)
The TSHDs are self-propelled sea-going ships equipped with propulsion machinery, sediment containers (hopper), dredge pumps, and other special equipment required to remove material from a channel or sea bottom. Hopper dredgers have propulsion power adequate to dredge against strong currents and the maneuverability for safe and efficient work in rough, open water. The dredged materials are raised by pumps through dragarms connected to the drag on the channel bottom and discharged to the hopper. Once loaded, it moves to the disposal site to unload before resuming dredging. Unloading is done by opening the doors at the bottom of the hopper allowing the materials to sink in an open-water disposal area, or may be pumped to upland disposal sites.

TSHDs are classified according to hopper capacity with the largest hopper having capacities of 6,500 m^3 or greater and the small hoppers having capacities from 500-2,000 m^3. It can travel at speeds of 2-3 mph during dredging operations and can dredge in depths from 3-25m.

Cutter Suction Dredger aka Cutterhead Suction Dredger (CSD)
The CSD draws a slurry of bottom material and water through a suction line and pumps the soil-water mixture through a floating discharge line to the disposal site. It contains a ladder with a cutter. The dredging system is executed by lowering the ladder into the dredging area, and as the ladder hits the

target dredging area, the cutter at the bottom of the ladder is activated and operated. The soil or sand and the water are then extracted simultaneously by the pump and loaded into the vessel.

The following table shows the advantages and disadvantages for each type of dredger discussed above.

Sidecasting Dredgers
The sidecasting dredger is a self-propelled, shallow draft, and sea-going vessel especially designed to remove materials from bar channels at small coastal harbors that are too shallow for hopper dredgers and too rough for CSDs to operate. It is similar to the hopper dredgers but usually without the hopper bins. Instead of collecting the dredged materials in hoppers, it pumps the materials directly overboard thru an elevated discharge boom. Since the materials are not collected, the vessel draft remains the same throughout the dredging operation. Dredging operations are controlled by steering the vessel in predetermined ranges through the project alignment.

The grab dredgers are relatively low-priced with modest manpower requirements, able to work in confined areas, able to pick up large particles such as boulders that are difficult for hydraulic dredgers to handle and the wire-rope connection of the bucket to the dredger enables it to work in sea-state. However, it has low capacity, experiences difficulty in accurately spotting the bucket (not a good channel digger), and does not get good results in light, free-flowing materials (materials get washed out as the bucket is raised).

The dipper dredger is moderately priced, has almost all the advantages of the grab, can be spotted more accurately, performs well in coarse sand, gravel, rock, and clay, including firm materials, and has broad project application. Its disadvantages include low to moderate dredging capacity, poor sea-state response, and can lose capacity in light material.

The bucket dredgers allow continuous operation, has high cutting force, allows minimum dilution, has definitive positioning for channels, and it has the capacity to pick up everything it excavates. However, bucket dredgers are costly and incur high costs for mobilization and maintenance. Moreover, it is very sensitive to swells.

The TSHDs are the only type that can work effectively, safely and economically in rough, open water. It can move more quickly and economically to the dredging area under its own power, its operation does not interfere with or obstruct traffic in the waterway, its method of operation produces usable channel improvement almost as soon as work begins since the dredger normally traverses the entire length of the problematic shoal, excavating a shallow cut each pass, and it may be the most economical to use where disposal areas are not available within economical pumping distances. The disadvantages of TSHDs are: its deep draft precludes its use in shallow waters, including barge channels; cannot dredge continuously since normal operation involves loading, transporting material to disposal site, unloading and returning; excavates with less precision than other types of dredgers; has difficulty dredging side banks of hardpacked sand; and consolidated clay material cannot be economically dredged.

The sidecasting dredgers are self- propelled, hence, can move rapidly from site to site. However, the shallow draft cannot remove large volumes of material compared to hopper dredgers. Some dredged materials can return to the channel prism due to the effects of tidal and littoral currents. Lastly, only has open-water disposal capacity, hence, cannot be used to dredge contaminated sediments.

The CSDs are the most efficient, versatile, and widely used dredger all over the world. It is capable of excavating most types of materials and pumping it thru pipelines in long distances to disposal sites. It operates on almost continuous dredging cycle, resulting in maximum economy and efficiency. In addition, the large and powerful machines are able to dredge rocklike formation as well as softer types without blasting. The downside for CSDs His that it has limited capability for working in open-water areas without endangering personnel and equipment. It has problems removing medium and coarse sand in maintaining open channels in rivers with rapid currents. When it works downstream, the material that is loosened cannot be pulled into the suction intake and deposits ahead of the dredger. Furthermore, the pipeline from the CSD can cause navigation problem in small, busy waterways and harbors

Preferred Option

Based on comparative analysis made, the CSD is deemed the most appropriate dredger type to be used in the proposed project. This will be augmented by the backhoe-dump truck tandem units in the upstream sections of the river.

A Cutter Suction Dredger (CSD) shall be used to initially break up a navigation channel at the delta towards the river mouth and then to the silting / catchment basin, and to remove the surplus deposits at the dredging channel.

Conventional land-based dredgers such as the excavators (in backhoe mode) and dump trucks will be used in tandem for upstream dredging or in the shallow river sections where dredging by CSD is not feasible.

The dredging activities will strictly follow the detailed engineering design plans for the dredging project duly approved by the DPWH Region 4B and will start from downstream and progress upstream. There will be no on-site processing. Moreover, no spoil area is required under the Project because all of the dredged materials will be transported by a belt conveyor to the dump ship and transported to the mother vessel that is anchored offshore.

The CSD will first be used from the offshore dredging area towards the river mouth. The vessel will pump the sand from the dredging segment area and will be loaded directly to the loading barges through an extended hose from the dredging mechanism.

At the point where the CSD cannot navigate the channel because of lack of depth, conventional mechanical dredging will be used. Backhoes will be used to extract the sand from the river and will be loaded onto the dump trucks. These trucks will then transport the sand to the main stockpiling area. This process will be done repeatedly. The CSD and mechanical dredging will be done simultaneously. The CSD will be stationed in the river mouth moving towards the inner part of the river while mechanical dredging operations will be conducted from the other end (upstream) of the dredging zone moving towards the sea.

The dredging project for the Busuanga River is set to utilize cutting-edge technology of Royal IHC Beaver Cutter Suction Dredgers, specifically the Beaver 65E for the hydraulic dredging of the river, and the Beaver 9029 C for the seabed. This state-of-the-art vessel, renowned for its efficiency and effectiveness, will be crucial in enhancing the river's navigability and promoting sustainable development in the region.

Equipped with a powerful cutter head and suction system, the Royal IHC Beaver CSD will expertly remove sediment and debris from the riverbed, thereby deepening the channel and ensuring smoother passage for vessels. With its innovative design and advanced capabilities, this dredger represents a significant step forward in modern engineering and underscores the commitment to optimizing waterways for increased economic opportunities and environmental conservation.

Plate 1-1. Beaver 65E Cutter Suction Dredger

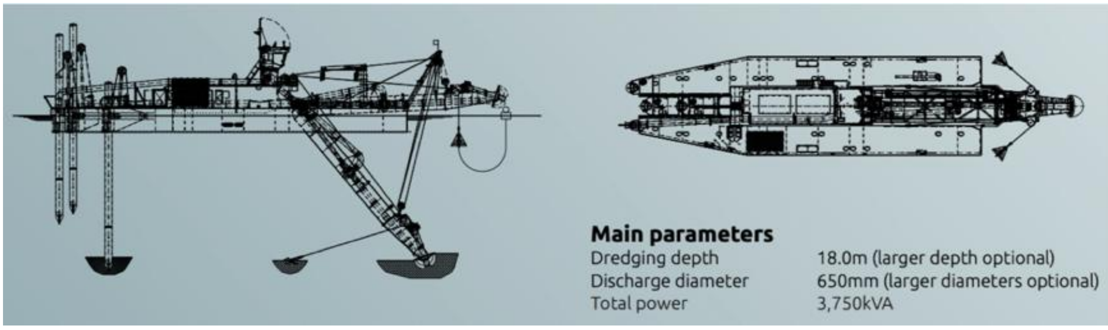


Plate 1-2. Schematic Layout of a Beaver 65E Cutter Suction Dredger

The Royal IHC Beaver® 65E Cutter Suction Dredger is a fully electrically powered version of the standard Beaver model. With zero emissions and minimal noise disturbance, the Beaver 65E complies with the latest environmental regulations, making it suitable for even the most sensitive environments. The electrically powered dredgers offer enhanced energy efficiency compared to conventional diesel-powered dredgers. The Beaver 65E is instantly ready for operation, as its electrical dredge pump drive delivers full power immediately without needing pre-heating. Moreover, the electrical drive requires less maintenance. While preserving the core efficiency and simplicity of the Beaver, technical changes were kept to a minimum. The Beaver 65E is well-suited for various common dredging projects, including land reclamation, maintenance dredging, and aggregate dredging. All standard Beaver types are available in an electrical version. The Beaver 65E stands as a reliable, efficient, and low-maintenance dredger that excels in productivity across all dredging depths, making it suitable for hydraulic dredging.

The Beaver 65E's robust construction features key attributes such as a low cost per cubic meter, a directly driven submerged pump (DDSP) enabling high-mixture density dredging, the Curve impeller for exceptional suction performance and low-energy consumption, first-class ergonomics and diagnostics, wear-resistant parts for the dredge pump, BV Coastal area certification, an integrated spud carriage installation, and dismountable design for transportation via road, rail, or sea. Regarding pump output, the Beaver 65E boasts a discharge pipe diameter of 650mm and a dredging depth of 18.0m. It can achieve a maximum volumetric concentration of in situ solids of 30%, with a final elevation at the end of the discharge pipe of 4.0m.

The Beaver 65E has a powerful and efficient dredge pump, specifically the IHC HR/MD 121-26-60, with a Curve® impeller inside. The pump has a power of 1,706 kW, effectively handling large volumes of dredged material. The electrical installation of the dredger includes a robust power supply of 3x 10kVac and a power capacity of 3,750kVA. It operates at 690Vac, 400Vac, 230Vac, and 24V DC voltages, with a battery capacity of 220Ah.

The cutter of the Beaver 65E is designed to handle demanding conditions. With a power at the shaft of 700 kW, it can absorb load peaks efficiently. The cutter has a diameter of 2,220mm and operates at a maximum speed of approximately 30 rpm.

The dredger has spud hoisting cylinders with a force of 798kN, allowing for stable positioning during dredging operations. The spud stroke, which represents the vertical movement of the spuds, is approximately 3.75m. Additionally, the spud carriage traveling cylinder has a stroke of 4.50m, enabling easy transportation and deployment of the dredger.

The Beaver 65E features a deck crane with a lifting power of 50kN and an outreach of 5.10m to support various tasks on deck. This crane enhances the versatility and efficiency of operations during dredging projects.

The Beaver 65E has received classification from Bureau Veritas as Class I, X Hull, MACH Dredger - no propulsion, making it suitable for coastal areas. It is designed with standard features that ensure short delivery times, competitive pricing, and availability of spare parts from stock. The dredger incorporates a fresh-water cooling system, and the dredge pump is driven through a pivoting gearbox. The cutter drive can accept temporary overload, allowing for high maximum cutter power. The hydraulic system is reliable, and the dredger is completely assembled and fully tested before delivery, ensuring it is ready for operation upon arrival at the site.

The Beaver 65E is an excellent choice for dredging projects due to its numerous advantages. Its robust design and powerful components enable efficient and effective operations across various dredging depths. The model offers high reliability and durability, reducing maintenance requirements and ensuring continuous productivity. The one-man operation feature enhances efficiency and minimizes manpower requirements. The dredger is equipped with essential amenities, such as an onboard toilet and washbasin, providing a comfortable working environment for the crew. Its wide range of services and auxiliary equipment, including workboats, boosters, and pipelines, further enhances its versatility and adaptability to various project requirements.

Moreover, the Beaver 65E provides access to an operations monitoring module, offering real-time data and insights for effective project management. The availability of air conditioning improves crew comfort, particularly in challenging operating conditions. The model's comprehensive package, from its technical capabilities to its support services, makes it a highly reliable and efficient choice for dredging projects, ensuring optimal performance, productivity, and reduced total ownership costs.

The IHC Beaver 9029 C Cutter Suction Dredger (Beaver 9029 C)

Plate 1-3. Beaver 9029 C Cutter Suction Dredger

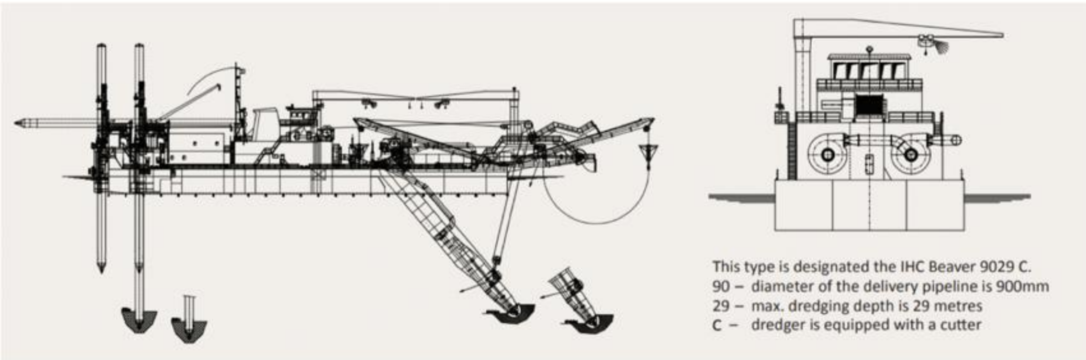


Plate 1-4. Schematic Layout of a Beaver 9029 C Cutter Suction Dredger

The IHC Beaver 9029C is a powerful cutter suction dredger specially designed to undertake challenging dredging projects, including the upcoming seabed dredging of Busuanga River. This impressive dredger, with a staggering power capacity of 13,000 kW, has gained recognition worldwide, attracting investments from renowned organizations like the Panama Canal Authority and Sinohydro (China). The IHC Beaver 9029C sets itself apart with its cutting-edge technology and advanced features, ensuring optimal efficiency and ease of maintenance. Notably, it boasts electrically driven cutter and winches, allowing for effective dredging even in hard soils. The incorporation of Cutter Special® pumps enhances performance, combining a large ball passage with exceptional suction capabilities and efficiency. Equipped with three dredge pumps, including a submerged single-walled pump and two double-walled pumps on board, this dredger ensures consistent performance through the use of identical wear parts across all pumps. Moreover, the engine room and on-board pumps are conveniently located at the main deck level, facilitating easy access for maintenance. The IHC Beaver 9029C prioritizes durability, employing wear-resistant materials for on-board pipelines and utilizing "white iron" wear parts for the dredge pumps. To provide enhanced comfort for the crew, a separate accommodation unit is ingeniously placed on vibration dampers, minimizing disturbances during operations. With its remarkable capabilities and cutting-edge features, the IHC Beaver 9029C stands as a prime choice for the upcoming Busuanga River dredging project, ensuring efficiency, reliability, and utmost performance.

The impressive capacity of the Beaver 9029C makes it an exceptional choice for the challenging task of seabed dredging. With an overall length of 99.60 meters (ladder raised) and a breadth of 18.60 meters, this dredger provides substantial coverage and stability. It boasts a maximum standard dredging depth of 29 meters, allowing it to efficiently excavate significant depths. The Beaver 9029C is equipped with powerful dredge pumps, including a submerged single-walled pump (HRCS 204-43-85) with a 1,500 kW pump drive and two inboard double-walled pumps (HRCS 204-43-85) with a combined pump drive power of 3,700 kW. The cutter, a Type Esco with 6 blades and a diameter of 2,330mm, operates at a robust power of 1,500 kW, enabling effective cutting and excavation. The winches, with line pulls of 750/650 kN and maximum line speeds of 30/20 m/min, ensure efficient control of the ladder and swing operations. The Beaver 9029C also features extensive spuds, with a length of 45.00 meters and a diameter of 1,600mm, providing stability during dredging operations.

Notably, this model is classified by Bureau Veritas as Class I, X Hull, allowing unrestricted navigation. With its comprehensive set of features, including spud carriage installation, anchor booms, a production measuring equipment, and accommodations for 26 persons, the Beaver 9029C is an ideal choice for seabed dredging. Its impressive power, advanced technology, and extensive capabilities make it a reliable and efficient model for executing complex dredging projects, ensuring optimal productivity and exceptional results.

1.3.3 Consequences of Not Proceeding with the Project or No Project Option

The IAC has already established the need for flood control measures in the flood prone areas of Occidental Mindoro, one of which is dredging of predetermined sections in selected rivers, including the Busuanga River. Not proceeding with the project could mean lost opportunity for the government to alleviate the flooding problems in the Busuanga River basin at no cost. No project options will mean that the worsening conditions of this river, flooding, damages to farmlands, and risks to life and property shall continue, unless other mitigating measures are implemented (and at cost to government). The high volume of sediment transported from the river into the sea will persist. It is also a possibility that the flooding situation can worsen in the future, which will mean that the government expenditures for disaster preparedness, management, relief, rescue and repair of flood-damaged structures will also increase. To do nothing is not a sensible option when there is this opportunity being offered.

Nevertheless, the probable adverse environmental impacts of dredging will not happen. But then again, these impacts can be mitigated and the operation can be performed sustainably if such impacts are systematically determined through this environmental impact assessment process and mitigating measures are properly designed and implemented.

1.4 SIZE, GENERAL WATER USE AND COMPONENTS

1.4.1 Total Area and Water Use

The whole catchment area of Busuanga River Watershed covers 530.07 km^2 (**Figures 1-14** and **1-15**). The project site, on the other hand, covers only the alluvial sections starting from Sta 9+000 or 1.95 km downstream of the bridge to the river mouth (Sta 1+050) for Section 1 – main channel; and from Sta 3+550 to Sta 0+950 for Section 2 – Branch, plus the navigation channel that starts from the shore to approximately 500m seaward.

The proposed project area covers approximately and **538.29 hectares** for the onshore area and **70.82 hectares** for the offshore area (navigation zone) for a total of **609.11 hectares**. Within the onshore project area is the river dredging basin stretching 10.55-line km in **175.69 hectares**. The stockpile area shall occupy 1 hectare inside the project area.

Project Area (onshore)	538.29
Project Area (offshore) Navigation Zone	70.82
TOTAL PROJECT AREA	**609.11**

The pilot channel (river) dredging zone covers 10.55 line kilometers and 175.69 hectares within the onshore project area. (**Figures 1-17** to **1-31**).

In terms of surface water classification, Busuanga River is Class C, wherein the intended beneficial uses are: Fishery Water for the propagation and growth of fish and other aquatic resources;

Recreational Water Class II – for boating, fishing or similar activities; and For agriculture, irrigation and livestock watering. The actual uses observed within the project area are for agriculture and very minor domestic use. The nearshore fisheries in the coastal waters fronting the Busuanga River Project is about 1 km from the shore and are largely of pelagic nature. On the other hand, offshore fishing in the Mindoro Strait is more common as it usually yields greater catch rates.

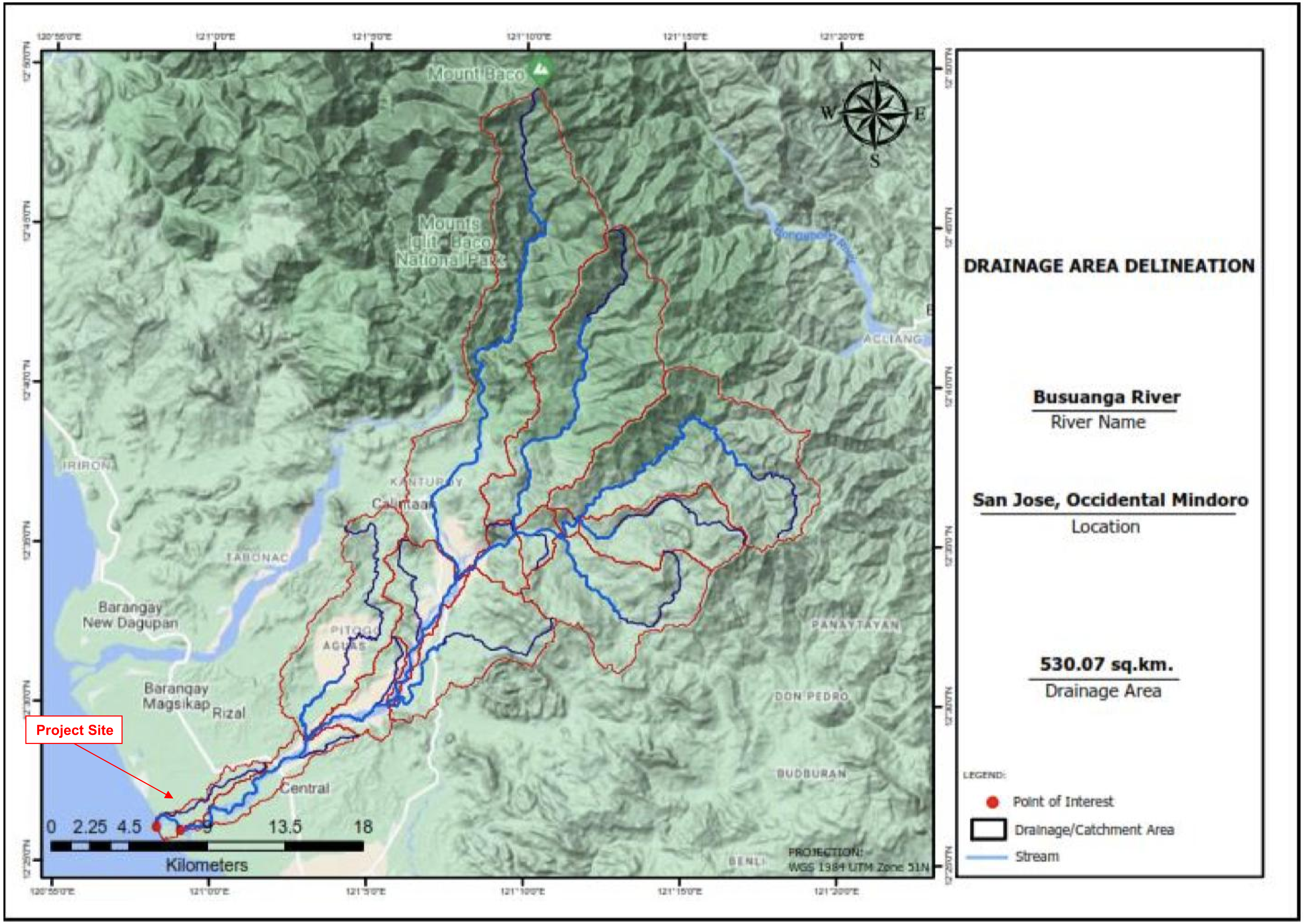
However, there is no definite fishing area. Fishers transfer from ‘open’ (meaning there is no territorial use rights in fisheries in the Philippines as yet) fishing grounds anywhere in the nearshore area where “fish bites” are reported to be good and where schools of fish have been sighted. In the nearshore area fronting the estuary, fisheries operation is conducted anywhere in coastal sea between 1 to 3 kilometers from the shore.

There is no ‘commercial’ fishing boats (as defined in the Fisheries Code) operating nearshore. Bigger municipal fishing boats (not more than 3 GT operate farther offshore, again shifting from one fishing site to another, depending on the prevailing monsoon season and seasonal surges of certain species of fish.

The Busuanga River is one of the streams that supply water and irrigation for agricultural purposes to the Rizal and San Jose. There are existing irrigation canals around the project site while more are being built. According to the barangay officials and residents of Adela, the construction of the irrigation system is not yet complete. Water flows through the canals only when there is precipitation. According to Mr. Arevalo of NIA Occidental Mindoro (KII), NIA operates several Communal Irrigation Systems (CISs) along the river. He mentioned that dredging should be undertaken in order to avoid future inadequacy of irrigation water resources.

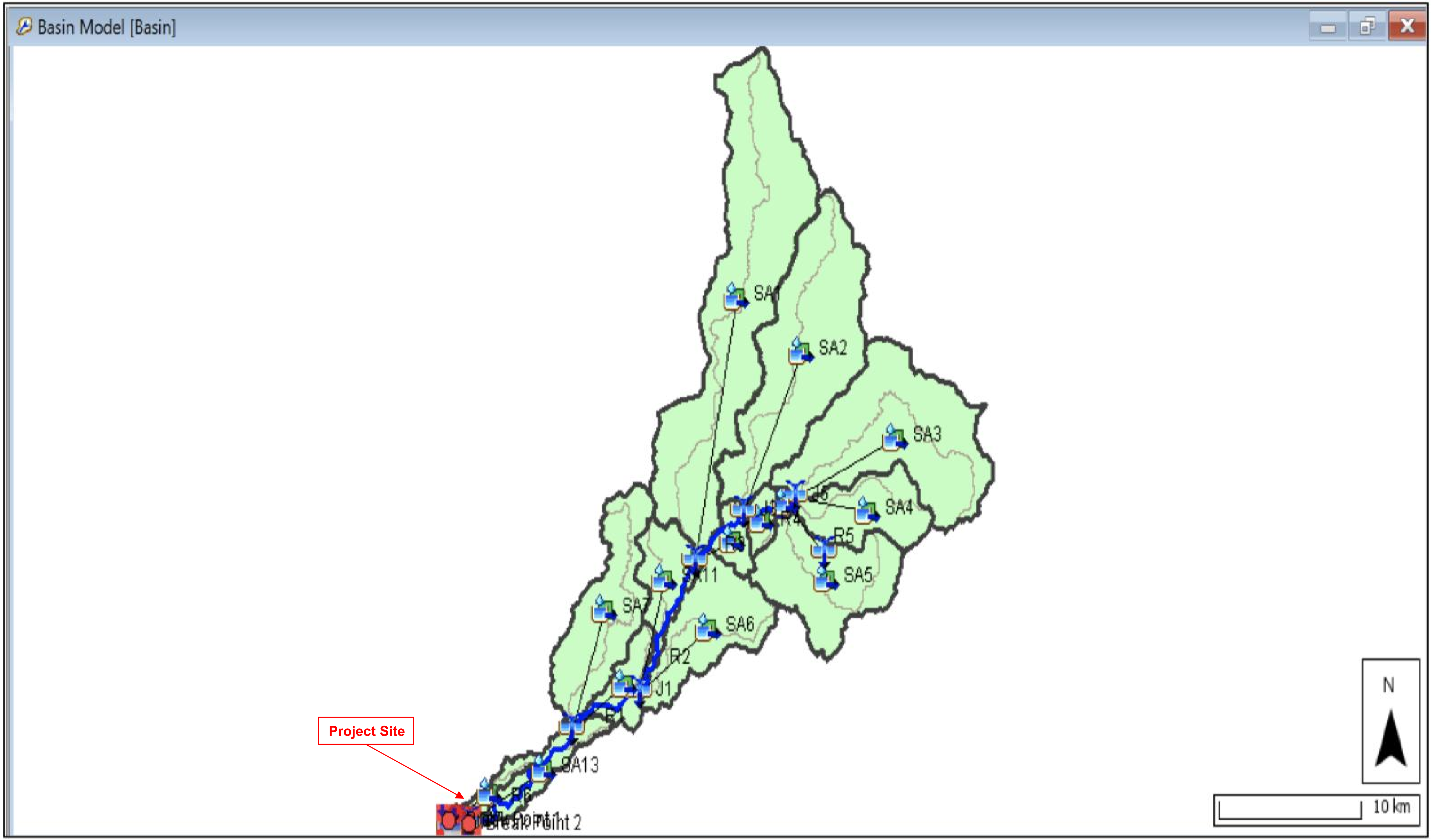
The water inlet is located far upstream of the project area, and therefore, the Project shall not impact on the water quality of this irrigation system though there may be minimal effects in terms of supply volume as the surface water level is eventually lowered.

Lastly, the IAC has established the alluvial sections of this river system as a River Dredging Zone as a flood mitigation measure, this is considered to be the future major activity within the lower Busuanga River in the coming years.



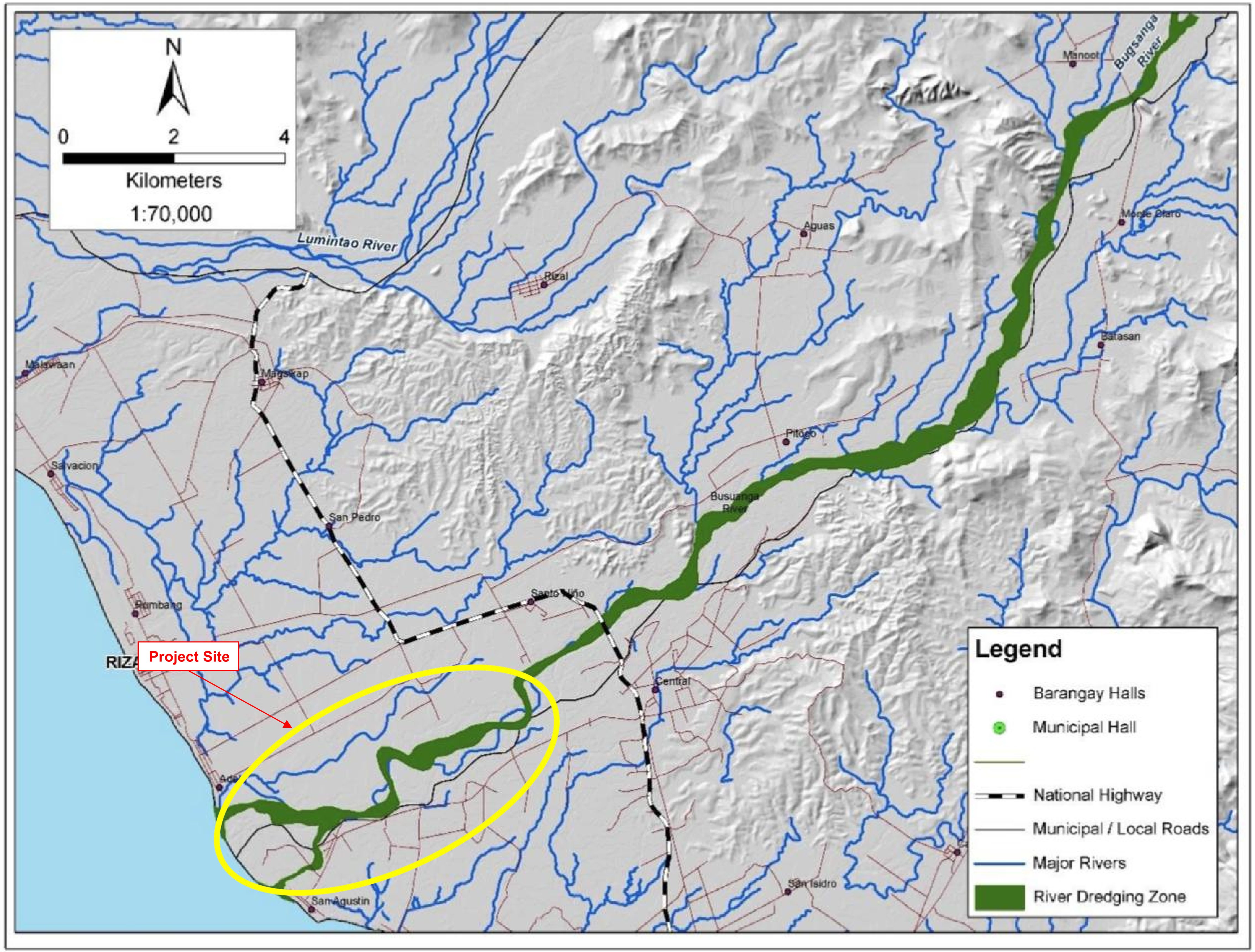
Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-14. Busuanga River System Watershed



Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-15. Busuanga River Basin Model



Source: MGB4B, 2020

Figure 1-16. River Dredging Zone of Busuanga River

1.4.2 Maps Showing in Particular, the Location and Boundaries of Project Area and Dredging Master Plan Showing Areas and Proposed Buffers.

The Project Area is located in the lower reaches of Busuanga River, stretching 500 m seaward (max) at the delta (navigation zone) going upstream up to 1.95 km downstream of Busuanga Bridge. In consideration of the integrity of existing and ongoing Flood Control (FC) infrastructure of the DPWH and of the bridge, the river dredging basin shall be limited to the portions delineated in the Approved DMP covering 175.69 hectares or 10.55 line kilometers for the channel component. Furthermore, a minimum of 10m (at mean low tide) buffer zones on both sides of the uneroded part of the riverbanks shall be maintained. Please see **Figure 1-8** above.

It should be noted though that this section of the river is continually shifting, hence, delineation of some portions of the banks/channels will be very complicated. This meandering characteristic is discussed in more detail under **Section 2.2.2.1 – Hydrology/Hydrogeology**.

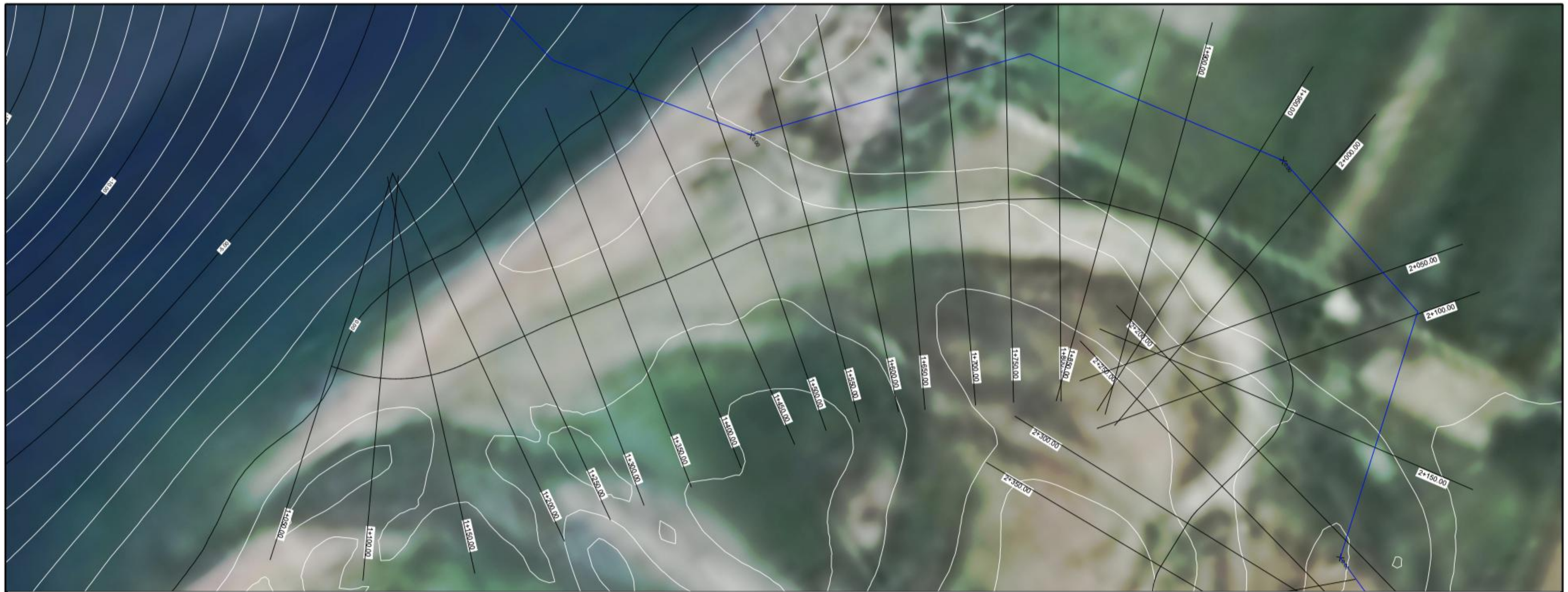
Figures 1-17 to **1-25** are the Dredging Plan and Profile of the Project overlain on longitudinal section showing therein the elevation profile of the Design Flood Level (blue), Ordinary Water Level (cyan), Existing Riverbed (red), and Design Riverbed Elevation (yellow). The profile along this line shows that there will be no dredging from Sta 9+000 going upstream. It also demonstrates that the target thickness of dredging varies for each section, with minimum of 0.71m (Sta 1+100) and maximum of 3.77 (Sta 7+850). This is generally correlated to the natural gradient of the river. The average dredging thickness is 1.799m. The surface water level shall ultimately be lowered after dredging. (Please refer to table below)

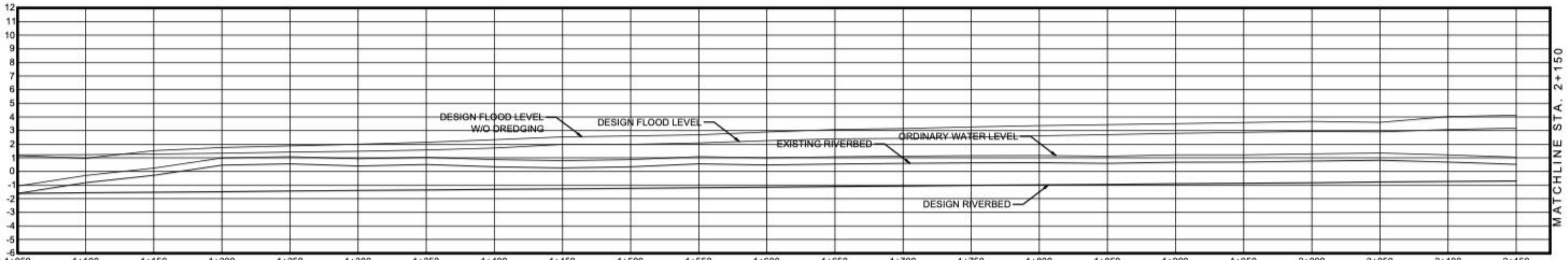
These were fully sourced from the Approved DMP for the Busuanga River Dredging Project attached as **Annex 1-B**. The said design report is in accordance with the DPWH-Design Guidelines, Criteria and Standards and other accepted engineering practices. It presents the details of the approach and methodology employed in the hydrologic and hydraulic assessment of the river. It includes discussion on the fundamental hydrology considerations and peak runoff estimation and hydraulics of open channel flow.

Table 1-2. Dredging Design Parameters

	Existing River Elevation (m)	Design River Elevation (m)	Thickness of Dredging (m)	Existing Water Depth from WS Q100 (m)	Design Water Depth from Design WS Q100 (m)
MEAN			1.799	3.60	3.11
MIN	-0.82	-1.53	0.71	1.88	0.49
MAX	14.51	11.15	3.77	4.88	4.2

For the navigation zone, the dredging design is demonstrated in **Figures 1-26 to 1-28**. This is detailed in **Annex 1-D**.





STATION	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400	1+450	1+500	1+550
DFL WITHOUT DREDGE	1.16	0.96	1.53	1.75	1.87	2.00	2.14	2.33	2.53	2.60	2.69
DESIGN FLOOD LEVEL	1.22	1.23	1.27	1.34	1.42	1.48	1.57	1.72	1.93	1.98	2.09
ORDINARY WATER LEVEL	-1.08	-0.29	0.25	0.99	1.08	0.93	1.04	0.87	0.79	0.87	1.08
EXISTING RIVERBED	-1.61	-0.82	-0.28	0.46	0.55	0.40	0.51	0.34	0.26	0.34	0.55
DESIGN RIVERBED	-1.61	-1.57	-1.53	-1.49	-1.44	-1.40	-1.36	-1.32	-1.28	-1.24	-1.20

STATION	1+600	1+650	1+700	1+750	1+800	1+850	1+900	1+950	2+000	2+050	2+100	2+150
DFL WITHOUT DREDGE	2.89	3.07	3.15	3.27	3.36	3.43	3.51	3.59	3.67	3.60	4.02	4.13
DESIGN FLOOD LEVEL	2.26	2.39	2.43	2.51	2.62	2.70	2.80	2.87	2.94	2.90	3.07	3.18
ORDINARY WATER LEVEL	1.00	1.07	1.12	1.16	1.17	1.12	1.21	1.22	1.29	1.35	1.22	1.05
EXISTING RIVERBED	0.47	0.54	0.59	0.63	0.64	0.59	0.68	0.69	0.76	0.82	0.69	0.52
DESIGN RIVERBED	-1.16	-1.11	-1.07	-1.03	-0.99	-0.95	-0.91	-0.87	-0.73	-0.78	-0.74	-0.70

PLAN & PROFILE STA. 1+050 - STA. 2+150

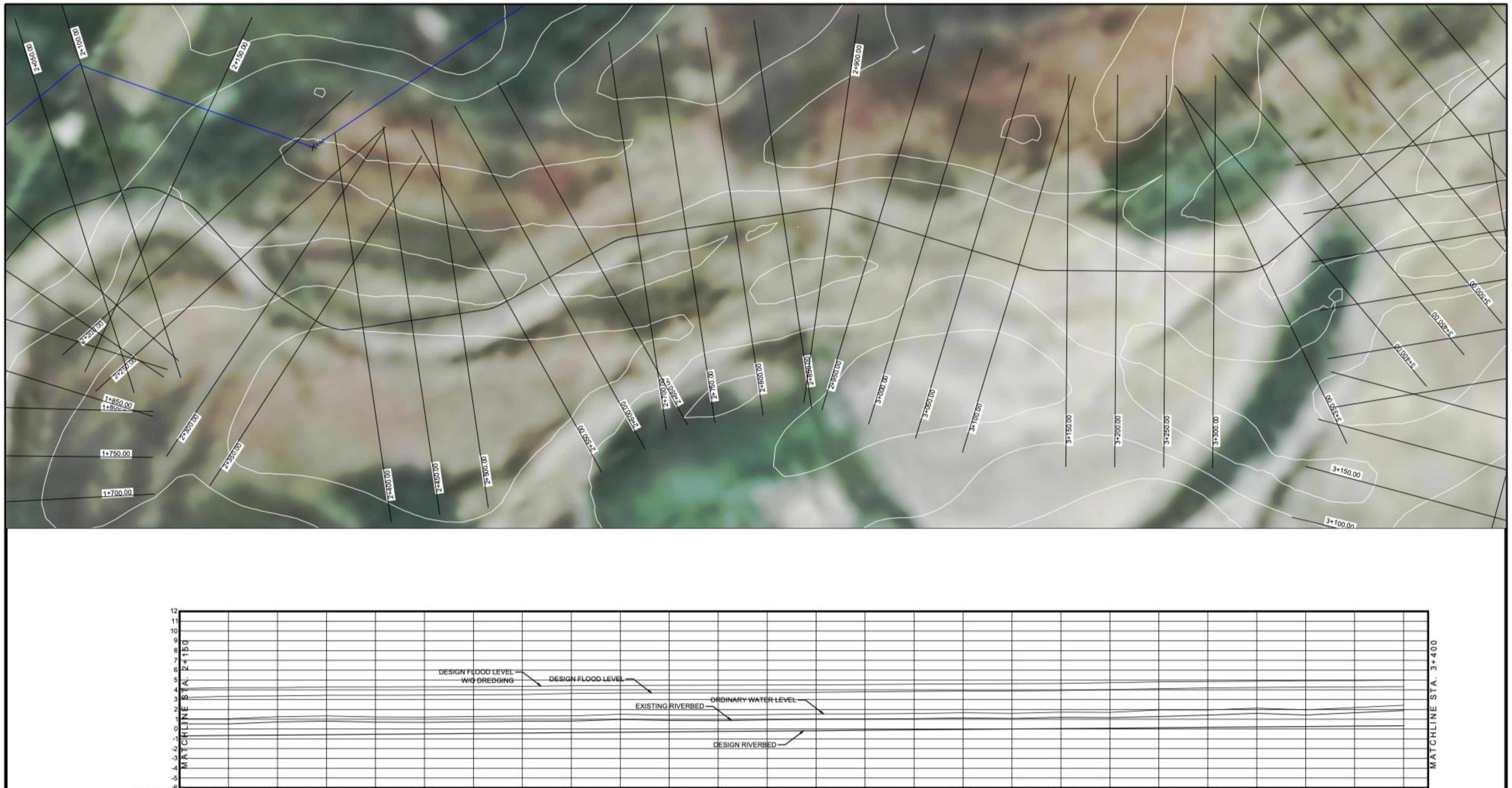
VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

THE DESIGNER/PROPONENT SHALL BE HELD FULLY RESPONSIBLE FOR THE FAILURE OF THE FACILITY DUE TO FAULTY DESIGN EXCEPT FOR THE CHANGES MADE WITHOUT HIS/THEIR CONFIRMITY.

DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-17. Dredging Master Plan and Profile of Project Area (Sta 1+000 to 2+150)



STATION	2+150	2+200	2+250	2+300	2+350	2+400	2+450	2+500	2+550	2+600	2+650	2+700	2+750
DFL WITHOUT DREDGE	4.13	4.22	4.22	4.29	4.29	4.31	4.32	4.35	4.42	4.44	4.46	4.47	4.49
DESIGN FLOOD LEVEL	3.18	3.35	3.37	3.45	3.44	3.46	3.49	3.52	3.63	3.67	3.69	3.69	3.71
ORDINARY WATER LEVEL	1.05	1.05	1.25	1.34	1.23	1.21	1.27	1.32	1.34	1.50	1.41	1.39	1.47
EXISTING RIVERBED	0.52	0.52	0.72	0.81	0.70	0.68	0.74	0.79	0.81	0.97	0.88	0.86	0.94
DESIGN RIVERBED	-0.70	-0.66	-0.62	-0.58	-0.54	-0.50	-0.45	-0.41	-0.37	-0.33	-0.29	-0.25	-0.21

STATION	2+800	2+850	2+900	2+950	3+000	3+050	3+100	3+150	3+200	3+250	3+300	3+350	3+400
DFL WITHOUT DREDGE	4.51	4.54	4.57	4.61	4.62	4.64	4.73	4.81	4.85	4.88	4.93	4.94	4.99
DESIGN FLOOD LEVEL	3.74	3.79	3.84	3.88	3.89	3.92	4.02	4.11	4.19	4.23	4.28	4.29	4.32
ORDINARY WATER LEVEL	1.54	1.54	1.58	1.66	1.60	1.72	1.69	1.80	1.95	2.13	1.96	2.19	2.42
EXISTING RIVERBED	1.01	1.01	1.05	1.13	1.07	1.19	1.16	1.27	1.42	1.60	1.43	1.66	1.89
DESIGN RIVERBED	-0.17	-0.12	-0.08	-0.04	0.00	0.04	0.08	0.12	0.17	0.21	0.25	0.29	0.33

PLAN & PROFILE STA. 2+150 - STA. 3+400

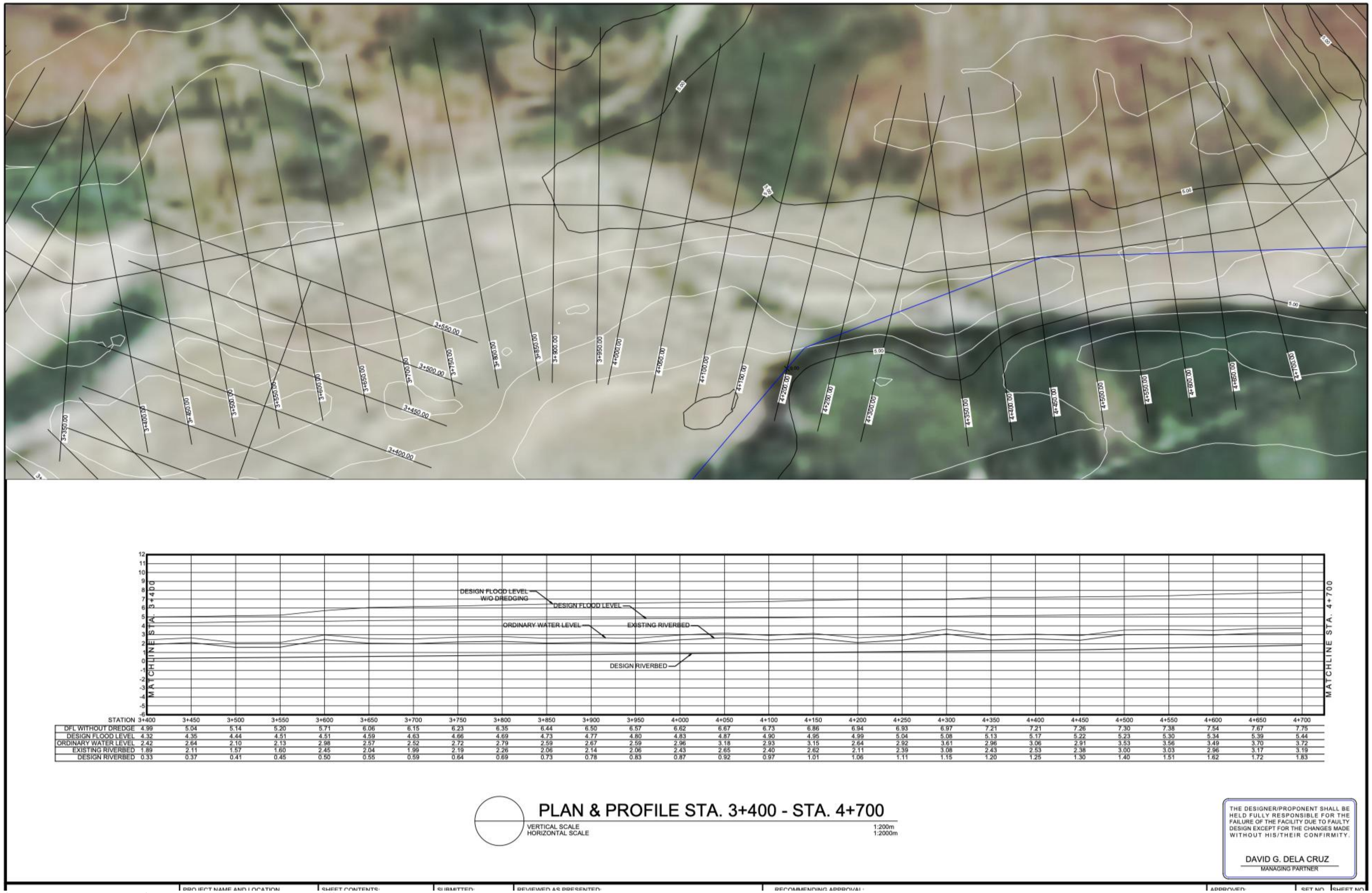
VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

THE DESIGNER/PROPONENT SHALL BE HELD FULLY RESPONSIBLE FOR THE FAILURE OF THE FACILITY DUE TO FAULTY DESIGN EXCEPT FOR THE CHANGES MADE WITHOUT HIS/THEIR CONFIRMITY.

DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-18. Dredging Master Plan and Profile of Project Area (Sta 2+150 to 3+400)

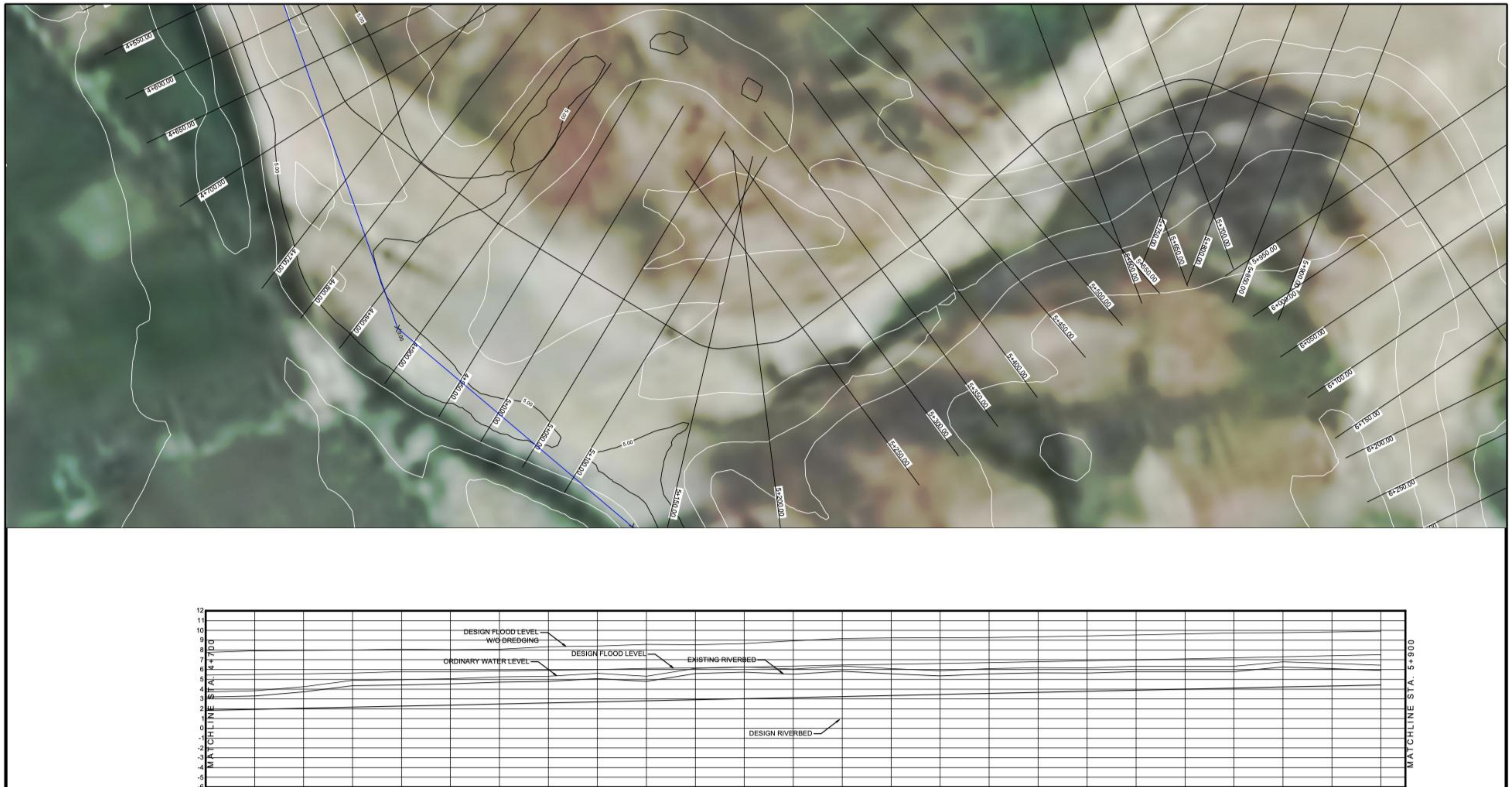


STATION	3+400	3+450	3+500	3+550	3+600	3+650	3+700	3+750	3+800	3+850	3+900	3+950	4+000
DFL WITHOUT DREDGE	4.99	5.04	5.14	5.20	5.71	6.06	6.15	6.23	6.35	6.44	6.50	6.57	6.62
DESIGN FLOOD LEVEL	4.32	4.35	4.44	4.51	4.51	4.59	4.63	4.66	4.69	4.73	4.77	4.80	4.83
ORDINARY WATER LEVEL	2.42	2.64	2.10	2.13	2.98	2.57	2.52	2.72	2.79	2.59	2.67	2.59	2.96
EXISTING RIVERBED	1.89	2.11	1.57	1.60	2.45	2.04	1.99	2.19	2.26	2.06	2.14	2.06	2.43
DESIGN RIVERBED	0.33	0.37	0.41	0.45	0.50	0.55	0.59	0.64	0.69	0.73	0.78	0.83	0.87

STATION	4+050	4+100	4+150	4+200	4+250	4+300	4+350	4+400	4+450	4+500	4+550	4+600	4+650	4+700
DFL WITHOUT DREDGE	6.67	6.73	6.86	6.94	6.93	6.97	7.21	7.21	7.26	7.30	7.38	7.54	7.67	7.75
DESIGN FLOOD LEVEL	4.87	4.90	4.95	4.99	5.04	5.08	5.13	5.17	5.22	5.23	5.30	5.34	5.39	5.44
ORDINARY WATER LEVEL	3.18	2.93	3.15	2.64	2.92	3.61	2.96	3.06	2.91	3.53	3.56	3.49	3.70	3.72
EXISTING RIVERBED	2.65	2.40	2.62	2.11	2.39	3.08	2.43	2.53	2.38	3.00	3.03	2.96	3.17	3.19
DESIGN RIVERBED	0.92	0.97	1.01	1.06	1.11	1.15	1.20	1.25	1.30	1.40	1.51	1.62	1.72	1.83

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-19. Dredging Master Plan and Profile of Project Area (Sta 3+400 to 4+700)



STATION	4+700	4+750	4+800	4+850	4+900	4+950	5+000	5+050	5+100	5+150	5+200	5+250	5+300
DFL WITHOUT DREDGE	7.75	7.92	7.95	7.99	8.08	8.02	8.07	8.34	8.40	8.57	8.54	8.65	8.94
DESIGN FLOOD LEVEL	5.44	5.49	5.56	5.64	5.79	5.79	5.86	5.93	6.00	6.12	6.17	6.25	6.34
ORDINARY WATER LEVEL	3.72	3.83	4.25	4.89	4.96	5.06	5.25	5.32	5.61	5.32	6.12	6.26	6.05
EXISTING RIVERBED	3.19	3.30	3.72	4.36	4.43	4.53	4.72	4.79	5.08	4.79	5.59	5.73	5.52
DESIGN RIVERBED	1.83	1.94	2.05	2.16	2.27	2.37	2.48	2.59	2.70	2.81	2.92	3.02	3.13

STATION	5+350	5+400	5+450	5+500	5+550	5+600	5+650	5+700	5+750	5+800	5+850	5+900
DFL WITHOUT DREDGE	9.17	9.24	9.25	9.27	9.34	9.43	9.54	9.64	9.74	9.76	9.83	9.92
DESIGN FLOOD LEVEL	6.47	6.54	6.62	6.71	6.80	6.90	6.99	7.09	7.20	7.31	7.41	7.52
ORDINARY WATER LEVEL	6.36	6.10	5.88	6.09	6.19	6.17	6.33	6.33	6.33	6.79	6.63	6.44
EXISTING RIVERBED	5.83	5.57	5.35	5.56	5.66	5.64	5.80	5.80	5.80	6.26	6.10	5.91
DESIGN RIVERBED	3.24	3.35	3.46	3.57	3.67	3.78	3.89	4.00	4.11	4.22	4.32	4.43

PLAN & PROFILE STA. 4+700 - STA. 5+900

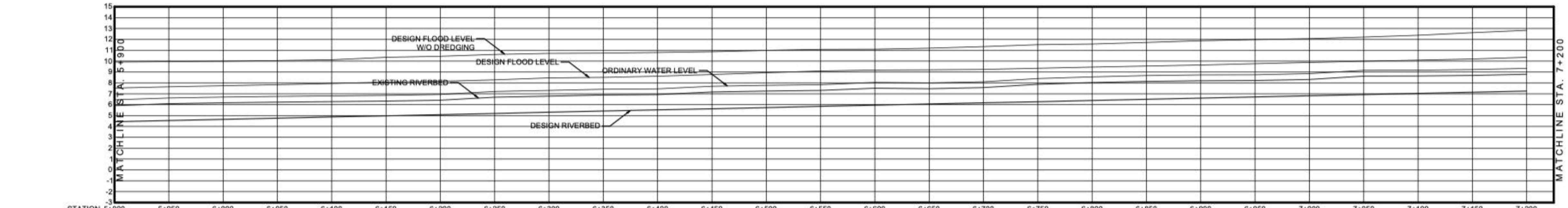
VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

THE DESIGNER/PROPONENT SHALL BE HELD FULLY RESPONSIBLE FOR THE FAILURE OF THE FACILITY DUE TO FAULTY DESIGN EXCEPT FOR THE CHANGES MADE WITHOUT HIS/THEIR CONFIRMITY.

DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-20. Dredging Master Plan and Profile of Project Area (Sta 4+700 to 5+900)



STATION	5+900	5+950	6+000	6+050	6+100	6+150	6+200	6+250	6+300	6+350	6+400	6+450	6+500
DFL WITHOUT DREDGE	9.92	9.96	9.99	10.05	10.13	10.35	10.45	10.62	10.71	10.74	10.80	10.87	10.99
DESIGN FLOOD LEVEL	7.52	7.64	7.74	7.83	7.94	8.06	8.15	8.28	8.46	8.51	8.61	8.77	8.94
ORDINARY WATER LEVEL	6.44	6.61	6.70	6.76	6.81	6.85	6.94	7.21	7.31	7.42	7.45	7.69	7.78
EXISTING RIVERBED	5.91	6.08	6.17	6.23	6.28	6.32	6.41	6.68	6.78	6.89	6.92	7.16	7.25
DESIGN RIVERBED	4.43	4.54	4.65	4.76	4.87	4.97	5.08	5.19	5.30	5.41	5.52	5.62	5.73

STATION	6+550	6+600	6+650	6+700	6+750	6+800	6+850	6+900	6+950	7+000	7+050	7+100	7+150	7+200
DFL WITHOUT DREDGE	11.09	11.10	11.19	11.33	11.51	11.57	11.72	11.87	11.98	12.07	12.21	12.38	1.62	12.83
DESIGN FLOOD LEVEL	9.09	9.18	9.20	9.24	9.35	9.45	9.55	9.65	9.76	9.89	9.99	10.09	10.20	10.35
ORDINARY WATER LEVEL	7.84	8.04	7.99	8.10	8.40	8.56	8.67	8.73	8.75	8.85	9.16	9.17	9.22	9.33
EXISTING RIVERBED	7.31	7.51	7.46	7.57	7.87	8.03	8.14	8.20	8.22	8.32	8.63	8.64	8.69	8.80
DESIGN RIVERBED	5.84	5.95	6.06	6.17	6.06	6.38	6.49	6.60	6.71	6.82	6.92	7.03	7.14	7.25

PLAN & PROFILE STA. 5+900 - STA. 7+200

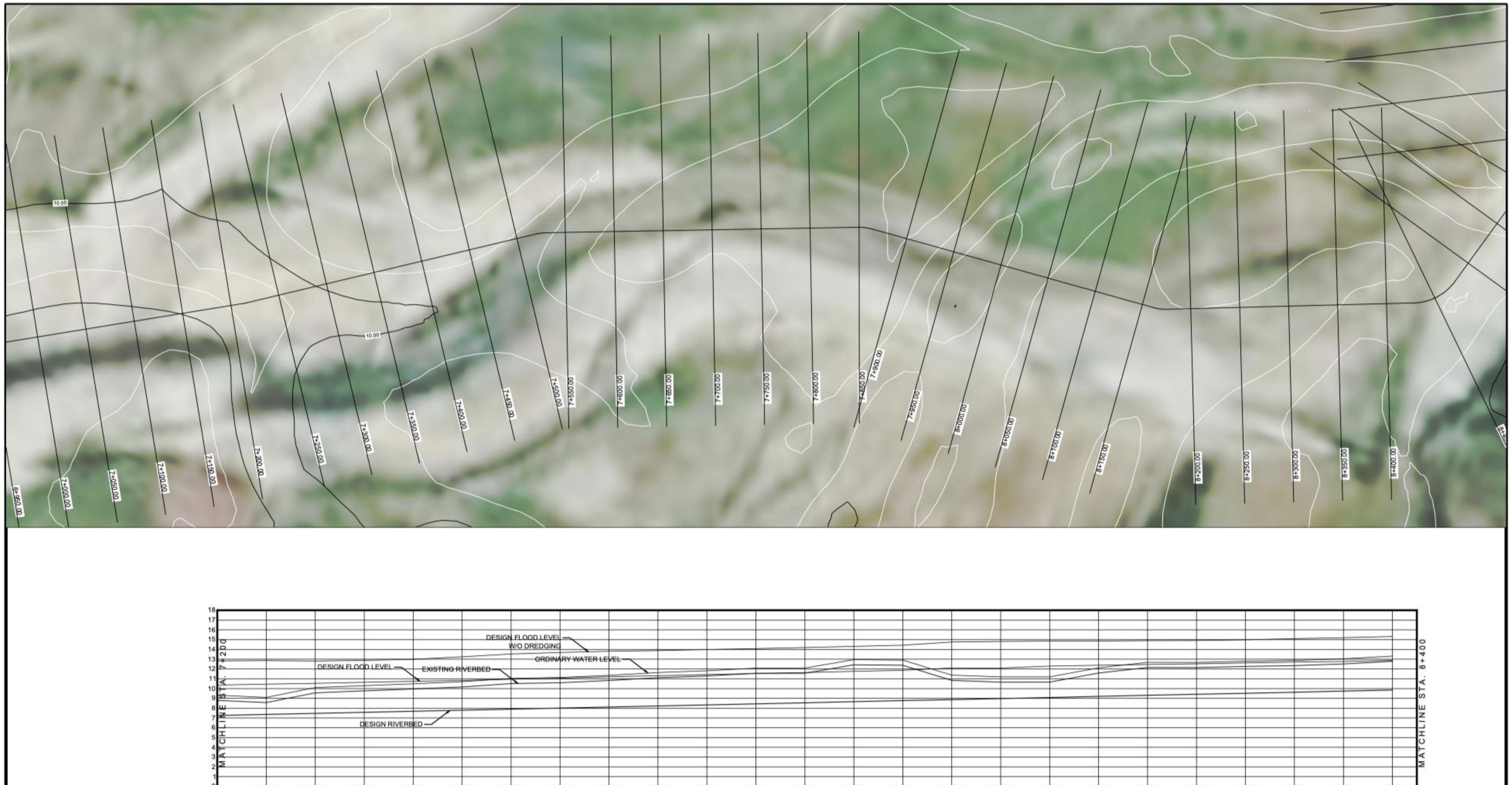
VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

THE DESIGNER/PROPONENT SHALL BE HELD FULLY RESPONSIBLE FOR THE FAILURE OF THE FACILITY DUE TO FAULTY DESIGN EXCEPT FOR THE CHANGES MADE WITHOUT HIS/THEIR CONFIRMITY.

DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-21. Dredging Master Plan and Profile of Project Area (Sta 5+900 to 7+200)



STATION	7+200	7+250	7+300	7+350	7+400	7+450	7+500	7+550	7+600	7+650	7+700	7+750
DFL WITHOUT DREDGE	12.83	12.86	12.81	12.88	12.99	13.25	13.53	13.69	13.81	13.88	13.99	14.09
DESIGN FLOOD LEVEL	10.35	10.45	12.81	10.64	10.74	10.84	10.95	11.05	11.21	11.32	11.43	11.53
ORDINARY WATER LEVEL	9.33	9.10	10.10	10.30	10.49	10.70	11.04	11.13	11.35	11.64	11.82	12.10
EXISTING RIVERBED	8.80	8.57	9.57	9.77	9.96	10.17	10.51	10.60	10.82	11.11	11.29	11.57
DESIGN RIVERBED	7.25	7.36	7.47	7.57	7.68	7.79	7.90	8.01	8.12	8.22	8.33	8.44

STATION	7+800	7+850	7+900	7+950	8+000	8+050	8+100	8+150	8+200	8+250	8+300	8+350	8+400
DFL WITHOUT DREDGE	14.19	14.31	14.43	14.76	14.82	14.85	14.85	14.90	14.91	14.98	15.10	15.20	15.32
DESIGN FLOOD LEVEL	11.64	11.76	11.87	12.11	12.10	12.30	12.38	12.45	12.52	12.62	12.70	12.77	12.88
ORDINARY WATER LEVEL	12.10	12.96	12.91	11.37	11.19	11.19	12.12	12.68	12.67	12.79	12.87	13.04	13.32
EXISTING RIVERBED	11.57	12.43	12.38	10.84	10.66	10.66	11.59	12.15	12.14	12.26	12.34	12.51	12.79
DESIGN RIVERBED	8.55	8.66	8.77	8.87	8.98	9.09	9.20	9.31	9.42	9.52	9.63	9.74	9.85

PLAN & PROFILE STA. 7+200 - STA. 8+400

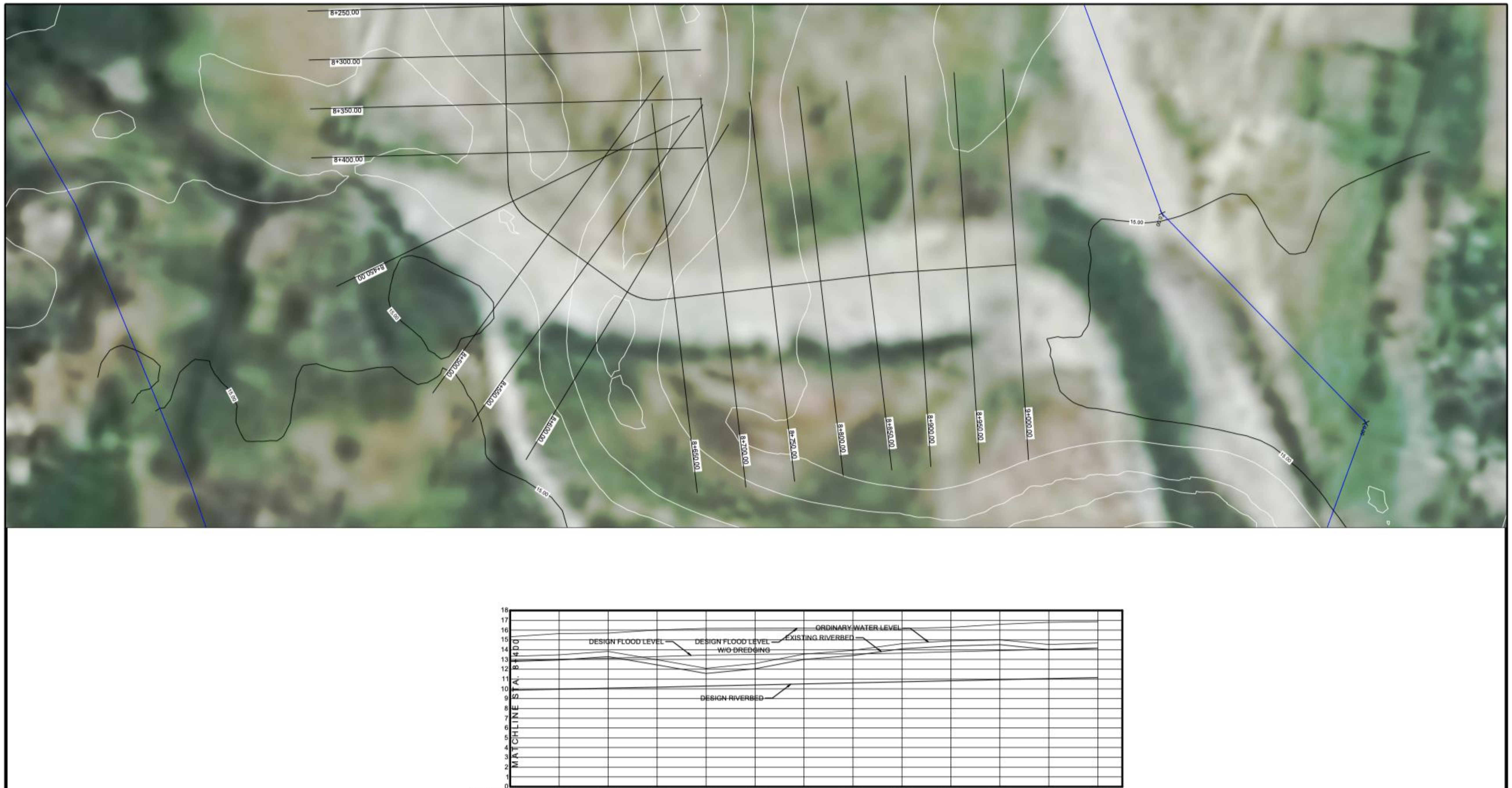
VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

THE DESIGNER/PROPONENT SHALL BE HELD FULLY RESPONSIBLE FOR THE FAILURE OF THE FACILITY DUE TO FAULTY DESIGN EXCEPT FOR THE CHANGES MADE WITHOUT HIS/THEIR CONFIRMITY.

DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-22. Dredging Master Plan and Profile of Project Area (Sta 7+200 to 8+400)



STATION	8+400	8+450	8+500	8+550	8+600	8+650	8+700	8+750	8+800	8+850	8+900	8+950	9+000
DFL WITHOUT DREDGE	15.32	15.64	15.69	16.02	16.17	16.18	16.19	16.20	16.16	16.28	16.59	16.79	16.85
DESIGN FLOOD LEVEL	12.88	13.01	13.11	13.29	13.45	13.52	13.58	13.56	13.64	13.78	13.90	14.02	14.15
ORDINARY WATER LEVEL	13.32	13.47	13.82	12.97	12.10	12.58	13.54	13.93	14.61	14.90	15.04	14.53	14.68
EXISTING RIVERBED	12.79	12.94	13.29	12.44	11.57	12.05	13.01	13.40	14.08	14.37	14.51	14.00	14.15
DESIGN RIVERBED	9.85	9.96	10.07	10.17	10.28	10.39	10.50	10.61	10.72	10.82	10.93	11.04	11.15

PLAN & PROFILE STA. 8+400 - STA. 9+000

VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

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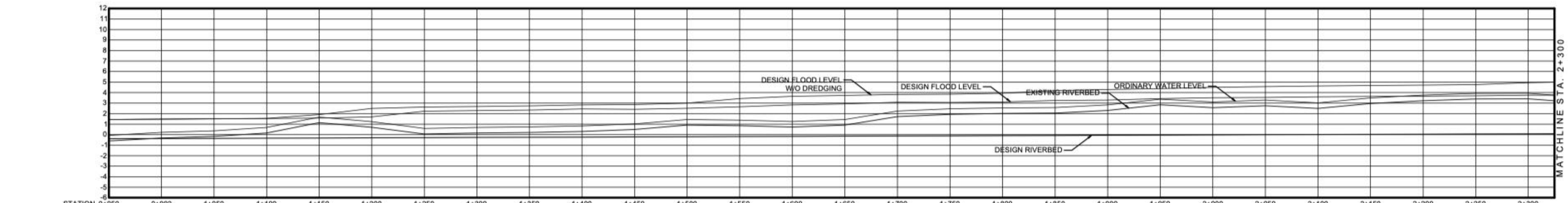
DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-23. Dredging Master Plan and Profile of Project Area (Sta 8+400 to 9+000)



STATION	0+950	0+992	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400	1+450	1+500	1+550	1+600
DFL WITHOUT DREDGE	1.44	1.47	1.51	1.54	1.91	2.49	2.62	2.67	2.73	2.83	2.86	3.00	3.43	3.64
DESIGN FLOOD LEVEL	1.44	1.47	1.50	1.53	1.57	1.69	2.23	2.29	2.34	2.44	2.41	2.50	2.65	2.83
ORDINARY WATER LEVEL	-0.07	0.21	0.36	0.68	1.67	1.23	0.59	0.68	0.73	0.83	1.02	1.44	1.38	1.25
EXISTING RIVERBED	-0.60	-0.32	-0.17	0.15	1.14	0.70	0.06	0.15	0.20	0.30	0.49	0.91	0.85	0.72
DESIGN RIVERBED	-0.39	-0.37	-0.36	-0.34	-0.32	-0.30	-0.29	-0.27	-0.25	-0.24	-0.22	-0.20	-0.18	-0.17

STATION	1+650	1+700	1+750	1+800	1+850	1+900	1+950	2+000	2+050	2+100	2+150	2+200	2+250	2+300
DFL WITHOUT DREDGE	3.73	3.82	3.85	3.93	4.18	4.29	4.38	4.49	4.57	4.63	4.67	4.71	4.76	4.94
DESIGN FLOOD LEVEL	2.92	3.08	3.06	3.11	3.25	3.29	3.25	3.51	3.54	3.60	3.63	3.65	3.69	3.75
ORDINARY WATER LEVEL	1.44	2.24	2.46	2.54	2.58	2.83	3.37	3.10	3.28	3.02	3.49	3.76	3.92	3.93
EXISTING RIVERBED	0.91	1.71	1.93	2.01	2.05	2.30	2.84	2.57	2.75	2.49	2.96	3.23	3.39	3.40
DESIGN RIVERBED	-0.15	-0.13	-0.12	-0.10	-0.08	-0.06	-0.05	-0.03	-0.01	0.00	0.02	0.04	0.06	0.07

PLAN & PROFILE STA. 0+950 - STA. 2+300

VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

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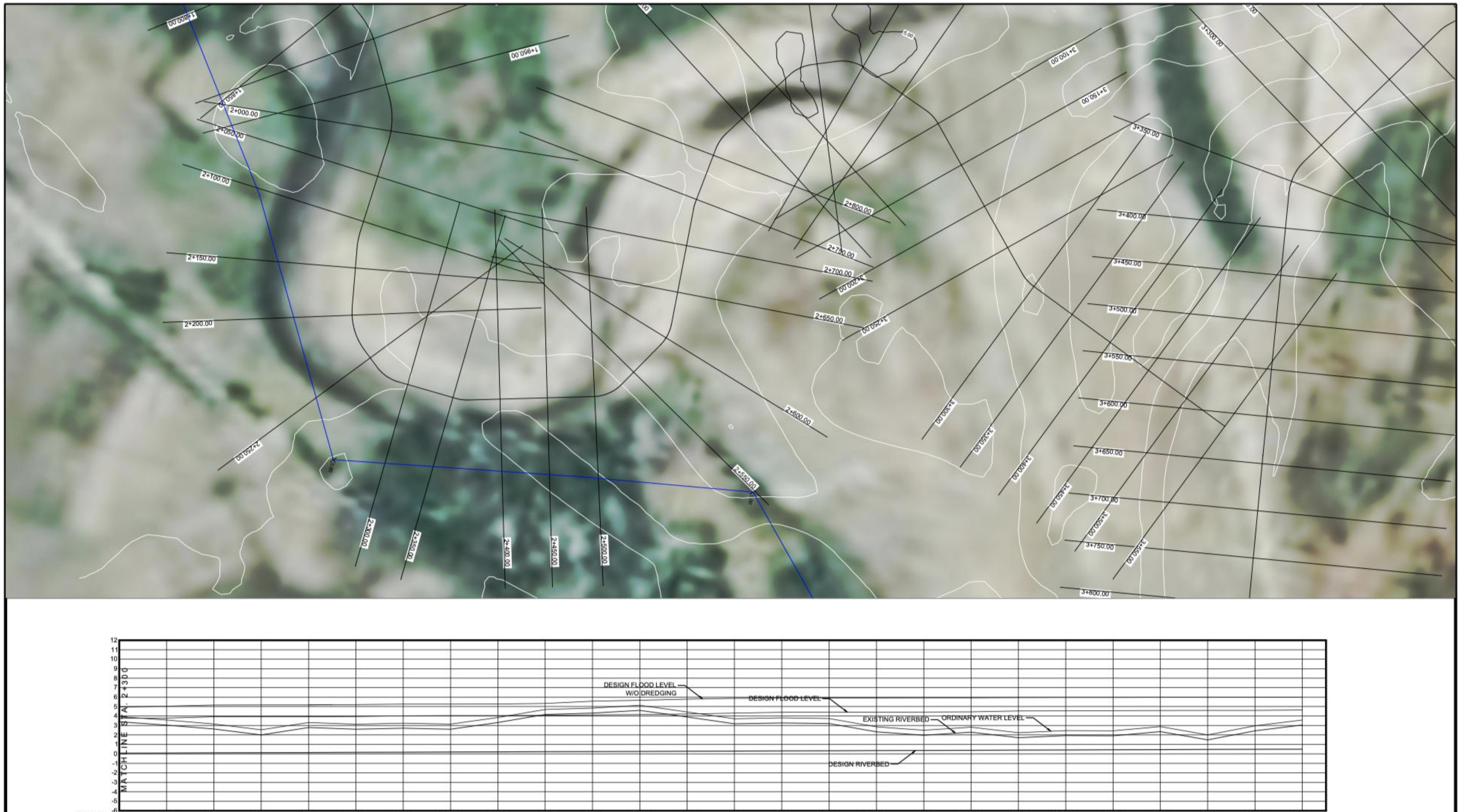
DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-24. Dredging Master Plan and Profile of Project Area (Sta 0+950 to 2+300)



STATION	2+300	2+350	2+400	2+450	2+500	2+550	2+600	2+650	2+700	2+750	2+800	2+850	2+900
DFL WITHOUT DREDGE	4.94	4.04	5.16	5.17	5.17	5.21	5.26	5.26	5.27	5.32	5.57	5.66	5.78
DESIGN FLOOD LEVEL	3.75	3.78	3.92	3.91	3.92	3.95	4.02	4.04	4.04	4.07	4.12	4.15	4.21
ORDINARY WATER LEVEL	3.93	3.57	3.16	2.54	3.31	3.13	3.24	3.14	3.84	4.69	4.84	5.13	4.43
EXISTING RIVERBED	3.40	3.04	2.63	2.01	2.78	2.60	2.71	2.61	3.61	4.16	4.31	4.60	3.90
DESIGN RIVERBED	0.07	0.09	0.11	0.12	0.14	0.16	0.17	0.19	0.21	0.23	0.24	0.26	0.28

STATION	2+950	3+000	3+050	3+100	3+150	3+200	3+250	3+300	3+350	3+400	3+450	3+500	3+550
DFL WITHOUT DREDGE	5.87	5.89	5.90	5.91	5.92	5.93	5.95	5.96	5.96	5.97	5.97	5.98	5.98
DESIGN FLOOD LEVEL	4.31	4.39	4.41	4.40	4.42	4.44	4.54	4.55	4.57	4.58	4.59	4.60	4.63
ORDINARY WATER LEVEL	3.71	3.80	3.73	2.86	2.50	2.82	2.23	2.46	2.44	2.88	2.10	2.97	0.00
EXISTING RIVERBED	3.8	3.27	3.20	2.33	1.97	2.29	1.70	1.93	1.91	2.35	1.48	2.44	3.05
DESIGN RIVERBED	0.29	0.31	0.33	0.35	0.36	0.38	0.40	0.41	0.43	0.45	0.47	0.48	0.50

PLAN & PROFILE STA. 2+300 - STA. 3+550

VERTICAL SCALE 1:200m
HORIZONTAL SCALE 1:2000m

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DAVID G. DELA CRUZ
MANAGING PARTNER

Source: DPWH Mindoro Occidental District Engineering Office, 2022

Figure 1-25. Dredging Master Plan and Profile of Project Area (Sta 2+300 to 3+550)

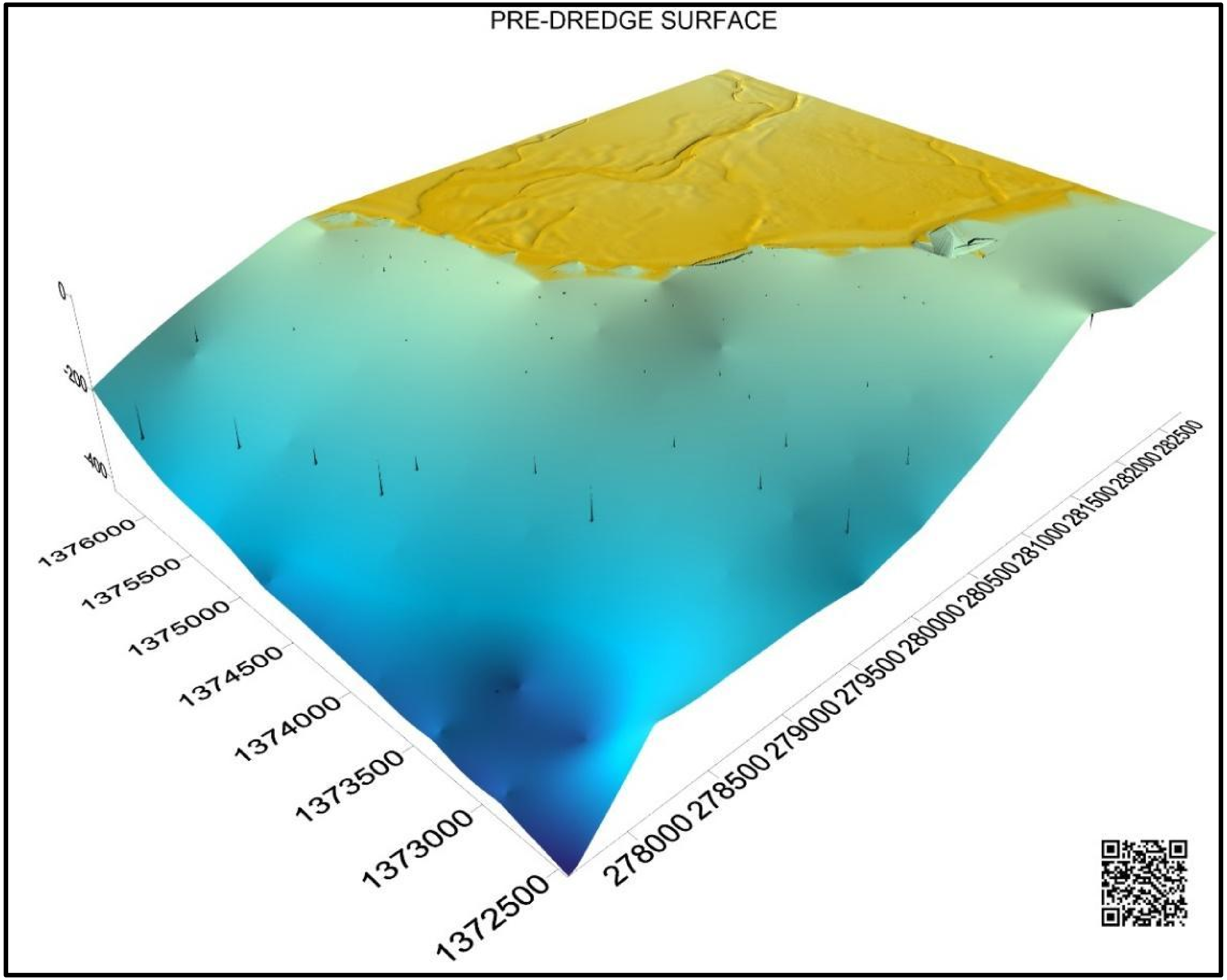


Figure 1-26. 3D View of Pre-Dredge Surface for the Busuanga River Navigation Zone

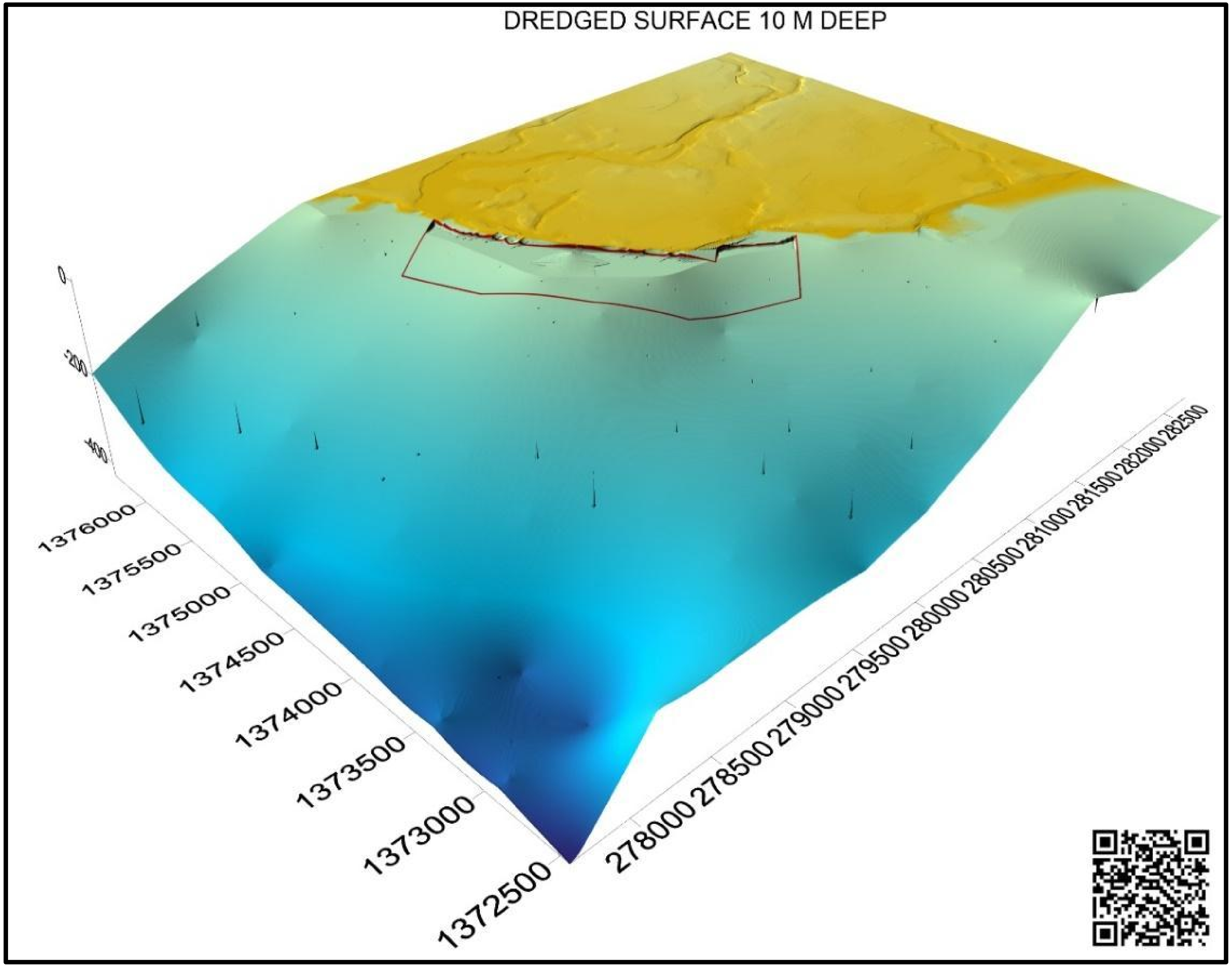


Figure 1-27. 3-D View of the Dredging Design for the Busuanga Navigation Zone at 10 Meters Depth

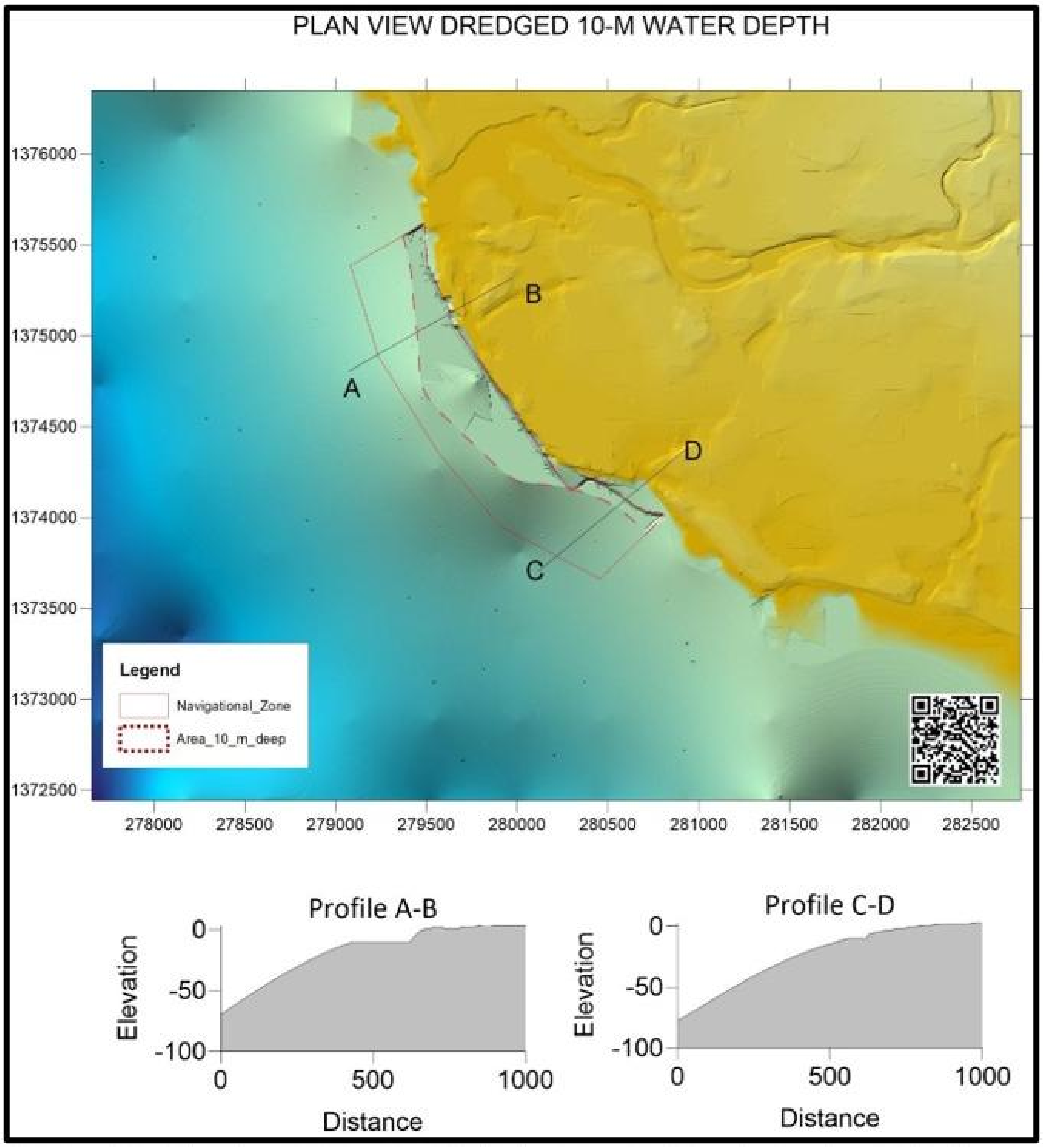


Figure 1-28. Plan View and Cross Sections of the Dredging Design for the Busuanga River Navigation Zone at 10-Meter Depth

1.4.3 Project Components

The major project components are:

1. Buffer zone
2. River dredging basin
3. Navigation zone
4. Stockpile area
5. Office, staging area and other support facilities
6. Handling and transport of dredged materials
7. Cost recovery through sale of dredged materials
8. Office, staging area and other support facilities

Buffer Zone
There shall be a minimum of 10m buffer zones (at mean low tide) from the toe of both sides of the uneroded part of the riverbanks. It should be noted though that this section of the river is continually shifting, hence, delineation of some portions of the banks/channels will be very complicated. The zone as set on the plan (**Figure 1-7**), is the 10m-wide perimeter of the project area.

Moreover, since the dredging basin is much smaller than the entire project area, the area in between the dredge zone and the project boundaries shall all serve as buffer since this shall be used merely for moving around and for the location of other components.

In areas where dredging zone is beyond existing river banks, the project proponent will follow the approved DMP in order to effectively implement the flood control measure as designed.

River Dredging Basin
This shall be the section within the river covering **175.29 hectares** as per the approved DMP. It is composed of two sections. Section 1 is the Main Channel starting from Sta 1+050 (downstream/mouth) to Sta 9+000 (upstream). Section 2 is the southern Branch starting from Sta 0+950 to Sta 3+550. The end point (Sta 9+000) is 1.95 km downstream of Busuanga Bridge.

Aside from other considerations, limits of this basin was delimited to a safe distance from the Flood Control (FCs) structures and the bridge to ensure their protection.

Navigation Zone
Likewise, there will be dredging at the delta from the shoreline going seaward and covering **70.82 ha** for the purpose of creating a navigational channel for the dredging vessel pursuant to DAO 2020-12, particularly Section 4: Prescribed Dredging Method.

A single navigation zone for the Busuanga River and its distributary may be more feasible, instead of 2 separate navigation zones so that the deltaic sediment pile between the main river mouth and the mouth of the distributary channel will be removed. This will facilitate water flow out to the sea as it will not be hampered by the predominant southeast direction of longshore current.

Stockpile Area
After the land-based dredging operation, the dredged materials will be transferred to containment areas or designated on-shore storage sites or the stockpile area. If necessary, the dredged materials will be left to naturally dewater, reducing its moisture content and volume. This will be located in the "island" between the two river mouths. It shall hold a volume capacity of about 40,000 m^3 of dredged materials. See **Figure 1-9**.

Support Facilities
The support facilities, to be located at barangay Adela, Rizal are composed of the following (**Figure 1-9**):

- Base Camp
- Field Office
- Employees' Quarters
- Warehouse

- Motor pool
- Equipment staging area
- Clinic
- Canteen
- Stockpile area

The Company shall rent existing houses in the area for use as base camp, field office and employees' quarters. Improvements and/or addition of other structures may be necessary. This shall be mainly for the land-based personnel. Current water and electricity service providers will supply all water and electricity. On the other hand, the dredging vessel shall have rooms and amenities for the dredging crew as well as onboard bilge for wastewater management.

The stockpile area shall be located in Brgy. Adela between the main channel and the branch. Minor construction works include fencing and installation of silt traps/canals.

For the cost recovery of the proponent, the dredged materials shall be commercially sold.
Office, staging area, stockpile area and other support facilities

Sand and Gravel Extraction/Dredging, Transport and Final Destination

Dredging
The dredging operation will involve simple, straightforward dredging and haul out of dredged materials. This process will be repetitive until the maximum designed riverbed elevation (per approved DMP) is attained, after which, such elevation shall be maintained. It is important to mention that dredging in itself is a mitigating process to address the perennial and increasing flooding problem in the area. This process is discussed in more detail in section 1.4.4 below.

Transport of Dredged Materials
For the disposal of dredged materials is for beneficial use, the more environmentally-friendly alternative is the use of such materials for productive purpose such as for construction or filling materials. Dredged-fill materials shall be transported to the designated disposal site/s (buyers), which will primarily be for the reclamation projects in Manila, other nearby provinces and in Cebu, as well as for other construction projects of the government.

A minimum of one mother vessel/cargo ship (35,000 m^3 capacity) will be anchored approximately 5 km offshore. A smaller barge (3,000 m^3 capacity) will be used to transport the dredged materials from the stockpile or port to the mother vessel. The materials dredged by a CSD (in the navigation zone and deeper portions of the RDZ) will be directly loaded to the hauling barge. On the other hand, riverbed materials dredged by land-based equipment shall be brought by dump trucks to the stockpile area for temporarily storage. Once the volume is deemed sufficient, it shall be hydraulically loaded from the stockpile area to the small barge, and then to the mother vessel. Afterwards, the mother vessel will carry the loaded aggregates and bring to the designated buyers' location/port. This cycle will be repetitive.

Planned Causeway
The proponent is planning to develop a causeway near the river delta for barge landing and loading purposes. A separate ECC and other related permits will be secured as needed.

1.4.4 Description of Dredging Activity, and Description of Support Facilities Including Dredging Equipment

Dredging in the Navigation Zone
The initial phase of operations shall be the seabed dredging at the delta for the purpose of opening up a navigational lane for the dredging vessel. The same vessel (CSD) shall be used to create its channel, thereby extracting seabed materials. Moreover, the process is direct barging, i.e., all extracted materials of all kinds from the navigation zone will be directly loaded into the small barge for transfer to the mother vessel.

The dredging project for the Busuanga River is considering the cutting-edge technology of Royal IHC Beaver Cutter Suction Dredgers, probably the Beaver 65E or the Beaver 9029 C for its water-based dredging equipment.

River Dredging

Dredging shall be done by utilizing a Cutter Section Dredger, probably a Royal IHC Beaver 65E, to clear and deepen the channel and allow the natural flow of the river to the sea. A CSD can be utilized for the excavating works along the channel by pumping the river deposits. The conventional cut (dislodge in-situ materials) - suck (thru pump) - discharge (thru discharge pipes) operation cycle shall be employed in extracting the alluvial deposits. The dredged materials are to be transferred via pipelines and deposited to the designated hauling site/stockpile near the dredging area or directly to the hauling barge. The initial slice is done along the portion nearest to the center of the river with successive parallel cuts following the same route. The direction of initial slice shall be taken, and the dredging shall proceed from river mouth to upstream.

Before executing the dredging in the river, the area must first be cleared of large boulders/rocks to avoid damage on the equipment, which may slow down the dredging capability of the equipment.

Using the conventional land-based operations for the shallower portions of the river where dredging by suction cutter is not feasible, land-based dredgers will be used such as excavators (in backhoe mode with 1.0 m^3 bucket) and 20-tonner dump trucks. A fleet of 5 excavators and 15 dump trucks can produce 1.5M to 2.0M tons of river materials per annum.

Dredging vessels will extract the raw materials through a suction hose connected to the vacuum pump with cutter suction head. The pump produces a vacuum which pulls the materials into the suction hose. For extraction of compacted materials, if any, dredgers have a cutter head at the end of the suction tube. The cutter head is used to loosen the materials and feed it to the opening of the suction tube.

On ideal conditions, the estimated extraction rate of the vessel is 12,000 m^3/day of river sand, which will pump to the loading barges for stockpiling and later will be transported to the mother vessel once the loading barge is in full storage capacity. In the case of land-based dredging, materials to be extracted will be hauled by trucks and stockpiled at the stockpile area near the coast.

There will be no on-site processing of the dredged materials.

The CSD will first be stationed at the navigation zone to dredge the underlying materials to a navigable depth. Henceforth, it will be used at the river mouth going upstream. Transporting of extracts is through an extended hose from the dredging mechanism to the initial collecting site, or directly to the hauling barge. The mechanical land-based dredging will start about 3 km from the river mouth going upstream. Backhoes will be used to extract the sand from the river and will be loaded onto the dump trucks. These trucks will then transport the sand to the main stockpiling area. This process will be done repeatedly. The CSD and mechanical dredging will be done simultaneously.

The proposed project will not generate unwanted dredged materials and hence, there will be no materials to be disposed of. If any, they may be disposed of at areas where it is needed as preliminary dump piles or supplemental filling or be donated to government and non-government organizations needing it.

Table 1-3 below shows the list of equipment that will be utilized:

Table 1-3. List of Major Equipment

No. of Units	Description	Capacity
2	2 Cutter Suction Dredger	12,000 m^3 / day
5	5 Hydraulic Excavator	1.0 m^3
15	15 Dump trucks	20 Tonner

No. of Units	Description	Capacity
1	1 Payloader	3 m^3
4	4 Service Vehicles	
1	1 Hauling Barge (small)	3,000 m^3

Cutter Suction Dredger (CSD)

The CSD contains a ladder with a cutter. The dredging system is executed by lowering the ladder into the dredging area, and as the ladder hits the target dredging area, the cutter at the bottom of the ladder is activated and operated. The soil or sand and the water are then extracted simultaneously by the pump and loaded into the vessel. The capacity of CSDs differ based on the soil condition. A 12,000 HP Dredger can dredge up to 1,200-1,300 m^2/hour with maximum conveying distance of 5km. It has a capacity 5 times bigger than Grab Dredger. Two CSDs will be used, each of which has a dredging capacity of 25,000 m^3/day.

Mechanical Method: Backhoe-Dozer-Dump Truck Tandem
In the inner and shallower sections of the river, a conventional mechanical dredging using excavators/backhoes in tandem with dump trucks will be used. Mechanical dredging means the work is done by way of digging or cutting.

Other Support Equipment
- Air compressor
- Welding machine
- Pressure washer
- Hydraulic pump
- Generator set (50 kVa)

The support facilities include the stockpile area, field office, employees' quarters, warehouse, motor pool, equipment staging area, clinic and canteen.

1.4.5 Identification of Infrastructure Requirements - Power and Water Supply

Fuel/Diesel, Oil, and Lubricants
The estimated diesel/oil requirement that will be needed to fuel the dredging equipment, accessories and other equipment is around 2,910 liters per day or 72,750 liters per month (25 days) of diesel and approximately 300 kg of lubricants. This will result in greenhouse gas byproducts, thus the engine exhaust pipes will be fitted with selective catalytic converters and particulate matter filters to minimize greenhouse gas emissions.

Fuel, oil and lubricants shall be supplied either by a local fuel station or private oil company and contained in DOE-MARINA approved containers and onboard dispensers. The containers will be regularly brought onboard the dredgers through the cargo barge. The dispensing mechanism shall be required to have a latch-on mechanism with the recipient fuel tank before these release petroleum fuel. The barge and dredger crew will be given by the Proponent updated orientation of petroleum fuel management (likewise waste management, safety and disaster response) protocols and these will form part of the Dredging Contractors' Health, Safety and Environmental Management Plan.

Below is the list of equipment and its estimated daily fuel consumption:

Table 1-4. Estimated Fuel Consumption per Equipment

	Description	Fuel Consumption	Fuel per day (L)
1	2 Cutter Suction Dredger	76 L/hr	760 x 2 = 1,520
2	5 Hydraulic Excavators	15 L/hr	150 x 5 = 750
3	15 Dump trucks	1 L/km	20 x 15 = 300
4	Payloader	15 L/hr	150 x 1 = 150

	Description	Fuel Consumption	Fuel per day (L)
5	4 Service Vehicles	10 km/L	10 x 4 = 40
6	Hauling Barge	15L/hr	150 x 1 = 150
		TOTAL	**2,910**

Power Supply
The dredging process requires all equipment to be diesel engine-driven, hence, no electricity is needed. The power requirements shall be provided by the engines of the dredging vessel/s. On the other hand, the power supply for offices and other support facilities will be sourced out from Occidental Mindoro Electric Cooperative (OMECO) to be supplemented by a 50 kVa generator set in case of power outages.

Water Supply
There shall be no groundwater abstraction for this project.

The dredging operation does not require a lot of water. The surface water at the dredged riverbed will be used to slurry the dredged material for simple hydraulic conveyance to the haul barge. The water requirements (domestic and drinking) for onboard dredging crew will be delivered in suitable containers filled from local sources and hauled onboard. The crew's water needs are projected for regular physical cleansing, drinking, and cooking.

The land-based equipment does not need water for the operations as well, except for cleaning and maintenance.

For drinking water, a vessel crew of 23 (including the anchor barge crew) is estimated to consume 54.5 L/day while the land-based personnel (dredgers and support staff) of 35 pax will be needing 82.95 L/day for a total of 137.45 L/day. The drinking water will be procured from local refilling stations to be brought onboard (vessel) and to the site through appropriate containers (5-gallon container) and to be provided with water dispenser.

Domestic water requirement for the vessel and crew is estimated at 350 L/day while the land-based staff shall be using approximately 650 L/day for a total of 1,000 L/day. Domestic water shall be sourced from the local concessionaire.

1.4.6 Description of Waste Management System for Silt

There shall be no unwanted dredged materials to be disposed of. All dredged materials will be brought to the hauling barge or stockpile for transfer to the mother vessel and transport to the end-user.

In any case, there shall be fugitive silt during the dredging operation because of the disturbance of the riverbed, and hence may cause increase in turbidity. The crew will keep the edge of the suction pipe as close as possible to the riverbed to lessen the agitation of the sand which may cause water quality deterioration. To prevent fugitive sediments and disturbed riverbed materials from being carried into other river sections, filtering curtains shall be installed in strategic points. Sediment filters will also be positioned in front of the estuary to sift sediment-laden water. If river streams are flowing rapidly during the rainy season, the measures will include installation of catchment basins where sand-laden waters are diverted and contained for sediment extraction. Loose soil runoff and sediments from riverside facilities will be sieved through filters before water is discharged into the waterways. Such loose soils will be piled up and can be re-used in reforestation areas in riverbanks. Erosion control measures that will include trench diaphragms, revegetation activities in slopes and open areas along the riverbanks will also help arrest siltation. The stabilization of river water where dredging has occurred will be enhanced through improvement of river flow velocity through riverbed compacting and slope stabilization. Construction of sediment controls such as silt fencing or revetments that will prevent riverside scouring and to collect soil particles in loose river bends and in sluggishly flowing portions will be instituted where required.

If silt curtains and other containment enclosures are not possible, the dredging shall be limited during periods of calm winds or low tides as the rate of spread of silts and suspended solids will be much lower due to the limited mixing.

In the stockpile area, perimeter silt fences are to be placed prior to the placement of the dredged materials to control potential silt-laden surface runoff from leaving the piles. The stockpiles are to be placed away from drainage channels and conveyances. A buffer zone of about 1 meter will be established between the edge of the pile and the surrounding silt fence, which will be vegetated whenever possible. Moreover, it shall be temporarily seeded if anticipated to be inactive for a period of 15 days or more.

1.4.7 Description of Waste Management System for Domestic Wastes

The dredging activities are predicted to generate various wastes. The waste management measures for each are listed in the table below.

Table 1-5. Waste Management Approaches

Waste Type and Quantity	Waste Management Method	Frequency
A. Solid and liquid wastes from the Crew of Dredging Vessel and Anchor Boat:		
1. Food wastes 5 kg/day	Both the dredger and the anchor boat will be required to incorporate a sink shredder, such as an "in-sink aerator," which will securely shred food debris before discharging it to sea	Twice a week
2. Plastic and recyclable wastes- 5 kg/day	Waste receptacles will be required for the collection of non-biodegradable and recyclable wastes, the contents of which will be appropriately disposed of by delivering them in properly sealed containers to a normal Municipal Solid Waste collection place	Twice a week
3. Liquid wastes 20 L/day	Human liquid waste must be pretreated at the dredger (onboard bilge system) and barges in line with MARINA rules, which comply with the Philippine Sanitation Code.	in accordance with MARINA Rules
4. Domestic wastewater 20 L/day	These must be free of oil and non-biodegradable elements. Hand washing and light cleaning will be permitted onboard the dredger and anchor barge. The dredger and barge operation's wastewater will be treated in the bilge system necessary on such vessels.	Daily monitoring
B. Waste oil from engine change oil, and waste lubricant 20L/week	These must be carefully gathered, stored, and sealed in receptacles that cannot be opened during bumps and rolling in severe weather. The used oil and lubes shall be later disposed onshore by 3rd Party DENR-accredited transporters and treaters.	These can be collected from the dredger under the supervision of the PCO.
C. Solid and liquid wastes from the Site Office 20 kg /day – solid 50 L/day - liquid	The site office's solid wastes shall be segregated in accordance with R.A. 9003, appropriately contained for collection by the LGU and to be disposed in the municipal sanitary landfill. The sanitary needs of the site Office and Barracks must be met by pre-existing sanitation facilities in the home or barracks to be rented. Additional sanitation facilities will be built to accommodate the other personnel beyond the allowed waste treatment capacity of the leased or constructed barracks or lodging.	Daily or twice weekly, depending on the Municipal garbage collection schedule.

Domestic solid wastes shall be composed of food scraps, paper, plastic, bottles, tin cans, etc. In addition to domestic wastes, a smaller volume of hazardous solid waste will be generated such as damaged spare parts, fluorescent lamps, batteries, empty chemical containers, etc.

The generated solid wastes are segregated according to its category to promote waste minimization. Compost pits and a material recovery facility (MRF) shall be established for proper temporary storage and final disposal of segregated wastes. Temporary storage shall be equipped with cover to prevent the propagation or attraction of pests. Monitoring and recording of volume collected per classification shall be applied. Biodegradable wastes shall be disposed to the compost pit while the recyclable wastes shall be stored in the MRF. Residual wastes shall be disposed to the Sanitary Landfill of San Jose and/or Rizal through their regular waste collection system.

1.4.8 Description of Waste Management System for Hazardous Wastes

Hazardous wastes will be generated during the construction and operation stages of the project from both the land-based or water-based activities including accidental oil spill.

The hazardous wastes shall be managed according to RA 6969. The generated hazardous wastes shall be properly organized in the storage facility such that hazardous wastes with different characteristic shall be sorted, labelled and kept separately. Proper handling of hazardous wastes generated from the maintenance of vehicles and equipment shall be handled, stored and disposed of properly to prevent hazard and contamination. A separate storage for waste oil, lubricants, and other hazardous waste shall be provided. The hazardous waste storage facility shall be built with impermeable of flooring (bund wall), proper ventilation, with oil and water separator and emergency devices. The design of the septic vault for infectious wastes will be impermeability of flooring, fully concrete with plastered walls, floor and cover, and provision of detachable cover for access of disposing infectious wastes. The hazardous wastes shall be temporarily stored in the bunded hazardous waste facility and to be collected, transported and/or treated by a 3rd Party DENR-accredited transporter/treater.

All operating vessel/s will have respective waste management facilities. Every new employee shall undergo orientation on waste management policies of the company. Records of daily visual monitoring and monthly inventory of generated hazardous wastes shall be maintained. Moreover, oil spill kit and fire extinguisher/s shall be made available in the storage facility.

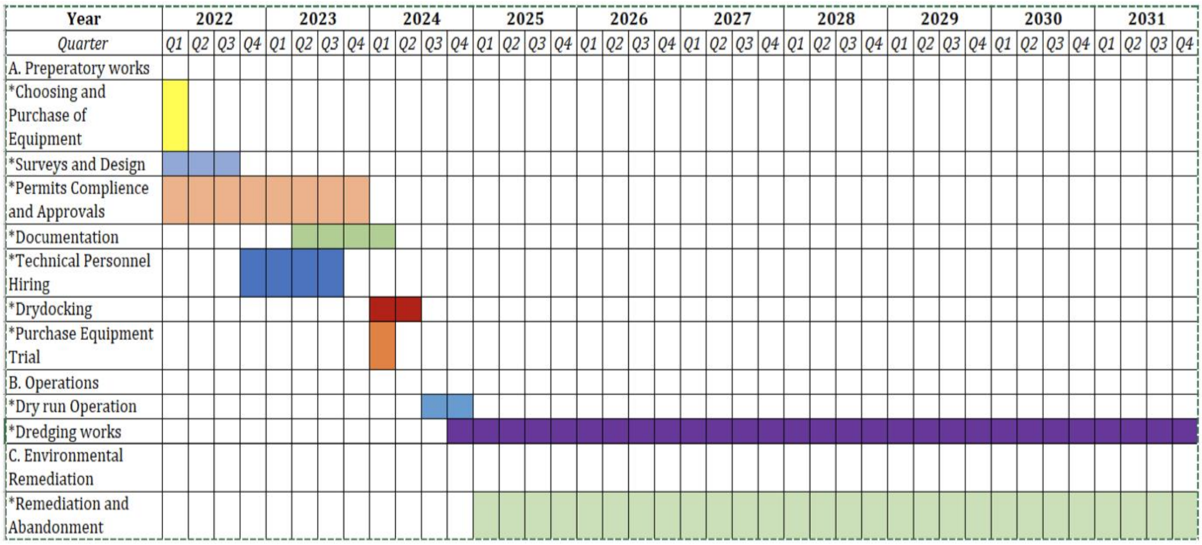
1.4.9 Description of Wastewater Management System

Wastewater in the camp and other project facilities shall be treated in 3-chambered septic tanks. Onboard the dredging vessel and barge, there will be an onboard bilge system for the wastewater. Moreover, the motor pool and equipment staging area shall be equipped with oil-water separators. Waste minimization will be practiced in all aspects of project operation.

1.5 SCHEDULE OF DREDGING

1.5.1 Dredging Activity Schedule

Table 1-6. Project Timeframe and Phases



General Stages of Development and Activities

There will be no site construction during the development stage activities of the dredging operations. Available rented office/staff houses will be used for administrative and management personnel.

For the operation phase, a CSD vessel, loading barges, hydraulic excavators, trucks and payloader will be mobilized to the designated dredging site. All the processes for extraction/dredging will be strictly mechanical, and no chemicals will be used.

<u>Compliance and Selection of Equipment and Personnel</u>
The schedule prior to actual dredging operation spans across 1 year or more. The activities that will be conducted during this time includes the preparation for application and approval of mandatory technical permits and compliance simultaneous to the selection and purchase of necessary equipment, as well as the selection and hiring of technical personnel which will be conducted during the first quarter.

<u>Trial Tests and Dry Docking</u>
Testing of purchased and installed equipment will be in the middle of the 2nd quarter or once the design of equipment is finalized. Drydocking of the dredging vessel will commence once the approval of the Dredging Permit has been released. The target date of the dry run activity of the dredging vessel and barge will be in the 2nd quarter. If there are no other issues and adjustment after the dry run of Dredger, the operations will commence in the mid- 3rd Quarter of the year.

<u>Start of Operations</u>
The river sand dredging is estimated to commence after the successful dry run of the dredging vessel.

1.5.2 Indicative Project Lifespan

The preliminary implementation schedule is presented in the Gantt chart in **Table 1-7** above. After the full acquisition of all permits and clearances, it is estimated that the operation or the dredging works shall take ten (10) years based on permitting limits subject for renewal or until such time that the river restoration is deemed adequate. Dredging will be active until the river restoration is accomplished in accordance with the Approved Dredging Plan wherein the projected dimensions and specifications of the dredging channel of Busuanga River are achieved and maintained and the river restoration is sufficient. Maintenance dredging may later be required to address the continuous replenishment to ensure the effectiveness and efficiency of this flood mitigation measure. This will depend on the evaluation of the DPWH and the IAC.

1.5.3 Project Size

The proposed project covers approximately **538.29 hectares** for the onshore and **70.82 hectares** for the offshore area (navigation zone) for a total of **609.11 hectares**.

Project Area (onshore)	538.29
Project Area (offshore) Navigation Zone	70.82
TOTAL PROJECT AREA	**609.11**

Inside the onshore project area is the River Dredging Zone which covers 175.69 ha along 10.55 line km divided into 2 sections as bellow:
Section 1 - Main Channel (Sta 1+050 to Sta 9+000)
Section 2 - Branch (Sta 0+950 to Sta 3+550)

Estimates of Volume of Dredging Materials and Extraction Rate
The initial volume of materials needed to be dredged to a level that will enable the carrying capacity of the river to handle 100-Year storms without overbanking / flooding was estimated at 4,538,686.02 m^3. This is broken down into the main channel at 3,876,537.17 m^3 and the branch at 6,62148.85 m^3.

For the navigation zone, the total volume of sand materials to be initially dredged out to create a navigable lane was estimated at 2,536,078.67m^3.

The extraction rate based on the approved dredging plan for the river is **4,538,686.02** m^3/annum. For the navigation zone, the entire volume stated above shall be extracted within the first six months, before starting the river dredging.

1.6 GENERAL STAGES OF DEVELOPMENT AND ACTIVITIES

1.6.1 Planning / Pre-Operations Phase

Project planning, pre-operation and preparation phase will include the following activities which are not expected to generate adverse environmental impacts.

1. Information, Education and Communication Activities
2. Securing agreements with other permit holders in the area, as necessary
3. Other Government Permitting and Clearance Requirements such as the LGU
4. Detailed Operations Planning
5. Detailed Safety Procedure Planning for Dredger and Anchor Boat
6. Detailed Environmental Management Plan preparation.

1.6.2 Construction Phase

The proponent shall be looking to rent existing houses in the area for use as site office, employees' quarters, motor pool, warehouse, and fuel storage. In any case, improvements or addition of other structures may be needed. The stockpile area shall be constructed in Brgy. Adela in the island between the main channel and the branch.

1.6.3 Operation Phase

The actual dredging operation shall start with the seabed dredging at the navigation zone using a CSD to open up a shoreline entry channel. If structural/geotechnical slope stabilization measures are necessary, this shall likewise be installed in appropriate location and to be undertaken in dry season.

Once the navigation zone dredging is completed and the CSD can navigate into the river, the river dredging phase will commence. The pilot channel is to be dredged by an amphibious dredger according to the approved DMP. The river deposits are piped by hydraulic means to waiting barge/s near shoreline. A repetitive removal of sediment by dredger from the river mouth going upstream and by mechanical method in shallower parts of the river (starting at approximately 3 km from river mouth and extending upstream), stockpiling, conveyance of dredged materials to hauling barge by hydraulic means and dump trucks to mother vessel, and haul out of dredged material by mother vessel to designated disposal site. The repetition continues until the design elevation and configuration are attained.

Execution Plan of the Project Based on the Approved Dredging Plan
Dredging will start from the proposed navigation zone simultaneously creating an entry point/opening and navigational channel for the dredging vessel. Dredging is then to continue within the designated pilot channel starting at Sta 1+050 (mouth) going upstream of the main channel (Section 1) to Sta 9+000. For Section 2, the pilot channel shall be from Sta 0+950 to Sta 3+550 of the southern branch of Busuanga River. Please refer to **Figures 1-17** to **1-25** above.

The dredging parameters such as width and depth of excavation shall be in accordance with the Approved Dredging Master Plan. An "As-Staked" plan shall be prepared by the Project Proponent in accordance with the provisions of DPWH D.O. NO. 15, Series of 2016.

1.6.4 Demobilization Phase

This is a river-restoration project to mitigate flooding problems in the area. As such, continuing implementation may be necessary for its maintenance. However, the life of the project is limited to permitting specifications. The estimated project duration is 10 years subject for possible renewal.

In the event that this project will be terminated, the demobilization phase refers to a particular period after dredging operations when the Proponent will have to stop operations, vacate the site and turn over the area/completed project to the government. The phase will involve final inspection, turnover and acceptance of completed structures and equipment, clean-up, and demobilization. Dredging equipment dismantling, sifters, loads, containers and other works and debris shall be properly collected and disposed of. A decommissioning and abandonment plan will be drafted and presented to the stakeholders for consultation and subsequent finalization. This is to ensure acceptability among the locals of the plans for the temporary structures. This plan shall only be implemented in the unlikely event that operating and maintaining the project is no longer feasible.

The abandonment plan will specify the dismantling, recovery and/or relocation plans for the various equipment, and development plan of the area as well as the accountabilities of RC-GPC.

The abandonment or the decommissioning plan of the project will be limited to the removal of the CSD and other equipment plus the other constructed support facilities. Replenishment of the materials at the river bottom will occur naturally. Since the project has a very minimal impact on the environment, both during the operations and after project life, the proponent shall instead focus on environmental enhancement activities such as rehabilitation of existing denuded areas within the project area. If absolutely necessary, flood mitigating measures may be done on the bank of the rivers to prevent any erosion in the future.

Before the Proponent will relinquish the project, it shall request the EMB or the Monitoring Team to witness the final water quality sampling at designated monitoring stations and the status of decommissioning activities to confirm Project compliance to environmental standards.

1.7 ORGANIZATION, MANAGEMENT AND MANPOWER

1.7.1 Organizational Structure and Management

This section contains the necessary instrument to create a proactive institutional requirement to ensure compliance with environmental regulations and policies and implement environmental safeguards and commitments. In the process of monitoring and evaluating post-EIA requirements and commitments, as well as other environmental regulations, it is critical to establish a capable and competent unit/group with clearly defined roles. For a long-term Project operation, it is critical to identify and provide the group that will implement the requirements.

In coordination with all divisions of the organization, the Environmental Protection and Enhancement Team of the Health, Safety, Environment and Community (HSEC) Division shall spearhead the implementation of the proposed Environmental Management Plan (EMP) for this project. Its main goal is to ensure that environmental, socioeconomic, political, and public health issues are addressed properly and promptly. It establishes the necessary mechanisms to strengthen the proponent's organizational relationship with its government partners, private sector and stakeholders.

Furthermore, the Company is committed to providing a safe and respectful workplace for all employees, free from any form of discrimination or harassment. Policies and procedures will be in place to address and prevent any incidents of bias or unequal treatment, fostering an atmosphere of professionalism and mutual respect among all team members.

Through this approach, Royal Crown-Groundport and Partners Corporation aims to build a cohesive and diverse workforce that can effectively contribute to the success of the Busuanga River Dredging Project while upholding the principles of equality, inclusivity, and equal opportunities.

Below is the indicative organizational structure for the Busuanga Dredging Project.

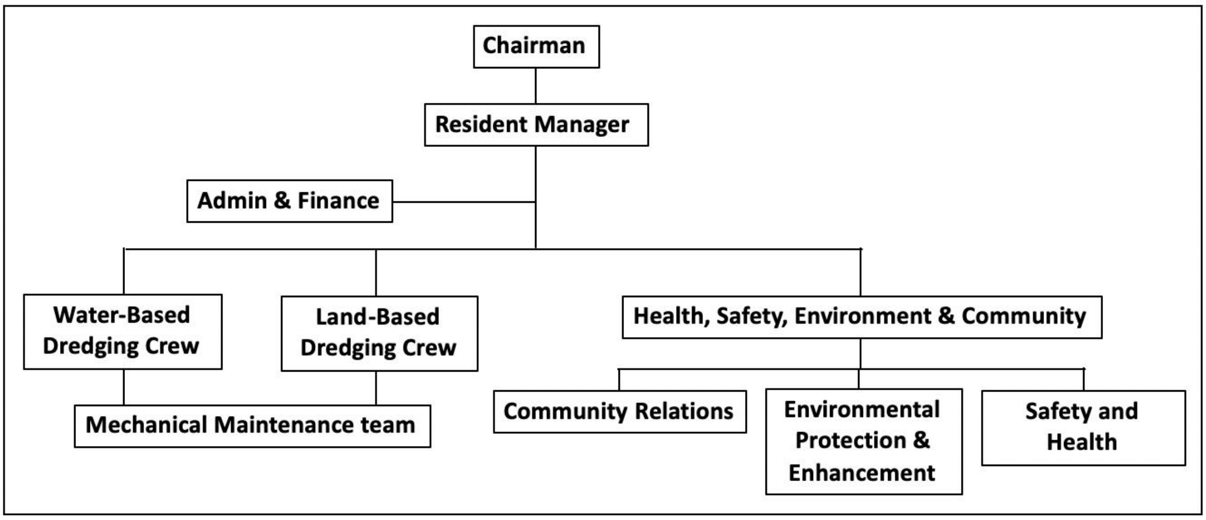


Figure 1-29. Organizational Chart

Accountabilities of the Principal and the Contractor

The JV (consortium) of Royal Crown-Groundport and Partners is the accountable entity in the implementation of this dredging project as well as in the compliance to legal, technical, safety, environmental and safety commitments attached to the project.

The consortium shall likewise be the Dredging Contractor itself. There shall be no 3rd Party Dredging Contractor involved.

1.7.2 Projected Manpower Requirements

Approximately 5 to 10 workers during construction and 60 personnel during dredging operation will be needed for the project.

There will be no major construction of structures since the Company will be renting existing houses for their support facilities. It will hire a few skilled and non-skilled construction workers for the needed improvements only. Subject to eligibility, the local labor force (both from primary and secondary impact areas) shall be given employment preference. In coordination with barangay officials, the basis for hiring includes skills qualifications, experience and good moral character.

To effectively carry out the dredging operations, 43 personnel will be employed. These individuals will be responsible for operating the dredging equipment, managing the dredge pump, controlling the cutter, and ensuring the efficient and safe execution of the dredging activities. The dredging team will work collaboratively, following best practices and adhering to environmental regulations to minimize potential impacts on the surrounding ecosystem. This is to be composed of CSD-based dredgers (43) and those using the backhoe-dump truck tandem (20).

For land-based support work, a total of 12 workers and personnel would be allocated. This consists of the management and the HSEC.

The Proponent guarantees equal employment opportunities for men and women who meet the physical strength requirements of the work. The aim is to create a diverse and inclusive workforce that benefits from a wide range of skills, experiences, and perspectives. By providing equal opportunities to qualified female employees, RC-GPC seeks to foster a supportive and empowering work environment that values and appreciates the contributions of all its team members. It shall not discriminate against others based on their legally-protected traits such as age, race, ethnicity, religion, disability, marital status, or sexual orientation. There will be a review of jobs that were normally associated for men and make them obtainable for women as well. The Company shall exert a conscious effort to maintain inclusivity and diversity in the workforce.

In the future, the Company will provide On-the-Job training possibilities for local and provincial workers. Training and upgrading of skills will be provided to the labor pool as part of the sustainability strategy. Also, the relevant provisions of the DOLE shall be complied with.

The manpower requirements during the construction and operation phases of the project are presented in **Table 1-7**.

Table 1-7. Manpower Requirements

Personnel	Pax	Assignment	Male	Female
Management and Support	**12**			
Project / Resident Manager	1	Land-based	✓	✓
Administrative Officer	1	Land-based	✓	✓
Accountant	1	Land-based	✓	✓
Logistics and General Services Officer	1	Land-based	✓	✓
Pollution Control Officer	1	Land-based	✓	✓
Safety & Health Officer	1	Land-based	✓	✓
Community Relations Officer	1	Land-based	✓	✓
Clerk	1	Land-based	✓	✓
Messenger/ Utility	1	Land-based	✓	✓
Cook	1	Land-based	✓	✓
Drivers	2	Land-based	✓	✓
CSD Dredging Crew	**20**			
Dredge Master III	2	Vessel-based	✓	✓
Dredge / Tug Master II	2	Vessel-based	✓	✓
Docking/ Rigging Foreman	2	Vessel-based	✓	N/A
Dredge man Foreman	2	Vessel-based	✓	N/A
Communication Eqpt Operator II	2	Vessel-based	✓	✓
Marine Engineer	2	Vessel-based	✓	✓
Dredge man II	2	Vessel-based	✓	N/A
Dredge man I	4	Vessel-based	✓	N/A
Electrician	2	Vessel-based	✓	✓
Land-based Dredging Crew	**20**			
Backhoe Operators	5	Land-based	✓	✓
Truck Drivers	15	Land-based	✓	✓
Anchor Barge Crew	**3**			
Launch Patron	1	Vessel-based	✓	✓
Dredge man II	1	Vessel-based	✓	N/A

Personnel	Pax	Assignment	Male	Female
Marine Engineer	1	Vessel-based	✓	✓
Maintenance Crew	**3**			
Maintenance Supervisor	1	Vessel-based	✓	✓
Mechanics	2	Vessel-based	✓	N/A
TOTAL	**60**			

Management and Administrative Personnel
The total number of management and admin personnel is 9. The management and admin personnel consist of the Project/Resident Manager, Administrative Officer, accountant, Logistics Officer, clerk, utility, cook and drivers. This team shall be responsible for overseeing the overall operations, project management, and administrative tasks. This team will ensure the smooth coordination and execution of the project, adhering to timelines, budgetary considerations, and quality standards.

Health and Safety, Environmental and Social (HSEC) Team
The HSEC shall comprise the Health & Safety Officer, Pollution Control cum Environmental Officer, Community Relations Officer and staff.

Vessel, Barge and Land-based Operations Workforce & Support Group
The dredging operations workforce consists of Dredging Supervisor, Maintenance Supervisor, Equipment Operator, Dredge Master, Backhoe Operator, Wheel Loader Operator, Dump truck Driver, Docking and Rigging Foreman, Dredgerman Foreman, Welder, Electrician, Warehouseman/Lube man, Data Encoder, Checker, Communication Equipment Operator and Dredge man.

Maintenance
Repair and Maintenance Crew shall be headed by a Maintenance Supervisor and will report directly to the Operations Manager on the Predictive & Preventive Maintenance of the vessel and support equipment.

1.7.3 Relationship of the Proponent with the Government and with the Dredging Contractor

The JV of Royal Crown-Grouundport and Partners Corp. will be the Project Proponent while the Provincial Government, together with the IAC on River Restoration shall have regulatory and monitoring powers over the Proponent. As discussed in Section 1.7.1 above, RC-GPC shall be the primary and sole accountable entity in the implementation of the project and in complying with all legal, technical, safety, environmental and safety commitments/conditionalities attached to it. The RC-GPC consortium shall conduct the dredging operations itself, and hence, there will be **NO** 3rd Party Dredging Contractor.

1.8 INDICATIVE PROJECT SCHEDULE AND COST

The indicative project cost for the Busuanga River Dredging Project is estimated at **603,310,000.00 Pesos** and broken down in **Table 1-8**.. The indicative project timeline is shown in **Table 1-7** above.

Table 1-8. Breakdown of Indicative Capital Investment Cost

Description	Amount (PHP)
Permitting	12,000,000
Water-based equipment	300,000,000
Land-based equipment	150,000,000
Salaries and other Equipment	30,000,000
Social Development Program	5,000,000
Environmental Programs	310,000
Environmental Guarantee Fund	1,000,000

Taxes and Royalties	100,000,000
Contingency Fund	5,000,000
TOTAL	**603,310,000**

SECTION 2. ECOLOGICAL PROFILE AND ASSESSMENT OF IMPACTS OF LAND DEVELOPMENT

2.1 STUDY AREA COVERAGE

The coverage of the environmental study of the Busuanga River Dredging Project is shown in **Figures 2.1-1 to 2.1-3**. This covers the proposed project area itself, the river dredging zone, navigation zone, and extended to its immediate surroundings. The proposed dredging activity is located between the municipalities of Rizal and San Jose, Occidental Mindoro. The Busuanga River is what separates the two towns.

2.1.1 LAND

As shown in **Figure 2.1-1**, the project area is the lower reaches of Busuanga River to the river delta in barangays Adela and San Pedro in Rizal and barangays San Agustin and Central in San Jose because this is where the project site is located. These encompass the RDZ divided as Section 1-Main Channel from Sta 1+050 to Sta 9+000 and Section 2-Branch from Sta 0+950 to Sta 3+550 as well as the navigation zone. It stretches 10.55 line km along the river extending to approximately 500 meters seaward from the river mouth. The project area is likewise shown in **Figures 1-1 to 1-3**.

The onshore limits of the project area is considered the main primary impact area. Numerous sandbars have accumulated within the channel as this is typically a braided type. However, the continuous meandering of the river has led to very frequent changes in the form and dimensions of these sandbars, and are therefore transitory in nature.

Available contiguous houses north of the main channel's river bank in Brgy. Adela shall be rented for use as support facilities such as the field office, staff house, warehouse, equipment staging area and motor pool covering 0.5 hectare. The stockpile area, on the other hand, shall be located south of the main channel near the shore, covering 1 hectare and also within the jurisdiction of Brgy. Adela. These 2 areas are within the proposed project area and therefore primary impact areas as well.

The study area also encompasses the floodplain on both sides of the river channel that are periodically inundated by floodwaters from Busuanga River, and are therefore considered secondary (indirect) impact areas. These areas are mostly agricultural areas with smaller low-density built-up areas.

These areas will benefit from the reduction in the frequency, extent and depth of flooding after some time, as the dredging operation will eventually remove the excess sediments from the river effectively and flood drainage will gradually improve. The impacts in these areas are considered secondary because these will only manifest after sufficient sediment volume have been removed and this flood management measure takes effect.

The study area covers the channel and alluvial floodplains of Busuanga River. These alluvial floodplains are mainly agricultural lands. In terms of ECAs, the nearest critical areas relative to the site are discussed with regards to potential conflict with the project. Natural hazards are reckoned from a regional to local (project site-specific) perspective.

2.1.2 WATER

The project area is limited to the lower reaches of Busuanga River, and therefore, the main study area (**Figure 2.1-2**). In terms of hydrological studies however, the whole watershed (**Figure 1-14**) was covered.

The Busuanga River Basin is the largest watershed system in the SAMARICA area of Occidental Mindoro with a watershed area of around 530.07 km^2. Its main channel, the Busuanga River, forms the boundary between the municipalities of San Jose and Rizal. It originates from multiple tributaries draining across the central mountain range of Mindoro island, that converge southwest to form the main river. The river generally flows in a southwest direction traversing through the hilly landscape of the San Jose-Rizal area, then into the broad alluvial plain of southwestern Mindoro, and exits at Apo East Pass. It traverses the barangays of Manoot, Monte Claro, Batasan, Pitogo, Santo Niño, and Adela in the municipality of Rizal, and barangays Central and San Agustin in the municipality of San Jose.

The lower reaches of Busuanga River, particularly the 10-kilometer stretch from its outlet point, displays a meandering pattern with generally low sinuosity but occasionally forms sharp bends. Farther upstream, the river shows prominent braided morphology as evident in the presence of multiple unvegetated, frequently shifting channels that converge and diverge within a very wide floodplain. The alluvial zone is a meandering and braided river traversing across the floodplain with extensive accumulation zones that are in the form mostly of point bars and narrow, elongated island bars.

There are no Water Quality Management Areas (WQMAs) in the whole Province of Occidental Mindoro, hence, water quality baselining shall be based on primary data gathering. The areas for freshwater sampling covered include the project site itself while the marine waters about 240 to 645 meters from the coastline.

The Freshwater Ecology baseline studies cover the lower reaches of the river downstream of the bridge, or the entire project area and immediate vicinities. Marine Ecology studies cover the coastal area to approximately 3 km from the river mouth.

In the preparation of the Dredging Plan, 50-meter slices of cross sections within the whole project area were drafted detailing the depth/profile of riverbed and water levels.

2.1.3 PEOPLE

In terms of people, the primary impact areas for this proposed project are the areas of barangays Adela and San Pedro in the Municipality of Rizal and barangays San Agustin and Central, Municipality of San Jose that cover the project area and adjacent to it. The households in these barangays will be the first to benefit from hiring priorities, livelihood opportunities and the SDP.

The secondary impact areas extend to the areas of the same 4 barangays that are farther from Busuanga River.

The whole of Rizal and San Jose municipalities are also regarded as a secondary impact area because the socioeconomic benefits that will come from the taxes, hiring and livelihood opportunities could extend to the entire jurisdictions of the two towns.

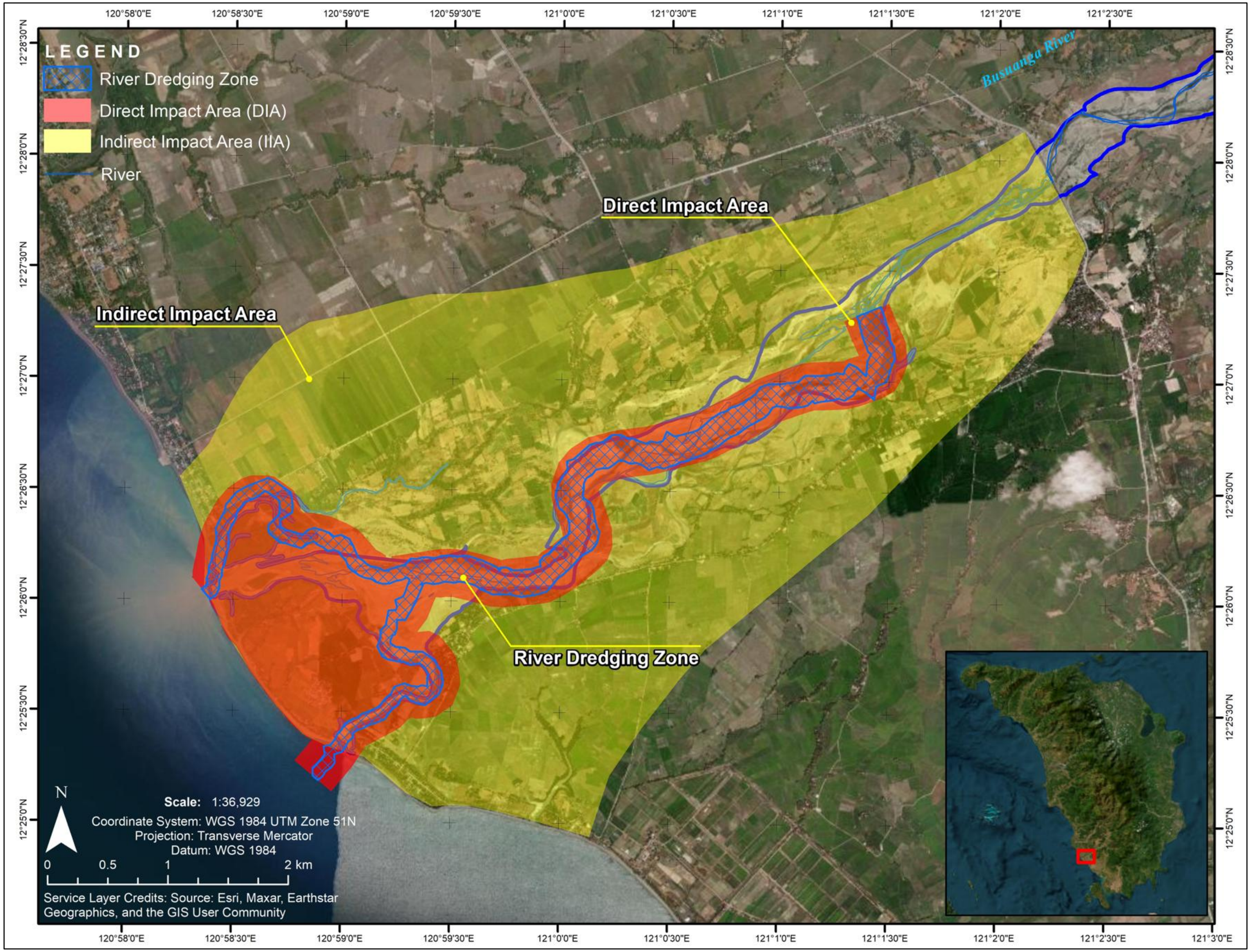


Figure 2.1-1. Study Area Indicating Impact Areas - Land

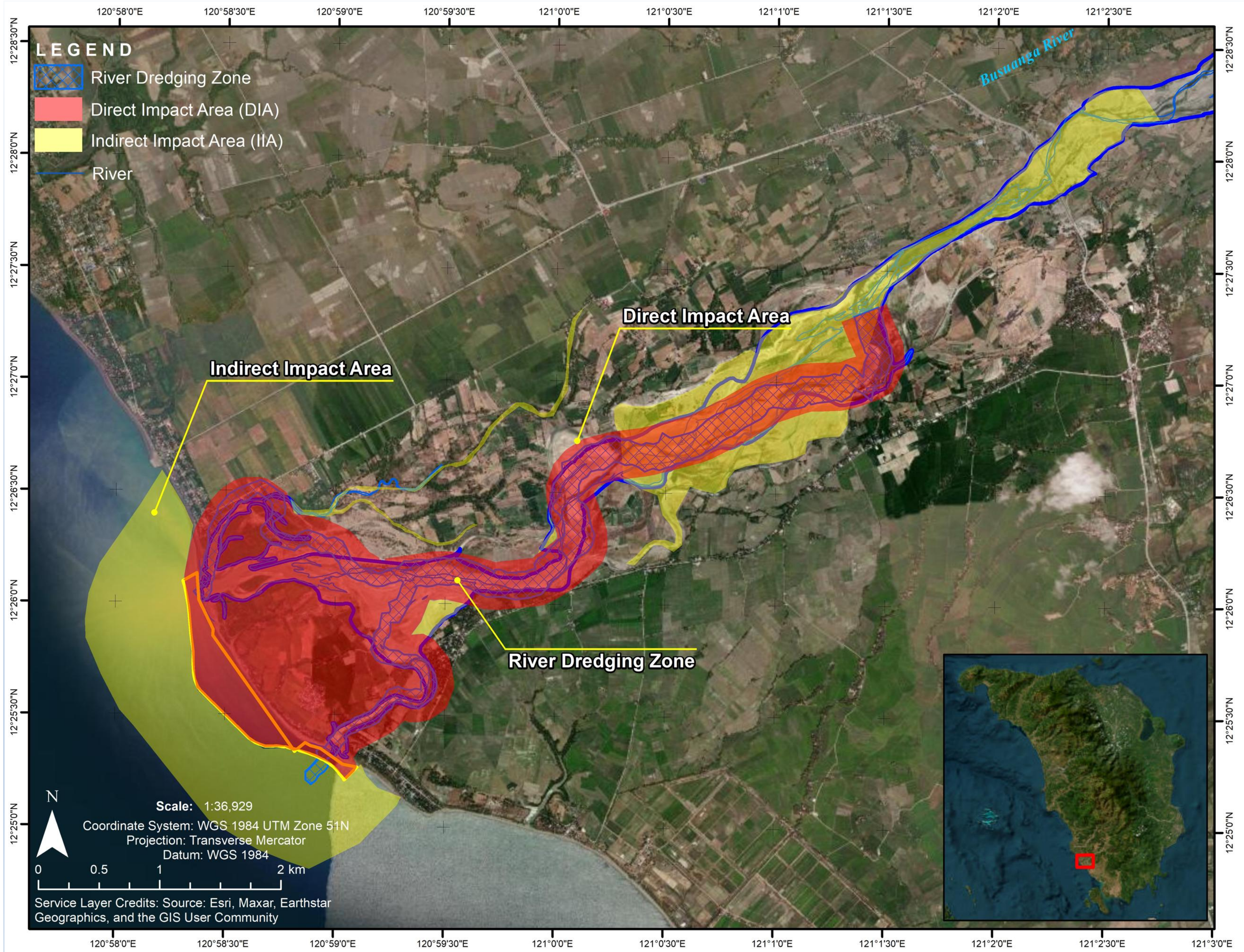


Figure 2.1-2. Study Area Indicating Impact Areas - Water

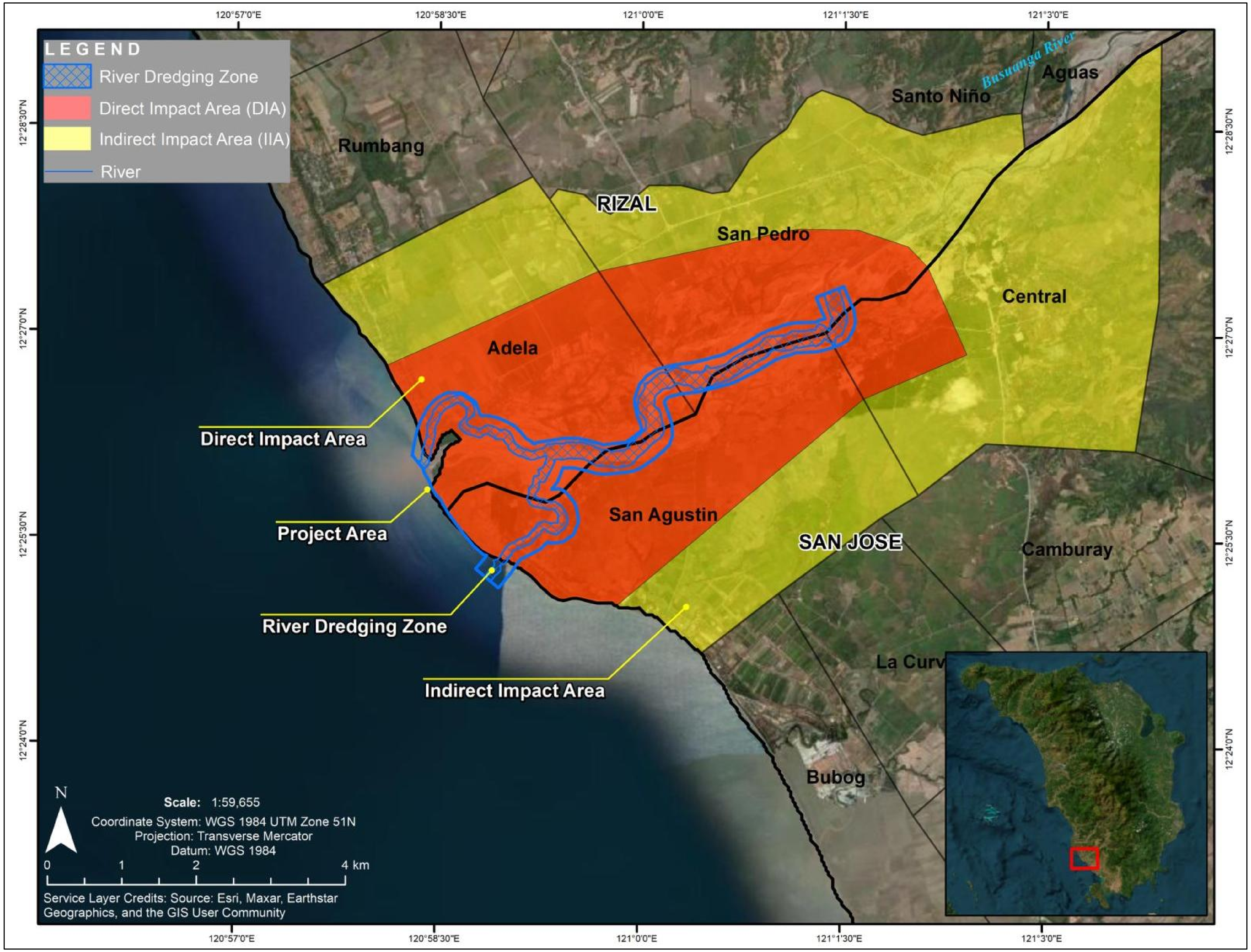


Figure 2.1-3. Study Area Indicating Impact Areas – People

SECTION 2. 2. ECOPROFILE AND ASSESSMENT OF IMPACTS

2.2 ECOPROFILE AND ASSESSMENT OF IMPACTS
2.2.1 LAND

Rizal and San Jose are coastal municipalities in the southern part of the province of Occidental Mindoro. The municipality of San Jose has a land area of 446.70 square kilometers, accounting for 7.63% of the total area of Occidental Mindoro. On the other hand, the municipality of Rizal has a land area of 242.50 square kilometers, which constitutes 4.14% of Occidental Mindoro's total area.

The topography of Rizal and San Jose is generally rugged, with narrow strips of coastal lowlands. Its terrain is characterized by successive mountain ranges, valleys, and elongated plateaus, with rolling lands along the coastal region.

The alluvial plains straddling Busuanga River only spans about 4 km to 8 km gradually going uphill before the gently rolling terrain is truncated by rugged ridges and mountains. The floodplains are predominantly used as agricultural lands, but its frequent inundation brings about continuous losses to the property and livelihood of the locals. The steepness of the slopes in the upstream portion of Busuanga River greatly contributes to the high velocity of surface runoff, and therefore creating a sudden torrent of water into the flat to gently sloping alluvial plains.

Potential Impacts of the Project
This Project is essentially an environmental protection measure in itself because its main purpose is for river restoration for disaster mitigation and flood control, hence the long-term impact is the reduction of flood hazard, and in effect, improved agricultural production in its immediate environs.

In any case, there shall likewise be adverse effects to the surrounding areas due to the project. This includes potential increase in river water turbidity to a level that can decrease productivity of the rice fields when this waters inundate it during typhoons or heavy rains.

There shall be impacts to the households arising from increased noise levels and any other disturbance because there are house clusters (barangays Adela and San Agustin) that are quite proximal to the lower portions (estuarine) of the site. Land-based vehicular traffic will be confined along the side of the river wherein the 10 meters easement from the toe of the river will be used as passage for the dump trucks hauling the sand from extraction point to stockpiling area. For barging, dump trucks hauling the sand from the stockpile area to the barge will pass thru the other side of the river that is uninhabited.

The characterization of the vicinities and possible impacts of the project on land are discussed in more detail in the following sections.

2.2.1.1 Land Use and Classification of Nearby Areas Including ECA

San Jose and Rizal are among the coastal municipalities of Occidental Mindoro. The Busuanga River extends from the municipality of San Jose (San Agustin Section and Central Section) to Rizal (Adela Section).

The landforms mainly consist of limestone and sedimentary rocks. All types of erosion may be present in riverbanks. The project vicinity is characterized by shrubland, grassland, forest plantation, open broadleaved forests, cultivated land, and in-land water area.

Roughly two-thirds of the land cover of San Jose is dedicated for forest growth, while one-fourth is for agricultural purposes. Other uses are for infrastructure, mining and quarrying, agro-industrial, tourism, and special use. A brief overview of the general land use in San Jose as presented in their CLUP is shown in the table below.

Table 2.2.1-1. General Land Use - Municipality of San Jose

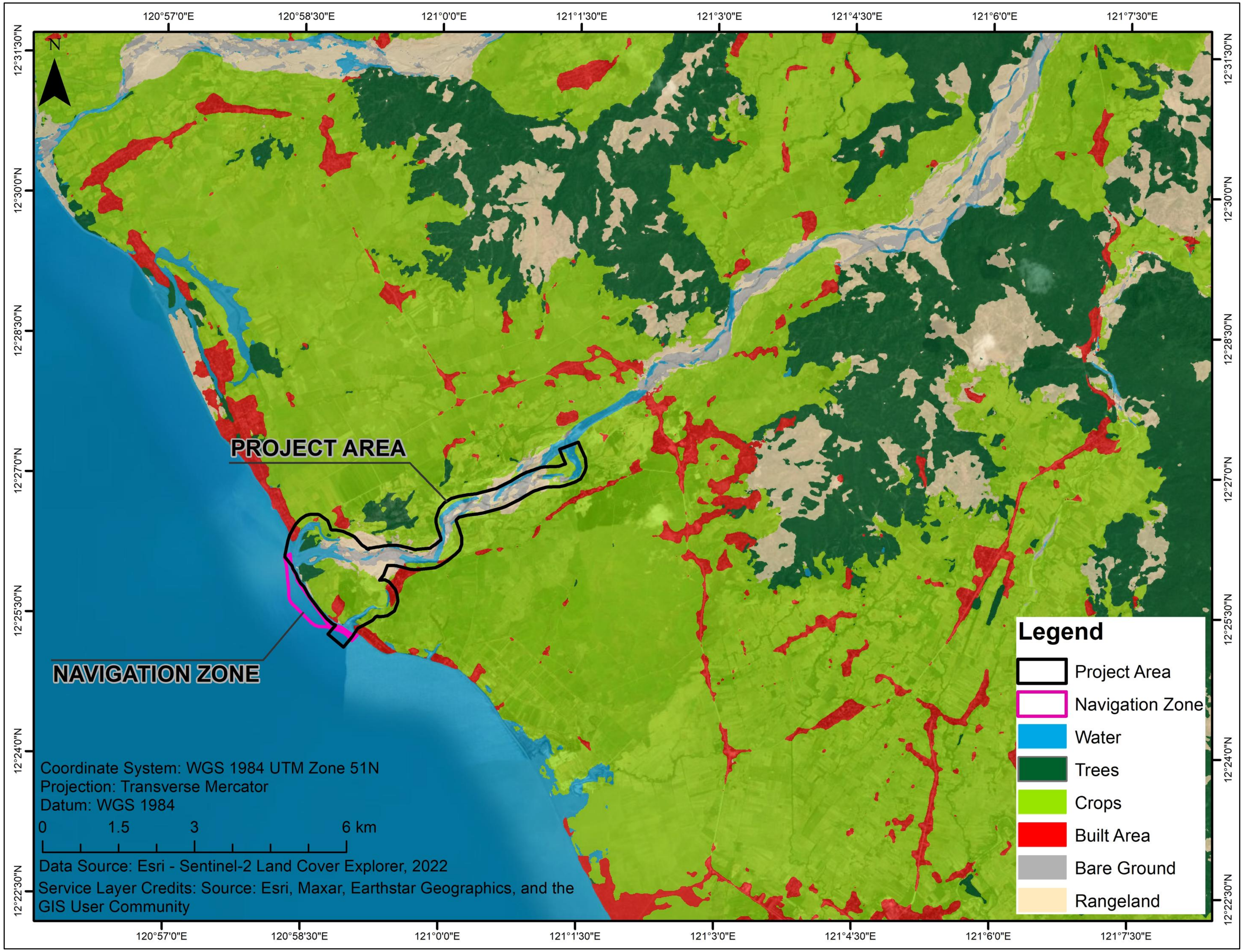
Land Use	Area (ha)	% Distribution
Built-up	3,711.87	5.53
Forest	44,811.37	66.81
Agriculture	17,034.35	25.40
Mining/Quarrying	178.05	0.27
Agro-Industrial	485.00	0.72
Special Use	8.00	0.01
Tourism	228.59	0.34
Others	611.37	0.91
TOTAL	**67,068.60**	**100**

Source: CLUP of the Municipality of San Jose. 2017-2030

On the other hand, the Municipality of Rizal covers an area of 48,700 hectares and is located around 24 km from the town of San Jose. To the south lies the Busuanga River, while the eastern boundary is marked by high mountains separating the two Mindoro provinces, and the west is bordered by the Mindoro Strait. The terrain consists of plains, black sandy beaches along the coast, hills, and valleys. Rivers such as Busuanga and Lumintao serve as natural drainage systems. The highest point, at 728 meters above sea level, is in Brgy. Manoot. Coastal areas and low-lying barangays are generally at an elevation of 3 masl. Rizal is predominantly an agricultural community where 55% of its total land area is being utilized for crop production.

The Project area is largely agricultural sparsely interspersed with human settlement zones. Some of the crop products include rice, corn, onion, garlic, and other root crops. There is also a good portion of livestock and poultry.

Majority of the areas near the project site are annual crops according to the 2020 land cover data of the DENR. Aside from this, residential and commercial areas can also be observed near the estuary and along the roads. In Rizal, the built-up areas located closest to the river are less than 50 meters away. As for San Jose, the built-up areas located closest to the river are less than 100 meters away. Comprehensive Land Use Plans (CLUPs) of Rizal and San Jose show that rice is the major crop grown in the area. See **Figure 2.2.1-1**.



Source: Esri Sentinel 2 Land CoverExplorer. 2020

Figure 2.2.1-1. Project Site vis-à-vis the 2020 Land Cover Map

2.2.1.1.1 Impact Analysis and Options for Mitigating Measures

The dredging project can be considered consistent with both the existing and proposed Land Use Plans of the municipalities of Rizal and San Jose. For either municipality, the covered project area is a “water body”. It needs to continue to provide drainage services to its catchment area and to provide water source for the agricultural lands around it. Inadequate functioning of the river drainage system result in the destruction of agricultural lands and crops, and hence, counterproductive to the development efforts of the government.

This Project is essentially an environmental protection measure in itself because its main purpose is river restoration for disaster mitigation and flood control.

The project site is more than 1.95 km downstream of Busuanga Bridge, hence distant enough not to cause any impact to it. On the other hand, there are existing, ongoing and planned flood control structures along the river built or maintained by the DPWH, some of which will be very near the planned dredging zone (<50m). Since the dredging project is in itself a cooperative venture with the IAC wherein DPWH is a vital member, the proponent shall make sure to conduct a survey during the ground staking in coordination with DPWH and discuss this matter before dredging in that particular station/area. They will have to discuss possible options and come up with the most advantageous in terms of flood mitigation and safety.

Should there be any potential damage to these structures, RC-GPC shall be implementing structural measures for the protection of the infrastructure and the riverbanks, such as the following:

1. Protection measures for the flood control structures, which may include reinforcement measures if absolutely necessary.
2. Bank protection and enhancement measures, which includes revegetation and slope alteration methods.
   - Slope alteration methods may be done to prevent erosion of riverbanks. This includes cut slope, installation of gabions, grading, and artificial fill or backfill, all of which conform to the standard engineering procedures. Bank slopes may also be stabilized by covering or spraying with concrete covered with wire mesh.

2.2.1.2 Encroachment in Environmentally Critical Areas (ECAs)

2.2.1.2.1 Environmentally Critical Areas (ECAs)

The designation of ECAs was meant to set the guidelines for the EIA system and protocols/procedures for projects in these areas and not necessarily for restriction or prohibition of activities/projects therein.

The area is considered environmentally critical due to its vulnerability to flooding, storm surge (and typhoons), liquefaction, and tsunamis. Nevertheless, the main purpose of the project is river restoration or flood control through dredging activities.

The project site does not encroach in any area with: sensitive biodiversity (KBAs); Ancestral Domain; tourist spot; critical slope; recharge area of aquifer; primary agricultural lands, mangroves and coral reefs. However, it is partly within an initial component of protected area; frequently visited by geologic hazards; with minor sustenance fishers present. These factors render the site environmentally critical. Details are shown in the table below.

Table 2.2.1-2. Summary of ECA’s Applicability

CATEGORIES OF ECA	RELEVANCE ON THE PROPOSED PROJECT SITE
1. All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	The proposed Project site is not declared as national parks, watershed reserves, wildlife preserves or sanctuaries. (**Figure 2.2.1-2**)
2. Areas set aside as aesthetic potential tourist spots	NONE. Area is not set aside for aesthetic tourist spot There is no existing tourism development area within or near the proposed project site as per DOT and the CLUP. The nearest ecological tourist destination from the river mouth of the project site are: De Kacks Resort (890m) and X’s Place 2 Beach

CATEGORIES OF ECA	RELEVANCE ON THE PROPOSED PROJECT SITE
	Resort 4.05 km) in Rizal; and Villa Paulina Resort and Spa (6.98 km) in San Jose. (**Figure 2.2.1-3**)
3. Areas which constitute the habitat for any endangered or threatened species of indigenous Philippine Wildlife (flora and fauna)	There are no endangered or threatened species present in the site None. Key Biodiversity Areas are outside and distant from site (**Figure 2.2.1-4**)
4. Areas of unique historic, archaeological, or scientific interests	There are no known unique historic, archaeological, or scientific interests at the project site.
5. Areas which are traditionally occupied by cultural communities or tribes	There is no ancestral domain area within or proximal to the Project site, the nearest of which is 10.58 km to the east (**Figure 2.2.1-2**). The project site is not occupied by cultural communities or tribes.
6. Areas frequently visited and/or hard-hit by natural calamities, geologic hazards, floods, typhoons, volcanic activity, etc.	1. Typhoon – prone 2. Flooding - prone 3. Liquefaction. – prone 4. Tsunami- susceptible, the project site is located along the coast with a nearby tsunami generator. 5. Storm surge- prone 6. Landslide – safe, flat to gently rolling topography 7. Ground rupture- safe 8. Volcanic hazards - safe
7. Areas with critical slopes	None. This is a flat to gently sloping area
8. Areas classified as prime agricultural lands	None. The project site does not fall into this category as it is a waterway. The irrigated lands are on both sides of the riverbanks, which may be considered prime agricultural land.
9. Recharge areas of aquifers	None. Recharge area is located upstream of project site
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.	Sustenance fishing with very low CPUE present at or near estuary.
11. Mangrove areas characterized by one or any combination or 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. areas which act as natural buffers against shore erosion, strong winds and storm floods; e. areas on which people are dependent for their livelihood.	NO mangroves present in the estuary of the project site
12. Coral reef characterized by one or any combination of the following conditions: a. with 50% and above live coralline cover; b. spawning and nursery grounds for fish; c. act as natural breakwater of coastlines	Coral reefs and seagrass meadows are ABSENT

2.2.1.2.2 NIPAS Areas

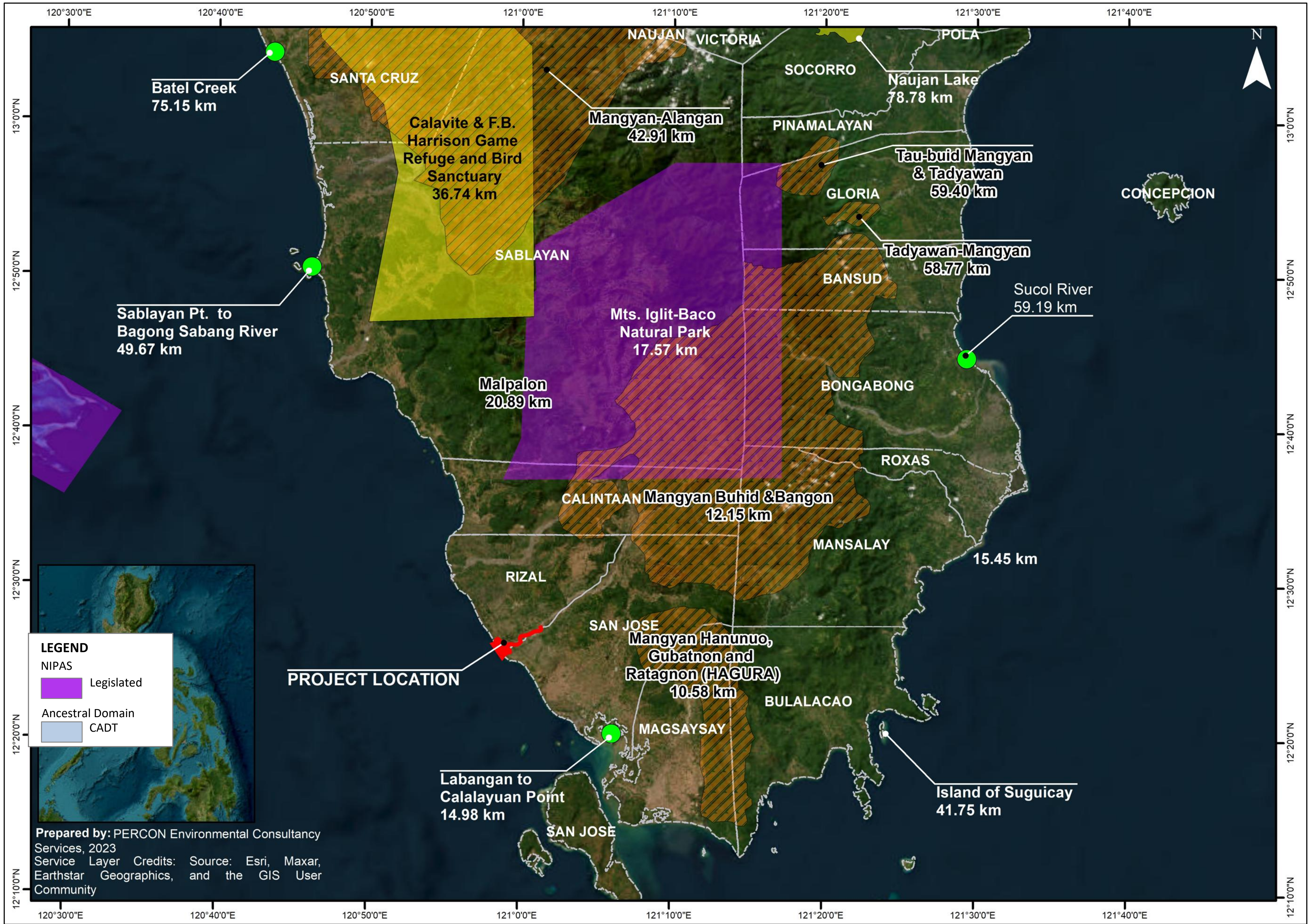
The nearest NIPAS site is Mounts Iglit-Baco National Park (MIBNP) in Occidental Mindoro, and Calavite and FB Harrison Game Refuge and Bird Sanctuary about 17.57 km and 36.74 km away from the project site, respectively. The nearest Marine Protected Area is Ilin-Strait Mariculture Park, about 20 km away from the project site. Since the environmentally critical areas are far from the project site, the Project is not expected to have a significant impact on these areas. Please refer to **Figure 2.2.1-2**.

Moreover, the nearest RAMSAR site is the Labangan to Calalayuan Point in San Jose, which is located 14.98 km to the southeast of Busuanga River.

2.2.1.2.3 Ancestral Domain

Ancestral Domains are areas generally belonging to indigenous. Cultural communities and indigenous people to ICCs/IPs comprising lands, inland, waters, coastal areas, and natural resources therein, held under a claim of ownership, occupied or possessed by ICCs/IPs themselves or through their ancestors, communally or individually, continuously to the present except when interrupted by war, force majeure or displacement by force, deceit, stealth or as a consequence of government projects or any other voluntary dealings entered into by government and private individuals, corporations, and which are necessary to ensure their economic, social and cultural welfare.

There are Ancestral Domain Title (CADT) areas in San Jose and Rizal. Nevertheless, these are distant from the project site ranging from 10.58 km (Mangyan Hanunuo, Gubatnon and Ratagnon) to 12.15 km (Mangyan Buhid and Bangon) aerial distance. See **Figure 2.2.1-2**.



SOURCE: geoportal.gov.ph; data from BMB and NCIP

Figure 2.2.1-2. Distances of Project Area and Protected Areas Relative to Project Area

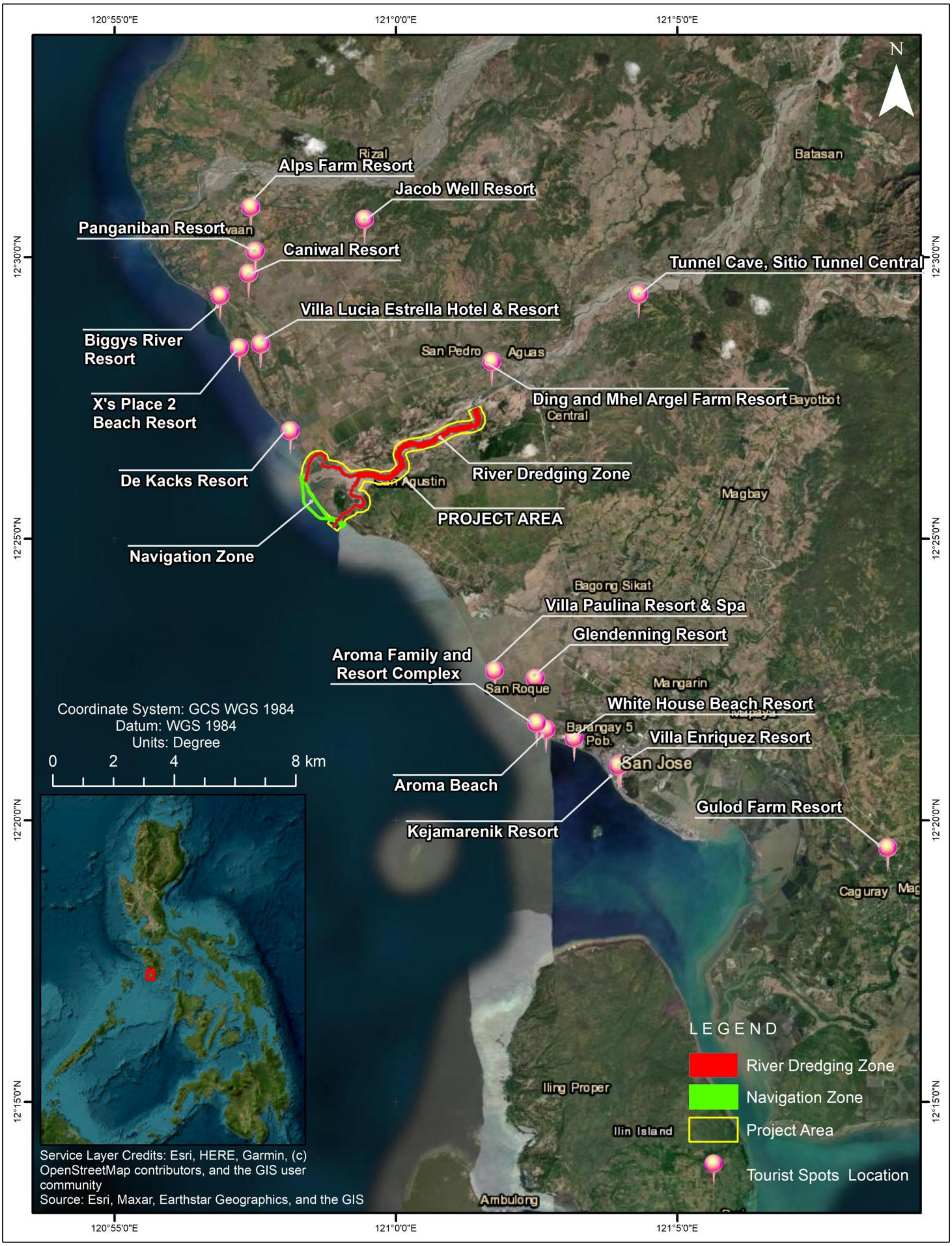
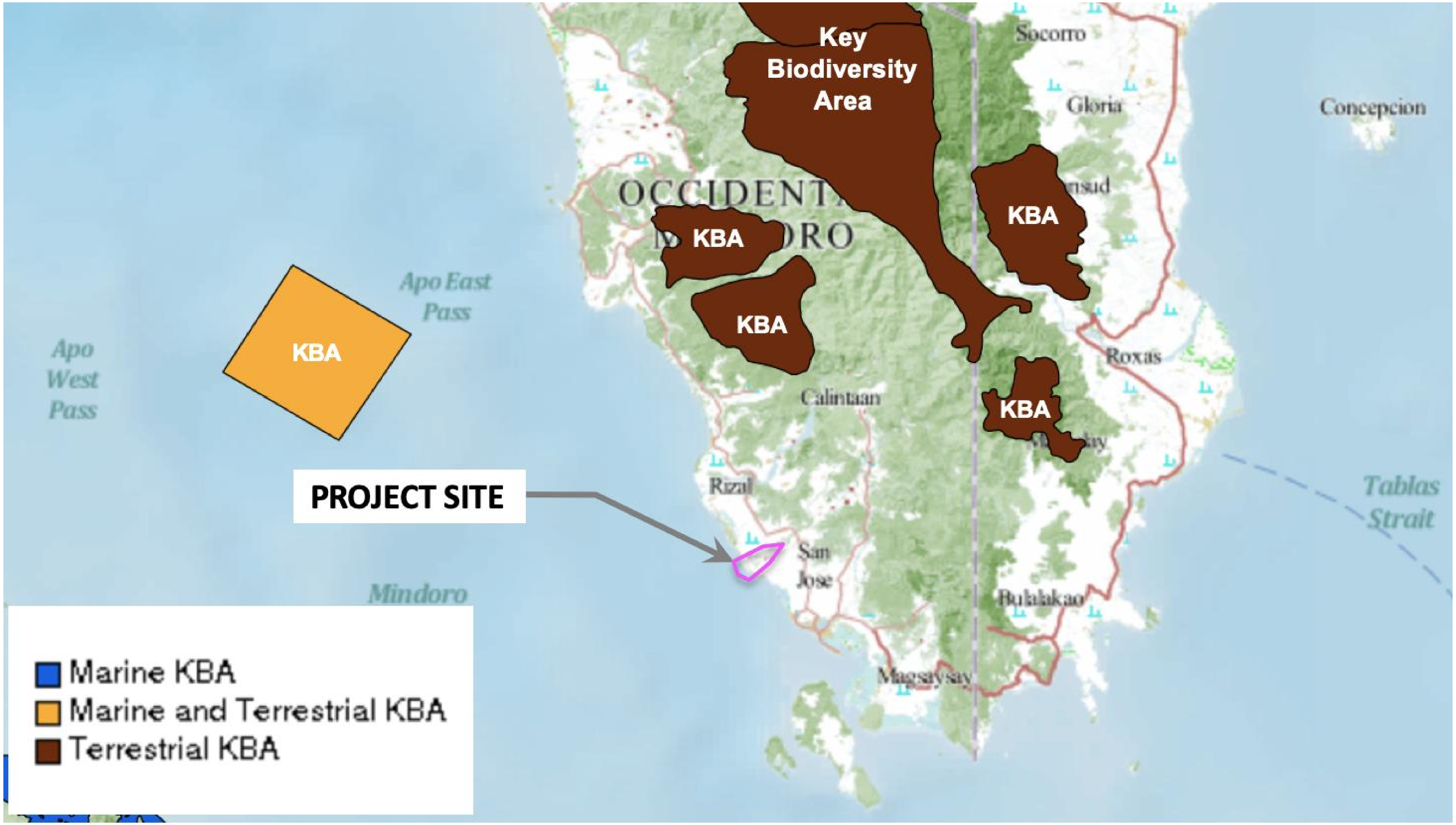


Figure 2.2.1-3. Map of Local Tourism Sites in the Municipalities of Rizal and San Jose



SOURCE: geoportal.gov.ph; data from BMB

Figure 2.2.1-4. Key Biodiversity Areas Map

2.2.1.2.4. Natural Hazards

The table below summarizes the possible natural/geologic hazards with corresponding susceptibility levels of the project area. The entries in the table are based on hazard maps and data from PHIVOLCS, MGB, UP-NOAH, OCHA and PAGASA and the Site Hazard Assessment Report from HazardHunterPH (**Annex 2-C**)

Table 2.2.1-3. Summary of Natural Hazards in the Project Area and Vicinity

Natural/ Geologic Hazard	Hazard Rating	Explanation	Source
Typhoons	Prone	Intensity Three in the Saffir-Simpson Scale – 178-209 kmh (**Figure 2.2.1-6**); 2 TY crossed near the area during the period 2017-2021 (**Figure 2.2.1-7**)	OCHA
Flood	High Susceptibility; 1 to 2 meters flood height and/or more than 3 days flooding.	High susceptibility within the site including active river channels, abandoned river channels, and areas along riverbanks, which are immediately flooded during heavy rains of several hours and are prone to flash floods. Moderate susceptibility in the floodplains. **Figure 2.2.1-8**	MGB
Storm Surge	Prone	Storm surge inundation will affect the estuary or areas in between the 2 river mouths. **Figure 2.2.1-9**	UP NOAH
Earthquake	Prone	Mindoro is transected by the Central Mindoro Fault, Aglubang River Fault and Southern Mindoro Fault. To the north along Verde Island Passage is the Lubang Fault, while the Manila Trench lies offshore to the west of the island (**Figure 2.2.1-5**). Significant earthquake events have affected Mindoro (**Table 2.2.1-4**). Earthquake intensity is degree VII (**Figure 2.2.1-6**)	PHIVOLCS
Tsunami	Prone	Manila Trench, an offshore earthquake and tsunami generator, is located northwest of Busuanga River. Several tsunamis have affected Occidental Mindoro in the past . Site is within tsunami inundation zone with max potential wave height of 5m at the coast. (**Figure 2.2.1-7**) To date, NO tsunami has been experienced in San Jose and Rizal.	PHIVOLCS
Ground Shaking	Prone	Site and vicinity may be affected by ground shaking during earthquake and can be mitigated by following the provisions of the National Building code and the Structural code of the Philippines. The HazardHunterPH website shows that the project site is about 21.2 km from the nearest causative fault, the Southern Mindoro Fault (see **Figure 2.2.1-5**).	PHIVOLCS
Liquefaction	Generally susceptible	According to HazardHunterPH, the alluvial and coastal areas of Rizal and San Jose, including the whole project area are generally susceptible to liquefaction as these are underlain by saturated and unconsolidated alluvial deposits. (**Figure 2.2.1-7**) Based on the subsurface investigation contracted by RC-GPC, liquefaction is unlikely to occur at the Project site. However, there is still a tendency that a liquefaction may occur for the area in between the 2 river mouths (island) because of proximity to the fault line, which can trigger ground shaking of soft unconsolidated sediments, and hence, may lead to	PHIVOLCS

Natural/ Geologic Hazard	Hazard Rating	Explanation	Source
		liquefaction.	
Ground Rupture	Safe	Approximately 21.2 km west of the nearest causative fault, the Southern Mindoro Fault.	PHIVOLCS
Rain-Induced Landslide (RIL)	Safe	Safe – area is gently rolling or with low to moderate slope	MGB
Earthquake Induced Landslide (EIL)	Safe	Safe – area is gently rolling to flat	PHIVOLCS
Volcanic Hazard (Ashfall)	Safe, may be affected by ash fallout	173.4 km south of Taal Volcano. May be affected by ashfall depending on the scale of eruption and prevailing wind direction at the time of eruption.	PHIVOLCS
Severe Wind	117.1 - 220 kph (20-YRP); 117.1 - 220 kph (500-YRP)		PAGASA

The nearest critical facilities from the dredging zone are: Adela Brgy. Hall (54m); Adela Elementary School (276m); Adela Cemetery (1 km); San Agustin Elementary School (303m); San Agustin District 6 Elementary School (1.8 km); Holy Family Academy (2 km); Curanta Elementary School (2.42 km); San Pedro Elementary School (2.4 km); and Pulanglupa Elementary School (2.6 km).

Table 2.2.1-4. Significant Earthquakes in Mindoro and Vicinity from 1970-2021

Year	North	East	Depth	Ml	Mb	Ms	Intensity Reports
1994	13.5	121.09	7		6.1	7.1	Oriental Mindoro -Intensity VIII
2017	13.95	120.528	176	5.6	6.5	6.3	Intensity IV - Calapan Sablayan &; Mamburao OccMin; Calapan and Naujan OrMin; Intensity Iii - Puerto Galera OrMin; Abra De Ilog and San Jose OccMin
2020	13.76	120.53	107			6.3	Intensity VI- Lubang OccMin; Intensity V- OrMin; Paluan OccMin.
2021	13.71	120.57	111			6.6	Intensity VI - Mindoro; Calapan City Puerto Galera And San Teodoro OrMin; Calintaan OccMin

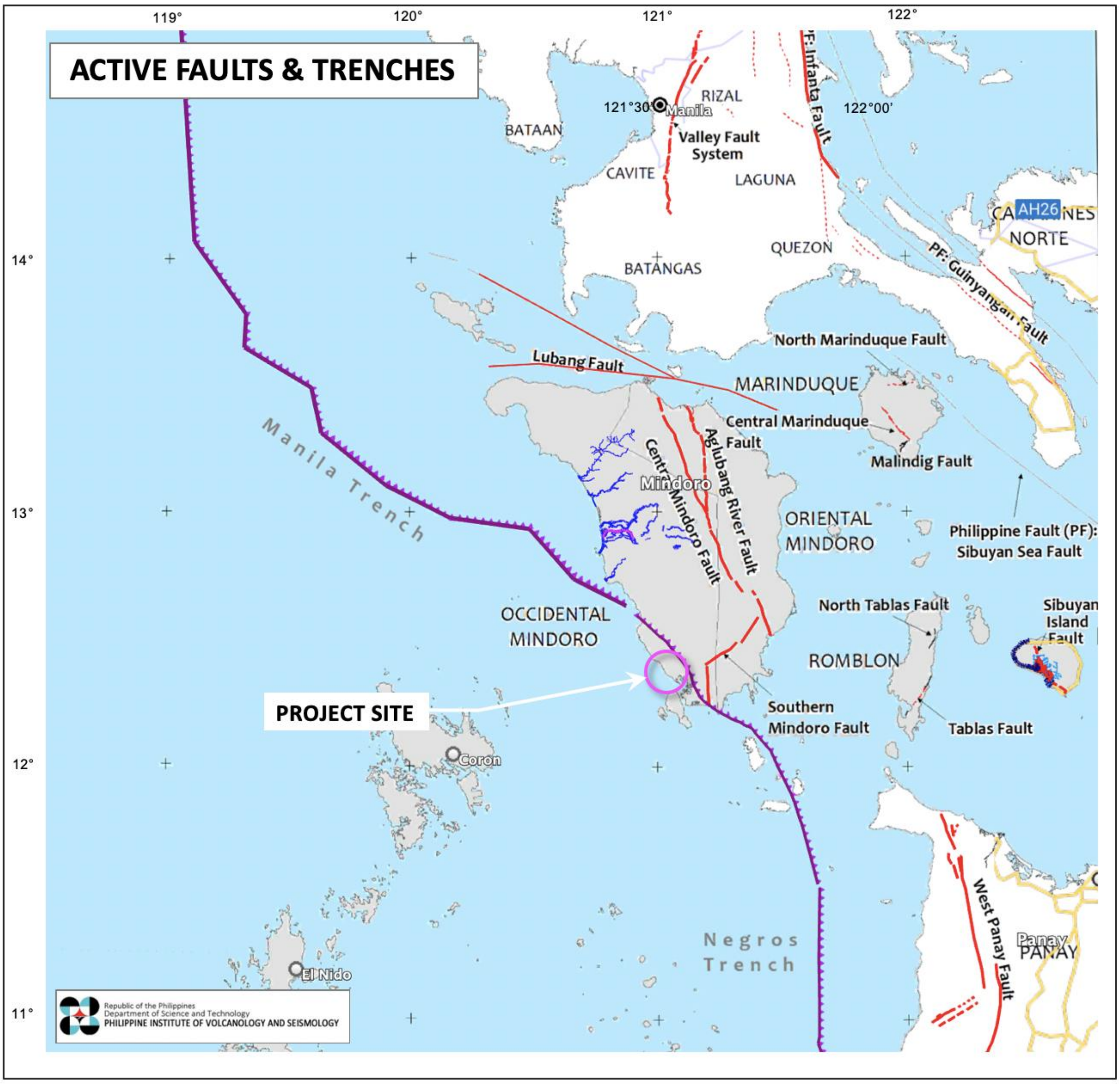
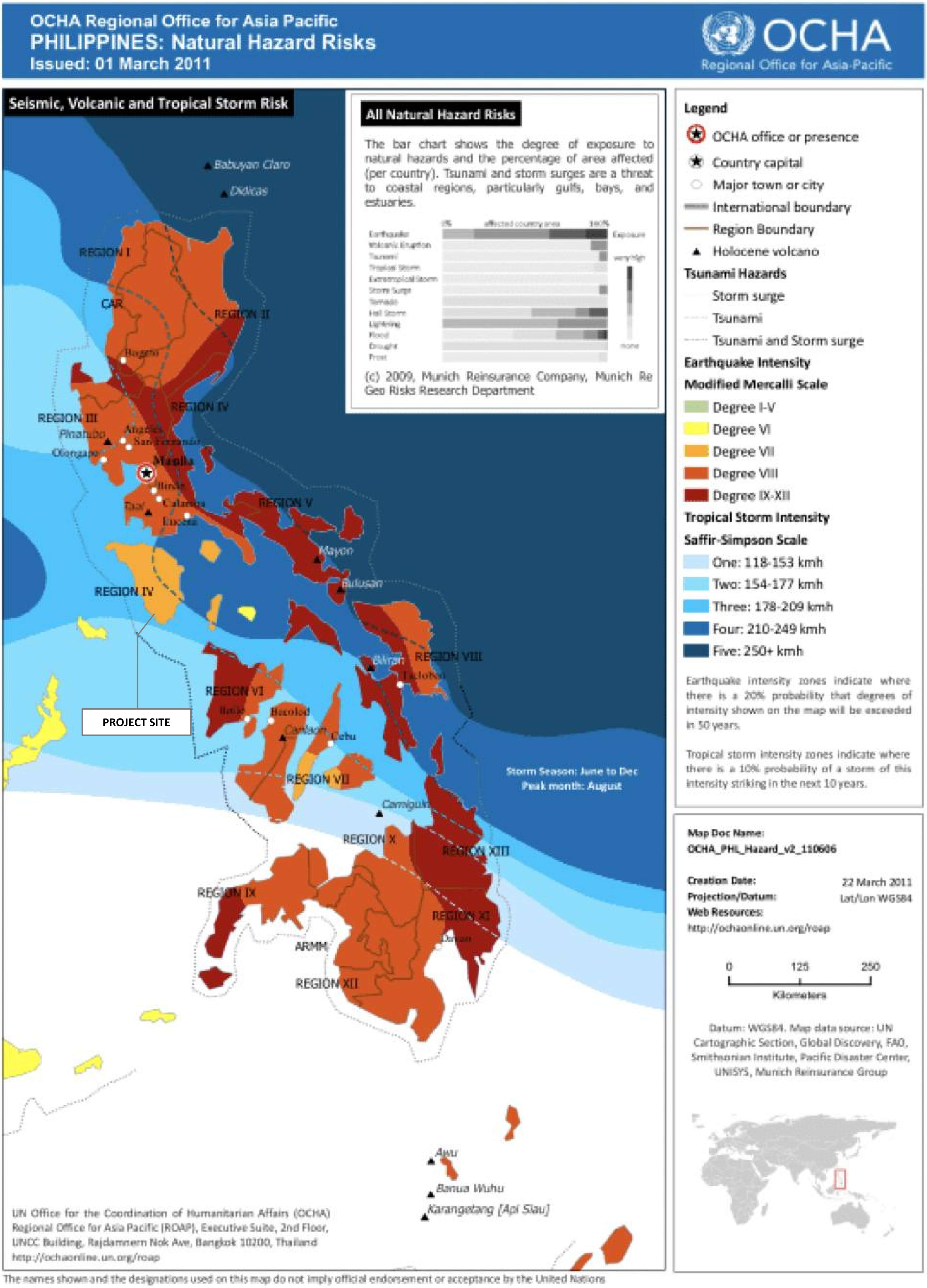
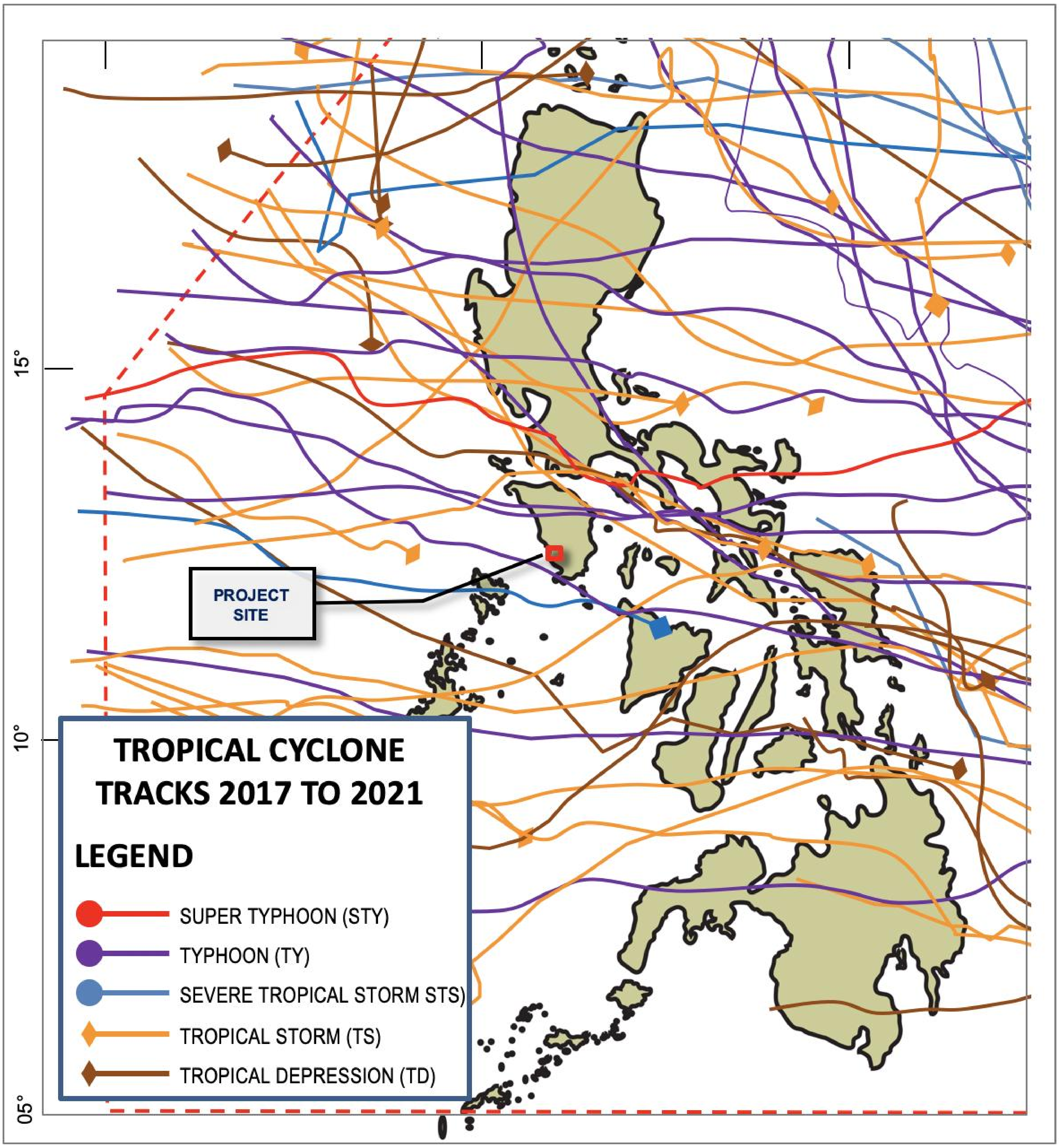


Figure 2.2.1-5. Active Faults and Trenches in Mindoro Island and Vicinity



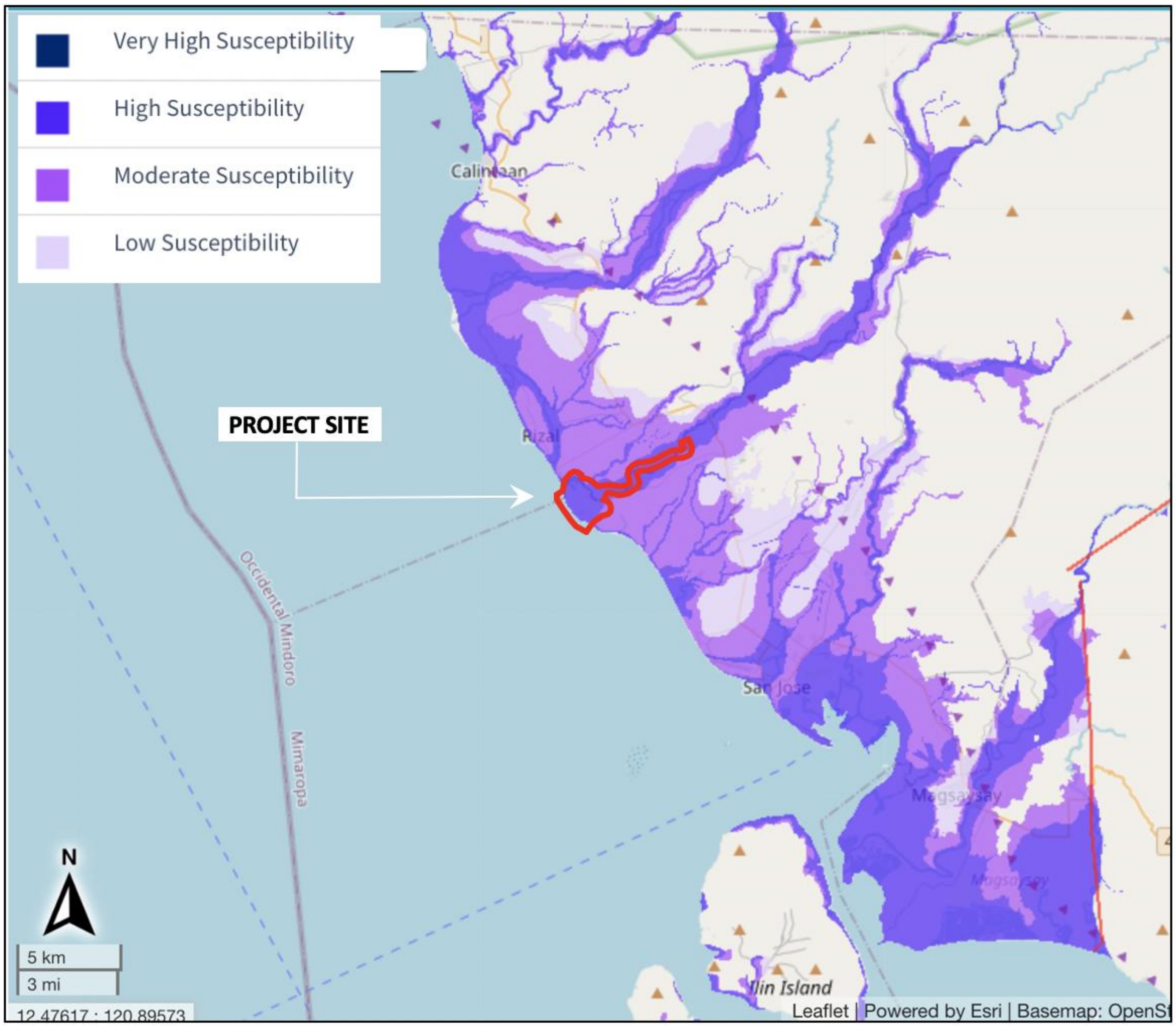
Source: OCHA. March 2011

Figure 2.2.1-6. Natural Hazards Risk Map of the Philippines



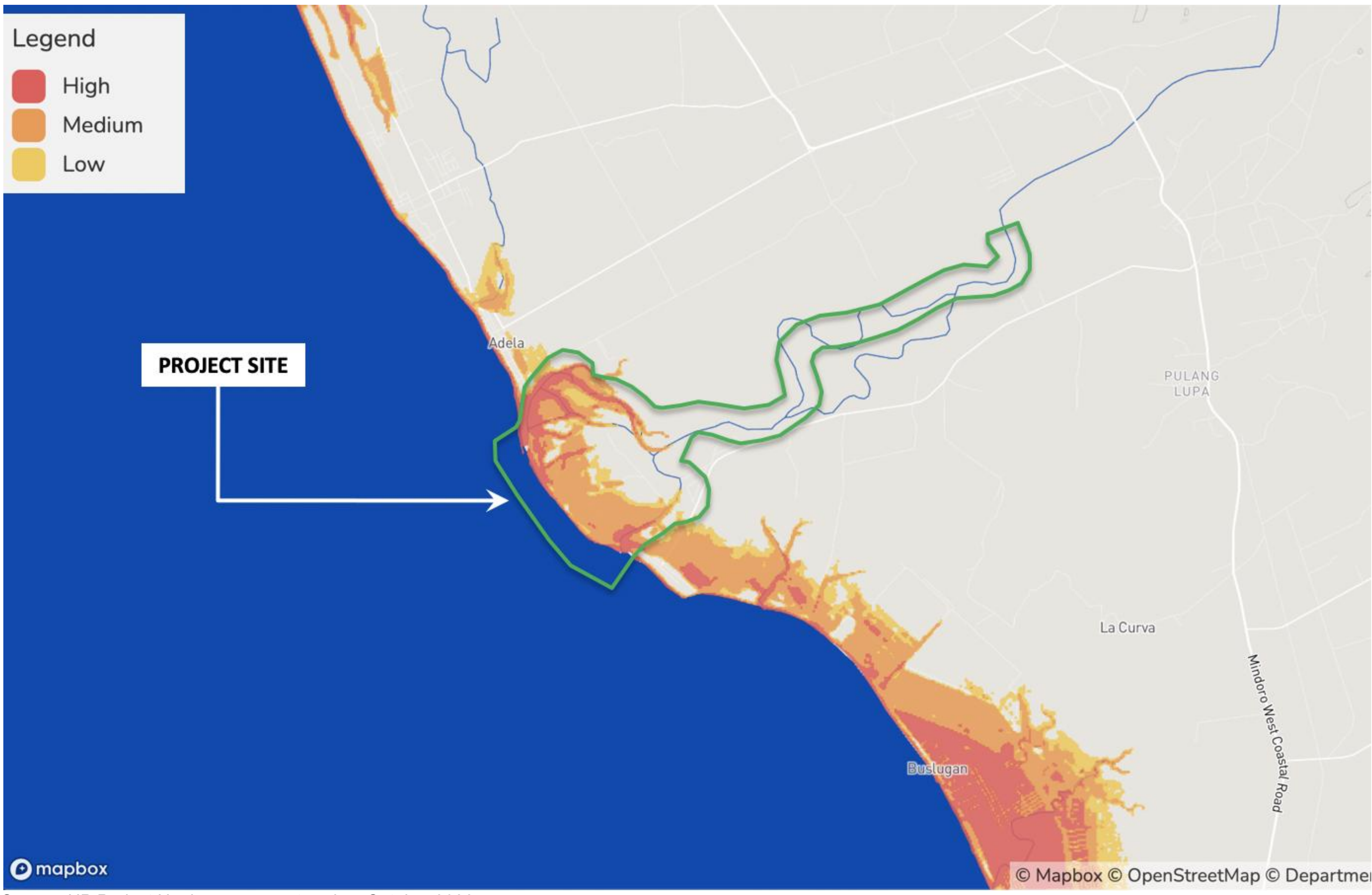
Source: PAGASA

Figure 2.2.1-7. Track of Tropical Cyclones in the Philippines – 2017 to 2021



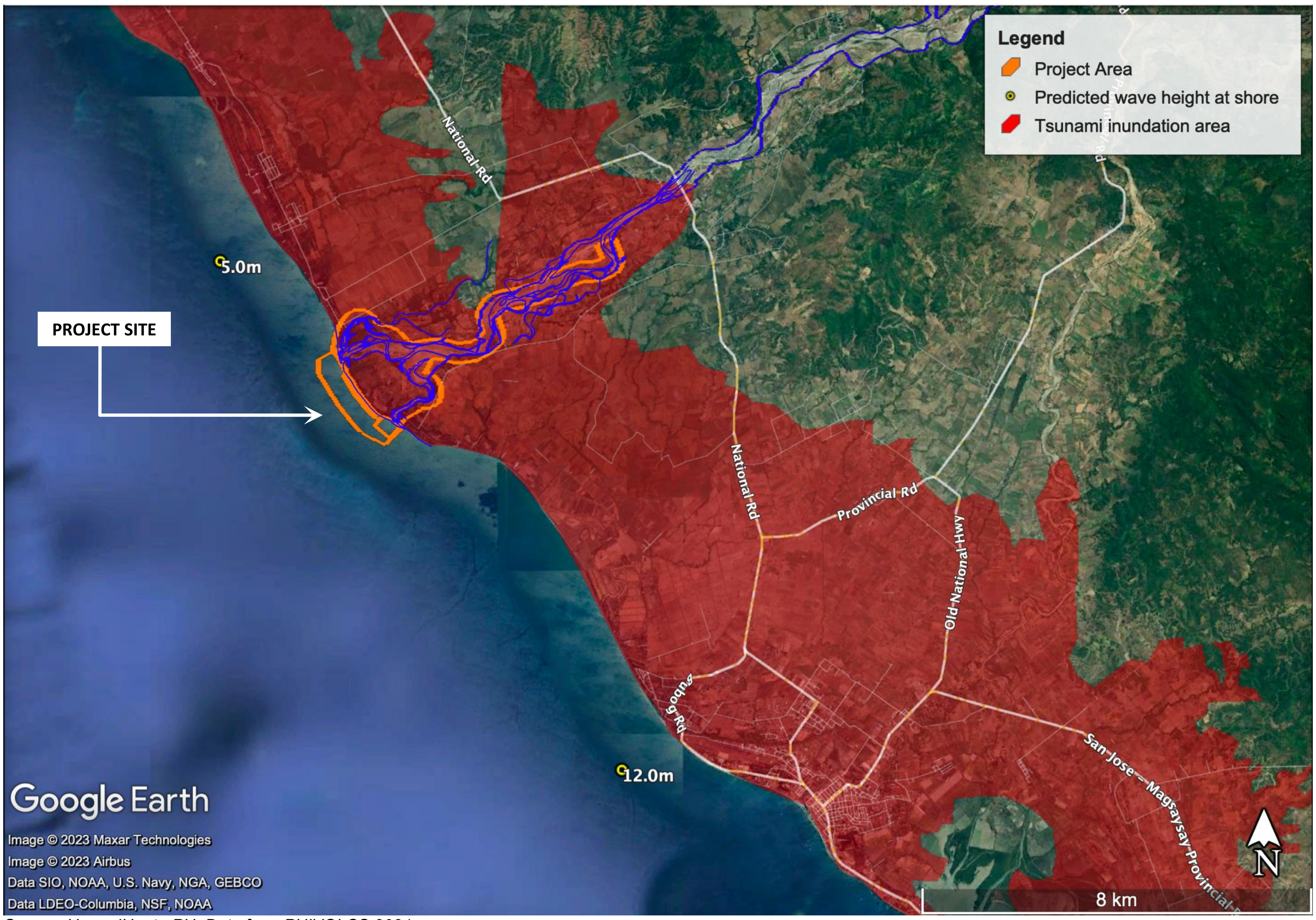
Source: MGB 2021

Figure 2.2.1-8. Flood Hazard Map of the Project Site and Vicinity



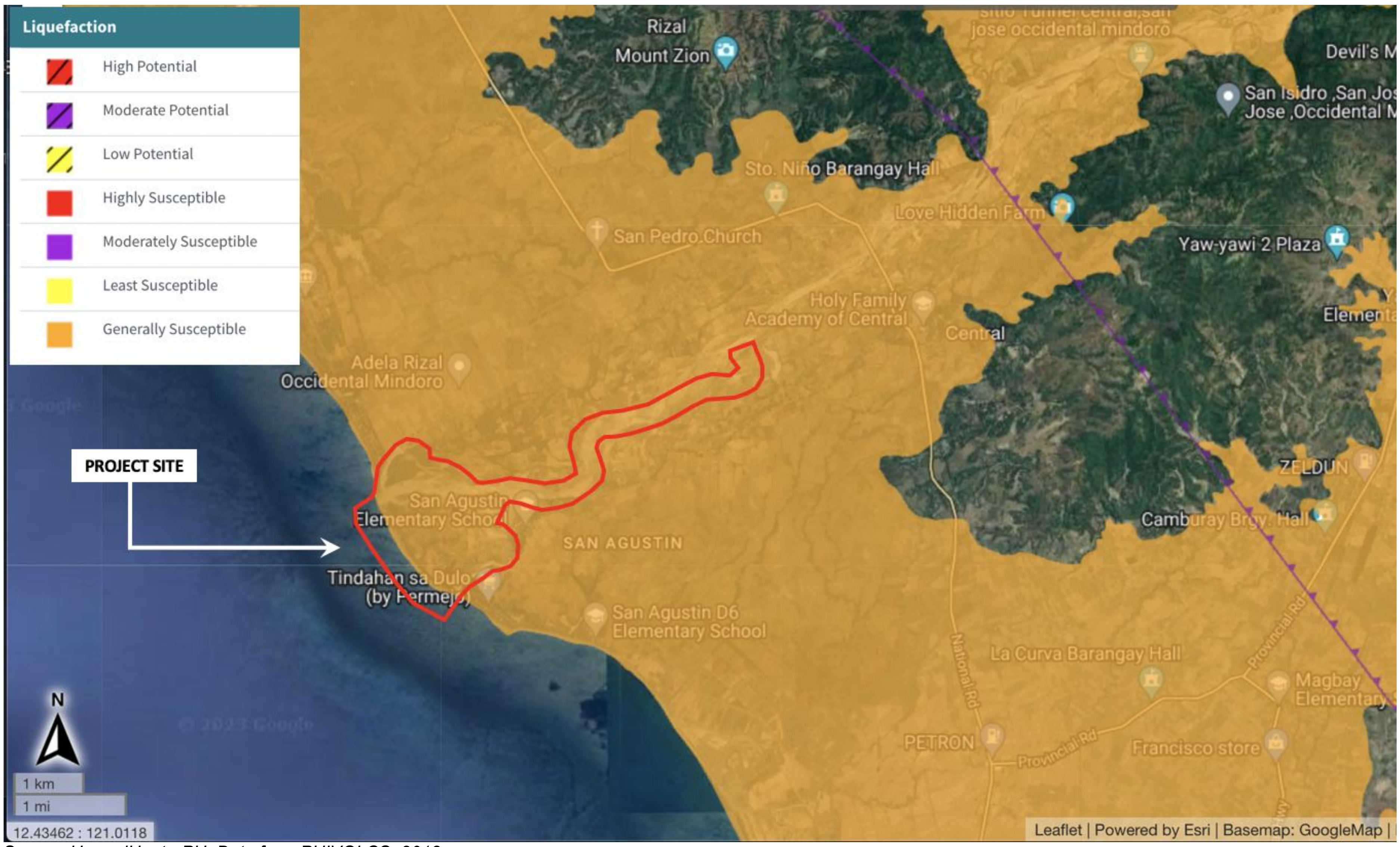
Source: UP Project Noah, screen captured on October 2023

Figure 2.2.1-9. Storm Surge Hazard Map (SSA 2) of Project Area and vicinity



Source: HazardHunterPH, Data from PHIVOLCS 2021

Figure 2.2.1-10. Tsunami Hazard Map of Busuanga River and Vicinity



Source: HazardHunterPH; Data from PHIVOLCS; 2018

Figure 2.2.1-11. Liquefaction Hazard Map of Rizal, San Jose and vicinity

Slope Stability Analysis

In relation to slope stability of the riverbanks, which could be susceptible to landslide, creep, and/or erosion, a numeric slope stability analysis is presented below and in detail in **Annex 2-A: Detailed Engineering Studies**.

The methodology is briefly outlined below:

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)
Safety Factors:
Permanent design situation: SF_s = 1.50 -
Seismic design situation: SF_s = 1.10 -

Stage of Construction 1
Earthquake: not included
Design situation: permanent

Stage of Construction 2
Earthquake: not included
Design situation: permanent

Stage of Construction 3
Earthquake
Horizontal seismic coefficient : K_h = 0.2000
Vertical seismic coefficient : K_v = 0.0000
Design situation: seismic

The stability analysis was done in 6 sites along the riverbanks. The soil parameters applied are given in **Table 2.2.1-4** while the slip surface parameters for each site are given in **Table 2.2.1-5**. The results of analysis are given in **Table 2.2.1-6**.

Table 2.2.1-5. Soil Parameters Used in the Analysis

Soil Type	Unit Weight γ (kN/m^3)	Stress-state	Angle of internal friction ϕ_{ef} (°)	Cohesion of soil C_{ef} (kPa)	Saturated unit weight γ_{sat} (kN/m^3)
Sandstone	25.81	effective	34.00	400.00	25.81
Poorly graded sand (SP), dense	18.50	effective	35.50	0.00	18.50

Table 2.2.1-6. Slip Surface Parameters

SITE	Analysis No.	Center x (m)	Center z (m)	Radius R (m)	Angle α_1 (°)	Angle α_2 (°)
Site 1	Analysis 1	113.74	1.11	2.01	-64.93	45.38
	Analysis 2	214.73	3.11	4.33	-37.88	63.28
Site 2	Analysis 1	129.90	10.19	11.22	-60.46	27.72
	Analysis 2	235.03	9.89	10.65	-25.27	62.02
Site 3	Analysis 1	102.45	16.15	9.12	-66.76	34.82
	Analysis 2	307.44	17.36	10.56	-34.51	64.33
Site 4	Analysis 1	101.61	18.48	9.51	-62.50	35.31
	Analysis 2	304.80	19.58	9.82	-25.65	54.77
Site 5	Analysis 1	133.66	5.34	7.19	-51.91	19.36
	Analysis 2	235.77	5.23	7.12	-20.37	50.39
Site 6	Analysis 1	24.14	2.75	4.29	-63.19	34.56
	Analysis 2	125.76	7.84	8.87	-13.63	54.35

The summary findings are as below:

Table 2.2.1-7. Results of Analysis of the (Circular) Slip Surface Without Optimization by Slope Stability Verification (Bishop)

	Sum of active forces – F_a (kN/m)	Sum of passive forces - F_p (kN/m)	Sliding moment – M_a (kNm/m)	Resisting moment – M_p (kNm/m)	Factor of Safety	Slope Stability
Site 1: Station not indicated						
Analysis 1 (St 1)	6.52	27.53	13.11	55.32	4.22 >1.5	ACCEPTABLE
Analysis 2 (St 1)	31.26	98.24	135.22	424.92	3.14 >1.5	ACCEPTABLE
Analysis 1 (St 2)	2.99	12.70	6.00	25.52	4.25 >1.5	ACCEPTABLE
Analysis 2 (St 2)	14.31	45.56	61.95	197.25	3.18 >1.5	ACCEPTABLE
Analysis 1 (St 3)	11.74	27.02	23.60	54.31	2.30 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	51.19	95.83	221.66	414.93	1.87 > 1.1	ACCEPTABLE
Site 2: Station not indicated						
Analysis 1 (St 1)	223.04	6,009.84	2,502.55	67,430.35	26.94 >1.5	ACCEPTABLE
Analysis 2 (St 1)	196.79	5,431.25	2,095.82	57,842.25	27.60 > 1.5	ACCEPTABLE
Analysis 1 (St 2)	127.58	5,754.39	1,431.48	64,564.27	45.10 > 1.5	ACCEPTABLE
Analysis 2 (St 2)	115.06	5,237.82	1,225.37	55,782.76	45.52 > 1.5	ACCEPTABLE
Analysis 1 (St 3)	356.33	5,996.21	3,998.07	67,277.47	16.83 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	300.04	5,418.76	3,195.41	57,709.81	18.06 > 1.1	ACCEPTABLE
Site 3: Station not indicated						
Analysis 1 (St 1)	190.30	5,625.20	1735.53	51301.79	29.56 >1.5	ACCEPTABLE
Analysis 2 (St 1)	210.48	6316.11	2222.65	66698.13	30.01 >1.5	ACCEPTABLE
Analysis 1 (St 2)	116.01	5384.67	1057.98	49108.14	46.42 >1.5	ACCEPTABLE
Analysis 2 (St 2)	130.71	6064.09	1380.35	64036.75	46.39 >1.5	ACCEPTABLE
Analysis 1 (St 3)	310.43	5615.87	2831.14	51216.77	18.09 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	344.53	6306.89	3638.28	66600.74	18.31 > 1.1	ACCEPTABLE
Site 4: Station not indicated						
Analysis 1 (St 1)	151.45	5485.75	1440.27	52169.62	36.22 >1.5	ACCEPTABLE
Analysis 2 (St 1)	112.25	4196.18	1102.27	41206.46	37.38 > 1.5	ACCEPTABLE
Analysis 1 (St 2)	83.13	5271.34	790.54	50140.46	63.41 > 1.5	ACCEPTABLE
Analysis 2 (St 2)	57.26	4044.66	562.28	39718.55	70.64 > 1.5	ACCEPTABLE
Analysis 1 (St 3)	257.17	5481.06	2445.71	52124.86	21.31 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	186.77	4192.78	1834.06	41173.10	22.45 > 1.1	ACCEPTABLE
Site 5: Station not indicated						
Analysis 1 (St 1)	52.00	129.39	373.82	930.16	2.26 >1.5	ACCEPTABLE
Analysis 2 (St 1)	39.71	89.58	282.59	637.41	30.01 >1.5	ACCEPTABLE
Analysis 1 (St 2)	23.84	59.55	171.38	428.19	2.50 >1.5	ACCEPTABLE
Analysis 2 (St 2)	18.18	41.42	129.46	294.89	2.28 >1.5	ACCEPTABLE
Analysis 1 (St 3)	81.94	123.36	589.14	886.95	1.51 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	61.29	85.26	436.36	607.03	1.39 > 1.1	ACCEPTABLE
Site 6: Station not indicated						
Analysis 1 (St 1)	31.22	85.92	133.93	368.61	2.75 >1.5	ACCEPTABLE
Analysis 2 (St 1)	70.72	130.00	627.32	1153.14	1.84 > 1.5	ACCEPTABLE
Analysis 1 (St 2)	14.27	39.46	61.24	169.30	2.76 > 1.5	ACCEPTABLE
Analysis 2 (St 2)	32.45	59.67	287.87	529.31	1.84 > 1.5	ACCEPTABLE
Analysis 1 (St 3)	48.72	82.50	209.00	353.94	1.69 > 1.1	ACCEPTABLE
Analysis 2 (St 3)	101.60	121.05	901.17	1073.70	1.19 > 1.1	ACCEPTABLE

All of the computed factors of safety are above and within the tolerance of 1.5 (stages 1 and 2 of construction) and 1.1 (stage 3 of construction), which are the standards for soil stability factor of safety according to DCGS Volume 2C. Therefore, the slope stability in all of the assessed sites are considered acceptable.

2.2.1.2.5 Impact Analysis and Options for Mitigating Measures

The project site does not encroach in any area with: sensitive biodiversity (KBAs); Ancestral Domain; tourist spot; critical slope; recharge area of aquifer; primary agricultural lands, mangroves, and coral reefs. These factors render the site environmentally critical.

1. Geologic hazards - the Project shall not induce these hazards but will be affected by them. There will be no construction activities to be undertaken. Nevertheless, safety and emergency precautionary protocols shall be implemented in the entire duration of the dredging activities for the safety of all its workers and equipment.

2. Sustenance fishers – There is no intense fishing effort in the coastal impact area of Busuanga River due to low catch rates. Nevertheless, small-scale/sustenance fisheries in the coastal area fronting the river estuary will not be dislocated or disrupted by Project operations. In any case, fishers will just move farther away from sediment-affected coastal shelf during project operations and resume their fishing operation directly in front of the estuary after dredging operations. The Project will support restoration of fish stocks through provision of assistance to the LGU in the formulation of a Fisheries Improvement Plan and to provide assets for more effective fisheries law enforcement.

   River fisheries will not be dislocated but only interrupted temporarily. Nevertheless, LGU sources and key informants declared that coastal and river fishing operations are seasonal and take place in the river only during the calm weather where river flow is not too intense. At any rate, more productive river fisheries will be supported by the project through the introduction of river fish culture (e.g., for Tilapias and freshwater prawns) and re-stocking of Tilapia and river prawns in appropriate areas after dredging is completed.

2.2.1.3 Possible Tenurial / Land Issues

There will be agricultural lands that will be affected by dredging based on the Approved Dredging Master Plan. Note that these are within the river regime, but planted to crops nonetheless. As such, the owners of the planted crops shall be determined post-ECC and shall be approached by RC-GPC for possible agreements with the intention of offering just compensation and possible alternative livelihood.

According to the General Notes of the DMP Section E, *"As-Staked" Plan shall be prepared by the owner. The preparation of the "As-Staked" Plan shall comply with the provisions of DPWH D.O. No. 15., Series of 2016.* This is to be conducted once the NTP is issued by DPWH. Only then can the proponent determine the owners of the planted crops to be affected. Please note that this is a very sensitive issue that has to be handled with certainty before the proponent approaches the owners. The identification shall be done in coordination with the Barangay LGU and the concerned units of the Municipal LGU.

Based on the records of EMB-4B, six ECCs were issued to West Island Aggregates Inc ("West Island") covering various projects in the same project area being applied for by RC-GPC. However, 3 among the 6 ECCs issued are now under issue because they were previously subject of a Memorandum of Agreement (MOA) with the Provincial Government of Occidental Mindoro. The MOA has already been revoked by the Provincial Government of Occidental Mindoro in a letter addressed West Island and dated March 4, 2020. Copies of the Revocation Letter, 3 ECCs - ECC-R4B-1003-0044, ECC-R4B-11060082, ECC-R4B-1003-0042 - Letter of Revocation, Letter from EMB Central Office are attached under **Annex 2B**.

Hence, Royal Crown has all the legal rights to proceed with this ECC application and in fact, the it has been awarded the Busuanga RDZ and DPWH 4B has approved its Dredging Master Plan (**Annex 1-B**).

This Project will coexist with any and all valid prior rights in the river that overlap with the Proposed Project site. Small-scale sand and gravel quarrying were evident. Nevertheless, it is explicitly stated in

DAO 2020-12 that no other quarrying permits shall be operational within the project site once the dredging project is in operation and this shall be an exclusive River Dredging Zone (RDZ). To wit:

Excerpt from DAO 2020-12:
***"Section 2. Scope of Operations**.* In order to open heavily-silted river channels of Occidental Mindoro, the areas starting from the coastline of river delta extending all the way upstream, in accordance with the DPWH Dredging Master Plan, shall be designated as exclusive River Dredging Zone (RDZ) by the Inter-Agency Committee (IAC) created under Item VII, Section 1 of this Administrative Order. Dredging activities shall be allowed within the RDZ, quarrying is strictly prohibited."

In the interest of establishing harmonious relations with stakeholders, however, existing small-scale/commercial and industrial sand and gravel quarrying permits in good standing will be respected and permit holders will be allowed to operate while this proposed project has not started operating.

The project site is not being used at present in any of the following water-based activities or projects:

- As areas for significant or commercial fishing;
  There are no commercial fishing operations (as defined in the Fisheries Code) in the coastal impact area. For one, commercial fishing boats are regulated/licensed by the BFAR and there is a vessel monitoring system in place. Secondly, the LGU does not license commercial fishing boats especially if they operate nearshore. Catch rates are too low for viable commercial fishing operations in the estuary impact area.
- As a water-based settlement (e.g. fishermen);
  There are no fisher settlements directly in the river
- As a source of bulk water supply;
  The river water is utilized for irrigation purposes but the intake point is located upstream of the project area.
- As a source of commercial/economic supply of fish and other marine species.
  There are no commercial fishing operations in the river. Even small-scale fisheries are not intense. Municipal fishers sell their catch in local markets and no commercial-scale fishing operation.

2.2.1.4 Terrestrial Ecology

2.2.1.4.1 Methodology

A. Description of the Sampling Locations
1. Terrestrial Flora

Primary data gathering for terrestrial flora assessment was conducted on October 9, 2023 in the downstream, midstream and upstream covering the proposed Busuanga River Dredging Project in the Municipalities of San Jose and Rizal in the Province of Occidental Mindoro. Floral assessment and evaluation are in accordance with "Patch Sampling Technique" *(Oshawa, 1991; Rice and Lambshed, 1994 as cited by Villegas, K. L. and Pollisco, F. A., 2008)* based on existing vegetative ecosystems. The approach uses selection and identification of sampling plots along the riverbanks and islets/ islands formed along Busuanga River as a landscape element to assess the plant communities within the area. Quadrat Sampling Method (QSM) with 20m x 20m (400m^2) dimensions were established in the downstream, midstream, and upstream along the transect line. A total of 9 nested sampling plots in the upstream, midstream, and downstream of the proposed dredging area in 3 barangays, namely; Adela, San Agustin, and San Pedro, all in the municipality of Rizal, Occidental Mindoro. Location of each sampling plots were recorded using handheld Global Positioning System (GPS) or android mobile phone with built-in GeoCam software and World Geodetic Systems (WGS) 1984 datum/ reference used in location surveys and geo-tagging. **Table 2.2.1-8** and **Figure 2.2.1-12** shows the location and map of terrestrial flora assessment conducted within SMRIS watershed area.

Table 2.2.1-8. Geographical Coordinates of Terrestrial Flora Sampling Plots

Sampling Plots	Location	Coordinates (WGS84)		Elevation (masl)	Type of Ecosystem
		Latitude	Longitude		

Sampling Plots	Location	Coordinates (WGS84)		Elevation (masl)	Type of Ecosystem
		Latitude	Longitude		
Downstream					
SP 1	Brgy. Adela, Rizal	N 12.435433°	E 120.973440°	1	Coastal
SP 2		N 12.434621°	E 120.976175°	2	Riparian
SP 3		N 12.434357°	E 120.978492°	4	Riparian
Midstream					
SP 4	Brgy. San Agustin, San Jose	N 12.437149°	E 120.989986°	7	Riparian
SP 5		N 12.437826°	E 120.996709°	8	Riparian
SP 6		N 12.436907°	E 121.002787°	10	Riparian
Upstream					
SP 7	Brgy. San Pedro, Rizal	N 12.446500°	E 121.006670°	13	Riparian
SP 8		N 12.447540°	E 121.009480°	13	Riparian
SP 9		N 12.449848°	E 121.012192°	15	Riparian

2. Terrestrial Fauna

Terrestrial faunal/ wildlife observation/ assessment primarily on avifauna (birds) in the proposed Busuanga River Dredging Project was conducted in October 9 to 10, 2023 using a transect line/ walk following foot trails along the river channel as access points. Wildlife species encountered along the transect line through sightings, aural observations, and markings on the ground i.e., feathers and fecal drops, and footprints were recorded following the international standard nomenclatural system. Photographs of wildlife species encountered in the field were taken for documentation purposes and further verification. Species not physically encountered were noted through Ethnobiology or Key Informant Interviews (KII) with local residents. Faunal survey covers vertebrate fauna belonging to avifauna (birds). **Table 2.2.1-9 and Figure 2.2.1-13** present the transect walk coordinates and location map of terrestrial fauna assessment of the proposed Busuanga River Dredging Project.

Table 2.2.1-9. Geographical Coordinates of Transect Walk for Terrestrial Fauna Assessment

Sampling Sites	Location	Starting		End		Length (m)
		N	E	N	E	
Downstream	Brgy. Adela, Rizal	12.435505°	120.973327°	12.433974°	120.984431°	1,520
Midstream	Brgy. San Agustin, San Jose	12.436991°	120.989935°	12.436854°	121.002840°	1,450
Upstream	Brgy. San Pedro, Rizal	12.446553°	121.002844°	12.449853°	121.012178°	780

Plates 2.2.1-1 to 2.2.1-10 describe the vegetative cover of the proposed project area from the downstream (mouth of Busuanga River) in Brgy. Adela, Rizal to the midstream (Brgy. San Agustin, San Jose) and upstream area (Brgy. San Pedro, Rizal).

Plate 2.2.1-1. Vegetative cover at the downstream area dominated by Lambayong (Ipomoea pes-caprae (L.) R. Br.) mixed with Aroma (Vachellia farnesiana (L.) Wight & Am.)

Plate 2.2.1-2. Portion of downstream area dominated by Mutha (Cyperus rotundus L.)

Plate 2.2.1-3. Islet near the Busuanga River dominated by Talahib (Saccharum spontaneum L.)

Plate 2.2.1-4. Vegetation along the mid-section

Plate 2.2.1-5. Islet devoid of vegetation at the mid-section

Plate 2.2.1-6. Vegetation along the riverbank

Plate 2.2.1-7. Planted Gmelina (Gmelina arborea Roxb. ex Sm.in Rees) along with Banana (Musa sapientum L) along the riverbank channel in the upstream portion

Plate 2.2.1-8. Islet devoid of vegetation in the upstream portion

Plate 2.2.1-9. Vegetation dominated with Ipil-ipil (Leucaena leucocephala (Lam.) de Wit.) along the river channel in the upstream area

Plate 2.2.1-10. Floodplains at the upstream area

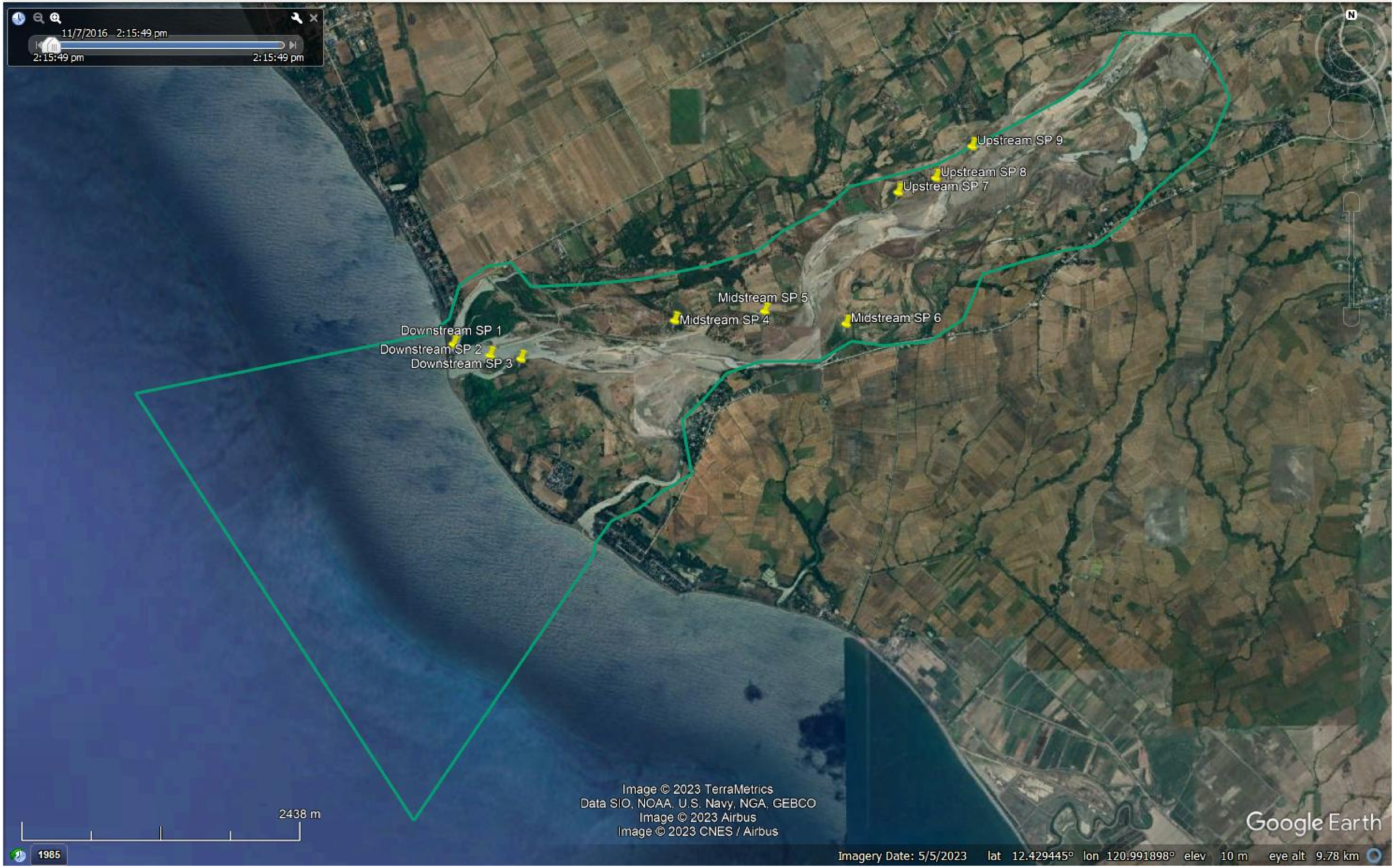


Figure 2.2.1-12. Location Map of Sampling Plots of Terrestrial Flora Assessment Along the Proposed Busuanga River Dredging Project

Figure 2.2.1-13. Map Showing the Transect Walk/ Line for the Terrestrial Fauna Assessment of the Proposed Busanga River Dredging Project

2.2.1.4.2 Quantitative and Qualitative Analysis

Complete enumeration and documentation of flora and faunal species in each sampling plots as well as species encountered along transect line/ walk were recorded in-situ following international standards for scientific taxonomic nomenclature and classification systems. For the aquatic ecosystem, secondary data gathering and key informant interviews were conducted to assess the freshwater environment.

1. Terrestrial Flora

Terrestrial flora within the proposed Busuanga River Dredging Project involves the assessment of floristic taxonomic classification and morphological composition, estimation of species relativeness indices (density, frequency, and dominance) vis-à-vis importance value (IV), biodiversity measurements (species richness, Shannon-Wiener, Pielou's Species Evenness, and Dominance), geographical distribution/ range, endemicity, conservation status, and uses or importance.

Summary of Floral Species Taxonomic Classification and Morphological Composition
Presents the overall summary of the assessment pertaining to the total number of individuals and number of species identified and recorded in-situ within the sampled area. The identification of floral species follows the international standards for nomenclatural classification and verified using the database of World Flora Online (WFO), the most comprehensive and authoritative list of the world's plants, maintained by the global community of taxonomic experts as a free and open-access resource. The assessment includes taxonomic classification (species, genera, and family), characterization of plant community or ecosystem that best describe the floral assemblages of the ecosystem, with respect to plant form/ habit (trees, shrubs, grass, palms, herbs, and vines) that best describe plant communities or assemblages of the ecosystem.

Estimation of Relative Indices (Density, Frequency, Dominance, and Importance Value)
Other important parameter includes the determination of importance value indices (IVI) with respect to species density, frequency, and dominance. The IVI measures of absolute and relative abundance of each species was used to describe and estimate the plant composition (Curtes and McIntosh, 1950) with the use of the following equation/ formula:

$$\text{Relative Density (RD), in \%} = \frac{\text{Number of Species}}{\text{Total Area Sampled}} \times 100\%; \qquad \text{Equation 1}$$

$$\text{Relative Frequency (RF), in \%} = \frac{\text{Number of Samples in which Species Occur}}{\text{Total Number of Sampling Plots}} \times 100\%; \qquad \text{Equation 2}$$

$$\text{Relative Dominance (RDom), in \%} = \frac{\text{Total Basal Area of Species}}{\text{Total Area Sampled}} \times 100\%; \qquad \text{Equation 3}$$

$$\text{Importance Value Index (IVI)} = \sum(\text{RD} + \text{RF} + \text{RDom}); \qquad \text{Equation 4}$$

Summary of Biodiversity Measurements
On biodiversity index, Shannon-Wiener Index (H') was used in estimating the biodiversity measurement and relative values of plant communities. It is a measure of the average degree of "uncertainty" in predicting to what an individual species chosen at random from a collection of S species and N individuals will belong (Magurran, 1988). Shannon-Wiener information theoretic index is one of the most popular methods for expressing diversity and important in determining the quality of every ecosystem. It is also being used as an indicator of biodiversity loss or gain when applied to monitoring. The computed index may result in diversity values H' ranging from zero (0) indicating low community complexity to 3.5 and above which implies a very high complexity of plant community. The index is computed using the relative densities of species (pi=ni/N), where ni is the abundance values for each i species and N is the total abundance for the data set.

$$H' = -\sum_{i=1}^{S} pi \ln pi, \text{ where} \qquad \text{Equation 5}$$

H', represents the symbol for the amount of diversity in ecosystem;

p_i, represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1); and
ln p_i, represents the natural logarithm of p_i

Meanwhile, Pielou's Evenness Index or J' denotes the maximum possible species diversity Hmax for a community were evenly distributed among all S species. It expresses H' relative to the maximum value that H' can obtain when all of the species in the sample are perfectly even with one individual per species (Magurran, 1988). It also expresses the condition of maximum evenness of species in a plant community. Species evenness is calculated as the proportion of species diversity of a particular plant community H' by the maximum possible diversity for the community denoted by J''=H/Hmax when H/Hmax the community has reached its maximum diversity. The value of J' will approach zero (0) as the community becomes dominated by a single species indicating decreasing diversity. Below is the equation for computing evenness index;

$J' = H'/H'_{(max)} = \sum(p_i)(\ln p_i)/\ln S$, where; Equation 6

S, is the number of species in a community;
p_i, represents the proportion or relative abundance of each individual species to the total (measured from 0 to 1); and
ln p_i, represents the natural logarithm of p_i

Computed values for H' and J' will then be referred to the Fernando Biodiversity Scale in the table below to quantify the sampled areas in terms of biodiversity and evenness levels.

Table 2.2.1-10. Fernando Biodiversity Scale and Evenness Index (1998)

Relative Values	Shannon-Wiener Index (H')	Pielou's Evenness Index (J')
Very High	3.50 and above	0.75-1.00
High	3.00-3.49	0.50-0.74
Moderate	2.50-2.99	0.25-0.49
Low	2.00-2.49	0.15-0.24
Very Low	1.90 and below	0.05-0.14

Source: Sylvatrop. The Technical Journal of Philippine Ecosystems and Natural Resources. 2013.

Summary of Conservation Status, Endemism, and Geographical Distribution/ Range

The database of International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (www.iucn.org/) and DENR Administrative Order 2017-11 "Updated National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species" were used to determine conservation status and geographical range/ distribution of species. Co's Digital Flora of the Philippines (www.philippineplants.org) was also instrumental in the verification of geographical distribution/ range of Philippine endemic forest trees. The aim is to convey the urgency of conservation issues to the public and the policy-makers, as well as help the international community to reduce species extinction. It is also aimed to provide scientifically based information on the status of the species and subspecies at a global level; draw attention to the magnitude and importance of threatened biodiversity; influence national and international policy and decision-making; and provide information to guide actions to conserve biological diversity. Plants and animals assessed for the IUCN Red List are the bearers of genetically and the building blocks of ecosystems, and information on their conservation status and distribution provides the foundation of making informed decisions about conserving extinction and the main purpose of the Red List is to catalogue and highlight those plants and animals that are facing higher risk of extinction either those listed. Likewise, the DENR AO 2017-11 and DAO 2019-09 were also used pursuant to Section 22 of Republic Act 9147, otherwise known as the Wildlife Conservation and Protection Act of 2001. For common understanding, each conservation status is defined applicable for terrestrial flora and wildlife fauna.

Uses/ Importance

On various uses and importance, each plant species plays a key role in maintaining ecological balance and ecosystems stability. It provides ecological goods and services for various purposes such as food (edibility and culinary), clean air and water, soil anchorage and slope stabilization, herbal or alternative medicines as remedy for various ailments of folkloric and traditional beliefs, sources of food and as shelter/ habitat for wildlife species, dyes/ tannins as coloring pigments, fuelwood and firewood, pulp and paper production, essential oils for cosmetic purposes, building and construction materials, aesthetic and recreational values, musical instruments and farm implements, shelterbelts and windbreaks, and many other services or applications i.e. reclamation/ reforestation, intercropping, and plantation forest. Some species are used by researchers and enthusiasts as keystone or indicator species for identifying quality of ecosystems. Uses and importance of each plant species were documented through technical researches/ studies conducted or compiled by various institutions i.e. List of Philippine Herbal Medicinal Plants (www.stuartxchange.org) World Agroforestry Center Tree Database (www.worldagroforestry.org) and Useful Tropical Plants (www.tropical.theferns.info/) for economic and ecological importance/ uses of plant species, and the Global Invasive Species Database (GISD) for plant behavior and invasiveness.

2. Terrestrial Wildlife Fauna

Terrestrial fauna is defined as animals that are living on land and are using the land for the most part of their lives. Terrestrial fauna also helps in maintaining the general health of ecosystems, i.e., as seed dispersals (zoophily) and/ or pollinators. Parameters used for assessing avifauna within the proposed dredging project site include species richness/ abundance, occurrences, distribution, conservation status, and diversity indices.

Taxonomic Classification/ Species Composition, Richness, and Abundance
Species composition describes the number of individual species for each faunal group while species richness is the simplest measure of species diversity and is either a count of the number of, or the list of, species inhabiting a given area or habitat. Measures of species diversity are formed from species richness by further classifying the species by attributes, such as abundance, size, or ecological role. Measures of species diversity link to many ecological and evolutionary processes such as population dynamics, competition, community dynamics, adaptive radiation, and the evolution of phenotypic plasticity. Species diversity is the basis for the diversity of higher taxa and ecological associations such as communities and biomes. On the other hand, abundance of species refers to the number of individuals of each species in an area.

Frequency of Wildlife Species/ Occurrence
Frequency of species describes the probability of finding a species within a particular area. The probability is based on the occurrence of that species in a series of sample units.

Conservation Status, Endemicity, and Geographical Distribution/ Range
Conservation status of wildlife species is in accordance with the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species and DENR AO 2019-09.

Shannon-Wiener Biodiversity and Pielou's Evenness Index
Species diversity and evenness measurement follow the Shannon-Wiener Index indicated by **H'** and Pielou's Evenness Index or J'. Computed values for **H'** and **J'** shall be referred to the Fernando Biodiversity Scale to quantify sampled areas in terms of diversity and evenness levels.

2.2.1.4.3 Baseline (Results)

1. Terrestrial Flora

Summary of Taxonomic and Morphological Composition
A total of 460 number of individuals belonging to seed plants (Angiosperm) that includes monocots and dicots comprising the taxonomic group of 39 morpho-species belonging to 39 genera and 16 families were identified and recorded within the sampled plots of proposed river dredging sites (see table below).

Table 2.2.1-11. Taxonomic Classification/ Composition of Flora Species in Busuanga River Project Area

Family	Genera	Species	Abundance
16	39	39	460

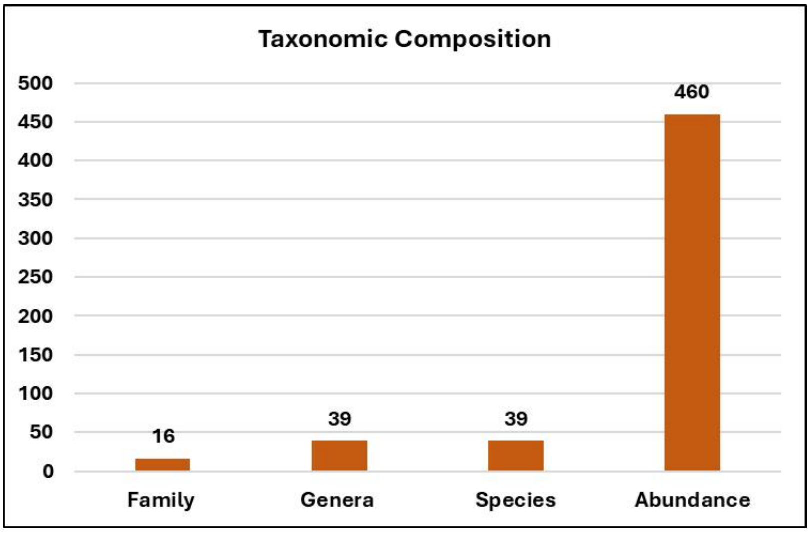


Figure 2.2.1-14. Taxonomic Composition of Plant Species Recorded Within the Project Area

Results of flora assessment shows that the midstream area have the highest number of individuals (abundance) with 174 representing 30 species with 30 genera and 13 families followed by the downstream section with an abundance of 166 from 22 species and 22 genera covering 12 families. Sampled plots in the upstream area have the least number of individuals with 120 composed of 19 species belonging to 19 genera from 11 families. The table and figure below present the taxonomic classification of flora species in the sampled plots within proposed Busuanga Dredging Project area.

Table 2.2.1-12. Taxonomic Classification of Flora Species from Sampled Plots

Sampling Sites	Family	Genera	Species	Abundance
Downstream	12	22	22	166
Midstream	13	30	30	174
Upstream	11	19	19	120
Average/ Total	12	24	24	460

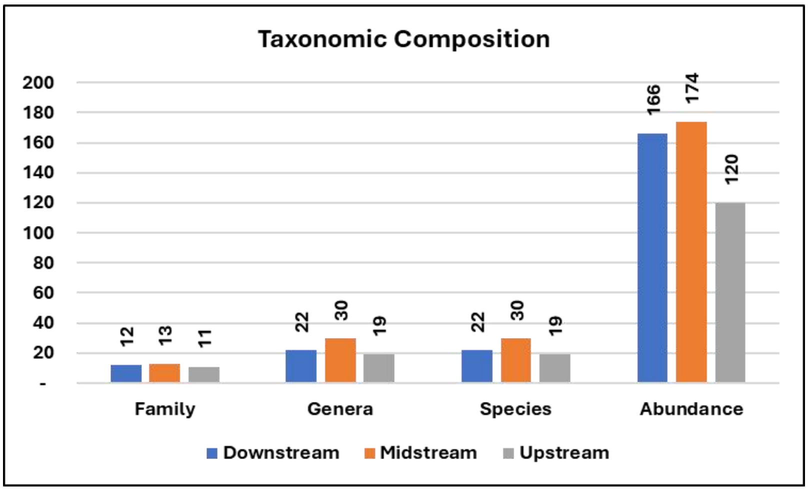


Figure 2.2.1-15. Taxonomic Classification of Flora Species from Sampled Plots

Meanwhile, the study area registered five (5) morphological composition in terms of plant form or habit consisting of trees, shrubs, vines, grasses, and herbs. The most speciosae (having several species) in terms of morphological composition relative to plant form/ habit belongs to trees and shrubs with 10 species or 25.64% apiece, followed by grasses and herbs with 8 species composed of 20.51% and 7 species with 17.95%, respectively. Vines, on the other hand, have the least number of species with four (4) accounting for only 10.26% of the total (see the table figure below).

Table 2.2.1-13. Morphological Composition of Floral Species Based on Plant Form/ Habit

Plant Form	No. of Species	% of Total
Trees	10	25.64%
Shrubs	10	25.64%
Vines	4	10.26%
Grasses	8	20.51%
Herbs	7	17.95%
Total	39	100.00%

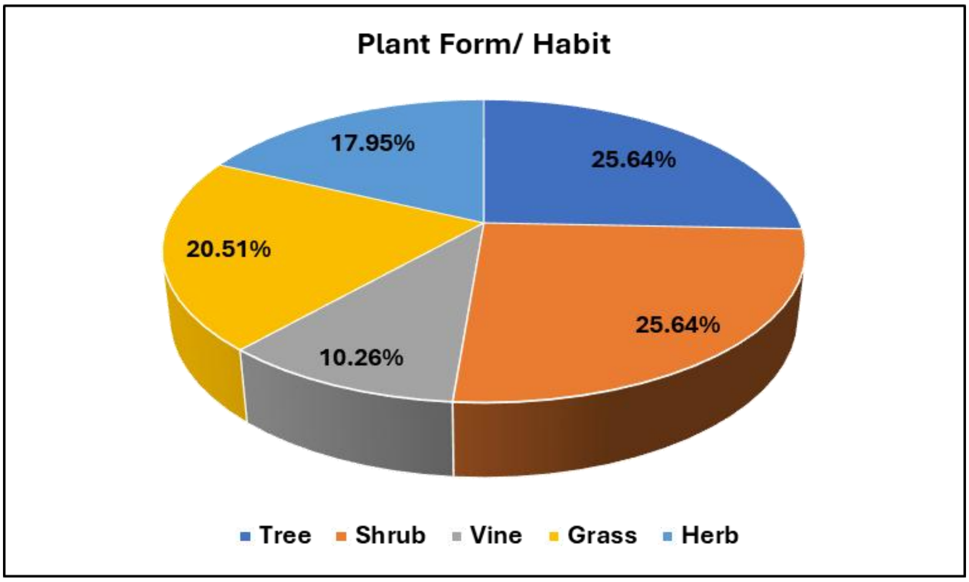


Figure 2.2.1-16. Morphological Composition of Floral Species Based on Plant Form/ Habit

The families of Fabaceae and Poaceae have the greatest number of representatives with seven (7) species apiece followed by Lamiaceae with four (4) species, and Asteraceae with three (3). The others have either two (2) families or one (1) species representative. The complete list of flora species recorded within the proposed Busuanga Dredging Project is shown in **Table 2.2.1-14** while **Table 2.2.1-15** shows their relative indices and importance values.

Table 2.2.1-14. List of Flora Species Recorded in-situ Along the Proposed Busuanga River Project Area

No.	Common Name	Scientific Name	Family Name	Plant Form/ Habit	Habitat	Endemism	Conservation Status		Threats
							IUCN	DAO 2017-11	
1	Ruellia	*Ruellia tuberosa* L.	Acanthaceae	Herb	Very common weed in open, usually wet places, in settled areas at low and medium altitudes.	Naturalized	LC	Not listed	None
2	Tuhod-manok	*Justicia gendarussa* Burm.f.	Acanthaceae	Shrub	Chiefly along streams at low and medium elevation in both secondary and primary forests, sometimes in thickets in and about towns, rarely planted.	Native	LC	Not listed	None
3	Bulak-manok	*Ageratum conyzoides* L.	Asteraceae	Herb	A common weed in open waste places, 0-2000m.	Naturalized	LC	Not listed	None
4	Sambong	*Blumea balsamifera* (L.) DC.	Asteraceae	Shrub	Low and medium elevation, usually common in open grasslands and thickets.	Native	LC	Not listed	None
5	Hagonoy	*Chromolaena odorata* (L.) R. M. King & H. Rob.	Asteraceae	Herb	one of the most invasive weeds of Asia and Africa	Naturalized	LC	Not listed	None
6	Bankalanan	*Melochia umbellate* (Houtt.) Stapf.	Byttneriaceae	Shrub	A common and characteristic shrub or treelet in old clearings, secondary forests, etc. at low and medium elevation.	Native	LC	Not listed	None
7	Barulad	*Waltheria indica* L.	Byttneriaceae	Shrub	A common weed in dry places in the settled areas at low and medium altitudes.	Naturalized	LC	Not listed	None
8	Agoho	Casuarina equisetifolia L.	Casuarinaceae	Tree	along sandy seashores, extending inland in open sandy valleys along streams, sometimes ascending to 800m.	Native	Least Concern	Not Listed	None
9	Apoi-apoian	*Gynandropsis gynandra* (L.) Briq.	Cleomaceae	Herb	At low and medium altitudes, occurring as a weed in waste places	Native	LC	Not listed	None
10	Lambayong	*Ipomoea pes-caprae* (L.) R. Br.	Convolvulaceae	Vine	Found on all sandy seashores and along the margins of some lakes.	Native	LC	Not listed	None
11	Melon-daga	*Zehneria japonica* (Thunb.) H. Y. Liu	Cucurbitaceae	Vine	along streams, old clearings, etc., at low and medium altitudes.	Native	LC	Not listed	None
12	Ampalaya	*Momordica charantia* L	Cucurbitaceae	Vine	in thickets, waste places, etc. at low and medium elevation.	Naturalized	LC	Not listed	None
13	Mutha	*Cyperus rotundus* L.	Cyperaceae	Grass	In open areas and thickets.	Naturalized	LC	Not listed	None
14	Binunga	*Macaranga tanarius* (L.) Müll. Arg.	Euphorbiaceae	Tree	In thickets and second-growth forests at low and medium elevation.	Native	LC	Not Listed	None
15	Alim	*Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll.	Euphorbiaceae	Tree	Common in thickets and secondary forests at low and medium altitudes	Native	LC	Not listed	None
16	Mani	Arachis hypogaea L.	Fabaceae	Herb	Cultivated	Naturalized	LC	Not listed	None
17	Dilang-butiki	*Centrocema mole* Mart. ex Benth.	Fabaceae	Vine	A common weed in cultivated fields and occasionally along ricefield dikes and canals.	Naturalized	LC	Not listed	None

No.	Common Name	Scientific Name	Family Name	Plant Form/ Habit	Habitat	Endemism	Conservation Status		Threats
							IUCN	DAO 2017-11	
18	Kakawate	*Gliricidia sepium* (Jacq.) Kunth ex Steud.	Fabaceae	Tree	low and medium elevation	Naturalized	LC	Not Listed	None
19	Ipil-ipil	*Leucaena leucocephala* (Lam.) de Wit L.	Fabaceae	Tree	An invasive species (CABI 2017).	Naturalized	LC	Not Listed	invasive. No threats to this species
20	Makahiya	*Mimosa pudica* L.	Fabaceae	Herb	open waste places at low and medium elevation in settled areas	Naturalized	LC	Not listed	None
21	Rain tree	*Samanea saman* (Jacq.) Merr.	Fabaceae	Tree	widely planted as a shade tree. In many places, spontaneous.	Naturalized	LC	Not listed	None
22	Aroma	*Vachellia farnesiana* (L.) Wight & Am.	Fabaceae	Shrub	Scattered in open grasslands, thickets, waste grounds, etc., sea-level to 400m.	Naturalized	LC	Not listed	None
23	Gmelina	*Gmelina arborea* Roxb. ex Sm. in Rees	Lamiaceae	Tree	extensively planted	Naturalized	LC	Not listed	None
24	Botonesan	*Hyptis capitata* Jacq.	Lamiaceae	Herb	Weed in settled areas, open waste places, fallow rice paddies (Merrill 1923), secondary forest and open fields	Naturalized	LC	Not listed	None
25	Suob-kabayo/ Bush mint	*Mesosphaerum suaveolens* (L.) Kuntze	Lamiaceae	Shrub	Very abundant in open, waste places at low and medium altitudes	Naturalized	LC	Not listed	None
26	Alagau	*Premna odorata* Blanco	Lamiaceae	Tree	Common In thickets and secondary forests at low altitudes	Native	Least Concern	Not Listed	None
27	Kulut-kulutan	*Triumfetta rhomboidea* Jacq.	Malvaceae	Shrub	Very common in open waste places, at low and medium altitudes.	Naturalized	LC	Not listed	None
28	Kollo-kollot	*Urena lobate* L.	Malvaceae	Shrub	an invasive environmental weed	Naturalized	LC	Not listed	None
29	Tibig	*Ficus nota* (Blanco) Merr.	Moraceae	Tree	Lowland and montane forest, often along stream, up to 1300m.	Native	LC	Not listed	None
30	Datiles	*Muntingia calabura* L.	Muntingiaceae	Tree	in and about towns	Naturalized	LC	Not listed	None
31	Giant reed	*Arundo donax* L.	Poaceae	Grass	Weed in settled areas, open waste places, in thickets and open areas.	Naturalized	LC	Not listed	None
32	Kawayan-tinik	*Bambusa spinosa* Roxb. ex Buch.-Ham.	Poaceae	Grass	At low and medium altitudes in settled areas	Naturalized	LC	Not listed	None
33	Amorseco	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Grass	In open places at low and medium elevation; very common lawn and roadside grass, a veritable pest	Native	LC	Not listed	None
34	Paragis	*Eleusine indica* (L.) Gaertn.	Poaceae	Grass	An abundant weed along roadsides, cultivated lands, pastures, and other open sites in the settled areas, 0-2000m.	Naturalized	LC	Not listed	None
35	Carabao	*Paspalum conjugatum* P. J. Berguis	Poaceae	Grass	In settled areas, about towns, along trails, streams, etc., often very abundant.	Naturalized	LC	Not listed	None

No.	Common Name	Scientific Name	Family Name	Plant Form/ Habit	Habitat	Endemism	Conservation Status		Threats
							IUCN	DAO 2017-11	
	grass								
36	Talahib	*Saccharum spontaneum* L.	Poaceae	Grass	In open areas at low and medium altitudes, ascending to 1,500m	Naturalized	LC	Not listed	None
37	Tambo	*Thysanolana latifolia* (Roxb. ex Hornem.) Honda	Poacaea	Grass	Banks of ravines, slopes, about cliffs, etc., at low and medium elevation, ascending to 1600m.	Native	LC	Not listed	None
38	Coronitas	*Lantana camara* L.	Verbenaceae	Shrub	A gregarious weed, in settled areas in thickets and waste places at low and medium altitudes.	Naturalized	LC	Not listed	None
39	Kandi-kandilaan	*Stachytarpheta cayennensis* (Rich.) Vahl	Verbenaceae	Shrub	Common weed in open and waste places at low and medium altitudes in settled areas	Naturalized	LC	Not listed	None

Table 2.2.1-15. Relative Indices and Importance Value of Flora Species in the Proposed Busuanga River Project Area

No.	Common Name	Scientific Name	Family Name	Plant Form/ Habit	Sampling Location			No. of Individuals	Relative Density (%)	Rank	Relative Frequency (%)	Rank	Relative Dominance (%)	Rank	IVI	Rank
					US	MS	DS									
1	Tuhod-manok	*Justicia gendarussa* Burm.f.	Acanthaceae	Shrub	9	5	2	16	3.4783	9	4.2254	1			7.7036	
2	Ruellia	*Ruellia tuberosa* L.	Acanthaceae	Herb		2		2	0.4348		1.4085				1.8432	
3	Bulak-manok	*Ageratum conyzoides* L.	Asteraceae	Herb	6	5		11	2.3913		2.8169				5.2082	
4	Sambong	*Blumea balsamifera* (L.) DC.	Asteraceae	Shrub	6	6	3	15	3.2609	10	4.2254	1			7.4862	
5	Hagonoy	*Chromolaena odorata* (L.) R. M. King & H. Rob.	Asteraceae	Herb	6	6	5	17	3.6957	8	4.2254	1			7.9210	10
6	Bankalanan	*Melochia umbellate* (Houtt.) Stapf.	Byttneriaceae	Shrub	1	3	2	6	1.3043		4.2254	1			5.5297	
7	Barulad	*Waltheria indica* L.	Byttneriaceae	Shrub	2	3		5	1.0870		2.8169				3.9039	
8	Agoho	*Casuarina equisetifolia* L.	Casuarinaceae	Tree			4	4	0.8696		1.4085		21.9660	2	24.2440	2
9	Lambayong	*Ipomoea pes-caprae* (L.) R. Br.	Convolvulaceae	Vine		3	24	27	5.8696	6	2.8169				8.6865	8
10	Apoi-apoian	Gynandropsis gynandra (L.) Briq.	Cleomaceae	Herb	2			2	0.4348		1.4085				1.8432	
11	Ampalaya	*Momordica charantia* L	Cucurbitaceae	Vine		6		6	1.3043		1.4085				2.7128	
12	Melon-daga	*Zehneria japonica* (Thunb.) H. Y. Liu	Cucurbitaceae	Vine		2		2	0.4348		1.4085				1.8432	
13	Mutha	*Cyperus rotundus* L.	Cyperaceae	Grass			15	15	3.2609	10	1.4085				4.6693	
14	Binunga	*Macaranga tanarius* (L.) Müll. Arg.	Euphorbiaceae	Tree	2	3		5	1.0870		2.8169				3.9039	
15	Alim	*Melanolepis multiglandulosa* (Reinw. ex Blume) Rchb. & Zoll.	Euphorbiaceae	Tree		2		2	0.4348		1.4085				1.8432	
16	Mani	*Arachis hypogaea* L.	Fabaceae	Herb	2	1		3	0.6522		2.8169				3.4691	
17	Dilang-butiki	*Centrocema mole* Mart. ex Benth.	Fabaceae	Vine		2	2	4	0.8696		2.8169				3.6865	
18	Kakawate	*Gliricidia sepium* (Jacq.) Kunth ex Steud.	Fabaceae	Tree			1	1	0.2174		1.4085				1.6258	
19	Ipil-ipil	*Leucaena leucocephala* (Lam.) de Wit L.	Fabaceae	Tree			1	1	0.2174		1.4085				1.6258	
20	Makahiya	*Mimosa pudica* L.	Fabaceae	Herb	9	5	3	17	3.6957	8	4.2254	1			7.9210	10
21	Rain tree	*Samanea saman* (Jacq.) Merr.	Fabaceae	Tree			1	1	0.2174		1.4085				1.6258	
22	Aroma	*Vachellia farnesiana* (L.) Wight & Arn.	Fabaceae	Shrub			4	4	0.8696		1.4085				2.2780	

No.	Common Name	Scientific Name	Family Name	Plant Form/ Habit	Sampling Location			No. of Individuals	Relative Density (%)	Rank	Relative Frequency (%)	Rank	Relative Dominance (%)	Rank	IVI	Rank
					US	MS	DS									
23	Gmelina	*Gmelina arborea* Roxb. ex Sm. in Rees	Lamiaceae	Tree	3			3	0.6522		1.4085		1.3729	4	3.4335	
24	Botonesan	*Hyptis capitata* Jacq.	Lamiaceae	Herb		5		5	1.0870		1.4085				2.4954	
25	Suob-kabayo	*Mesosphaerum suaveolens* (L.) Kuntze	Lamiaceae	Shrub		3		3	0.6522		1.4085				2.0606	
26	Alagau	*Premna odorata* Blanco	Lamiaceae	Tree			3	3	0.6522		1.4085		5.4915	3	7.5521	
27	Kulut-kulutan	*Triumfetta rhomboidea* Jacq.	Malvaceae	Shrub	19	7	6	32	6.9565	3	4.2254	1			11.1819	5
28	Kollo-kollot	*Urena lobate* L.	Malvaceae	Shrub	8	4		12	2.6087		2.8169				5.4256	
29	Tibig	*Ficus nota* (Blanco) Merr.	Moraceae	Tree	2	1		3	0.6522		2.8169				3.4691	
30	Datiles	*Muntingia calabura* L.	Muntingiaceae	Tree	4	5		9	1.9565		2.8169		71.1697	1	75.9431	1
31	Giant reed	*Arundo donax* L.	Poaceae	Grass		16	12	28	6.0870	5	2.8169				8.9039	7
32	Kawayan-tinik	*Bambusa spinosa* Roxb. ex Buch.-Ham.	Poaceae	Grass	2	3		5	1.0870		2.8169				3.9039	
33	Amorseco	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Grass	30	24		54	11.7391	2	2.8169				14.5560	4
34	Paragis	*Eleusine indica* (L.) Gaertn.	Poaceae	Grass	6	4		10	2.1739		2.8169				4.9908	
35	Carabao grass	*Paspalum conjugatum* P. J. Berguis	Poaceae	Grass	25	22	10	57	12.3913	1	4.2254	1			16.6167	3
36	Talahib	*Saccharum spontaneum* L.	Poaceae	Grass	8	6	16	30	6.5217	4	4.2254	1			10.7471	6
37	Tambo	*Thysanolana latifolia* (Roxb. ex Hornem.) Honda	Poaceae	Grass		10		10	2.1739		1.4085				3.5824	
38	Coronitas	*Lantana camara* L.	Verbenaceae	Shrub	8	5	6	19	4.1304	7	4.2254	1			8.3558	9
39	Kandi-kandilaan	*Stachytarpheta cayannensis* (Rich.) Vahl	Verbenaceae	Shrub	6	5		11	2.3913		2.8169				5.2082	
	TOTAL				**166**	**174**	**120**	**460**	**100**		**100**		**100**			

Summary of Relative Indices and Importance Value

Measures of absolute and relative indices are used to assess the contribution of each species to a community. These measures include density, the number of individuals within a chosen area; relative density, the density of one species as a percentage of total density; frequency, the percentage of total quadrats or points that contains at least one individual of a given species; relative frequency, the frequency of one species as a percentage of total frequency; dominance, the total basal area of a given species per unit area within the community; relative dominance, the dominance of one species as a percentage of total dominance; and importance value, expressed as the relative contribution of a species to the entire community expressed as a combination of relative density, relative frequency, and relative dominance.

Each measure offers a different insight into the abundance of the species composing a community. Density provides the number of individuals per unit area but density is not necessarily proportional to dominance because dominance of a given species expresses the area occupied by the species. A species composed of primarily large individuals can have high dominance but it will likely have low density, and unless regularly distributed, it will also have low frequency. Frequency, which is often independent of density, expresses one measure of the distribution of individuals within the community. A clumped species can have high density but also low frequency because it occurs in a limited portion of the community. In contrast, a species that is individually and regularly distributed over the landscape will have a high frequency but can have low density. The importance value, as a combination of relative density, frequency, and dominance, is used to summarize the influence of an individual species within the community. Recognize that two species with the same importance value can have markedly different values for relative density, frequency, or dominance as any differences can be overshadowed by the addition process. The list of all flora species with their corresponding relative indices and importance value is shown in **Table 2.2.1-14** above.

Relative Density

The species with rated with the highest relative density in all the sampling plots belongs to Carabao grass (*Paspalum conjugatum* P. J. Berguis) of the family Poaceae with 12.3913% (57 individuals) followed by Amorseco (*Chrysopogon aciculatus* (Retz.) Trin) of the family Poaceae and Kulut-kulutan (*Triumfetta rhomboidea* Jacq.) of family Malvaceae with 11.7391% (54 individuals) and 6.9565% (32 individuals), respectively. The rest of the species with the highest relative density is shown in **Table 2.2.1-15.** Note that these species are known to thrive best in the riparian zones and riverbanks providing immediate soil cover but are not enough to control erosion of the riverbanks because of its shallow root system and low soil anchorage. Further, these species are known to “nurse” other plant species to grow and becomes “pioneer species” forming a new ecological succession or plant community which tends to colonize and dominate the previously disturbed area. In addition, these species are sources of foods and nutrients for grazing animals like carabaos, goats, cattle, and even birds and insect pollinators.

Relative Frequency

The flora species with the highest Relative Frequency at 4.2254% is shown in **Table 2.2.1-15** above. These are present in all sections (upstream, midstream, and downstream) of the proposed dredging area represented by 9 species with 209 individuals from a total of 13 sampled plots. Note that the values generated suggest that they can also be present in other areas depending on their ecosystem unless it has been intentionally introduced outside of its natural habitat.

Relative Dominance

The species to have the highest relative dominance include Datiles (*Muntingia calabura* L.) of Muntingiaceae with 71.1697% followed by Agoho (*Casuarina equisetifolia* L.) of family Casuarinaceae, and Alagau (*Premna odorata* Blanco) and Gmelina (*Gmelina arborea* Roxb. ex Sm. in Rees), both belongs to family Lamiaceae with 5.4915% and 1.3729% respectively (**Table 2.2.1-15)**. These species have large basal area and are responsible for the highest value compared to other species identified. Said species may have the tendency to dominate the area, provided that no extractive activities will occur in the future.

Importance Value Index

The species with the highest relative dominance include Datiles (*Muntingia calabura* L.) of Muntingiaceae with 75.9431% followed by Agoho (*Casuarina equisetifolia* L.) of family Casuarinaceae and Carabao grass *Paspalum conjugatum* P. J. Berguis) of family Poaceae with 24.2440% and 16.6167%, respectively. Completing the top 10 flora species having the highest relative dominance are Amorseco (*Chrysopogon aciculatus* (Retz.) Trin.) of family Poaceae with 14.5560%, Kulut-kulutan (*Triumfetta rhomboidea* Jacq.) of family Malvaceae with 11.1819%, Talahib (*Saccharum spontaneum* L.) of family Poaceae with 10.7471%, Giant reed (*Arundo donax* L.) of family Poaceae with 8.9039%, Lambayong (*Ipomoea pes-caprae* (L.) R. Br.) of family Convolvulaceae with 8.6865%, Coronitas (*Lantana camara* L.) of family Verbenaceae with 8.3558%, Hagonoy (*Chromolaena odorata* (L.) R. M. King & H. Rob.) of family Asteraceae and Makahiya (*Mimosa pudica* L.) of family Fabaceae wit with 7.9210% and 7.9210%, respectively (see **Table 2.2.1-15**).

Summary of Biodiversity Index (H') and Pielou's Evenness Index (J')

The Convention on Biological Diversity (CBD) defines biodiversity or "biological diversity" as the variety or variability among living organisms and from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Other define biodiversity or biological diversity refers to variety or variability among living organisms and the ecological complexes in which they occur, and encompasses ecosystem, species, and genetic diversity (D.B. Jensen, M. Torn, and J. Harte., 1990).

Measurement of biodiversity is important given the obvious declines on habitat quality in almost every ecological system. For this purpose, the Shannon-Weiner Biodiversity Index was used to examine the overall community characteristics and quality of two or more distinct habitats and to describe the degree of uncertainty of predicting the species of an individual picked at random from the community. The uncertainty of occurrence increases both as the number of species increases and the individuals are evenly distributed among all species in a given community. Using the Fernando Scale (1998), Shannon Biodiversity Index may result in diversity value (H') ranging from zero indicating low community complexity to 3.5 and above which indicates very high community complexity. This is the condition where maximum possible species diversity composing the community is evenly distributed among all species. It is also a condition where biodiversity is high and have reached its maximum evenness while a community composed of single species or being dominated by a single species will have low biodiversity as its evenness reaches zero.

The Shannon-Wiener Biodiversity Index (H') of all sampling plots in within the proposed dredging site recorded an average of H'=2.7804 and Pielou's Evenness Index J'=0.8779 indicating "moderate" biodiversity index and "very high" evenness index following the Fernando Biodiversity Scale and Evenness Index. Sampled plots in the midstream area recorded a biodiversity index at 3.0842 indicating "high" species diversity and "very high" evenness index at 0.9068 followed by sampled plots in the upstream area with 2.7095 and 0.8504 indicating "moderate" diversity with "very high" evenness while sampled plots in the downstream area registered 2.5476 and 8766 indicating "moderate" diversity with "very high" evenness index (see table and figure below).

Table 2.2.1-16. Diversity and Evenness Index of Flora Species

Sampling Locations	Shannon-Wiener (H')	Pielou's Evenness Index (J')
Downstream	2.5476	0.8766
Midstream	3.0842	0.9068
Upstream	2.7095	0.8504
Average	2.7804	0.8779

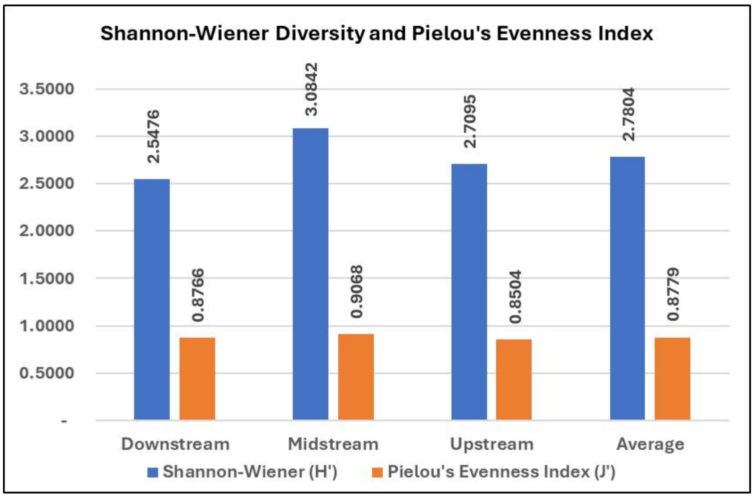


Figure 2.2.1-17. Shannon-Wiener Diversity Index and Pielou's Evenness Index

Summary of Conservation Status, Endemism, and Geographical Distribution/ Range

Conservation Status based on IUCN

The Philippines is considered as one of the megadiverse countries in the world. The 7,100 islands comprising the Philippines possesses high level of endemicity of marine/aquatic and terrestrial flora and fauna species, regarded as one of the biodiversity hotspots in the world, Philippines is one of the world's biologically richest nation and has the most threatened and fragile ecosystems. Many endemic species are confined to forest fragments that cover 7% of the original extent of the hotspots. The 93% of the original forest have been cleared due to logging and extractive activities for agricultural/farming expansions and other developments to accommodate the needs of the growing population. And with this, the Philippines have been placed as one of the most endangered areas at the same time remains as one of the most diverse areas on the planet. At the very least, one-third of more than 9,250 vascular plant species are endemic to the Philippines (*Source: Conservation International, 2007 Biodiversity Hotspots – Philippines. Accessed from www.biodiversityhotspots.org*). The Conservation Status under the IUCN Red List of Threatened Species and DENR 2017-11 "Updated National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species.

Of the 39 morpho-species recorded in-situ, none of the flora species were identified or cited as threatened species under IUCN. All species were categorized as Least Concern (LC). Likewise, none of the flora species were cited under DENR AO 2017-11.

Endemism

Endemism refers to the distribution of a species limited to a geographic area and which can therefore be found naturally in a particular place or area. In consequence, endemic species are those that live in a limited area, such as a mountain range, lake or island, among others. There are two (2) categories of endemicity, native and naturalized/ introduced. Species is considered native or endemic or indigenous if naturally occurring and found only within specific area as part of a particular ecosystem while naturalized, also called non-indigenous, introduced, alien, and exotic species which have been transported by human activity, intentional or accidental, into a region where it does not naturally occur *(Source: Philippine Official Reference for Forest-Related Terms and Definitions. No Date.)*.

The naturalization process of species is an ecological phenomenon through which a species, taxon, or population of exotic origin integrates into a given ecosystem becoming capable of reproducing and growing in it and proceed s to disseminate spontaneously. In some instances, the presence of a species in a given ecosystem is so ancient that it cannot be pre-supposed whether it is native or introduced. An introduced species (alien, exotic, adventive, immigrant, foreign, non-indigenous, or non-native), is defined as species living outside of its native distributional range, but which has arrived through human interventions, either directly or indirectly, and either by deliberately or accidentally. Non-native species can have various effects on the local ecosystem. Introduced species that become established and spread beyond the place of introduction are considered naturalized. The process of anthropogenic introduction is distinguished from biological colonization, in which species spread to new areas through "natural" (non-human) means such as storms and rafting. The impact of introduced species is highly variable. Some have a substantial negative effect on a local ecosystem (in which case they are also classified more specifically as an invasive, while other introduced species may have little or no negative impact (no invasiveness). Some species have been introduced intentionally to combat pests for biocontrols and may be regarded as beneficial as an alternative to pesticides in agriculture for example. In some instances, the potential for being beneficial or detrimental in the long run remains unknown. The effects of introduced species on natural environments have gained much scrutiny from scientists, governments, farmers and others.

The terrestrial flora assessment revealed that 13 species or 66.67% out of the 39 species are endemic species to the Philippines while the remaining 26 species or 66.67% are considered naturalized, introduced or exotic species (**Table 2.2.1-17** and **Figure 2.2.1-18**).

Table 2.2.1-17. Endemicity of Flora Species Within the Proposed Project Area

Endemicity	No. of Species	% of Total
Native	13	33.33%
Introduced	26	66.67%
Total	**39**	**100.00%**

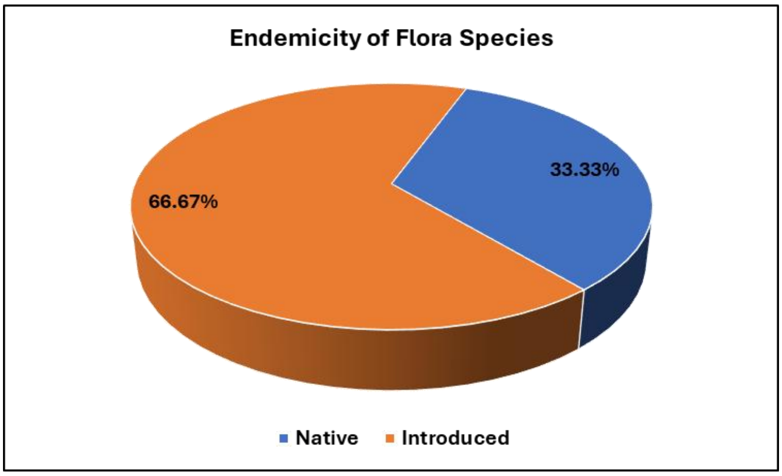


Figure 2.2.1-18. Endemicity of Flora Species Within the Proposed Project Area

The conservation status and endemicity of all flora species in the sampled plots within the proposed dredging project area is presented in **Table 2.2.1-14** above.

<u>Geographical Range/ Distribution</u>
Of the 39 species, majority are considered naturalized or introduced species which are common in the riverine/ riparian and lowland areas. Majority of the species recorded in-situ are widely distributed throughout the Philippines and even distributed or widely occurring in the Asian Region to Australia, Africa, Americas, and the Pacific Region. The 13 native species are among the notable species that are restricted to Philippines. On the other hand, most of the introduced species are already acclimatized or naturalized to Philippine environment. Some of them are native to North America and Mexico, has an extensive distribution in the country as part of the reforestation and rehabilitation program of the government in the past decades. See **Table 2.2.1-17**

<u>Uses/ Importance</u>
Various literatures were used for the uses and importance of species which include World Agroforestry Centre Database (www.worldagroforestry.org), Philippine Medicinal Plants (www.stuartxchange.com), and Useful Tropical Plants (https://tropical.theferns.info/). Variety of uses can be cited such as edibility, folkloric/ herbal medicine, timber or wood, and many more. For instance, Aroma (*Vachellia farnesiana* (L.) Wight & Am.), which are very common and widely distributed along coastal area and downstream of the proposed dredging site has several uses. Roasted pods of Aroma can be used in the culinary, sweet and sour dishes; flowers used in preparing tea; ripe seeds

put through a press to make oil for cooking. However, there are anecdotal reports of seeds used to kill rabid dogs, the activity attributed to an unnamed toxic alkaloid. in the Philippines, Aroma is used as folkloric herbal medicine, the aroma bark is considered astringent, in decoction is used in the treatment of prolapse rectum and as an injection for leucorrhea. Poultice of young leaves used for ulcers and sores previously washed by a decoction of same leaves. Bark exudes a gum similar to gum Arabic wherein mucilage can be prepared from the gum. Flowers known commercially as Cassie flowers and used as raw materials for making perfume. Tree is grown extensively in France for the flowers fragrant perfume. Cassie perfume used for bouquets and hair pomades. Diluted with other odors it imparts a true flowery fragrance. Woody branches used in India as tooth brushes. The tannin-rich bark is used for tanning leather. A black dye is obtained from the pods. In some parts of India, the bark and pods are used as dye-stuff and for tanning. In Mexico, the pods studied as alternate feed for sheep. Generally, the species recorded in the area are known to have medicinal properties that can be used to treat various ailments such as Sambong (*Blumea balsamifera* (L.) DC.) of the family Asteraceae, which can be used as folkloric herbal medicine. The leaves of the species can be used as poultice for abscesses; decoction of roots and leaves for fevers, kidney stones, and cystitis; decoction of leaves used to induce diuresis for purpose of treating kidney stones; Sitz-bath of boiled leaves, 500 grams to a gallon of water, for rheumatic pains of waist and back; used in upper and lower respiratory tract affections like sinusitis, asthmatic bronchitis and influenza; applied while hot over the sinuses; used for wounds and cuts; fresh juice of leaves to wounds and cuts; poultice of leaves applied to the forehead for relief of headaches; In Dumingag, Zamboanga del Sur, the Subanens use leaf infusion for the treatment of cough; tea is used for colds and as an expectorant; likewise, has antispasmodic and antidiarrheal benefits. For postpartum baths. Tea leaves use as emmenagogue, for treatment of menstrual cramps or dysmenorrhea. As such, folklore advise against use during pregnancy or for women who want to get pregnant. In Vietnam, decoction of fresh leaves used for cough and influenza or as inhalation of vapor from boiling of leaves. Poultices of pounded leaves applied to hemorrhoids; an alcoholic maceration used as liniment for rheumatism. Other uses could be as pesticide, roots and leaves used as natural pesticides against storage pests and leaf hoppers in rice; a repellent, the species is being used by Ayta people of Porac, Pampanga as repellent against hematophagous insects. Dry or fresh leaves and stems are burned or hung inside the house. In addition, Agoho (*Casuarina equisetifolia*) has a life span of 40-50 years and displays fast early growth. Under favorable conditions, early growth rates are about 2 m/year in height and the trees have good form in cultivation. On favorable sites, it can yield an annual increment of 15 cubic m/ha of wood in 10 years. Leaf litter from plantations is often removed as fuel and this draws heavily upon soil phosphorus and potassium reserves. This can result in reduced yield in the subsequent rotation. *C. equisetifolia* is commonly confined to a narrow strip adjacent to sandy coasts, rarely extending inland to lower hills. Found on sand dunes, in sands alongside estuaries and behind fore-dunes and gentle slopes near the sea. It may be at the leading edge of dune vegetation, subject to salt spray and inundation with seawater at extremely high tides. Grows vigorously on barren, polluted sites and thrives in deep sandy soils. Colonizes sterile tin tailings. As erosion control, the species is salt tolerant and grows in sand, *C. equisetifolia* is used to control erosion along coastlines, estuaries, riverbanks and waterways. In Sarawak, Indonesia the species is protected because of its importance in controlling coastal erosion. The highly regarded wood ignites readily even when green, and ashes retain heat for long periods. It has been called ‘the best firewood in the world’ and also produces high-quality charcoal. Calorific value of the wood is 5,000 kcal/kg and that of the charcoal exceeds 7,000 kcal/kg. It has been used for both domestic and industrial fuel such as for railroad locomotives. In Asia, leaf litter from plantations is often removed to be used as fuel. As fiber material, wood is used to produce paper pulp using neutral sulphate and semi-chemical processes, and as a raw material for rayon fibers. As timber, C. equisetifolia yields a heavy hardwood with an air-density of 900-1000 kg/cubic m. Heartwood is pale red, pale brown to dark red-brown, moderately to sharply differentiated from the sapwood, which is yellowish or pale yellow-brown with a pink tinge. Grain is straight, slightly interlocked or wavy; texture fine to moderately fine and even. Shrinkage is moderate to very high, and in the latter case the wood is difficult to season due to severe warping and checking. Wood is hard to very hard and strong. The heartwood is highly resistant to pressure treatment, but sapwood is amenable to such treatment. Heartwood is also resistant to dry-wood termites. On sawn timber, the rays are prominent on radial faces. Uses include house posts, rafters, electric poles, tool handles, oars, wagon wheels and mine props. As shade or shelter, many areas where the species naturally occurs are susceptible to tropical cyclones or typhoons, and its general tolerance to strong winds has encouraged its use in protective planting. The abundance of highly branched twigs absorbs wind. As tannin or dyestuff, the bark contains 6-18% tannin and has been used extensively in Madagascar for tanning purposes. It penetrates the hide quickly and furnishes swollen, pliant, soft leather of pale reddish-brown color. As medicine, root extracts are used for medical treatment of dysentery, diarrhea and stomachache. In West Malaysia, a decoction of the twigs is used for treating swelling and the powdered bark is used for treating pimples on the face. As nitrogen fixing, the root nodules containing the actinorhizal symbiont Frankia enable *C. equisetifolia* to fix atmospheric nitrogen. These root nodules can be prolific. As ornamental, it is grown as ornamental along streets and seashores. It is remarkably suited for boundary planting as it does not intercept much of the incoming solar radiation and yields substantial quantities of green leaf manure on lopping besides other products. As soil improver, the species possesses proteoid roots and forms associations with vesicular arbuscular mycorrhizae. As intercropping, high productivity and properties that enhance soil fertility, *C. equisetifolia* shows promise as an agroforestry species for arid and semi-arid areas. Experiments at Prabhunagar, India, showed citrus trees grew larger under *C. equisetifolia* than in pure stands.

2. Terrestrial Fauna

<u>*Summary of Taxonomic Classification/ Species Composition, Richness, and Abundance*</u>
The terrestrial fauna assessment conducted at various locations (downstream, midstream, and upstream) of the proposed dredging project site yielded 184 number of individuals (abundance) belonging to 33 species (richness) of avifauna (bids) representing 29 genera and 23 families and as shown in the table below.

Table 2.2.1-18. Taxonomic Classification of Avifauna Species Within the Project Area

Taxonomic Classification	Number
Family	23
Genera	29
Species	33
Abundance	184

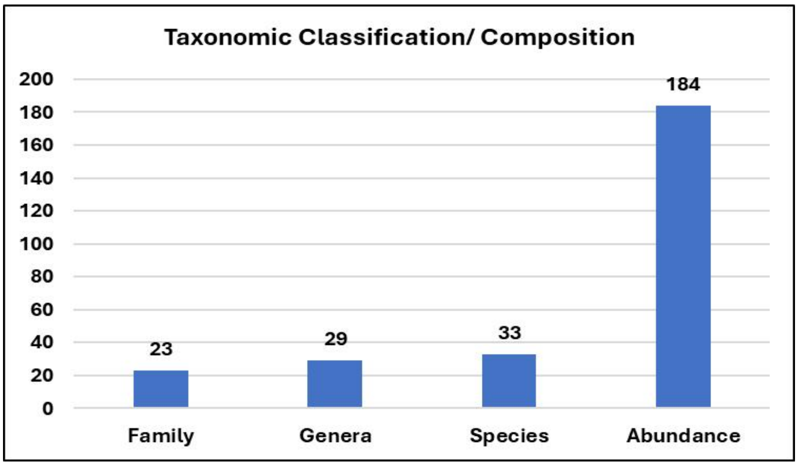


Figure 2.2.1-19. Taxonomic Classification/ Composition of Avifauna Species Within the Project Area

Results of fauna assessment shows that the midstream area have the highest number of individuals (abundance) with 83 representing 20 species with 19 genera and 16 families followed by the downstream section with an abundance of 55 number of individuals from 20 species and 19 genera covering 16 families. Sampled plots in the upstream area have the least number of individuals with 46 composed of 22 species belonging to 19 genera from 15 families. **Table 2.2.1-19** and **Figure 2.2.1-20** present the taxonomic classification of flora species in the sampled plots within proposed Busuanga Dredging Project area.

Table 2.2.1-19. Taxonomic Classification of Fauna Species from Sampled Plots

Sampling Sites	Family	Genera	Species	Abundance
Downstream	14	16	17	55
Midstream	16	19	20	83

Upstream	15	19	22	46
Average/ Total	**15**	**18**	**20**	**61**

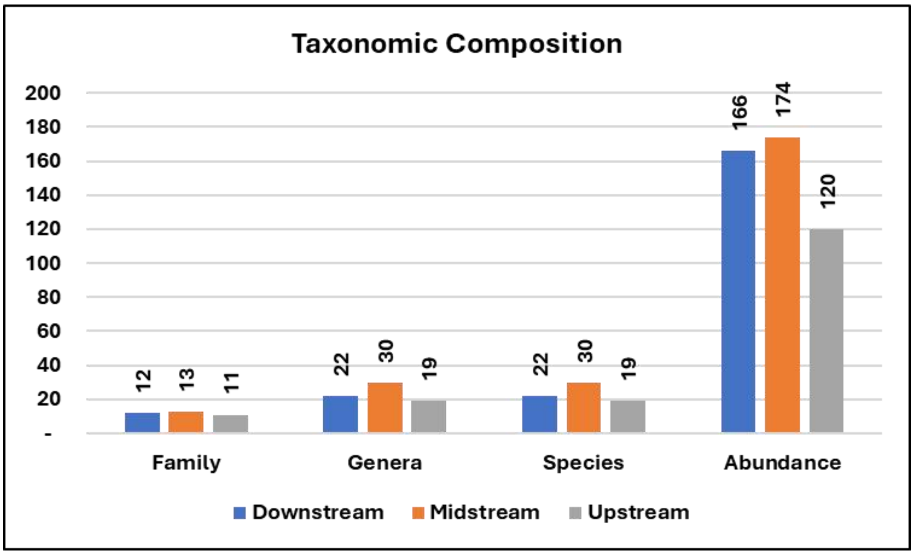


Figure 2.2.1-20. Taxonomic Composition of Fauna Species Within the Sampled Plots

Summary of Relative Abundance and Relative Frequency

The list of relative abundance and relative frequency of all fauna species is shown in the table below.

Table 2.2.1-20. List of Wildlife Fauna Species Recorded in-situ Within the Project Site with Conservation Status and Relative Indices

No.	Common Name	Scientific Name	Family Name	Endemicity	Conservation Status		No. of Indiv	Rel Abund (%)	Rank	Rel Freq (%)	Rank
					DAO 19-09	IUCN					
1	White-collared Kingfisher	*Todiramphus chloris* Boddaert, 1783	Alcedinidae	Resident	Not listed	LC	1	0.5435		1.6949	
2	Glossy Swiftlet	*Collocalia esculenta* Linnaeus, 1758	Apodidae	Resident	Not listed	LC	9	4.8913	4	5.0847	1
3	Cattle Egret	*Bubulcus ibis* Linnaeus, 1758	Ardeidae	Resident	Not listed	LC	16	8.6957	3	5.0847	1
4	Great White Egret	*Egretta alba* Linnaeus, 1758	Ardeidae	Migrant	Not listed	LC	9	4.8913	4	3.3898	2
5	Little Egret	*Egretta garzetta* Linnaeus, 1766	Ardeidae	Migrant	Not listed	LC	2	1.087		1.6949	
6	Black-crowned Night-heron	*Nycticorax nycticorax* Linnaeus, 1758	Ardeidae	Migrant	Not listed	LC	5	2.7174		3.3898	2
7	White-breasted Woodswallow	*Artamus leucoryn* Linnaeus, 1771	Artamidae	Resident	Not listed	LC	4	2.1739		3.3898	2
8	Pied Triller	*Lalage nigra* Forster, 1781	Campephagidae	Resident	Not listed	LC	1	0.5435		1.6949	
9	Common Ringed Plover	*Charadrius hiaticula* Linnaeus, 1758	Charadriidae	Resident	Not listed	LC	4	2.1739		3.3898	2
10	Zitting Cisticola	*Cisticola juncidis* Rafinesque, 1810	Cisticolidae	Resident	Not listed	LC	1	0.5435		1.6949	
11	Zebra Dove	*Geopelia striata* Linnaeus, 1766	Columbidae	Resident	Not listed	LC	6	3.2609		3.3898	2
12	Spotted Dove	*Spilopelia chinensis* Scopoli, 1786	Columbidae	Resident	Not listed	LC	3	1.6304		3.3898	2
13	Slender-billed crow	*Corvus enca* Horsfield, 1822	Corvidae	Resident	Not listed	LC	2	1.087		1.6949	
14	Large-billed Crow	*Corvus macrorhynchos* Wagler, 1827	Corvidae	Resident	Not listed	LC	8	4.3478	5	3.3898	2
15	Philippine Coucal	*Centropus viridis* Linnaeus, 1786	Cuculidae	Endemic	Not listed	LC	4	2.1739		5.0847	1
16	Chestnut Munia	*Lonchura atricapilla* Vieillot, 1807	Estrildidae	Resident	Not listed	LC	22	11.9565	2	3.3898	2
17	Barn Swallow	*Hirundo rustica* Linnaeus, 1758	Hirundinidae	Migrant	Not listed	LC	8	4.3478	5	5.0847	1
18	Tahiti (Pacific) Swallow	*Hirundo tahitica* Gmelin, 1789	Hirundinidae	Resident	Not listed	LC	2	1.087		3.3898	2
19	Brown Shrike	*Lanius cristatus* Linnaeus, 1758	Laniidae	Migrant	Not listed	LC	1	0.5435		1.6949	
20	Long-tailed Shrike	*Lanius Schach* Linnaeus, 1758	Laniidae	Resident	Not listed	LC	3	1.6304		3.3898	2
21	Gull-billed Tern	*Gelochelidon nilotica* Gmelin, 1789	Laridae	Migrant	Not listed	LC	1	0.5435		1.6949	
22	Striated Grassbird	*Megalurus palustris* Horsfield, 1821	Locustellidae	Resident	Not listed	LC	1	0.5435		1.6949	
23	Blue-tailed Bee-eater	*Merops philippinus* Linnaeus, 1766	Meropidae	Resident	Not listed	LC	4	2.1739		1.6949	

No.	Common Name	Scientific Name	Family Name	Endemicity	Conservation Status		No. of Indiv	Rel Abund (%)	Rank	Rel Freq (%)	Rank
					DAO 19-09	IUCN					
24	Richard's Pipit	*Anthus richardi* Vieillot, 1818	Motacillidae	Resident	Not listed	LC	4	2.1739		5.0847	1
25	Yellow Wagtail	*Motacilla flava* Linnaeus, 1758	Motacillidae	Migrant	Not listed	LC	1	0.5435		1.6949	
26	Pied Bushchat	*Saxicola caprata* Linnaeus, 1766	Muscicapidae	Resident	Not listed	LC	1	0.5435		1.6949	
27	Plain-throated Sunbird	*Anthreptes simplex* Müller, 1843	Nectariniidae	Resident	Not listed	LC	1	0.5435		1.6949	
28	Olive-backed Sunbird	*Cinnyris jugularis* Linnaeus, 1766	Nectariniidae	Resident	Not listed	LC	2	1.087		3.3898	2
29	Eurasian Tree Sparrow	*Passer montanus* Linnaeus, 1758	Passeridae	Resident	Not listed	LC	45	24.4565	1	5.0847	1
30	Arctic Warbler	*Phylloscopus borealis* Blasius, 1858	Phylloscopidae	Migrant	Not listed	LC	1	0.5435		1.6949	
31	Philippine Bulbul	*Hypsipetes philippinus* Forster, 1795	Pycnonotidae	Endemic	Not listed	LC	2	1.087		3.3898	2
32	Yellow-vented Bulbul	*Pycnonotus goiavier* Scopoli, 1786	Pycnonotidae	Resident	Not listed	LC	9	4.8913	4	5.0847	1
33	Pied Fantail	*Rhipidura nigritorquis* Vigors, 1831	Rhipiduridae	Resident	Not listed	LC	1	0.5435		1.6949	
					TOTAL		**184**	**100**		**100**	

Relative Abundance

Among the avifauna species observed within the proposed project site, the Eurasian Tree Sparrow (*Passer montanus* Linnaeus, 1758) has the highest relative abundance with 24.4565% (45 individuals) followed by Chestnut Munia (*Lonchura atricapilla* Vieillot, 1807) with 11.9565% (22 individuals) and Cattle Egret (*Bubulcus ibis* Linnaeus, 1758) with 8.6957% (16 individuals). See **Table 2.2.1-20** above.

Relative Frequency

The fauna species with the highest relative frequency are Eurasian Tree Sparrow (*Passer montanus Linnaeus*, 1758), Cattle Egret (*Bubulcus ibis* Linnaeus, 1758), Philippine Coucal (*Centropus viridis* Linnaeus, 1786), Richard's Pipit (*Anthus richardi* Vieillot, 1818), Glossy Swiftlet (*Collocalia esculenta* Linnaeus, 1758), Yellow-vented Bulbul (*Pycnonotus goiavier* Scopoli, 1786), and Barn Swallow (*Hirundo rustica* Linnaeus, 1758) with 5.0847% each. See **Table 2.2.1-20** above.

Summary of Conservation Status and Endemicity

The conservation status of wildlife species is in accordance with the IUCN Red List of Threatened Species and DENR AO 2019-09. All fauna species recorded within the vicinity of the project area were classified as Least Concern (LC) under IUCN and not included in the list under the DAO 2019-09.

In terms of endemicity, majority of the fauna species within the vicinity of the project site are residents (72.73%) while the migrants or migratory species are 21.21% and the endemics has 6.06% (see **Table 2.2.1-21**).

Table 2.2.1-21. Endemicity of Fauna Species

Endemicity	No. of Species	Percent (%)
Endemic	2	6.06%
Migrant	7	21.21%
Resident	24	72.73%
Total	**33**	**100.00%**

Shannon-Wiener Biodiversity and Pielou's Evenness Index

Species diversity and evenness measurement follow the Shannon-Wiener Index indicated by **H'** and Pielou's Evenness Index or J'. Computed values for **H'** and **J'** shall be referred to the Fernando Biodiversity Scale to quantify sampled areas in terms of diversity and evenness levels.

The biodiversity indices of all terrestrial fauna species recorded within the project area were computed using the equation of Shannon-Weiner Index (H'). The result shows that the study area has moderate biodiversity index with H' = 2.9437 and evenness index with J' = 0.8133 following the Fernando et al. (1998). This also implies that the abundance of dominant species is evenly distributed in the area (see table below).

Table 2.2.1-22. Fauna Biodiversity Indices

Parameters	Value	Description
Shannon-Weiner Index (H')	2.8437	Moderate
Species evenness (J')	0.8133	Very High
Species richness (R)	33	
Abundance (A)	184	

Conclusion

None of the flora species found in the vicinity of the proposed project area is cited as either critically endangered, endangered, and vulnerable under IUCN and DENR AO 2017-11;

None of the fauna species recorded in the project area were cited as critically endangered, endangered, and vulnerable following IUCN Red List and DENR AO 2019-09;

In terms of endemicity, majority of the plant species, particularly those that are present in the islets are introduced and exotic.

Summary of Findings

Terrestrial Flora

Terrestrial flora assessment of the proposed dredging project area recorded in-situ a total of 460 number of individuals belonging to seed plants (Angiosperm) that includes monocots and dicots comprising the taxonomic group of 39 morpho-species belonging to 39 genera and 16. The midstream area has the highest abundance with 174 individuals representing 30 species with 30 genera and 13 families followed by the downstream section with an abundance of 166 from 22 species and 22 genera covering 12 families. The upstream area has the least number of individuals with 120 composed of 19 species belonging to 19 genera from 11 families.

The study area also registered 5 morphological composition in terms of plant form or habit consisting of trees, shrubs, vines, grasses, and herbs. The most speciosae (having several species) in terms of morphological composition relative to plant form/ habit belongs to trees and shrubs with 10 species or 25.64% apiece, followed by grasses and herbs with 8 species composed of 20.51% and 7 species with 17.95%, respectively. Vines, on the other hand, have the least number of species with 4 (10.26% of total).

The species with the highest relative density belongs to Carabao grass (*Paspalum conjugatum* P. J. Berguis) of the family Poaceae with 12.3913% (57 individuals) while the species having the highest relative dominance include Datiles (*Muntingia calabura* L.) of Muntingiaceae with 71.1697% followed by Agoho (*Casuarina equisetifolia* L.) of family Casuarinaceae, and Alagau (*Premna odorata* Blanco) and Gmelina (*Gmelina arborea* Roxb. ex Sm. in Rees), both belonging to family Lamiaceae with 5.4915% and 1.3729% respectively. Overall, the species to have the highest importance value (IV) include Datiles with 75.9431% followed by Agoho and Carabao grass with 24.2440% and 16.6167%, respectively. The importance value, as a combination of relative density, frequency, and dominance, is used to summarize the influence of an individual species within the community. Recognize that two species with the same importance value can have markedly different values for relative density, frequency, or dominance as any differences can be overshadowed by the addition process.

On biodiversity index, the Shannon-Wiener Biodiversity Index (H') of all sampling plots recorded an average of H'=2.7804 and Pielou's Evenness Index J'=0.8779 indicating "moderate" biodiversity index and "very high" evenness index following the Fernando Biodiversity Scale and Evenness Index. Sampled plots in the midstream area recorded a biodiversity index at 3.0842 indicating "high" species diversity and "very high" evenness index at 0.9068 followed by sampled plots in the upstream area with 2.7095 and 0.8504 indicating "moderate" diversity with "very high" evenness while sampled plots in the downstream area registered 2.5476 and 0.8766 indicating "moderate" diversity with "very high" evenness index.

On conservation status, all flora species recorded in all the sampled plots were cited as Least Concern under IUCN and not included in the list under DENR AO 2017-11. Meanwhile, the terrestrial flora assessment revealed that 13 species or 39.4% out of the 39 species are native, an endemic species to the Philippines while the remaining 26 species or 66.67% are considered naturalized, introduced or exotic species. Majority are considered naturalized or introduced species, which are common in the riverine/ riparian and lowland areas. Most of the introduced species are already acclimatized or naturalized to Philippine environment. Some of them that are native to North America and Mexico, has an extensive distribution in the country as part of the reforestation and rehabilitation program in the past decades. The 13 native species are among the notable species that are restricted to the Philippines.

Terrestrial Fauna

For the terrestrial fauna (wildlife), the assessment conducted at various locations (downstream, midstream, and upstream) of the proposed dredging project site yielded 184 individuals (abundance) belonging to 33 species (richness) of avifauna (birds) representing 29 genera and 23 families. The midstream area has the highest abundance with 83 individuals representing 20 species with 19 genera and 16 families followed by the downstream section with an abundance of 55 number of individuals from 20 species and 19 genera covering 16 families. Sampled plots in the upstream area has the least number of individuals with 46 composed of 22 species belonging to 19 genera from 15 families.

Among the avifauna species observed, Eurasian Tree Sparrow (*Passer montanus* Linnaeus, 1758) has the highest relative abundance with 24.4565% (45 individuals) followed by Chestnut Munia (*Lonchura atricapilla* Vieillot, 1807) with 11.9565% (22 individuals) and Cattle Egret (*Bubulcus ibis* Linnaeus, 1758) with 8.6957% (16 individuals).

In terms of conservation status, all fauna species recorded within the vicinity of the project area were classified as Least Concern (LC) under IUCN and not included in the list following the DENR AO 2019-09. On endemicity, majority of the fauna species within the vicinity of the project site are residents (72.73%) while the migrants or migratory species are 21.21% and the endemics has 6.06%. With respect to biodiversity, the results show that the study area has **moderate** biodiversity index with H' = 2.9437 and evenness index with J' = 0.8133 following the Fernando et al. (1998). This also implies that the abundance of dominant species is evenly distributed in the area.

2.2.1.4.4 Key Impacts and Mitigation Measures

Removal of Vegetation/ Loss of Habitat
By and large, the proposed project will entail massive earthmoving during operation stage and may entail potential massive erosion of riverbanks especially during heavy downpours.

Threats to Existence and/or Loss of Important Local Species
Several documented studies and researches show that there will be no excessive concentration of air pollutants that are toxic to flora and fauna during the operation stage. During the baseline study, no abnormal signs and symptoms regarding the physiological processes of the plants and animals were observed as well as current major threats to flora and fauna population.

By and large, as the proposed project will entail massive earthmoving but within the river dredging zone/channel only. In any case, there are areas within the river where sand (and soil) have accumulated and are presently vegetated. For such areas, it is highly recommended to have a TREE INVENTORY prior to ANY development or dredging operation, to determine which trees are to be relocated or felled/ cut. For those trees that shall be relocated and/ or cut, it is highly recommended to transfer them at the nearest forested area or at the buffer zone of the project area in order to avoid/ mitigate local extinction of such species. Tree cutting may be applied at the DENR concerned office for those trees that are defective and overmature. Replacement ratio following the DENR guidelines on trees to be removed, relocated, or cut based on results of tree inventory should be applied for all tree species to be affected by the project. The replacement ratio will be accounted for as part of the company's contribution to National Greening Program (NGP) and carbon sequestration initiative to contribute in GHG emissions and reductions program of the government.

Threats to Abundance, Frequency and Distribution of Important Species
The loss of vegetation as a result of land clearing may affect the number or population, frequency, and distribution of wildlife species as a result of further habitat fragmentation and source of food for survival of some species. Other than land clearing and removal of vegetative cover, the noise, dusts, and traffic will be generated from heavy equipment during dredging operation and/or earthmoving activities will affect the behavior of wildlife species. The tendency is for faunal species to migrate to nearby areas where disturbance of habitat is less.

Threats to abundance, frequency, and distribution of floral species is minimal considering the operation will be confined in the river regime. In exceptional cases where there might be some globally important species within the dredging zone, such will be earth-balled and relocated to the buffer zone. Replacement planting of tree species that will be affected or removed/cut during the course of land development phases will be implemented. Planting of appropriate species in the riverbanks after the dredging will help minimize soil erosion and this is highly encouraged to serve as carbon sink program.

Hindrance to Wildlife Access

Hindrance to wildlife access during dredging operation is minimal and only for a short-term period. Faunal species will tend to migrate to areas where disturbance is minimal in search for food and habitat. The use of endemic fruit-bearing trees species such as bignai-pugo, *ficus spp*. as well as bamboo, and other floral species attractive to wildlife should be planted at the riverbanks. Once vegetative cover is restored at the riverbanks, wildlife species will return for food and habitat.

GHG emissions and carbon sequestration program/s
To compensate for the GHG emissions, rehabilitation of disturbed areas and full stocking density of riverbanks should be conducted using globally threatened, indigenous, and endemic species such as molave, bitaog, batino, and bamboo. These species are able to sequester large amounts of carbon which they assimilate into their tissues and these may also lower micro-climatic condition of the area. Sources of planting materials may be obtained near the vicinity of the project site while forest nurseries for growing such species should be established. The forest nursery should be big enough to accommodate the total number of seedlings, including mortality rate at the nursery and plantation, needed for replacement planting of relocated, removed, or cut in accordance to replacement ratio provided for by the DENR. Other than replacement trees for relocated, removed or cut, the number of trees and area to be planted for carbon sink should compensate the amount of GHG emissions. This could be an off-site plantation as long as it is within the host community. It is also recommended that a local Forester be employed to manage the seedling production and carbon sink initiative program of the company.

Replacement of Trees Cut Due to Land Clearing
Prior to project implementation, the proponent will coordinate with the DENR to seek clearance for the identification of required documents for the issuance of needed tree cutting permit (PD 705). Moreover, to compensate for loss of habitats, the proponent will replace the number of trees removed/cut and plant them in nearby areas or in accordance with the advice of the DENR. Species that will be used for the reforestation must be indigenous trees and/or fruit bearing trees endemic in the place that can attract the return of wildlife species.

As per DENR Memorandum Order no. 05 of 2012 mandated that "*Uniform replacement ratio for cut or relocated trees"* item 2.2 *"For planted trees in private land and forest lands... tree replacement shall be 1:50 while naturally growing trees on the same area, including those affected by the project shall be 1:100 ratio in support of the National Greening Program (NGP) and Climate Change Initiatives of the Government*".

Measures to Minimize Decrease/Migration of Faunal Species
Land clearing will be confined on designated sites for development only. During dredging operation, the contractor will ensure to prohibit his employees to engage in any mode of wildlife collection and/or hunting, rather, the contractor shall promote conservation and protection of remaining wildlife species. Promote wildlife protection using innovative means such as putting up of warning signage's on strategic areas for public information and warning.

Tree Cutting Permit
Prior to land clearing operation, it is recommended that proponent should conduct tree inventory prior to application for tree cutting and/or tree relocation permit for those trees that will be affected by the construction.

Replacement of Trees/ Vegetation Affected Due to Land Clearing/ Dredging of Islets
To compensate the loss vegetation, the proponent should replace the number of trees loss during dredging of the islets and plant them in the nearby areas or within the riverbanks. Augmentation or enrichment planting using propagated seedlings (nursery grown) or wildlings should also be conducted off-site for Carbon Sink program. The number of seedlings for replacement should follow the DENR Memorandum Order 2012-05 "Uniform Replacement Ratio for Cut or Relocated Trees" item 2.2 "For planted trees in private and forest lands not covered under….. tree replacement shall be 1:50 while naturally growing trees on the same area, including those affected by development projects shall have 1:100 ratio in support of the National Greening Program (NGP) and Climate Change initiatives of the Government." As such, a construction and operationalization of nursery area is highly recommended, preferably near or within the project site) for the production of seedlings, both for forest trees (native/ endemic species) are highly recommended to ensure high percentage of survival

rate) which will be used as replacement or enrichment planting. Improvement of general landscape inside and outside of the project site through planting of ornamentals would add aesthetics to the overall housekeeping of the project site. Replacement planting should be coordinated with concerned DENR Field Office to be credited as part of the Company's contribution to National Greening Program (NGP) as should be part of the Company's implementation of Reforestation and Carbon Sink Program.

Prohibition of Wildlife Poaching/Collection
The proponent should also ensure that its employees must be prohibited/ warned/ informed not to engage in any mode of wildlife collection and/or hunting for the conservation and protection of remaining wildlife species. Moreover, promote wildlife protection using innovative means such as putting up of warning or signages on strategic areas for public information and warning.

2.2.2 WATER

2.2.2.1 Hydrology/Hydrogeology

2.2.2.1.1 Change in Drainage Morphology / Inducement of Flooding/ Reduction in Stream Volumetric Flow

The municipality is traversed by 11 rivers and creeks, a system that also serves as a natural drainage. Bounded by the Mindoro Strait and the West Philippine Sea on the southwestern part is the Municipality of San Jose, including its island barangays. Busuanga River also has a tributary river system within the area which is the primary source of agricultural land irrigation. This river plays a common boundary between the Municipality of Rizal and San Jose.

The dredging project could potentially disrupt fish habitats, breeding grounds, and migration patterns. This disturbance may lead to a decline in fish populations. Additionally, the project has the potential to alter or even destroy aquatic habitats, including submerged vegetation and nesting areas. Furthermore, the dredging could introduce sediment resuspension, which might adversely affect various water quality parameters. The project's impacts could extend to the river's hydrodynamics and sediment transport patterns, potentially influencing erosion, sedimentation, and water flow dynamics. There's also a possibility that the dredging could disrupt the water supply used in agriculture.

Since the proposed project is within the Busuanga River, which has fundamental roles in the locality as a source of water and may affect the river and community as a whole, the proponent, in conducting the EIA Study, necessarily has to focus on the Water and Aquatic Resources Impact. This includes evaluating the potential impacts on fish populations, aquatic habitats, and water quality parameters such as pH, dissolved oxygen, and turbidity. Additionally, the study considers the potential for contamination from project activities such as dredging or waste disposal and proposes measures to mitigate these impacts.

Watershed Characterization
The delineated basin of the Busuanga River has a total land area of 530.07 square kilometers.

A watershed, also called catchment or drainage basin, refers to the topographic area that collects rainfall and discharges surface stream flow through the outlet of the watershed *(Mays, 2005)*. Watershed delineation is the process in which the boundaries of a watershed are identified by passing an imaginary line that traces the ridges and divides. The delineated area represents a 'bowl' and rainfall falling into this area drains into the portion with lowest elevation called the outfall or outlet. This outlet is designated as a point of interest located along the river of a watershed. The topographic, geometric, as well as the soil and land cover characteristics of the watershed are major factors in the transformation of rainfall into the volume that flows through the desired outlet along the river.

To delineate the watershed of Busuanga River, the digital elevation model of Mindoro Island obtained from the National Mapping and Resource Information Authority (NAMRIA) which has a resolution of 5m was used in the study. The delineated watershed of Busuanga River has an area of 530.07 km^2. Please refer to the following figure.

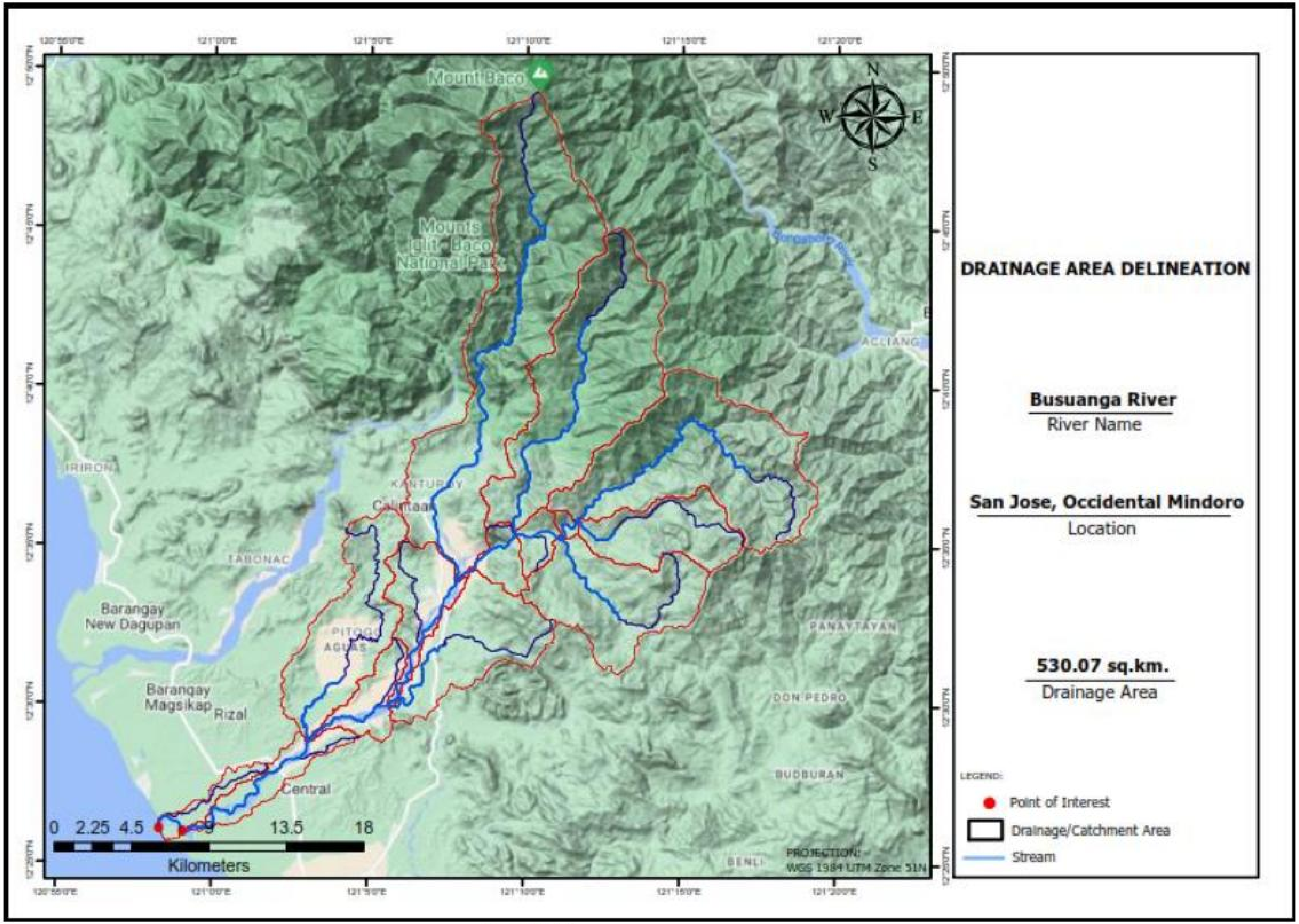


Figure 2.2.2-1. Busuanga River System Watershed

HEC-HMS Hydrologic Model

HEC-HMS developed by USACE was implemented in this study to simulate the hydrologic processes of Busuanga River. The sub-basins and reaches were generated in the basin model. The location of the outlet or sink of the basin is defined as the upstream boundary condition of the hydraulic model.

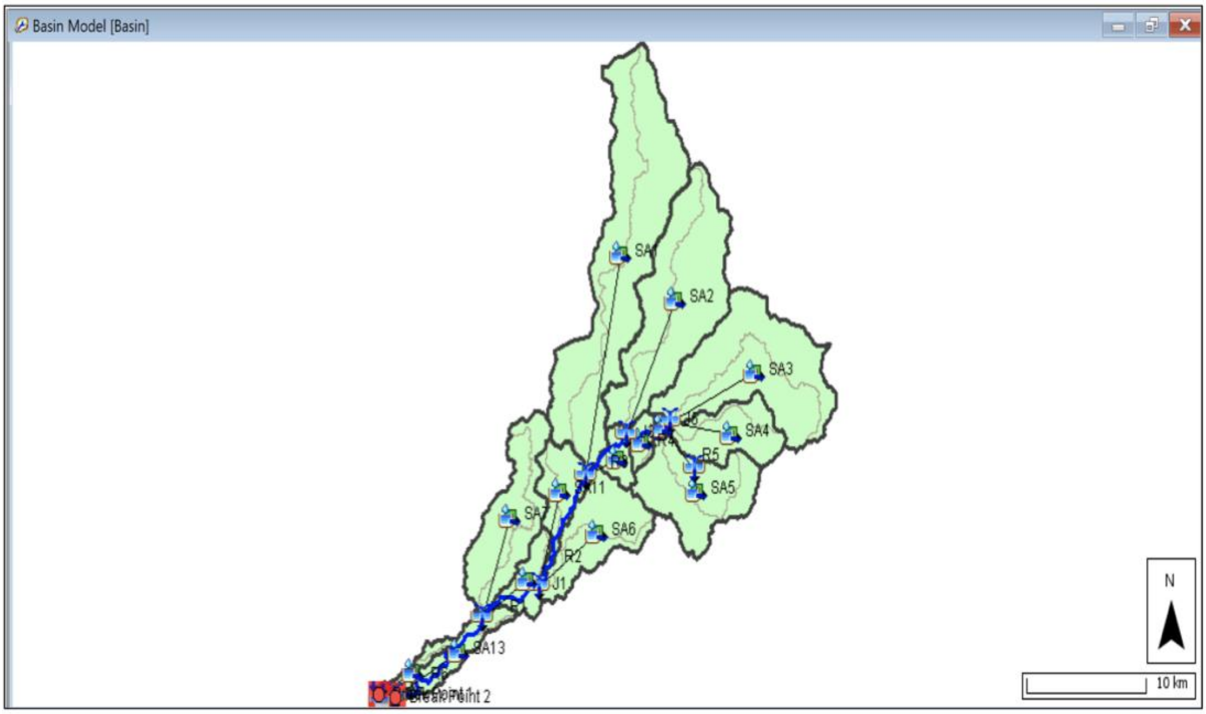


Figure 2.2.2-2. HEC-HMS Basin Model Used in the Study

The physical characteristics such as the area of the delineated subbasin, length of watercourse, length of watercourse from the center of area as well as the elevations at the origin and point of interest was determined using the topographic map with a scale of 1:50, 000 and 30m resolution digital elevation map (DEM).

Table 2.2.2-1. Physical Characteristics of Subbasins and Watersheds of Busuanga River

Subbasin ID	Catchment Area (km^2)	Length (km)	Lca (km)	ELEVATION Highest (m)	Lowest (m)	Diff. (m)
0	116.81	35.63	19.9	1980	65	1915
1	85.28	23.57	12.32	1720	120	1600
2	103.99	23.69	9.68	1304	140	1164
3	10.31	4.53	3.55	120	65	55
4	6.91	2.92	1.44	140	120	20
5	26.07	8.78	4.02	260	64.5	195.5
6	52.3	17.77	5.61	1304	140	1164
7	8.2	4.51	3.9	65	64.5	0.5
8	8.8	6.89	3.56	64.5	39	25.5
9	37.39	10.62	6.63	120	37	83
10	32.3	14.34	8.62	760	39	721
11	6.5	5.08	3.48	39	37	2
12	5.24	3.84	3.36	37	36	1
13	9.59	7.24	4.25	100	36	64
14	6.78	4.66	2.83	36	10	26

Subbasin ID	Catchment Area (km^2)	Length (km)	Lca (km)	ELEVATION		
				Highest (m)	Lowest (m)	Diff. (m)
15	6.55	4.51	1.57	10	5	5
16	8.96	3.19	1.35	10	5	5

Baseflow

Baseflow is a sustained runoff of prior rainfall that was stored temporarily in the river basin. The baseflow can be assumed to be constant during flood. When a streamflow gauging station is located near the target river basin, the mean daily discharge of one day before the flood is used as the baseflow. When there are no data available, 0.05m^3/s/km^2 can be used for the baseflow.

For Busuanga River, the catchment area is 530.07 km^2 and the corresponding baseflow is 26,503 m^3/sec.

Morphologic Evolution of Busuanga River

A reconstruction of the channel planform from topographic map dating back to the early 1950s and GoogleEarth satellite images dating back to 1985 shows that the alluvial portion of Busuanga River, which is a meandering and braided type of river, has been continually shifting. Sandbars are incessantly formed and then scoured. Now and then, the main channel shifts its course and the rivermouth changes position. There is no indication how this attribute will change in the near future, but it can be influenced by anthropogenic interventions.

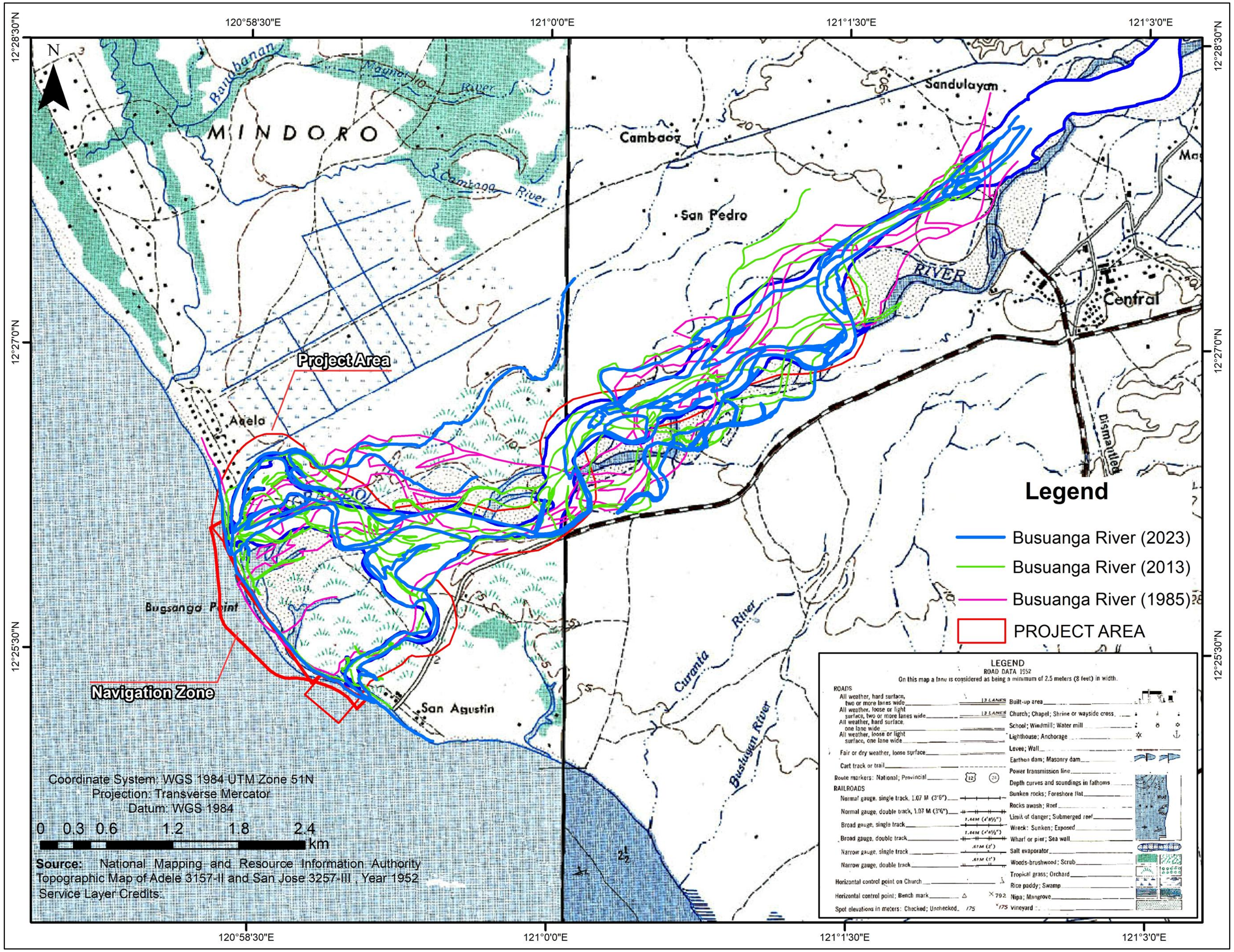
The changes in the upstream portion (downstream of the Busuanga River) is more on the shift to the northern side and narrowing of the main channel. In the middle part, the changes are less conspicuous. The more obvious channel shifting happened downstream, wherein the main channel has arched northwards, thereby widening the river regime. Another significant change is the development of the southern branch into a perennial channel. Whereas in the 1950s map, this southern river mouth was merely a small tidal creek, then it began to link with the main Busuanga River after 1985 and continued to widen and deepen to its current state.

In the natural evolution of any floodplain, the river can always reclaim its old abandoned channels within that plain in any event that its present course presents more resistance to the passage of water. In cases of heavy rainfall and therefore voluminous runoff, the river will choose the easiest passageway to empty its load into the sea. Inversely, it can also etch a totally new path if its channel is severely clogged and the water cannot freely flow downstream.

In terms of urban planning, these areas that serve as the river's "playground" should not be inhabited. Development of buildings and structures within it should follow the proper engineering measures to counteract such natural phenomenon.

The dredging project in itself is designed to create morphologic changes in Busuanga River. Nevertheless, the morphologic change/s that will be brought by the dredging activities is designed to improve the carrying capacity of the river and restore it to its most favored form especially in terms of mitigating flood hazards.

Figures 2.2.2-3 illustrates how the channel of Busuanga River has changed throughout the years. It should be noted that some changes occur in a single flooding event while some are through the normal occurrence of erosion/deposition cycles. The trace of the current channel was overlain on older planforms in the figure for ease of comparison.

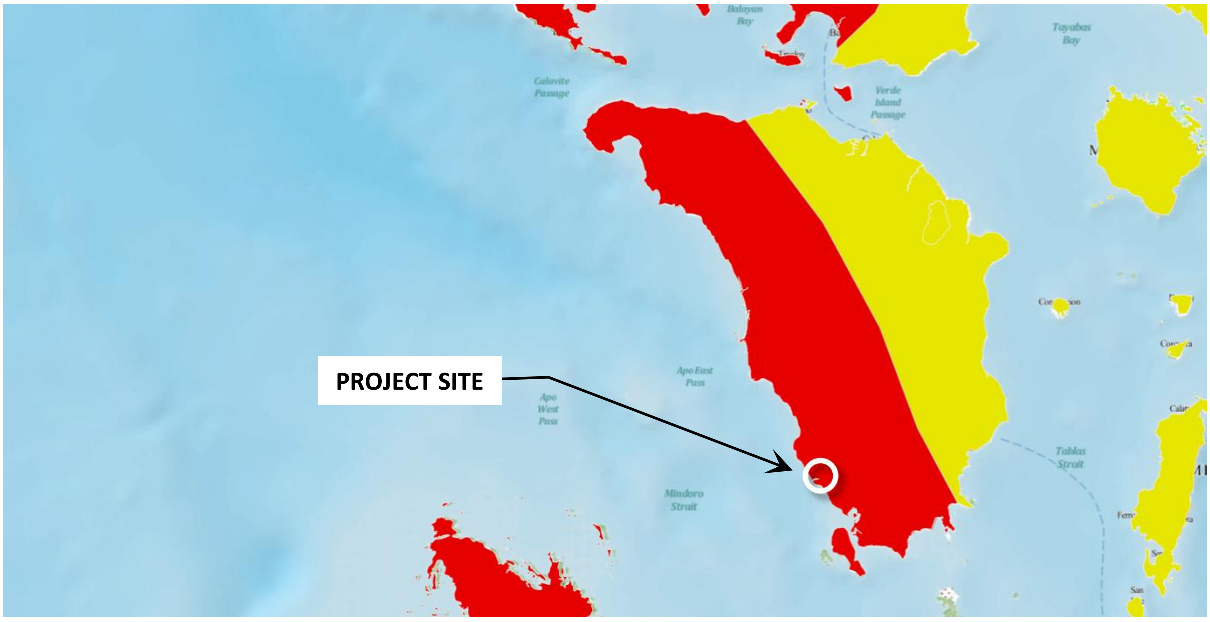


Source: NAMRIA Topographic Map. 1952

Figure 2.2.2-3. Morphologic Evolution of Busuanga River and Its Alluvial Plain – 1952 to Present Scenario

Climate Including Rainfall, Temperature and PAGASA Climate Projections for 2020 and 2050

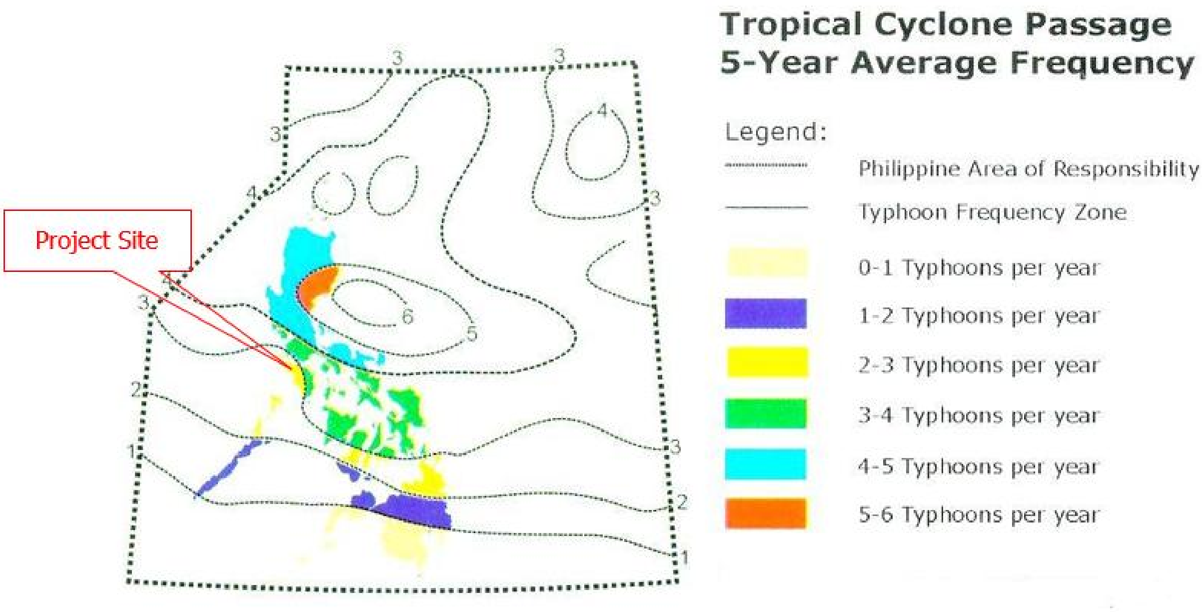
The climate of the region is classified as Type I as defined by the Coronas Classification system and shown in the Climate Map of Mindoro (figure below). Such areas exhibit two pronounced seasons, the dry season extending from November to April and the wet season from May to October. The latter is dominated by the southwest monsoon season with severe weather conditions associated with typhoons.



Source: PAGASA

Figure 2.2.2-4. Climate Map of Mindoro

The project area is affected by tropical storms/typhoons with a statistical frequency of zero to one cyclone per year as shown in the Tropical Cyclone Passage (figure below), which also confirms the observed flooding occurrences in the area.



Source: PAGASA

Figure 2.2.2-5. Tropical Cyclone Passage

Table 2.2.2-2. Projected Changes in Seasonal Rainfall and Temperature for Occidental Mindoro in the Mid21st Century (2036-2065) Relative to 1971-2000

Season	Scenario	Range*	Baseline (1971-2000)		Projected Change				
			Rainfall (mm)	Temp (°C)	Percent (%)	Rainfall amount (mm)	Seasonal Rainfall Amount (mm)	Change in °C	Seasonal Mean Temperature (°C)
December-January-February (DJF)	Moderate Emission (RCP4.5)	Lower Bound	160	26.5	-1.7	-2.7	156.8	1	27.5
		Median			13.2	21.1	180.6	1.3	27.8
		Upper Bound			52.3	83.4	242.9	1.7	28.2
	High Emission (RCP8.5)	Lower Bound			-1.4	-2.2	157.3	1.3	27.8
		Median			9.5	15.1	174.6	1.6	28.1
		Upper Bound			25.9	41.2	200.7	2	28.5
March-April-May (MAM)	Moderate Emission (RCP4.5)	Lower Bound	266	28.3	-5	-13.3	252.6	1	29.3
		Median			2.6	6.9	272.8	1.3	29.6
		Upper Bound			12.7	33.7	299.6	1.8	30.1
	High Emission (RCP8.5)	Lower Bound			-18.3	-48.7	217.2	1.4	29.7
		Median			-3.3	-8.7	257.2	1.7	30
		Upper Bound			23.3	62	327.9	2.3	30.6
June-July-August (JJA)	Moderate Emission (RCP4.5)	Lower Bound	1091	27.3	-25.1	-273.7	817.5	0.9	28.2
		Median			-20.6	-224.4	866.8	1.2	28.5
		Upper Bound			3.6	39	1130.2	1.7	29
	High Emission (RCP8.5)	Lower Bound			-28.1	-307	784.2	1.4	28.7
		Median			-13	-141.4	949.8	1.5	28.8
		Upper Bound			11.6	126.4	1217.6	2.2	29.5
September-October-November (SON)	Moderate Emission (RCP4.5)	Lower Bound	763	27.1	-19.5	-148.8	613.8	1	28.1
		Median			-3	-22.6	740	1.1	28.2
		Upper Bound			4.2	31.7	794.3	1.8	28.9
	High Emission (RCP8.5)	Lower Bound			-18.1	-137.7	624.9	1.4	28.5
		Median			-3.6	-27.5	735.1	1.5	28.6
		Upper Bound			7.9	59.9	822.5	2.2	29.3
ANNUAL AVERAGE (Moderate Emission, Median)			**570**	**27.3**	**-1.95**	**-54.75**		**1.22**	**28.525**

Source: PAGASA

Using PAGASA's Climate Projections (**Table 2.2.2-2**), the annual rainfall in 2036 and 2065 will decrease by 1.95% (219.8 mm). Rainfall will increase from December to May but decrease from June to November, the latter being the months with more rainfall, hence, the net decrease. June to August (JJA) will remain to be the season with the most rainfall.

Based on PAGASA's projections, the annual average temperature for 2036 and 2065 is 28.52°C. March to May (MAM) remain the warmest months with mean temperature of 29.6°C. This is an increase of 1.3°C (from 28.3°C). December to February (DJF) likewise increased by 1.3°C but still the coldest season with a mean temperature of 27.8°C.

RIVER BATHYMETRY BASELINE

A river bathymetric survey was conducted in a 200 meter-interval within the 8-kilometer extension from the mouth of Busuanga River. Each target station has a middle (thalweg or the deepest portion of the river), left riverbank, and right riverbank -side geographic location readings with corresponding water depth measurements. The river water depth measurement was done using a meter stick on the shallow areas, while a marine echo sounder was used for areas with deeper water levels. Offsetting from the original target station was also applied in areas with strong water currents and not easily accessible. A total of 129 actual stations, with an average water depth of -0.63 meters, within the 8-km extension from the mouth of Busuanga River were surveyed and recorded during the actual initial survey works at Busuanga River. The details are shown in **Annex 2-D.** This also contains discussion of the geological investigation conducted.

The river bathymetric map generated by the sounding is shown in the 2 figures below.

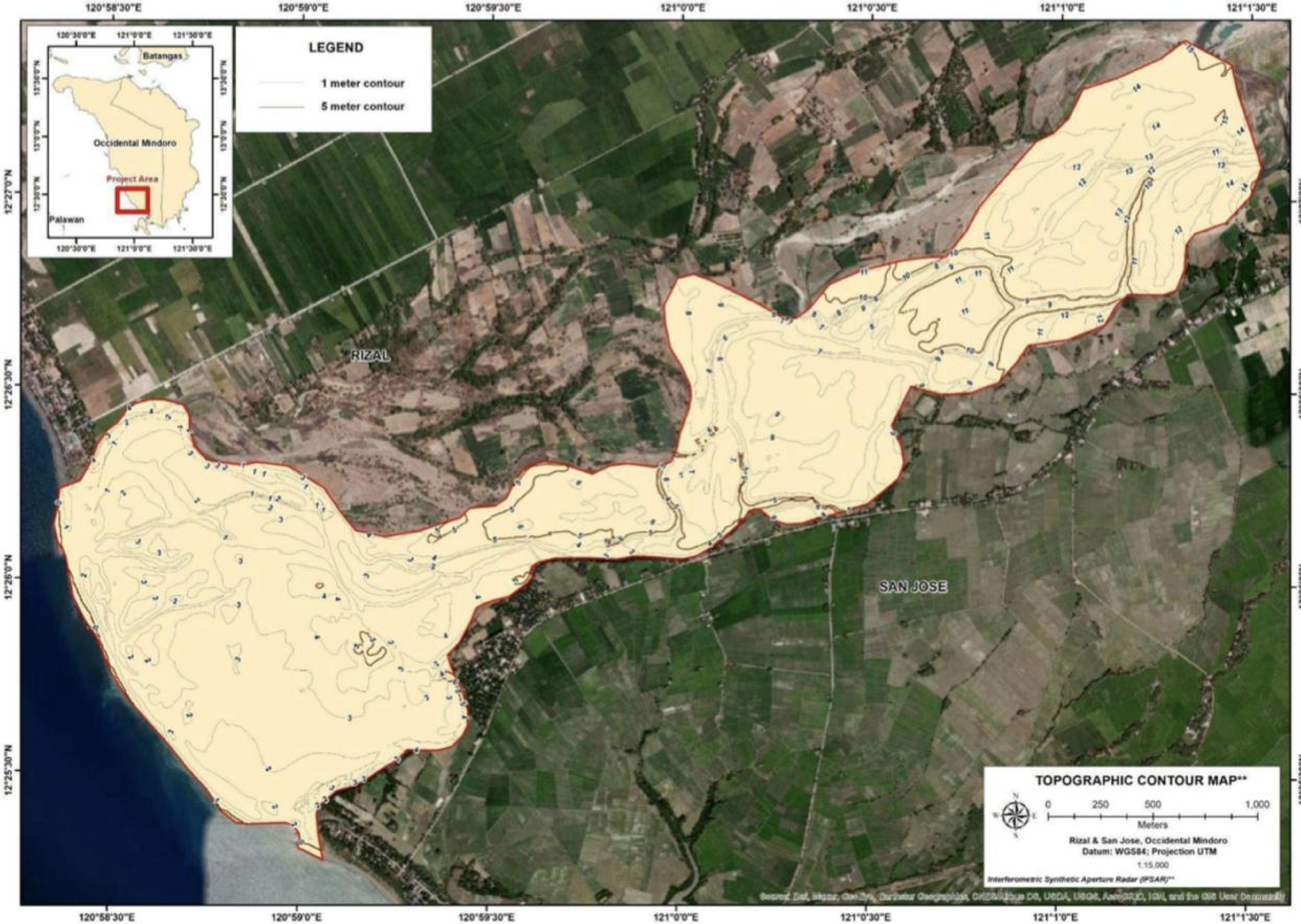


Figure 2.2.2-6. Bathymetric Contour Map of Busuanga River

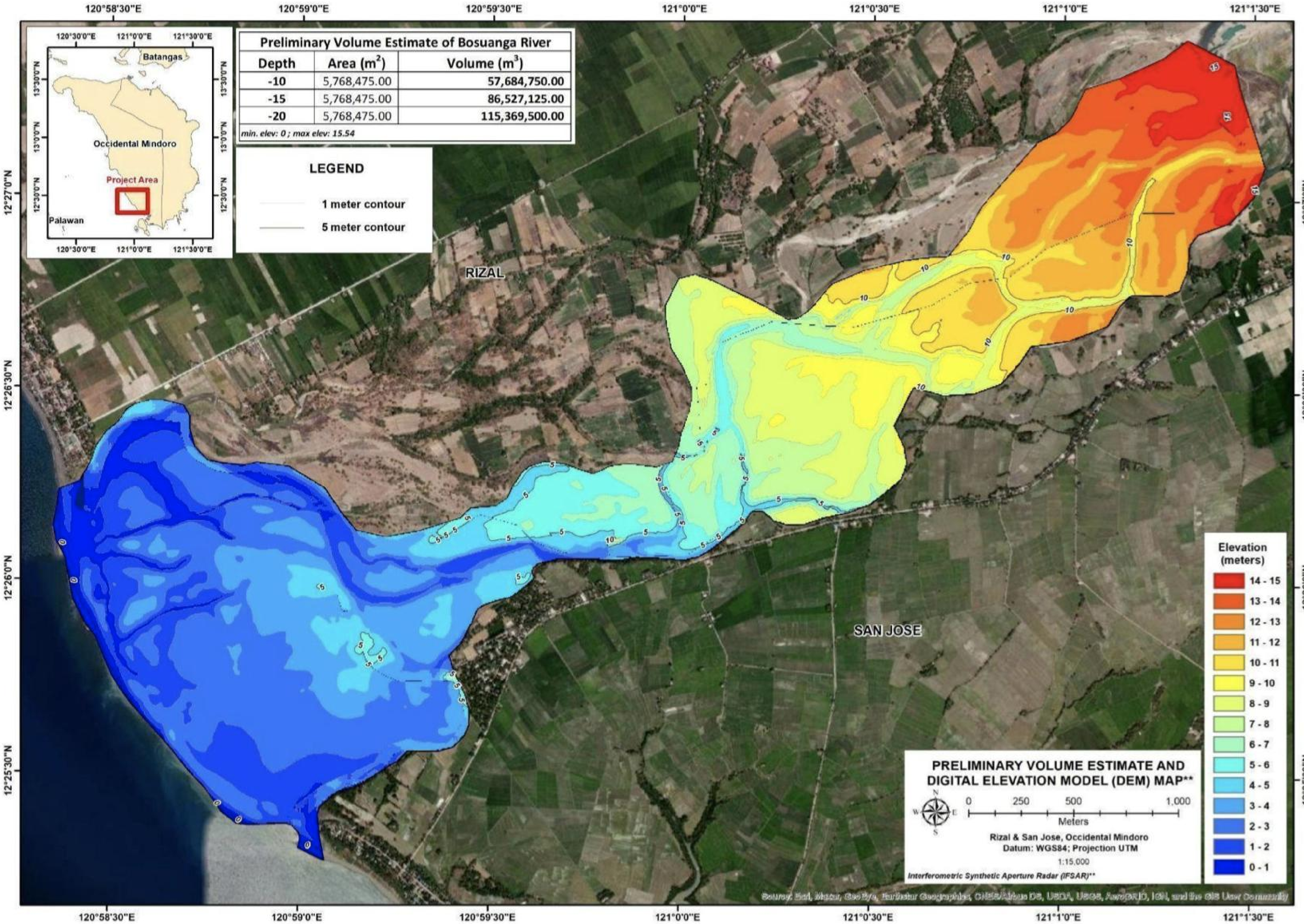


Figure 2.2.2-7. Digital Elevation Model (DEM) of Busuanga River

Flood Modeling

This is detailed under **Section 3.2.1.6: Probable Flood**.

Simulated Water Surfaces Profile Profiles for 100-yr Floods
The peak discharges of 1,205.90 m^3/s (main downstream), 1,972.33 (section 1) and 936.1 m^3/s (section 2) m^3/s, all corresponding to 100-yr flood were simulated using the steady state 1-dimensional flow of the HEC-RAS program. In this section, the water surface profiles for the (1) baseline scenario "without" the dredging project and (2) scenario "with" the dredging project are presented for the 100-yr floods. The results for all the cross-sections can be found in pages 80 to 101 of **Annex 2-A.**

Figures 2.2.2-8 shows the simulated water surface profiles for the "without" and "with" dredging project for 100-yr flood. In the figure, the water surface profile is along the 10,550.0 km length of Busuanga River, starting from the river mouth. Comparison of the water surface profiles for the "without" and "with" dredging project show that there is a change in water levels along the length of the dredged channel.

Probable Flood
Using a 2D-unsteady flow model, the probable inundation in the target river stretch before and after the proposed dredging project was determined.

Design Cross Sections
Other variables considered include the design cross sections as reflected in the approved DMP (pages 14-28 of **Annex 1-B**). These are also shown in the following **Figures 2.2.2-9** to **2.2.2-19** for Section 1 or the Main Channel and **Figures 2.2.2-20** to **2.2.2-23** for Section 2 or the “Branch”.

Design Riverbed Profile
Another variable is the design riverbed profile. The average slope of the channel is 0.18% and the design channel is set to follow this natural slope. The elevation of the design riverbed from the offshore towards the upstream ranges from -11.53m to 4.83 masl. In addition, the elevation of the design riverbed starting from the mouth of the branch up to the junction ranges from -11.19m to -4.98m.

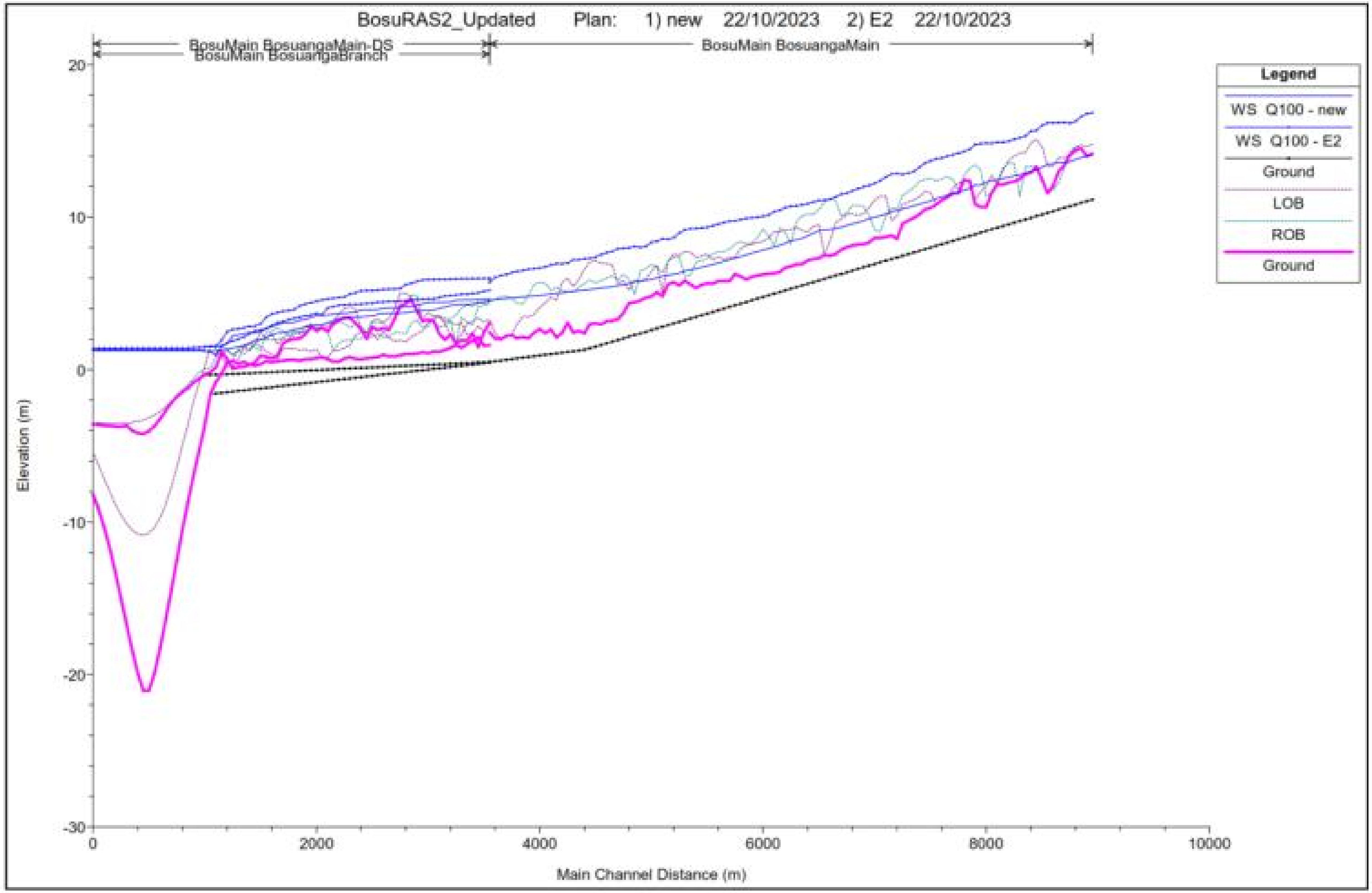


Figure 2.2.2-8. Water Surface Profiles for the Baseline Scenario "With and Without" the Dredging Project at 100-yr Flood

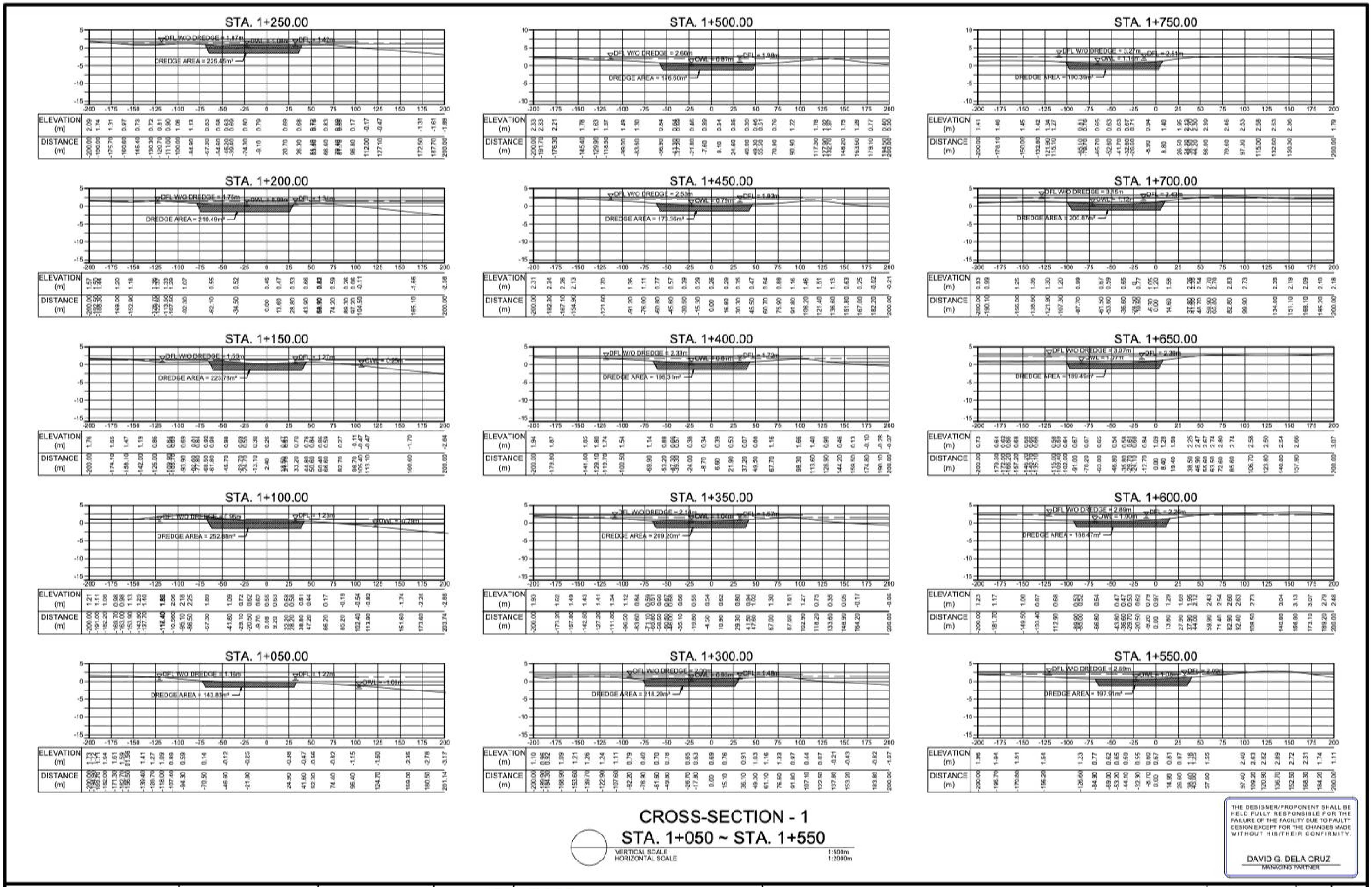


Figure 2.2.2-9. Design Cross Section-1: Sta 1+050 to Sta 1+750

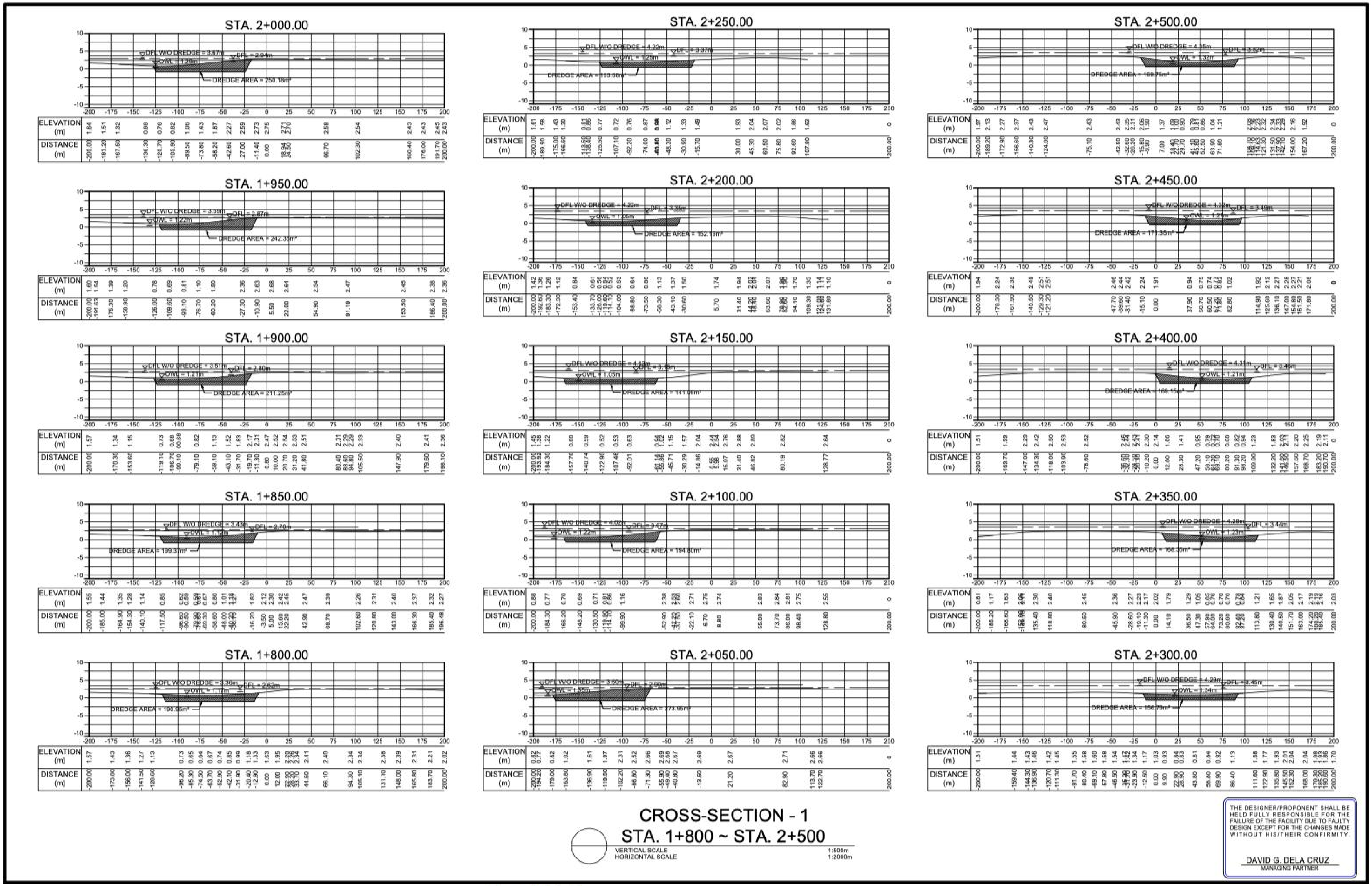


Figure 2.2.2-10. Design Cross Section-1: Sta 1+800 to Sta 2+500

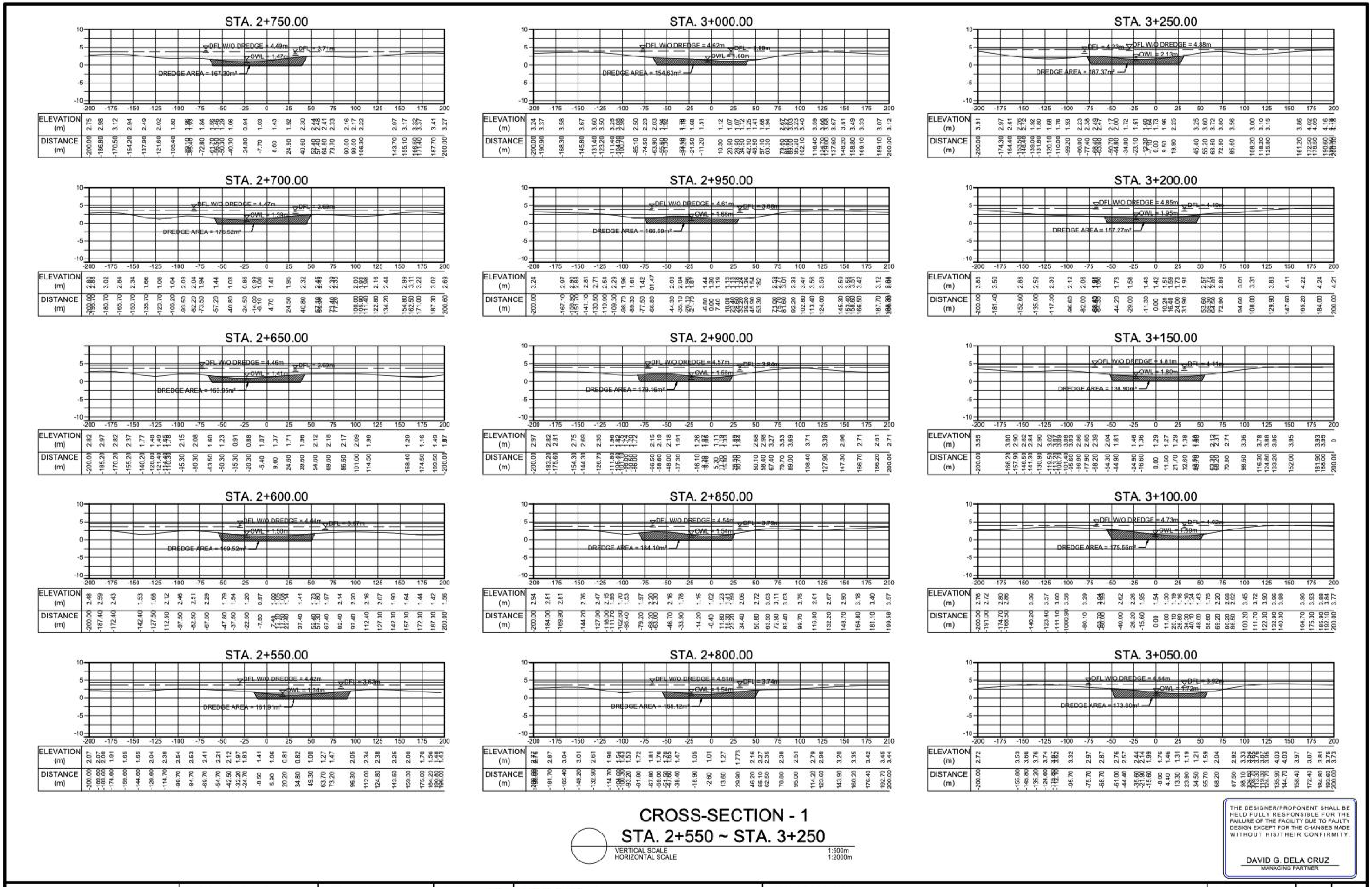


Figure 2.2.2-11. Design Cross Section-1: Sta 2+550 to Sta 3+250

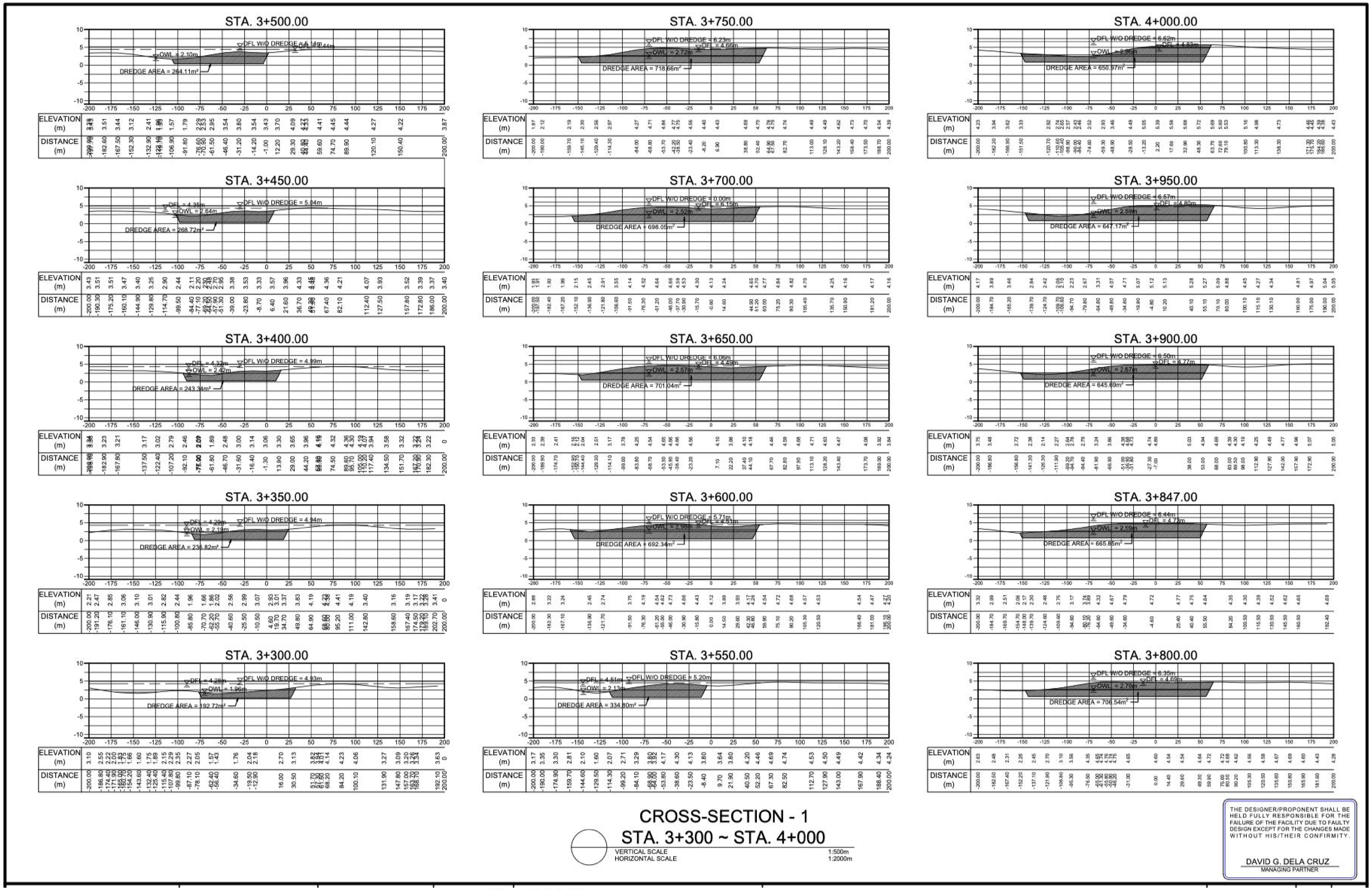


Figure 2.2.2-12. Design Cross Section-1: Sta 3+300 to Sta 4+000

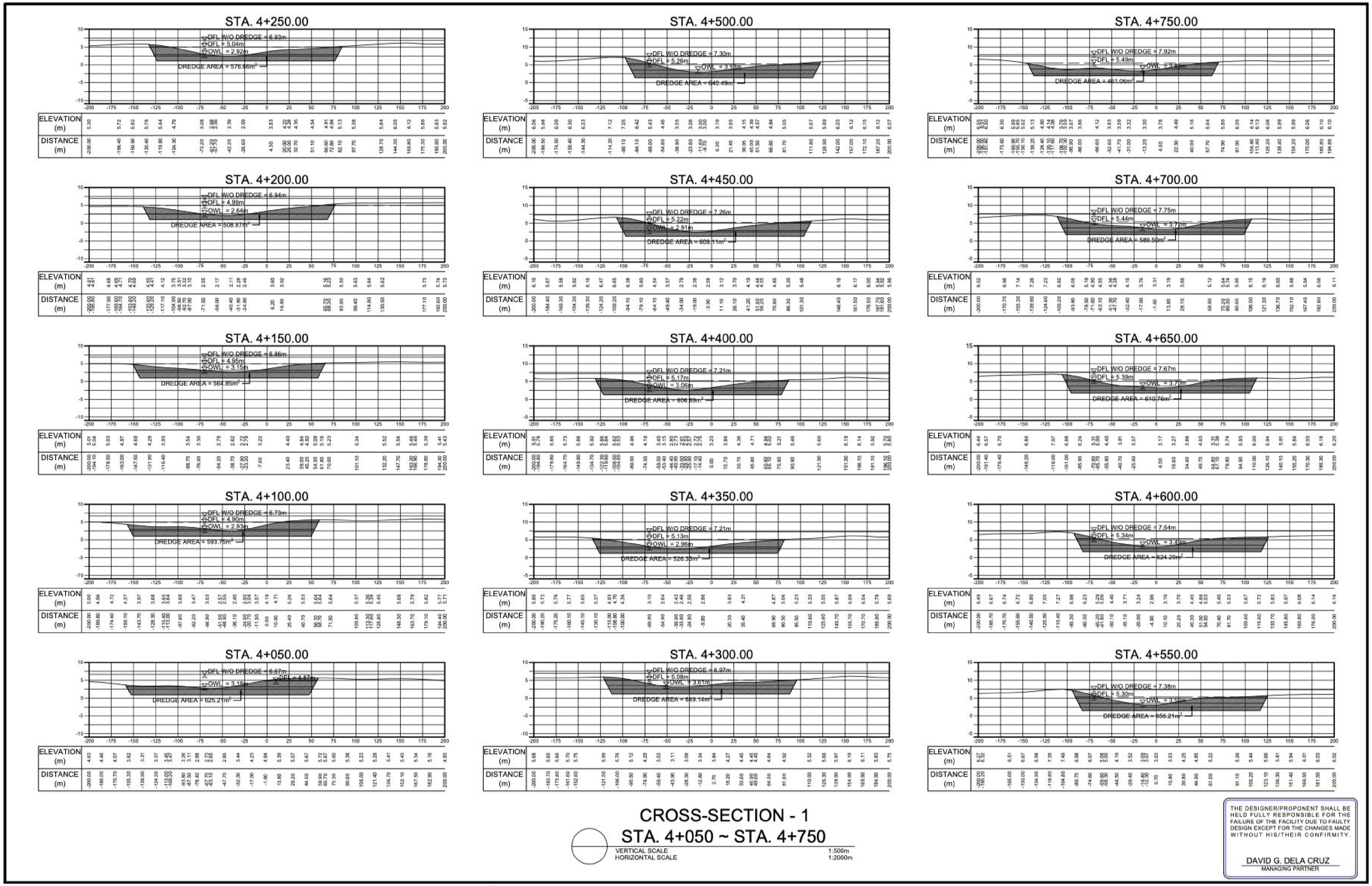


Figure 2.2.2-13. Design Cross Section-1: Sta 4+050 to Sta 4+750

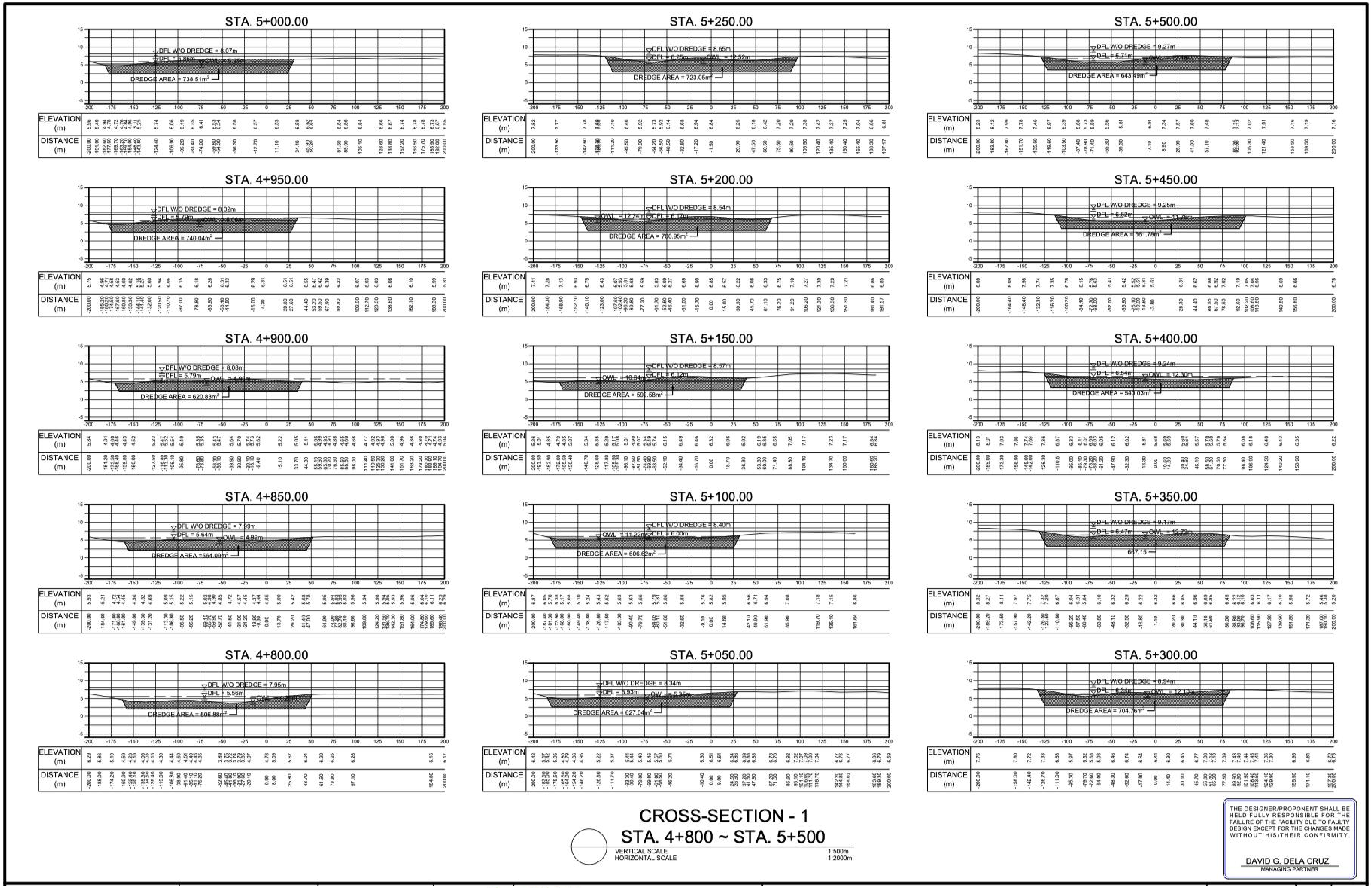


Figure 2.2.2-14. Design Cross Section-1: Sta 4+800 to Sta 5+500

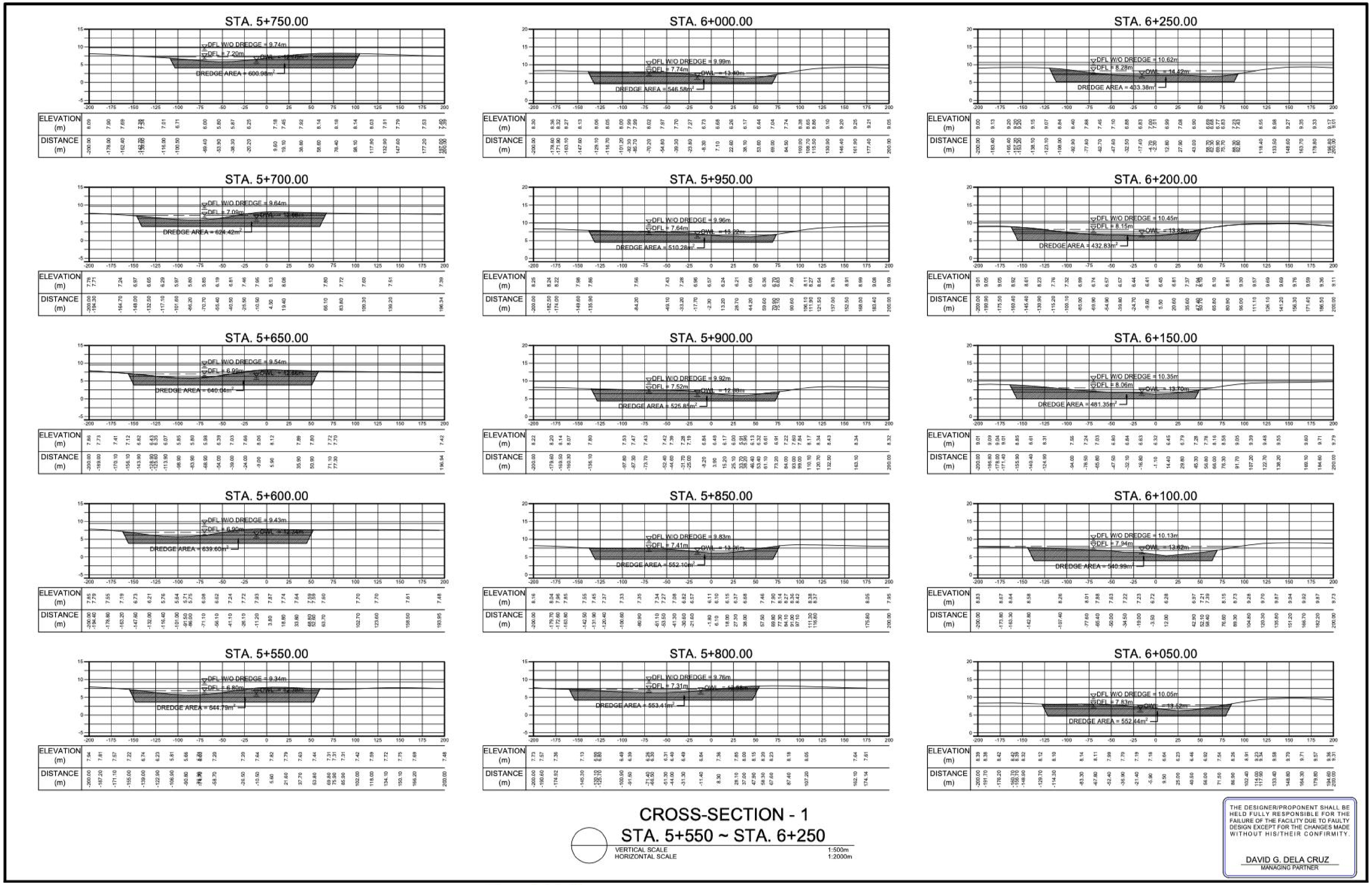


Figure 2.2.2-15. Design Cross Section-1: Sta 5+550 to Sta 6+250

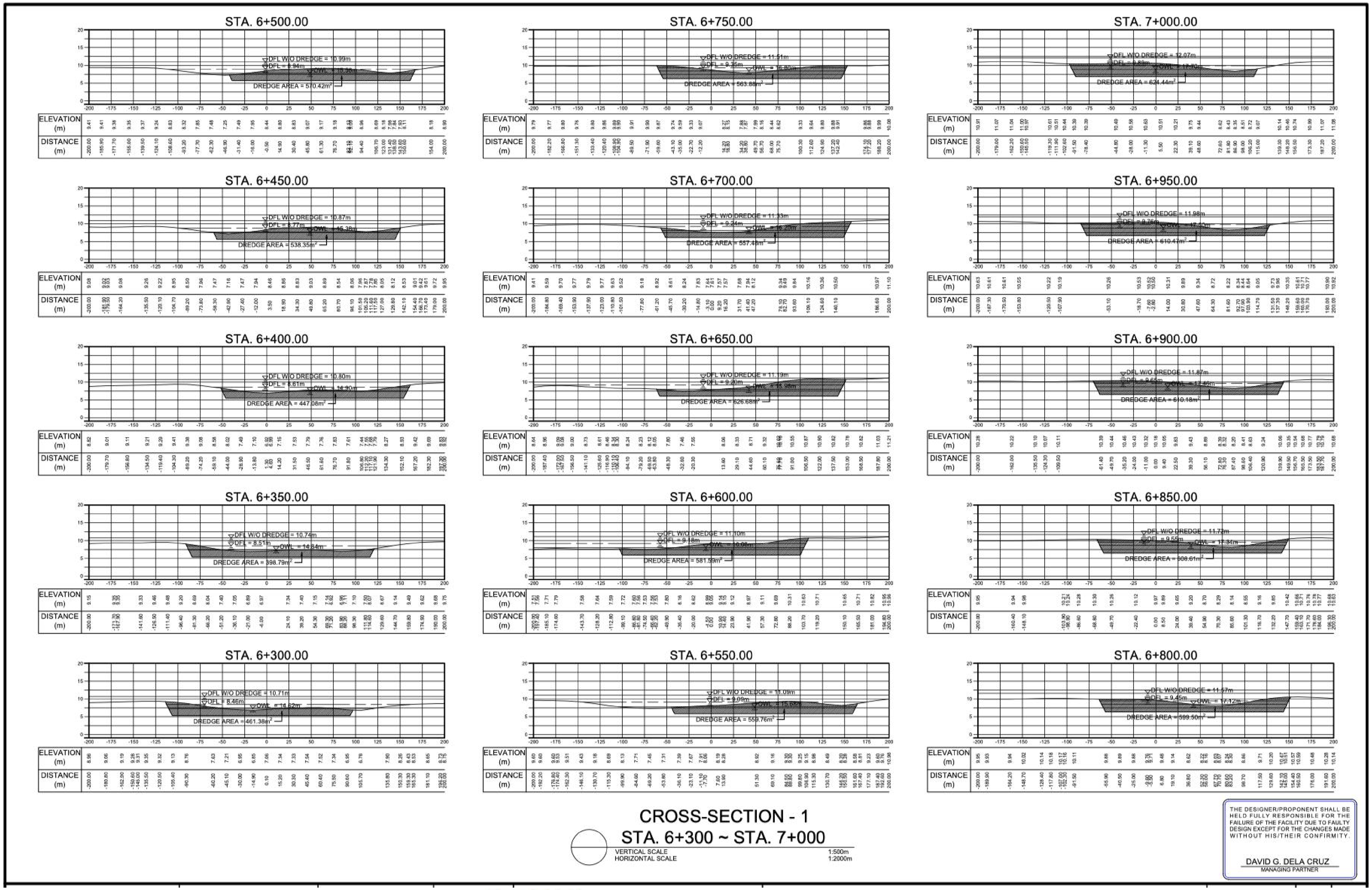


Figure 2.2.2-16. Design Cross Section-1: Sta 6+300 to Sta 7+000

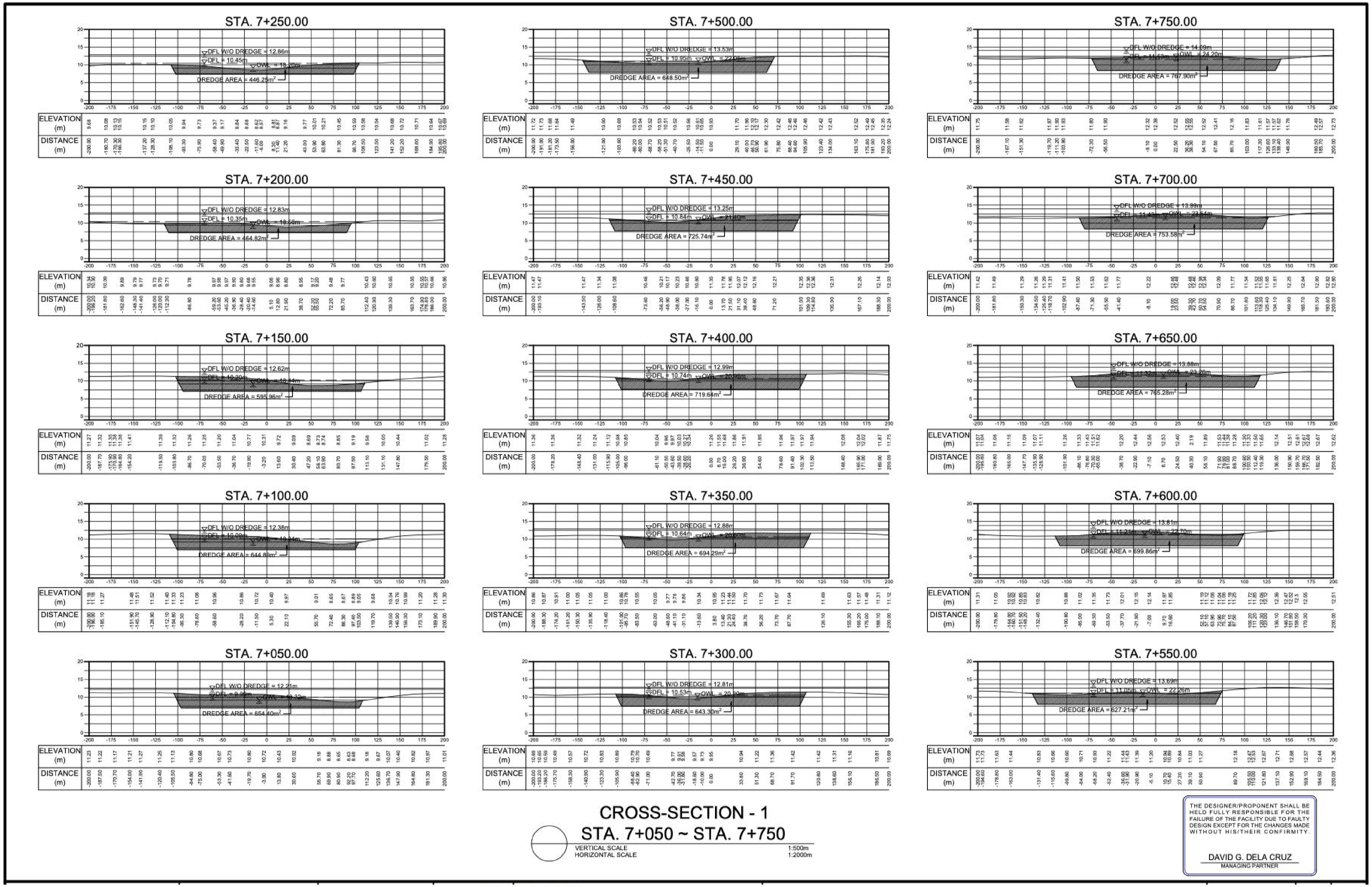


Figure 2.2.2-17. Design Cross Section-1: Sta 7+050 to Sta 7+750

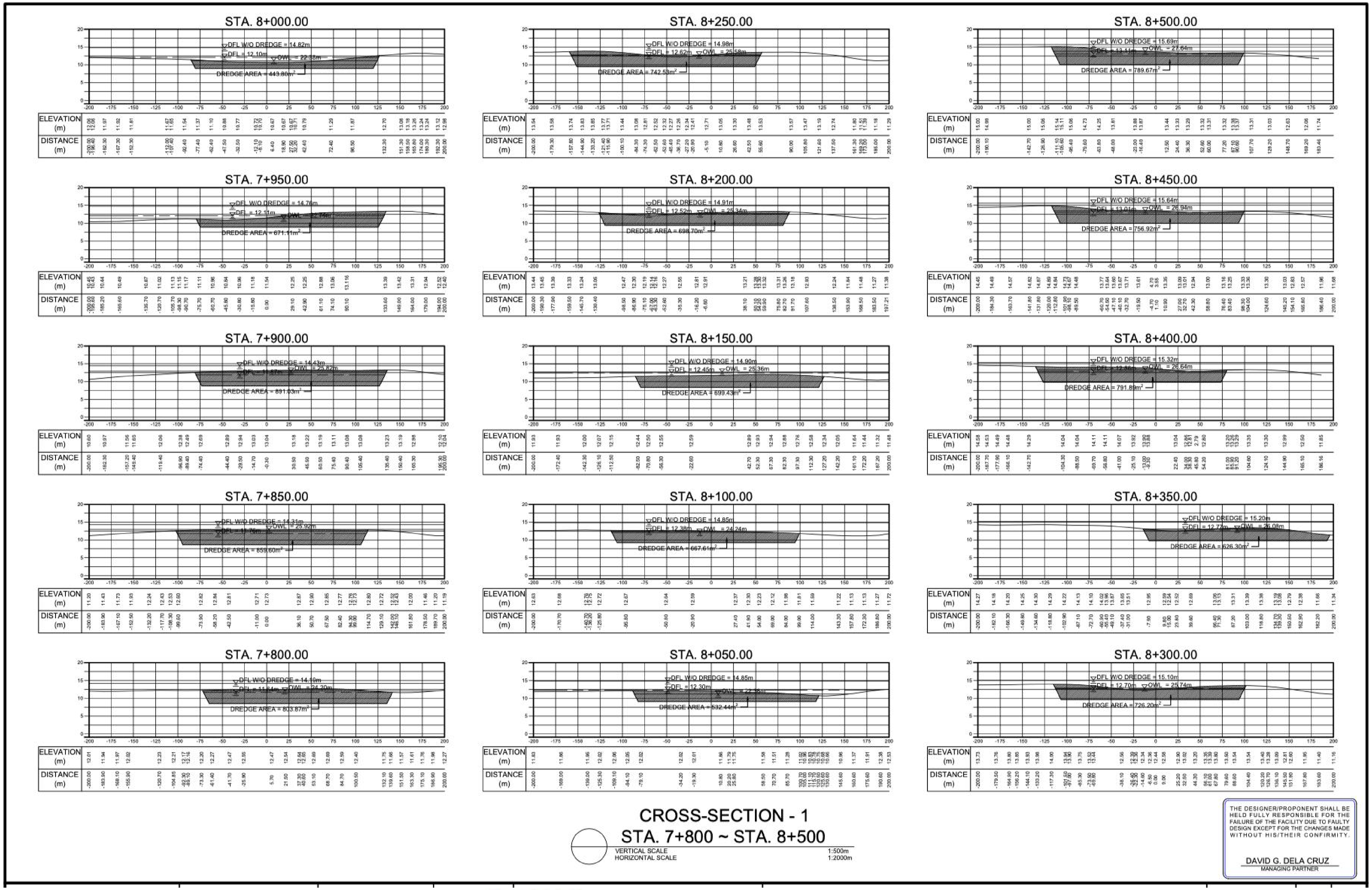


Figure 2.2.2-18. Design Cross Section-1: Sta 7+800 to Sta 8+500

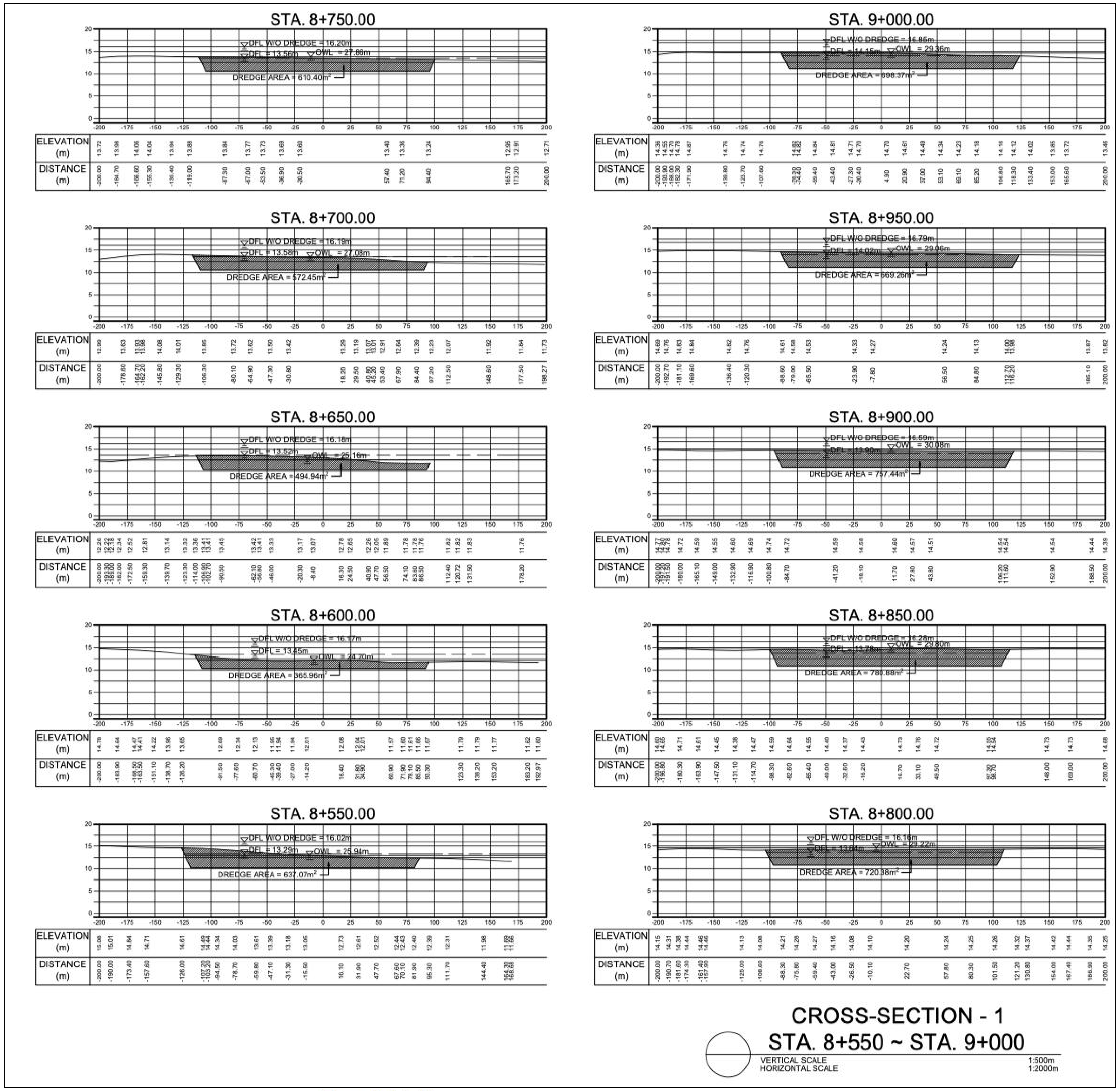


Figure 2.2.2-19. *Design Cross Section-1: Sta 8+500 to Sta 9+000*

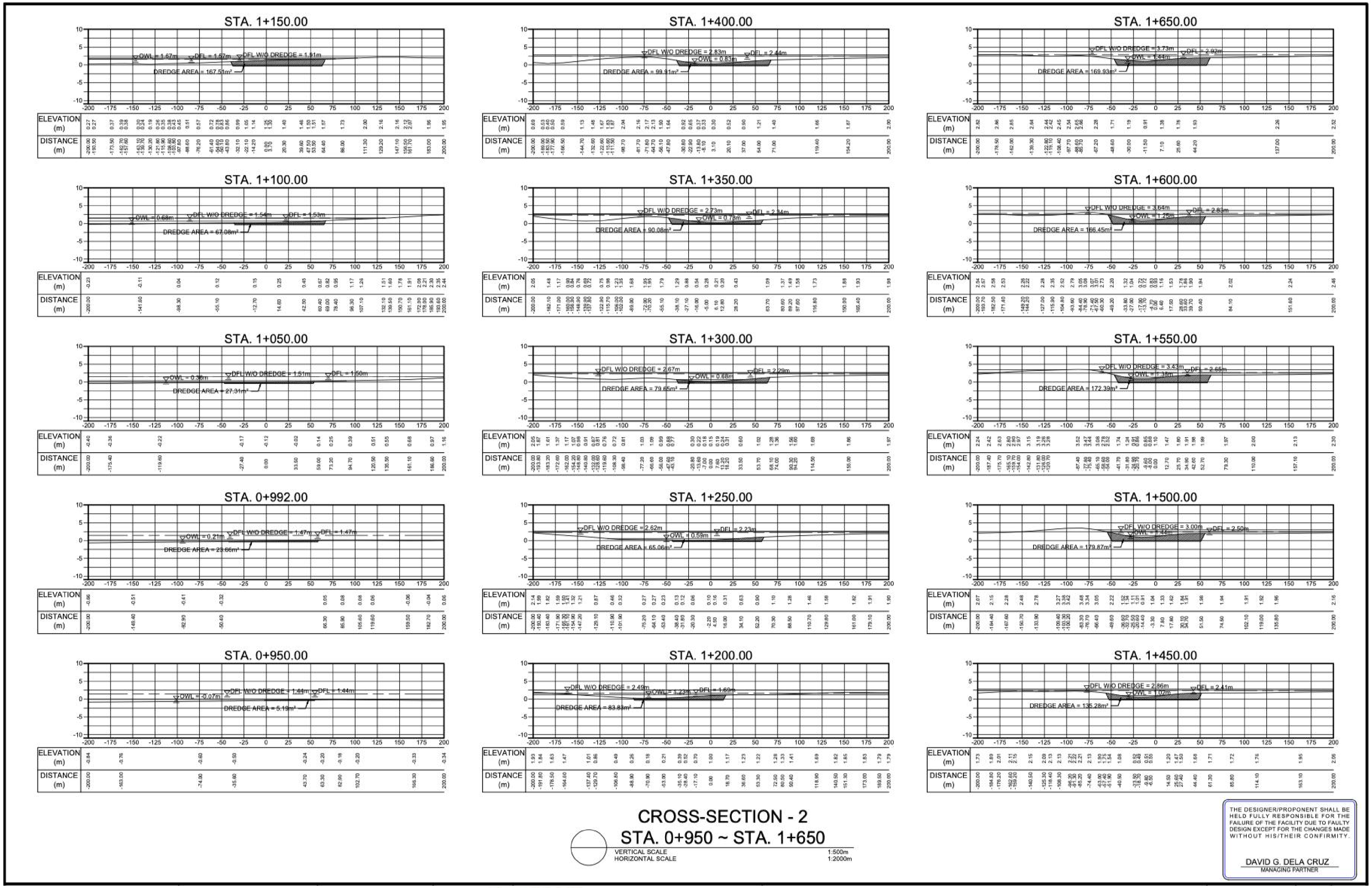


Figure 2.2.2-20. Design Cross Section-2: Sta 0+950 to Sta 1+650

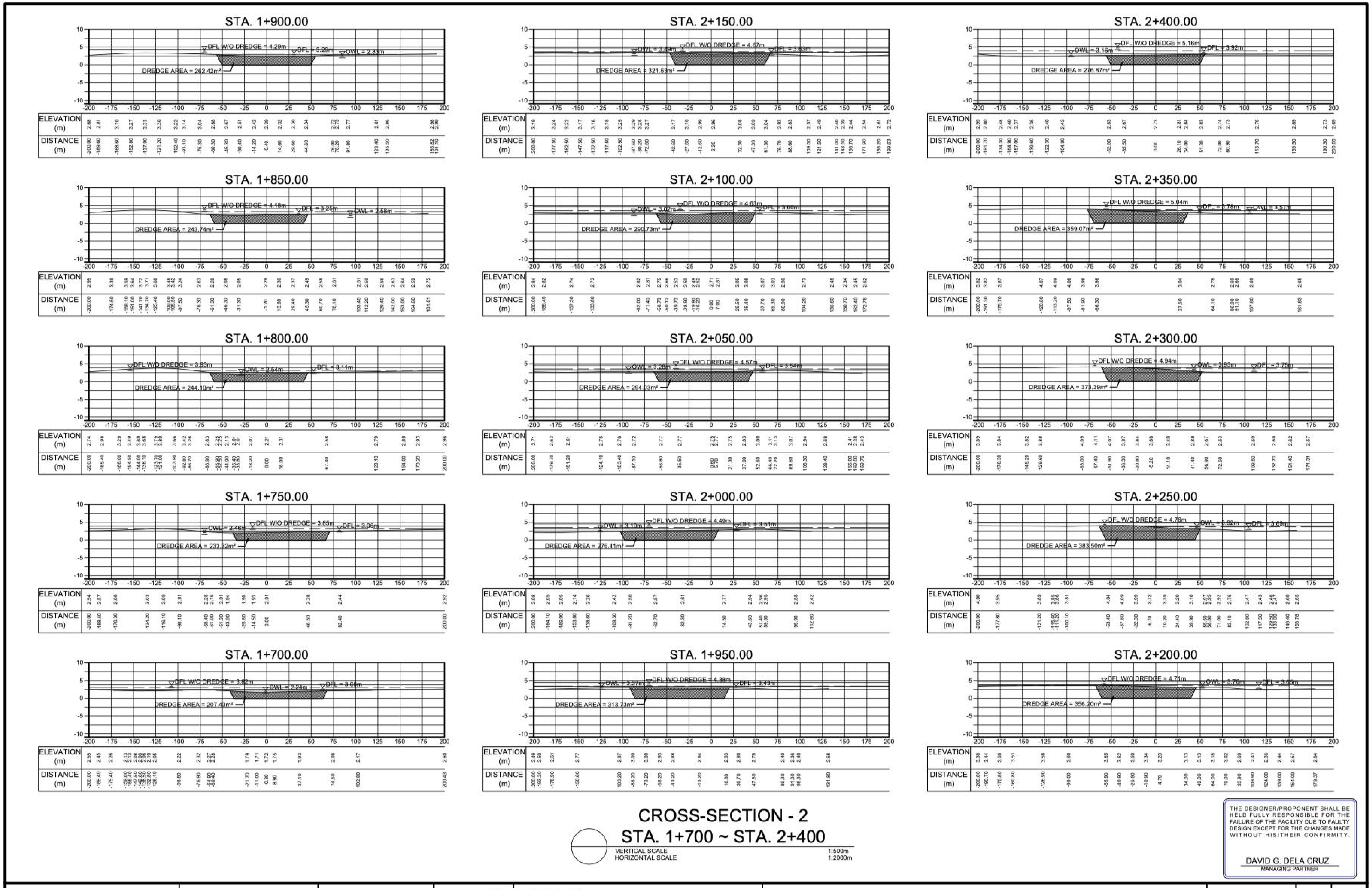


Figure 2.2.2-21. Design Cross Section-2: Sta 1+700 to Sta 2+400

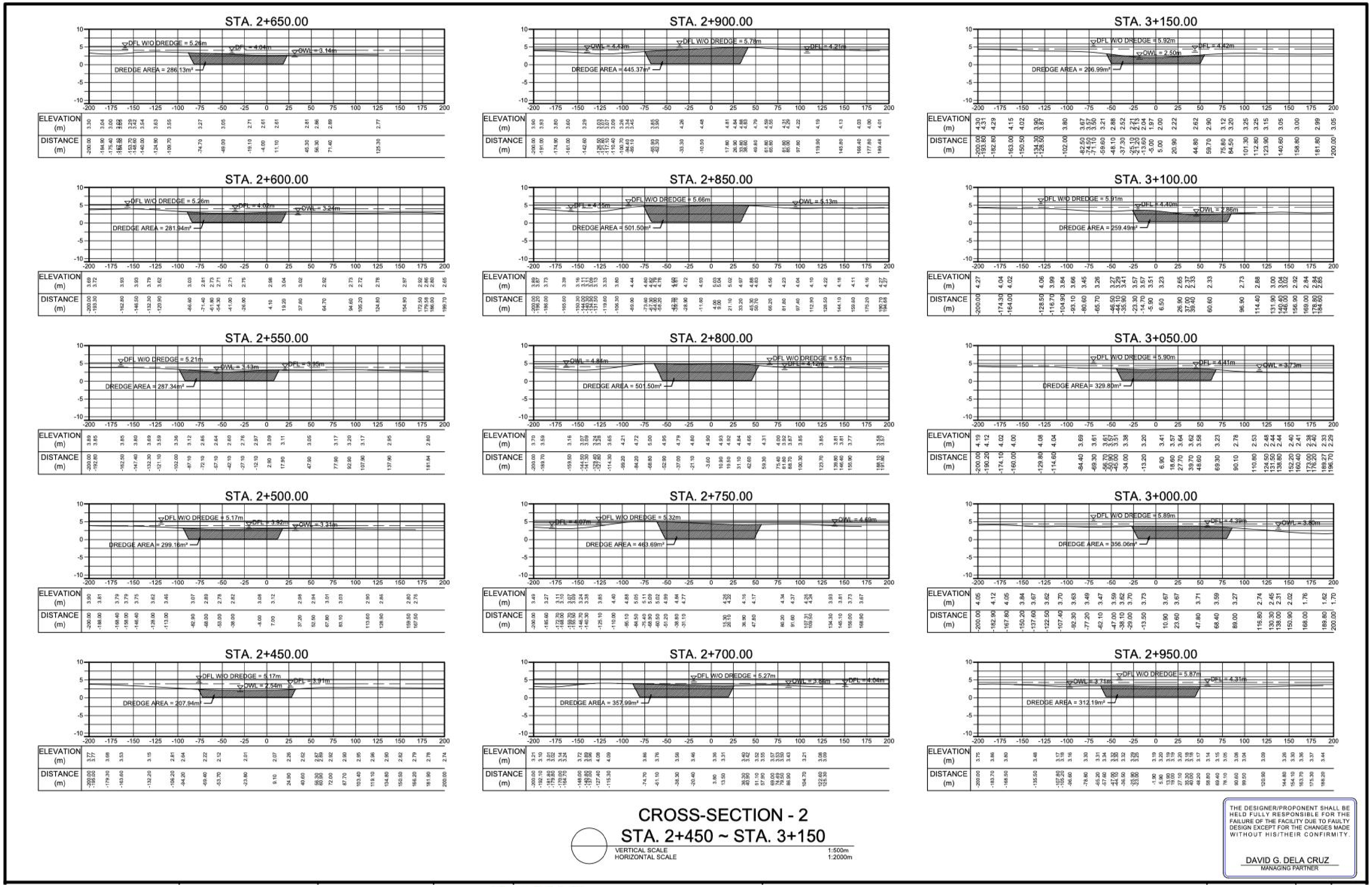


Figure 2.2.2-22. Design Cross Section-2: Sta 2+450 to Sta 3+150

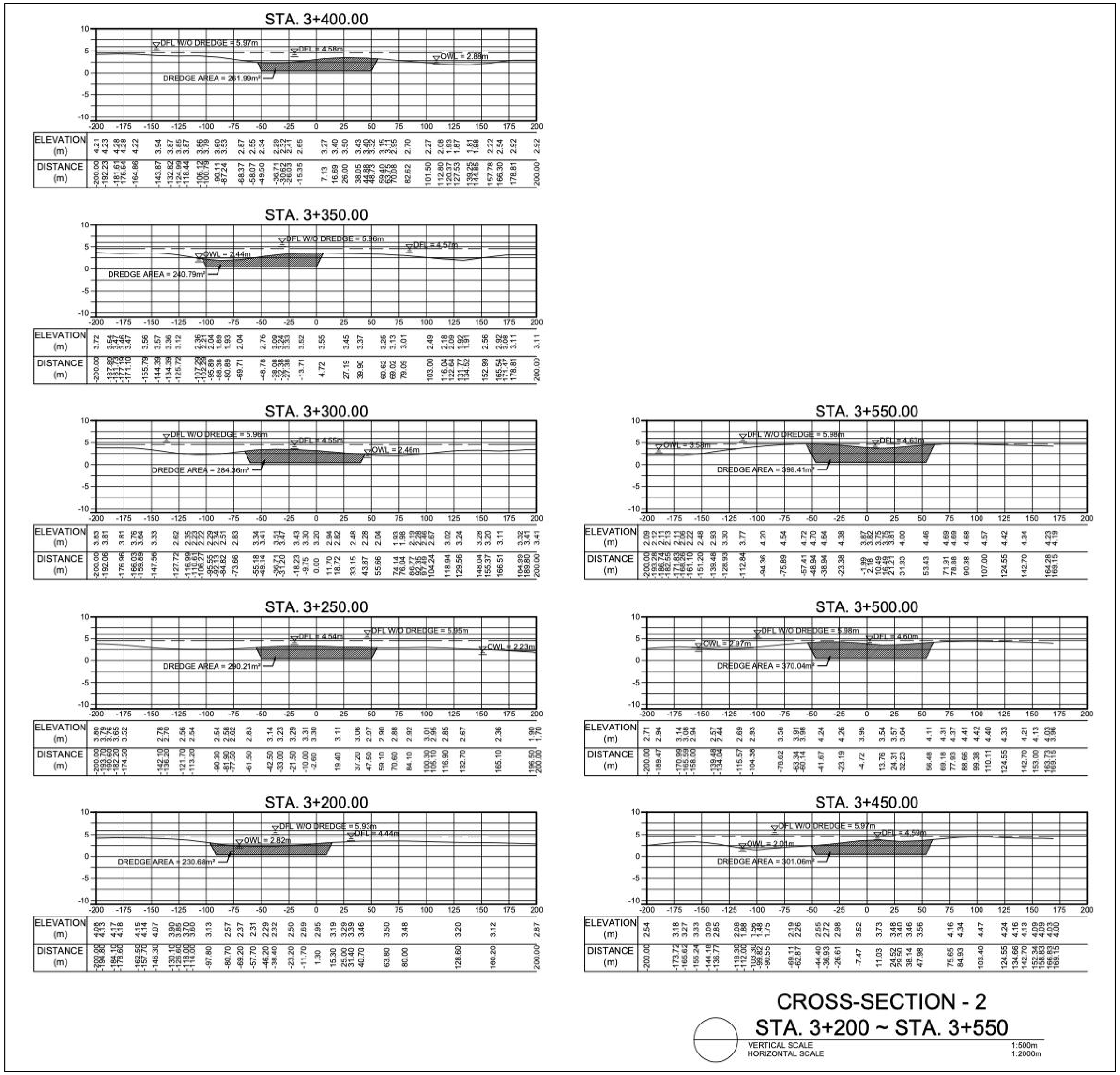


Figure 2.2.2-23. Design Cross Section-2: Sta 3+200 to Sta 3+550

Present Condition
A 2D unsteady flow was conducted to determine the capacity of the river and floodplains for a 100-YRP storm. The result, as shown in the inundation map in **Figure 2.2.2-24**, the lack of definite river channel of the Busuanga River results into the river discharge splitting across the floodplains. Although most of the floodplain experiences flooding with a depth equal or less than 1m, a significantly wide area is still expected to be affected.

Post-Dredging Condition
Simulated flood scenario implementing the proposed flood control measure (dredging) is presented to denote the possible improvement in the flooding situation in the project area. In this analysis, a 10m-deep cut was introduced along the main channel. The resulting 100-yr flow hydrograph was used as the upstream boundary while the downstream boundary condition was still set to a stage hydrograph with a value of 2m. Shown in **Figure 2.2.2-25** is the projected inundation map after dredging operations.

It can be seen that after the proposed dredging project, the flooding within the Busuanga River Basin will be mostly contained within the pilot dredging channel, thus, resulting in a significant reduction in flooded areas.

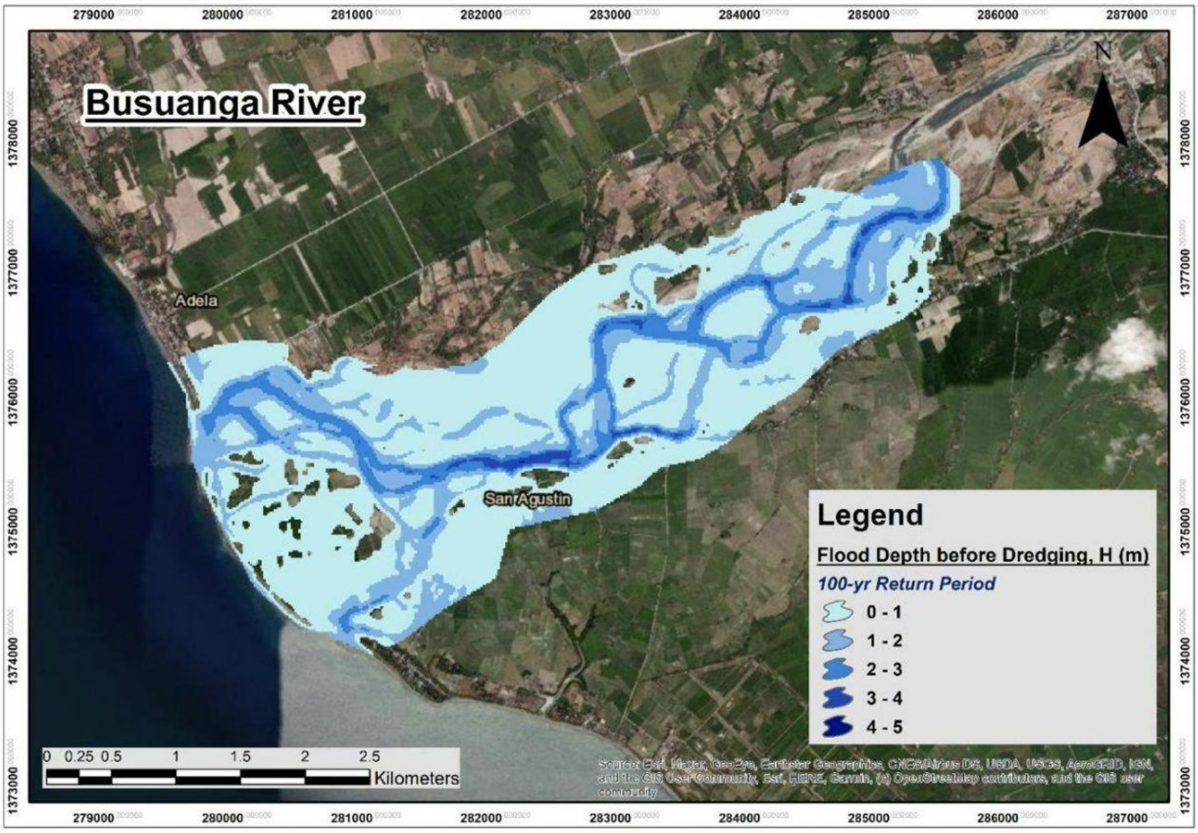


Figure 2.2.2-24. Inundation Map Without Dredging – 100 Year Flood

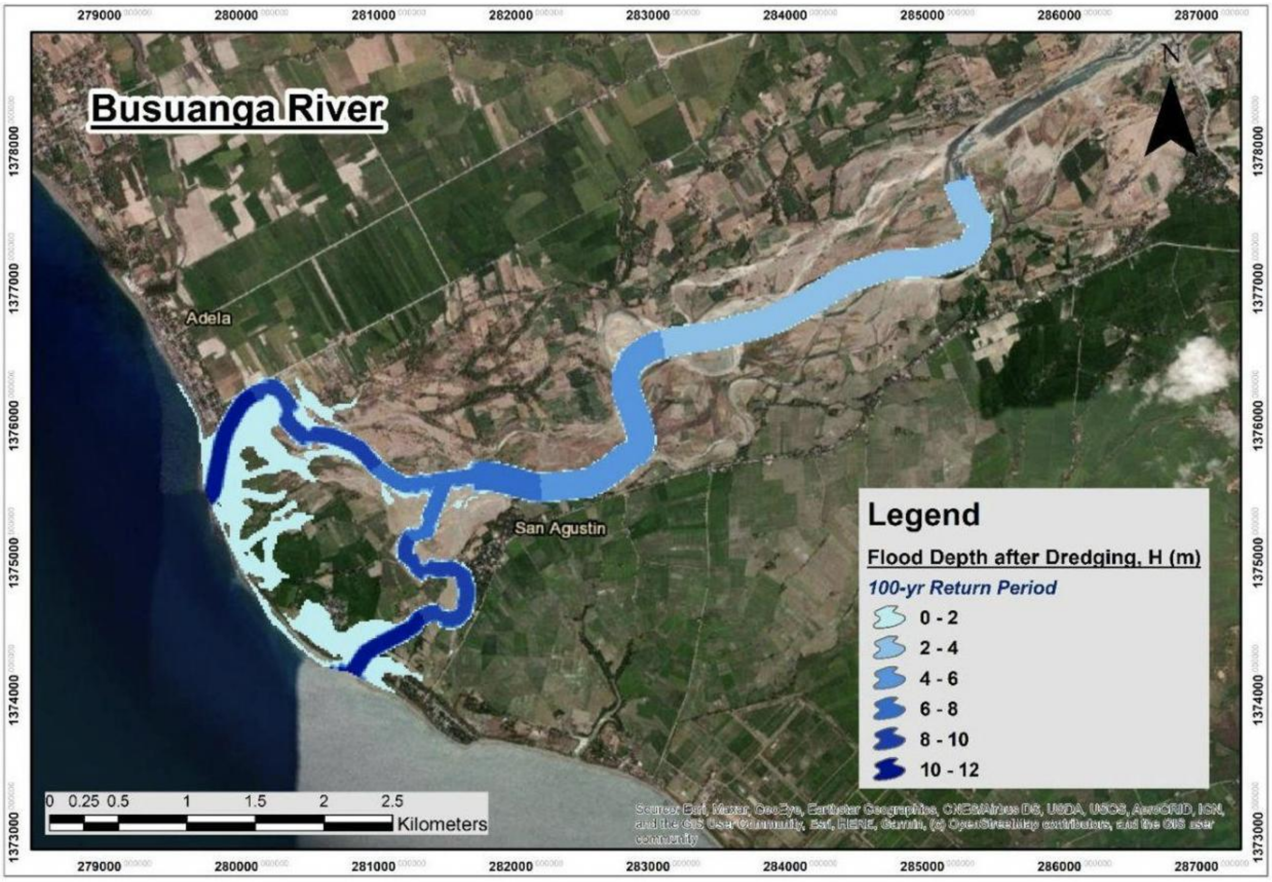


Figure 2.2.2-25. Inundation Map With Dredging – 100 Year Flood

The hyetographs derived are summarized in the succeeding table.

Table 2.2.2-3. 100-Yr Design Excess Rain, Basin Rainfall

Duration (hour)	!00-Yr (mm/hr)	Loss (mm/hr)	Total Excess Rainfall 100-Yr (mm/hr)	Percent to Total
1	-2.93	0	-2.93	-1.61
2	-3.06	0	-3.06	-1.68
3	-3.05	0	-3.05	-1.68
4	-3.11	0	-3.11	-1.71
5	-3.05	0	-3.05	-1.68
6	-2.75	0	-2.75	-1.51
7	-2.00	0	-2.00	-1.10
8	-0.53	0	-0.53	-0.29
9	2.39	0	2.39	1.31
10	8.37	0	8.37	4.60
11	21.36	0	21.36	11.73
12	52.47	0	52.47	28.82
13	84.29	0	84.29	46.3
14	33.37	0	33.37	18.33
15	13.60	0	13.60	7.47
16	4.85	0	4.85	2.66
17	0.65	0	0.65	0.36
18	-1.37	0	-1.37	-0.75
19	-2.42	0	-2.42	-1.33
20	-2.83	0	-2.83	-1.55
21	-3.05	0	-3.05	-1.68
22	-3.21	0	-3.21	-1.76

Duration (hour)	!00-Yr (mm/hr)	Loss (mm/hr)	Total Excess Rainfall 100-Yr (mm/hr)	Percent to Total
23	-3.02	0	-3.02	-1.66
24	-2.93	0	-2.93	-1.61
TOTAL	182.04	0	182.04	100
MAX	84.29	0	84.29	46.30

Summary Result, 100-Yr:

The results of the hydrologic analysis employing both hydrologic modelling and extreme value analysis in the determination of the design discharges for the 100-yr return periods for each of the dredging sections are presented below. The simulated peak discharges from the hydrologic modelling are used in the hydraulic modelling study.

Table 2.2.2-4. Computed Peak Discharges (100-Yr)

Peak Discharge	100-yr
Main Downstream	1,205.9 m^3/s
Section 1 Junction	1,972.33 m^3/s
Section 2 Branch	936.10 m^3/s

Impact Analysis on Drainage Morphology and Flooding

The proposed Busuanga River dredging project is designed to alter the drainage morphology, stream flow, and ultimately the carrying capacity of the river.

The preceding characterizations, modeling, and discussions point to the deepening of the riverbed, which will result to the lowering of the water surface for Q100 from the mouth going upstream towards the end point of the project area. These denote an increase in the carrying capacity of the river, and hence, an enhancement effect on the flooding susceptibility of the area as it will be lessened after some time. Majority of the numerous sandbars that are clogging the channel shall be dredged out and the river bed is deepened. This is in effect, a river restoration or improvement.

In the natural evolution of any floodplain, the river can and will always reclaim its old abandoned channels within that plain in any event that its present course presents more resistance to passage of water. In cases of heavy rainfall and therefore voluminous runoff, the river will choose the easiest passageway to empty its load into the sea.

The channel of Busuanga River has changed throughout the years with constant course shifting, and the alternating deposition and scouring of sandbars. It should be noted that some changes occur in a single flooding event while some are through the normal occurrence of erosion/deposition cycles.

In the simulated flood scenario implementing the proposed flood control measure (dredging), the possible improvement in the flooding situation in the project area is very visible wherein the inundation after dredging will be mostly contained within the pilot dredging channel, thus, resulting in a significant reduction in flooded areas.

It can therefore be said that the morphologic change/s that will be brought by the dredging activities is designed to improve the carrying capacity of the river and restore it to its most favored form especially in terms of mitigating flood hazards.

2.2.2.1.2 Change in Stream, Lake Water Depth.

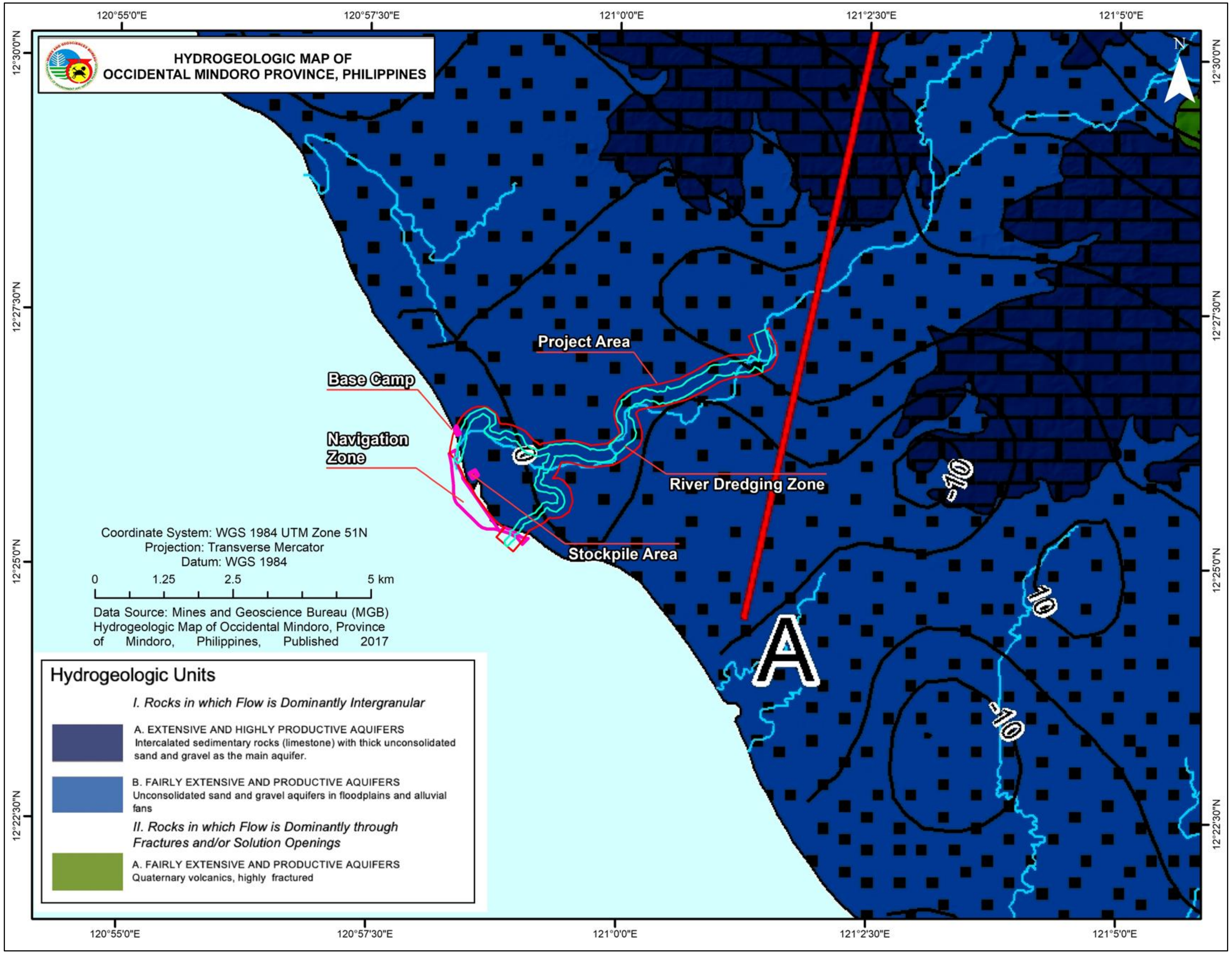
Groundwater Characteristics

Based on the 2017 Hydrogeologic Map of MGB (figure below) the project site is within a fairly extensive and productive aquifer hosted in rocks in which flow is dominantly intergranular. It is underlain by thick unconsolidated sand and gravel, which is typical of river channels, flood plains and alluvial fans. It has an average potential recharge of 0.3 to 0.8 meters, greater near influent rivers, with known productive well yields mostly about 20 L/s but as high as 60 L/s in some sites. This Quaternary Alluvium unit is a moderately to highly permeable layer that contains unsealed shallow water table occurring in the spaces between the grains and is susceptible to saltwater intrusion near the coast up to a certain distance going inland. For instance, the artesian well in the Barangay Hall of Brgy. Adela, Rizal, which is located near the coast, is said to yield salty water during the dry months. The locals only use it during the wet season and as domestic water only.

Underneath the alluvium is an extensive and highly productive aquifer hosted in rocks in which flow is dominantly intergranular. This aquifer is composed of a layer of intercalated sedimentary rocks (limestone) with high to very high permeability, has an average potential recharge of 0.5 to 1 meter, greater near influent rivers, with known productive well yields mostly about 50 to 100 L/s but as high as 150 L/s in some sites.

Impact Analysis on Change in Stream/Lake Water Depth

As discussed in the preceding section, there will be a lowering of the riverbed and subsequently, the water surface/depth. This is deemed as a positive impact because it will improve the carrying capacity of the river, and hence, lessen the flooding in the area and vicinities.



Source: MGB IVB. 2017

***Figure 2.2.2-26.** Hydrogeologic Map of the Project Area and Vicinity*

2.2.2.1.3 Depletion of Water Resources / Competition in Water Use

There are proximal house clusters (with shallow and/or deep wells) surrounding the site but there shall be no groundwater abstraction to be associated with the project activities. Hence, no impact is foreseen in the groundwater resources in terms of both quality and quantity and there shall be no competition in water use.

In terms of surface water, there are fishermen nearshore and offshore and a few sustenance fishers along the river, especially near the estuary. There is no competition since the dredging operation shall be done by phases (in small area) and the fishers can still have access to the rest of the project area that are not in active dredging phase.

For the irrigation water, the inlet is located far upstream of the project site, and there shall be no adverse effect on the water supply. In fact, dredging is seen to be beneficial in enhancing the irrigation water supply.

2.2.2.2 Physical Oceanography

2.2.2.2.1 Change/Disruption in Circulation Pattern Due to Dredging

A. BATHYMETRY - Baseline

Bathymetric surveying is the measurement of water depths and description of offshore and the adjoining coastal area. The bathymetric map generated from the water depth charting has its paramount importance in the design of a safe navigation zone for the dredging fleet that shall be cruising to and from the Busuanga River channel and mother ship, and in the estimation of the sand materials to be removed or to be dredged out to deepen the proposed navigation zone through the foreshore and delta lobe to avoid grounding and prevent downtimes and accidents.

A Global Navigation Satellite System (GNSS) is used as the primary positioning system and is coupled with digital single beam echo sounder (SBES) to record the water depth. The depth data are collected every second and are stored with GNSS positions and time tag. The depths are corrected for the draft of the transducer, tidal variation and sound velocity in water. The raw depths are reduced for change in sea level due to the tide and calibration parameters from the surface elevations to produce elevations on the bottom of the survey area. The elevations are used to produce isobath contour map and 3-D views.

The bathymetric survey at the upper shoreface fronting the Busuanga River delta covers an area of approximately 3 km^2 and bounded by coordinates from 12°24’45” N to 12°26’45” N latitude and from 120°57’20” E to 120°59’40” E. The coordinate system used in the survey is WGS84 UTM Zone 51N.

The survey vessel used was a motorized fishing boat. The survey pole mounted on the side of the vessel carries the transducer at the bottom and the GNSS antenna on top. The GNSS and the transducer are arranged so that they are vertically collinear to each other.

CHCNAV GNSS i50 RTK was used as the navigational positioning system. This is a full constellation receiver that tracks GPS, GLONASS, Galileo, BeiDou and QZSS signals. It has a horizontal and vertical accuracies of 8mm and 15mm respectively.

CHC D230 single beam echo sounder was used for depth measurement. It has a sounding accuracy of 0.01m, detection range of 0.3m to 300m and transmitting in 200khz frequency.

The survey speed was carried out at a range of 7 to 10 km/hr.

Prior to the commencement of the survey, track-lines were created at 100m x 250m line grid spacing and 1000m by 3000m line length. The final spacing in the field was then determined according to the conditions and depth of water at the time of survey.

The RTK base or reference station was erected in the immediate vicinity of the survey area using the observed coordinates. The reference station transmits GNSS derived coordinate corrections to the rover to provide real time, on the fly horizontal and vertical positions to centimeter accuracy. The coordinates of the base station in WGS84 Zone 51N is as follows: 12°26'10.89"N latitude; 120°58'23.66"E longitude; and 2m elevation.

Data Processing:
During the survey operation the changes in water level elevation is constantly monitored by the GNSS. Horizontal and vertical corrections were provided by the RTK base station. The vertically corrected water level was subtracted to the measured water depth to get the bottom elevation. This corrected elevation data together with its coordinates and time tag were imported to the Surfer 18 Software. The resulting xyz data was gridded into 1m x 1m resolution digital terrain model (DTM). The DTM was then used to create contour at whatever interval is required, relief and 3D visual representation of the data which can be overlain into the final drawing.

Contouring and Modeling:
The bathymetric map generated by the sounding is shown in **Figure 2.2.2-27**. A grid of regularly spaced depth values was generated from the processed shot points using ordinary kriging algorithm used by Golden Software Surfer version 18. A grid spacing of 1 meter was used. This node spacing was selected as an optimum value to avoid the generation of artificial artifact. Depth contours were generated from the grid at a 5 m interval spacing.

The survey area shows a relatively parallel contours and an average slope of 13 percent grade or 7.4 degrees. The deepest value measured is -552 meters and the shallowest is -0.5 meters. It is interpreted that the area has a smooth surface underlain with sand and has no coral growth. Comparison of the grid values to the actual sounding values shows close agreement. Cross sections toward the shoreline are shown in **Figure 2.2.2-28**. A 3D viewed from the SW is shown in **Figure 2.2.2-29**.

A more detailed discussion of the bathymetric survey is presented in **Annex 2-E**. This also contains discussion of the geological investigation conducted.

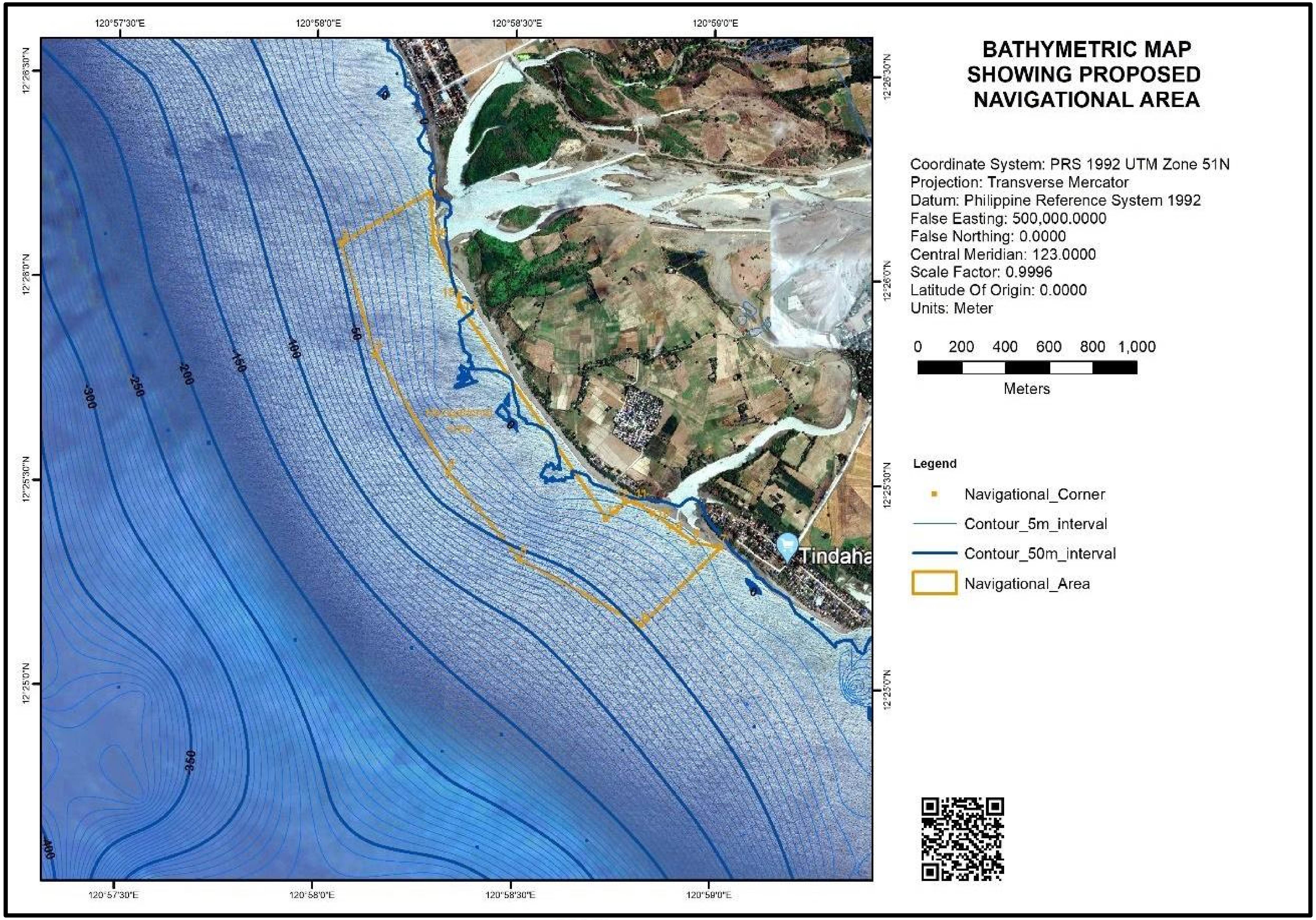


Figure 2.2.2-27. Bathymetry of the Survey Area

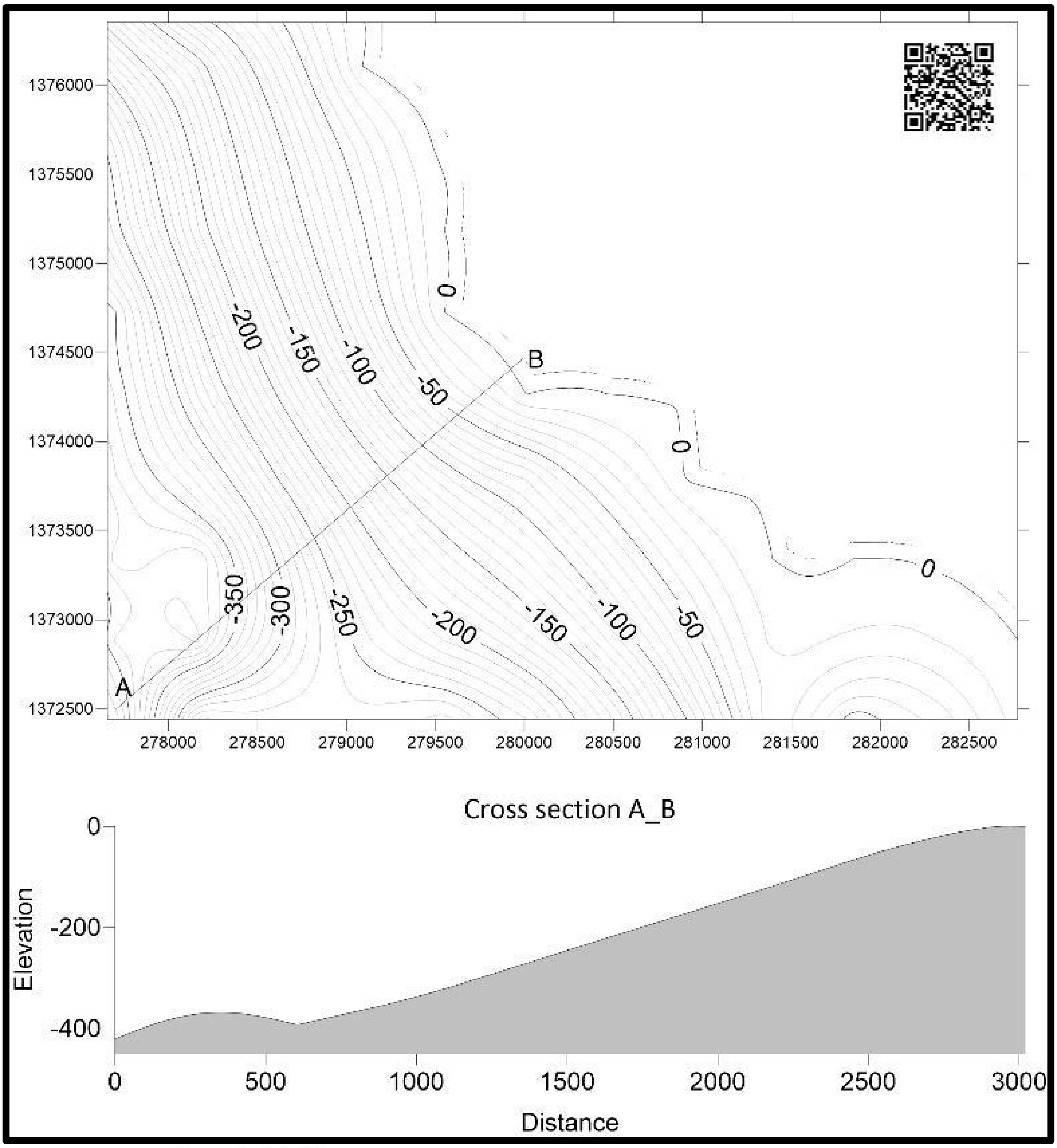


Figure 2.2.2-28. Bathymetry and Cross Section Profile Along Line A-B

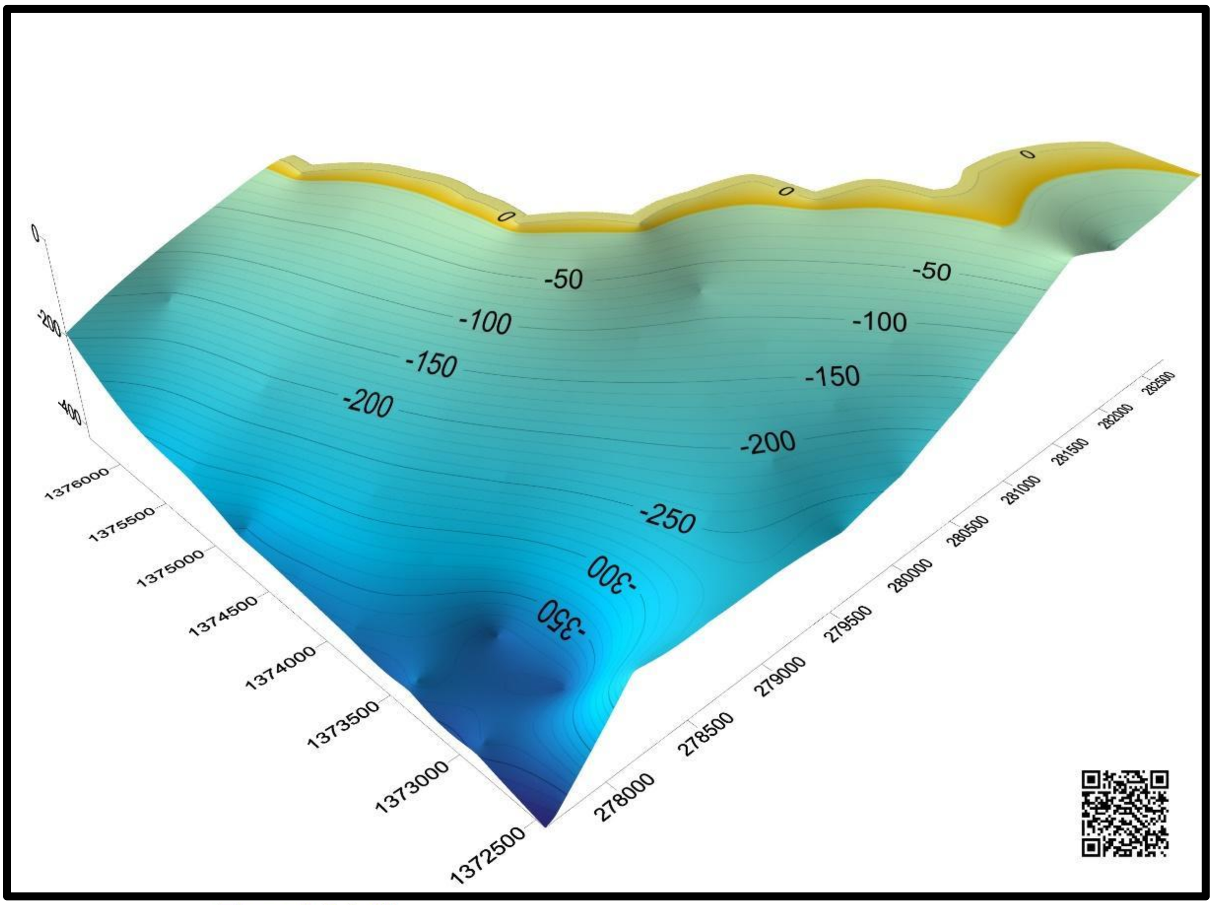


Figure 2.2.2-29. 3-D View of the Survey Area Viewed from the SW

<u>Coastal Morphology</u>
The seabed at the shoreface zone has a moderate seaward slope of about 7.4 degrees, equivalent to about 13% slope grade. The deepest value measured is -552 meters and the shallowest is -0.5 meters. It is interpreted that the area has a smooth surface underlain with sand and has no coral growth.

The shoreline morphology is generally discordant, meaning there are slight curvatures along the stretch: convex seaward at the delta front and concave seaward in shallow embayments flanking the delta. In contrast, the shallow embayments at the delta flanks suggest incidental or temporal coastal erosion during extreme weather events. It results from the supply and export imbalance of sand materials in those sections.

The sandbar partially blocking the old river mouth points landward. This phenomenon also suggests that the river mouth is wave-dominated. Furthermore, the sandbar at the mouth of the distributary propagates towards the southeast. This indicates that the longshore current direction is more pronounced towards the southeast.

The Busuanga River delta is composed of heterogenous, unconsolidated pebbly to gravelly coarse to fine sand. The larger fragments that compose the pebbles, gravel and small cobbles have smooth surfaces and are sub-rounded to well-rounded fragments of basalt, andesite, sandstone, quartz, some limestone which were derived most likely from the lithologies that make up the Mansalay Formation, Lumintao Formation, Socorro Group, limestones, clastics sediments, volcanics and from the alluvial deposits. Few magnetite grains are associated;

Detrital materials in the shallow foreshore are composed largely of pebbly to gravelly coarse to fine SAND. The sand grains are sub-angular to sub-rounded. Milky white grains of quartz/silica and shell fragments are ubiquitous and abundant. Dark gray specks common. Few magnetite associated; and

The sea-bottom sediments at the deeper parts of the surveyed area are largely fine to medium sand with silt.

B. NUMERIC (HYDRODYNAMIC) MODELING

To measure the physical movements, processes, behaviors, and inputs with regards to the coastal circulation, water movement, tide fluctuations, and provide an in-depth understanding of the wind and water conditions prevailing in the coastal waters of Mindoro Strait, specifically at the delta by the outfall/mouth of Busuanga River, specifying its purpose for the proposed dredging operations in Barangays Adella and San Agustin, all located in the Municipality of Rizal, Province of Occidental Mindoro, a numerical model was conducted that would also provide and contribute to the limited data available for the public to fully construe the natural coastal sea processes within the study area (**Figure 2.2.2-30**).

The main objective of the numerical modeling was to determine the effect of the proposed dredging activities on the hydrodynamics and water quality from the outfall and delta of Busuanga River up to the immediate coastal waters of the Mindoro Strait containing a predefined area of 1,250 hectares. It is specifically employed to identify potential, or candidate disturbed areas because of improper dredging practices like accidental spillage of dredged materials, which if left uncontrolled, would eventually disrupt the normal environmental conditions at the immediate coastal areas of the Mindoro Strait extending seaward, especially during the actual dredging operation phase.

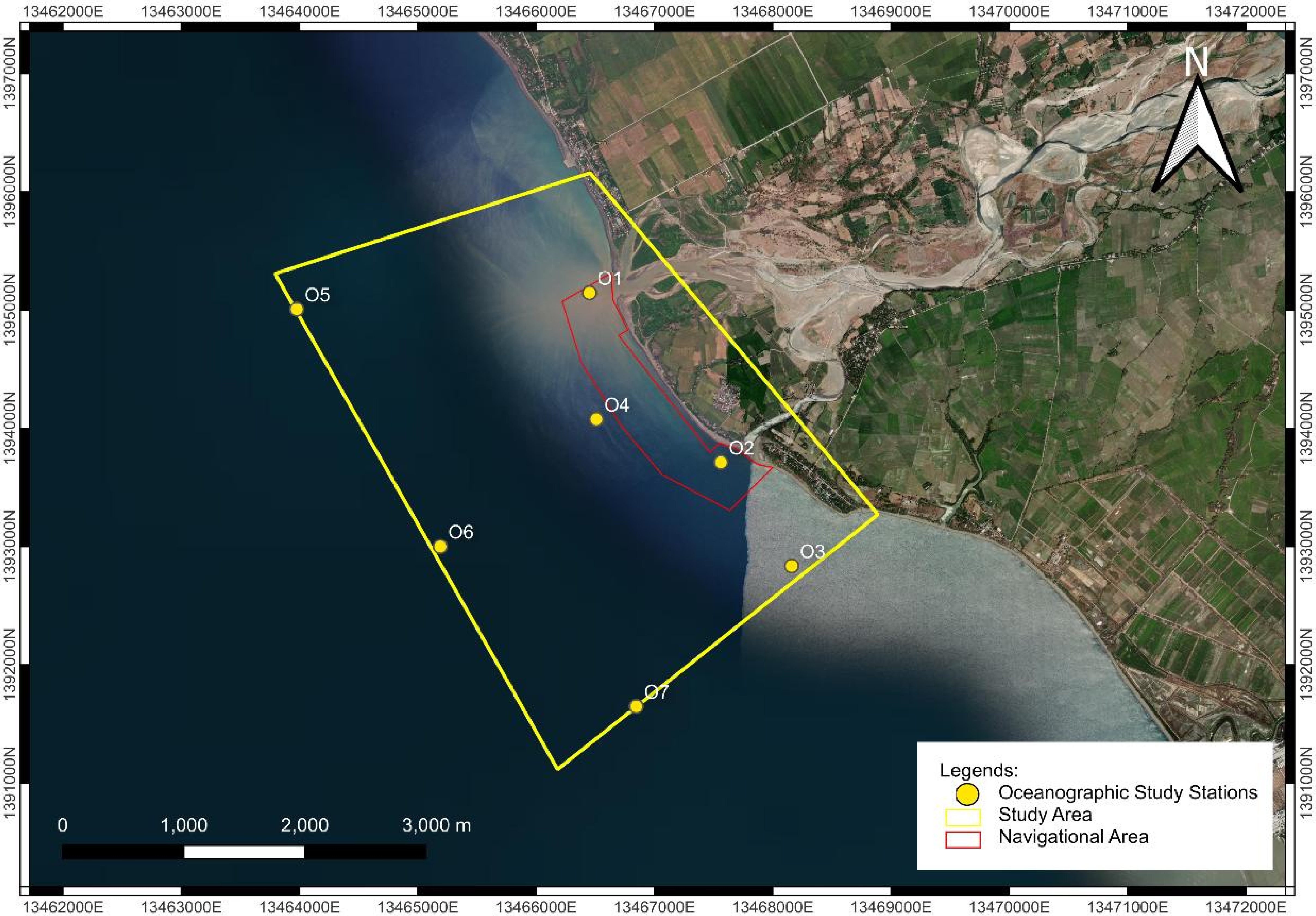


Figure 2.2.2-30. Map of the Proposed Project Area (red) and the Oceanographic Study Area Extent (yellow)

Description of the Model

The current patterns in the study area were analyzed using a two-dimensional non-linear numerical model of the coastal zone. The coastal model for the currents and elevation is essentially based on the shallow water equations derived from the two-dimensional (2D) Navier-Stokes equations for an incompressible fluid using the shallow water and Boussinesq assumptions and the continuity equation. The formulations allow the inclusion of the non-linear interaction between the wind and the coastal current. The governing equations of the present coastal circulation model are written in the Cartesian coordinate system as:

Conservation of momentum in x-direction:

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + g\frac{\partial \eta}{\partial x} - fv + \frac{gu\sqrt{u^2+v^2}}{c^2(d+\eta)} - \frac{F_x}{\rho(d+\eta)} - \nu_t\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right) = 0 \quad (1)$$

Conservation of momentum in y-direction:

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + g\frac{\partial \eta}{\partial y} + fu + \frac{gv\sqrt{u^2+v^2}}{c^2(d+\eta)} - \frac{F_y}{\rho(d+\eta)} - \nu_t\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right) = 0 \quad (2)$$

Conservation of mass, also known as the continuity equation:

$$\frac{\partial \eta}{\partial t} + \frac{\partial[(d+\eta)u]}{\partial x} + \frac{\partial[(d+\eta)v]}{\partial y} = R - E + q \quad (3)$$

where u and v represents velocity (m.s^{-1}) in the x- and y-axes, respectively, η is the water surface elevation (m), *d* is the still water depth (m), *Fx, y* is the *x*- and *y*- components of external forces (Pa) (i.e., wind stress), *f* represents the Coriolis parameter (*f* = 2*Ω sin θ*), where *Ω* is the earth's angular velocity and *θ* is the geographic latitude (rad.s^{-1}), *g* is the acceleration due to gravity(m.s^{-2}), *ρ* is the water density (kgm^{-3}), *t* is the eddy viscosity (m^2.s^{-1}), *c* is the Chezy coefficient (m$^{1/2}$s^{-1}), *R* refers to direct rainfall rate(m/s), *E* is the rate of evaporation (m/s) and *q* represents the river discharges and withdrawal of water (m/s).

The surface stress term is assumed as a quadratic function of the wind W with components in the x and y-axes given by:

$$\tau_{sx} = \rho_a c_d W_x W \quad , \quad \tau_{sx} = \rho_a c_d W_y W \quad (4)$$

Where ρ*a* is the air density, *cd* is a drag coefficient and $W_{x,y}$ are the wind components in the *x* and *y* axes, respectively.

Equations (1) and (2) define the current accelerations in the *x* and *y*-axes respectively. The first terms on the left of both equations represent the local change of the flow velocities and the remaining terms on the left represent changes in the fluid acceleration due to advection of momentum. On the right-hand side of both equations (in the order written), effects due to earth's rotation (Coriolis acceleration), sea surface elevation gradient, surface stress and bottom frictional effects, and horizontal momentum diffusion provide the necessary physical factors affecting coastal circulation. Basically, these equations represent conservation of momentum in the coastal sea. Current velocities are predicted using these equations.

On the other hand, Equation (3), which is simply the equation of mass continuity, represents conservation of water mass. It helped the project to come up with a justified prediction of the water level evolution or coast surface elevation from known current velocities due to the wind.

Assumptions and Limitations
The foremost information needed by the numerical (hydrodynamic) model is a processed bathymetric map from the actual bathymetric survey conducted. The bathymetry data which covered the pre-defined 1,250 hectares of coastal waters adjacent to the two outfalls and deltas of the Busuanga River were used.

The wind is the main driving force for most coastal processes and therefore constitutes the second most important information for the model. The action of the wind normally modifies the depth-driven motion of the sea and therefore requires accurate information. The temporal variation of a uniform wind is normally used in the model, but a spatially varying wind speed can also be used. In this study, a uniform wind speed and direction is based on long-term average wind fields, reinforced with actual wind data collected in the area.

As for this study, two model scenarios were assessed to predict the water movement and the dispersal of total suspended sediments in the coastal water areas:

1. Moderate south-westerly wind (HABAGAT), the direction of 180 to 225 degrees from the north at an assumed wind speed of 4 m/s were used to induce current over a period of 30 days.
2. Moderate north easterly wind (AMIHAN), the direction of 10 to 85 degrees from the north at an assumed wind speed of 4 m/s was used to induce current over a period of 30 days.

Hydrodynamic models were employed for the assessment. The water quality module simulated transport and simple water quality processes using the flow data from the hydrodynamic module. In addition, the sediment plume is followed in two dimensions over time, whereby a dynamic concentration distribution is obtained by calculating the mass of pollutants in the model grid cells.

Basically, the hydrodynamic model setup consists of refined grids, distributed in a way to resolve the high resolution required near the coast of the study area, while providing enough coverage offshore of Mindoro Strait. The grid size ranges from 15 meters down to 5 meters, covering the approximately pre-defined area of 1,250 hectares of proposed coastal dredging extent. The satellite imagery used to explore the coastal vicinity of the mentioned barangays in Project Description, especially in the Barangays Adela and San Agustin, near the lower portion of Busuanga River, and its adjacent waters are enhanced using the small grid size of about 10 meters.

The transport of sediments is dependent on the results of the hydrodynamic model outputs which were then used as inputs for the water quality model to assess the impact of an unavoidable sediments' spillage in the following scenarios – pre-development, during the development, and after the operational phase of the project.

Water Circulation – Baseline and Impact Assessment
An assessment of the water movement, flow velocities, and tidal fluctuations was conducted to provide a clear overview of the actual flow patterns and tidal levels which could be used as inputs, as well as in calibrating the hydrodynamic model to be set up and used for this study. The survey activities were conducted on October 9 to 11, 2023 to gather primary field data such as water surface flow, under-water current observations, water level fluctuations, and photo documentation.

Methodologies of the field surveys and data gathering process are summarized below:

Field Observations

- **Tidal Water Levels**

The predicted tide signals for the nearest tidal gauge station at San Jose, Occidental Mindoro were used as a reference for the tidal influence of the local tidal station established at the proposed project site. As there are no adequate long-term water-level observations that could be used for subsequent analysis and with tidal levels based on tide prediction tools are assumed in good agreement with other available tide prediction models, the major tidal constituents of these stations can be used as representative values for the study area.

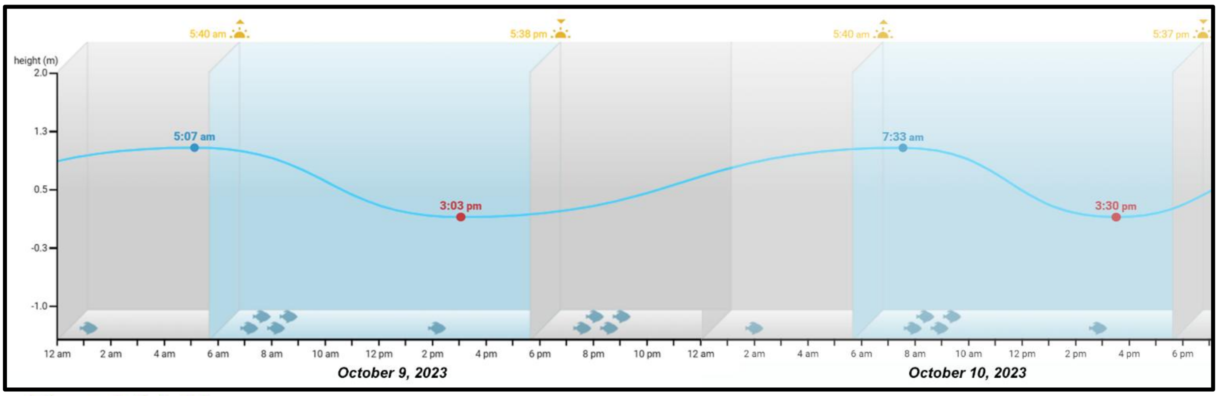


Figure 2.2.2-31. Predicted Tide Levels in the Vicinity of the Study Area from October 9 to 10, 2023 with Reference to San Jose, Occidental Mindoro Port Tidal Station

To determine the type of tide in the area, the recorded actual water levels were plotted and compared with that of the time series of the predicted tidal water levels of San Jose, Occidental Mindoro Port, whose patterns were subjected to harmonic analysis to quantify the equivalent representative tidal constituents.

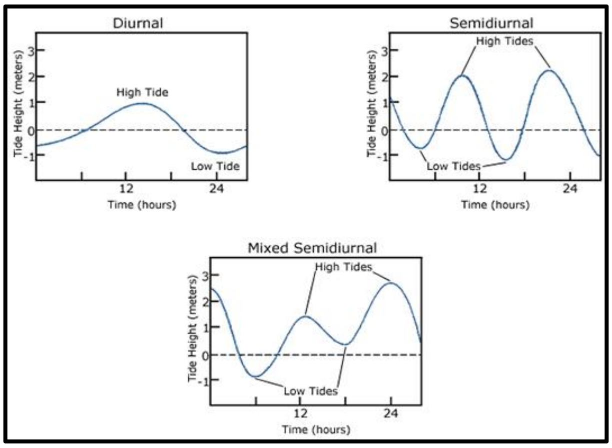
The Form Number (F) or the amplitude ratio, is a convenient way to determine the type of tide (diurnal, semi-diurnal, or some combination of the two). It is computed as the sum of the main two diurnal amplitudes (K1+O1) divided by the sum of the main two semidiurnal amplitudes (M2+S2). Based on the values of tidal harmonics derived from predicted tidal levels, the average of the computed Form Numbers of San Jose, Occidental Mindoro Port is 0.70 meters.

The said value can be interpreted as an indication that the area is experiencing a diurnal tide cycle with one high tide and one low tide in a 24-hour cycle. The predicted tidal fluctuations at San Jose, Occidental Mindoro Tidal Station, and the actual tide readings at the local tide station at the delta of the Busuanga River from October 9 to 11, 2023 are shown below (**Table 2.2.2-5**). The graphical representation of the predicted tides at San Jose, Occidental Mindoro Tidal Station, and from the National Oceanic and Atmospheric is presented below as well (**Figure 2.2.2-32**).

Table 2.2.2-5. Predicted Tidal Fluctuations at San Jose vs. Actual Tidal Readings at Local Tide Station at the Mouth of Busuanga River

Date	Description	San Jose Tide Station (Predictive)		Busuanga Site Local Tide Station Readings	
		Elevation in meters	*Time*	*Elevation in meters*	*Time*
October 9, 2023	High Tide	1.1 m	5:07 am	1.05 m	5:15 am
	Low Tide	0.2 m	3:03 pm	0.20 m	3:15 pm
October 10, 2023	High Tide	1.1 m	7:33 am	1.0 m	7:40 am
	Low Tide	0.2 m	3:30 pm	0.4 m	3:35 pm

Reference: Predicted Tides at San Jose, Occidental Mindoro Tide Station for October 9 to 10, 2023



Source: National Oceanic and Atmospheric Administration

Figure 2.2.2-32. Summary of Tidal Constituents at San Jose, Occidental Mindoro Port Tidal Station and Typical Tidal Types from National Oceanic and Atmospheric Administration

- **Observed Wind Patterns, Surface, and Sub-surface Water Movement at the Study Area**

Wind, as one of the principal driving forces influencing most coastal processes, constitutes vital information for physical oceanography and was therefore included in the field observations. A portable anemometer and weather tracker were used to measure wind speed, wind direction, and other relevant environmental conditions.

The Kestrel NV 4500 Pocket Weather Meter is the Kestrel's flagship meter (Plate 2.2.2-1) that is capable of monitoring and reporting an exhaustive list of environmental parameters – from headwind (true and magnetic), crosswind, wind direction, altitude, pressure trend, temperature, barometric pressure, dew point, wind chill, and more. It has onboard data logging and storage capability of up to 4,500 data sets and comes with a sealed data transfer interface with the option to connect via Bluetooth.

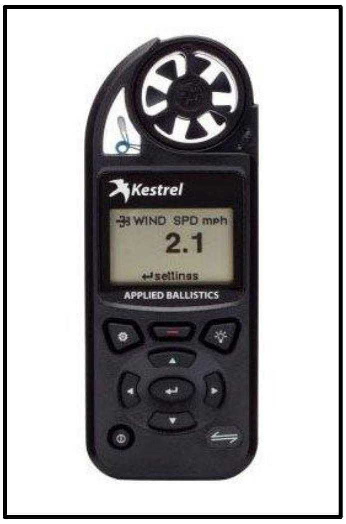


Plate 2.2.2-1. Kestrel NV 4500 Pocket Weather Meter being Used for Data Gathering

Based on observation, mean wind velocities ranged from 1.40 to 3.50 m/s with directions heading South, East, and Southeast. The prevailing wind during the oceanographic survey was brought by the Northeast Monsoon or Amihan which is apparent from the months of October to March.

Table 2.2.2-6. Summary of Wind Influence Observed at the Study Area on October 9-11, 2023

No.	Time	Wind Speed	Cross Wind	Head Wind	Temperature	Humidity	Heat Index	Dew Point	Baro	Altitude	Dens Altitude	Direction
		m/s	*m/s*	*m/s*	*ºC*	*%*	*ºC*	*ºC*	*inHg*	*m*	*m*	*NSWE*
O5	10:09 AM	1.3	29.8	29.7	27	83.6	28	27.8	1008.4	36	704	NE
O6	10:58 AM	0.8	21.83	27.2	29.83	87	30	28.8	1007.8	42	772	E
O7	11:01 AM	1.9	26.1	26.8	29.8	85.3	32	27.7	1007.8	43	714	E
O4	11:51 AM	0.7	32.2	32.5	32.4	80.4	31	28	1007.2	48	797	NE
O3	12:15 PM	2.0	30.2	29.8	30.5	80.3	33.0	27.3	1006.9	51	745	E
O2	12:30 PM	2.3	27.8	28.0	31.0	82.0	34.0	27.5	1007.2	48	757	NE
O1	01:00 PM	2.1	28.5	28.1	30.2	81.0	33.0	27.6	1007.4	46	752	NE

Measurements of the magnitude of water surface flows were also made during this observation period using a digital flow meter. The water velocity probe (Plate 2.2.2-2) consists of a protected water turbo prop positive displacement sensor coupled with an expandable probe handle of up to 6 feet depth ending in a digital readout display. This handheld tool is primarily used to measure underwater current velocities at varying depth ranges of up to 6 feet. This is a tool dedicated to measuring flows in streams, rivers, canals, coastal waters, storm waters, wastewater, and industrial process waters. The flow meter propeller rotates freely on its bearing shaft with no mechanical interconnections for minimal friction. Magnetic material in the propeller tip passes a pickup point in the water velocity meter handle producing electrical impulses that are carried to the readout display by an internal cable. The water velocity computer receives an electrical signal from the propeller, amplifies the signal, and converts the reading to feet per second (or meters per second, depending on programming). The large LCD screen displays average, minimum, and maximum water velocity readings. Also, up to 30 sets of minimum, maximum, and average data readings can be stored in the water velocity computer. These data points can be reviewed on the computer screen for future analysis. The water velocity computer has a water-resistant housing and incorporates a unique four-button operation for changing functions and resetting the display. The Flow Probe can be used to measure the true average water velocity of a channel's flow. If the turbo-prop sensor is in the water flow, the computer will average the water velocity. One reading is taken per second, and a continuous average water velocity is displayed. To obtain the true average velocity, the flow probe should be slowly moved throughout the cross-sectional area being measured. Once the reading becomes steady, the true average water velocity of the cross-sectional area is obtained. This allows for highly accurate flow measurements, which average the differences in velocities that occur throughout a flow's cross-section and with water surges over time. The average water velocity can be saved by pressing the save button and reviewing it later. Significant errors can occur when measuring water flow other than directly parallel to the direction of flow. The Global Water Flow Probe Alignment Fin is designed to help orient the flow probe parallel to flow when the end of the probe can't be seen well due to the depth or cloudiness of the water. To use this accessory, immerse the flow probe and rotate it back and forth until the least amount of resistance is felt due to the water flowing past the alignment fin.

Plate 2.2.2-2. The Global Water Digital Current Meter (Model: Flow Probe 111)

The average surface flow for both surface water and sub-surface water was observed at marked sampling stations last October 9 and 10, 2023 (**Table 2.2.2-7**). Surface water flow average velocities range from 0.7 to 2.3 m/s at trajectory directions heading south and the southeast. Sub-surface water flows were taken at three different depth ranges of -0.5m, -1.0m, and -1.5m respectively. Sub-surface water flow average velocities ranged from 0.10 to 0.30 m/s consistently towards the north and northwesterly direction. It can be noted that the subsurface water flows near the shoreline is directed into the northwesterly trajectory direction while those that are from the coastline were due in a north trajectory direction (**Figure 2.2.2-33**). In addition, it can be assumed that the water surface flows were not entirely influenced by the prevailing wind, but by the area's terrain configuration.

Table 2.2.2-7. Summary of Surface Water and Sub-surface Water Flow Observed

Stn ID	COORDINATES		SUBSURFACE WATER						SURFACE WATER	
	Latitude	Longitude	Depth/ (m)	Temp °C	Depth (m)	Velocity (m)	Average Velocity (m)	Direction NSWE	Average Velocity (m/s)	Flow Direction / Trajectory
O5	12°25'58.166"	120°56'56.278"	92.5	29.32	- 0.50	0.2	0.17	NW	1.3	SE
					- 1.00	0.2				
					- 1.50	0.1				
O6	12°24'54.793"	120°57'35.521"	395	29.7	- 0.50	0.1	0.30	NW	0.8	S
					- 1.00	0.4				
					- 1.50	0.4				
O7	12°24'12.104"	120°58'29.075"	407	30.11	- 0.50	0.1	0.10	NW	1.9	S
					- 1.00	0.1				
					- 1.50	0.1				
O4	12°25'28.778"	120°58'18.195	128	29.87	- 0.50	0.1	0.23	N	0.7	SE
					- 1.00	0.2				
					- 1.50	0.4				
O3	12°24'49.596"	120°59'11.589"	108.7	29.57	- 0.50	0.2	0.30	NW	2	S
					- 1.00	0.3				
					- 1.50	0.4				
O2	12°25'17.280"	120°59'01.007"	10.6	30.2	- 0.50	0.2	0.20	N	2.3	SE
					- 1.00	0.1				
					- 1.50	0.3				
O1	12°26'02.539"	120°58'16.308"	14.1	29.16	- 0.50	0.2	0.23	NW	2.1	SE
					- 1.00	0.2				
					- 1.50	0.3				

The following images present the activities of data gathering captured during the deployment and use of various equipment in conducting the oceanographic survey in the project's impact area:

Plate 2.2.2-3. Actual Oceanographic Surveys for identified stations

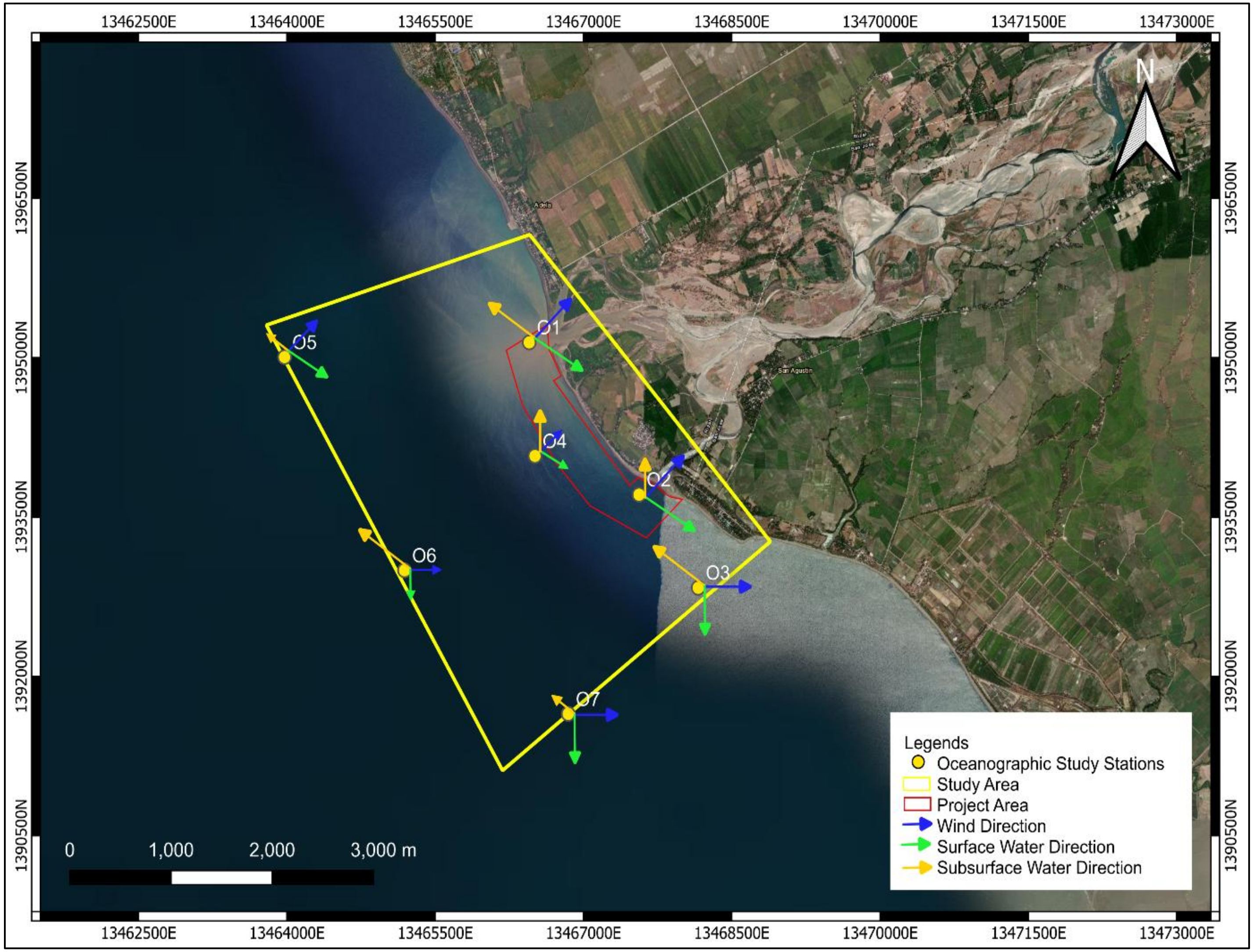


Figure 2.2.2-33. Graphical Representation of the Observed Surface Wind, Surface Water and Sub-surface Water Flow Directions at the Project Area

C. NUMERICAL SIMULATIONS OF WATER CIRCULATION AND MOVEMENT

To help quantify the baseline coastal circulation, tracer plume dispersion, and suspended sediment transport in the coastal study area, the hydrodynamic model was used to simulate the effect of the representative tidal events representing the transition month from Amihan to Habagat wind fields (or summer months to the rainy season). The first 5 days of these simulations were used to ensure that the model reached its steady state, thus preventing the effect of numerical oscillations because of the initial conditions of the model run. The numerical simulation started from the 15th of the month until the 5th of the next month, using the first 5-days of hydrodynamic simulation as the initial condition in the computations. The duration of the modeling performed is limited to one month, while also acknowledging that a long-term, comprehensive data set to fully model in detail the complex coastal circulation was not available at the time of preparing this report.

- **Predicted Water Circulation under the Baseline Condition**

The hydrodynamic flow simulations were used to analyze the spatial distribution of current and water movement of the coastal areas of the study area. The next sets of figures below aimed to show the predicted depth-average current for Amihan wind conditions (gentle wind breeze with a speed of 4 m/s from the northeast) during tidal flooding and ebbing. The right panels show the predicted current speeds as a function of time. The direction axis indicates the direction the current is heading towards.

The model runs show that the general trend of water movement during Amihan or with the northeasterly winds forcing it to the southeast towards the coastlines near the mouth (delta) of Busuanga River as it flows continuously down to the coastlines of neighboring municipalities down south.

In Scenario A-1, with the northeasterly wind forcing during high tides, the wind-induced surface water flow velocities range from 0.7 to 2.3 m/s while the sub-surface water flows mean velocities range from 0.11 to 0.30 m/s in the southeasterly direction along the coastlines of the study area (**Figure 2.2.2-34**).

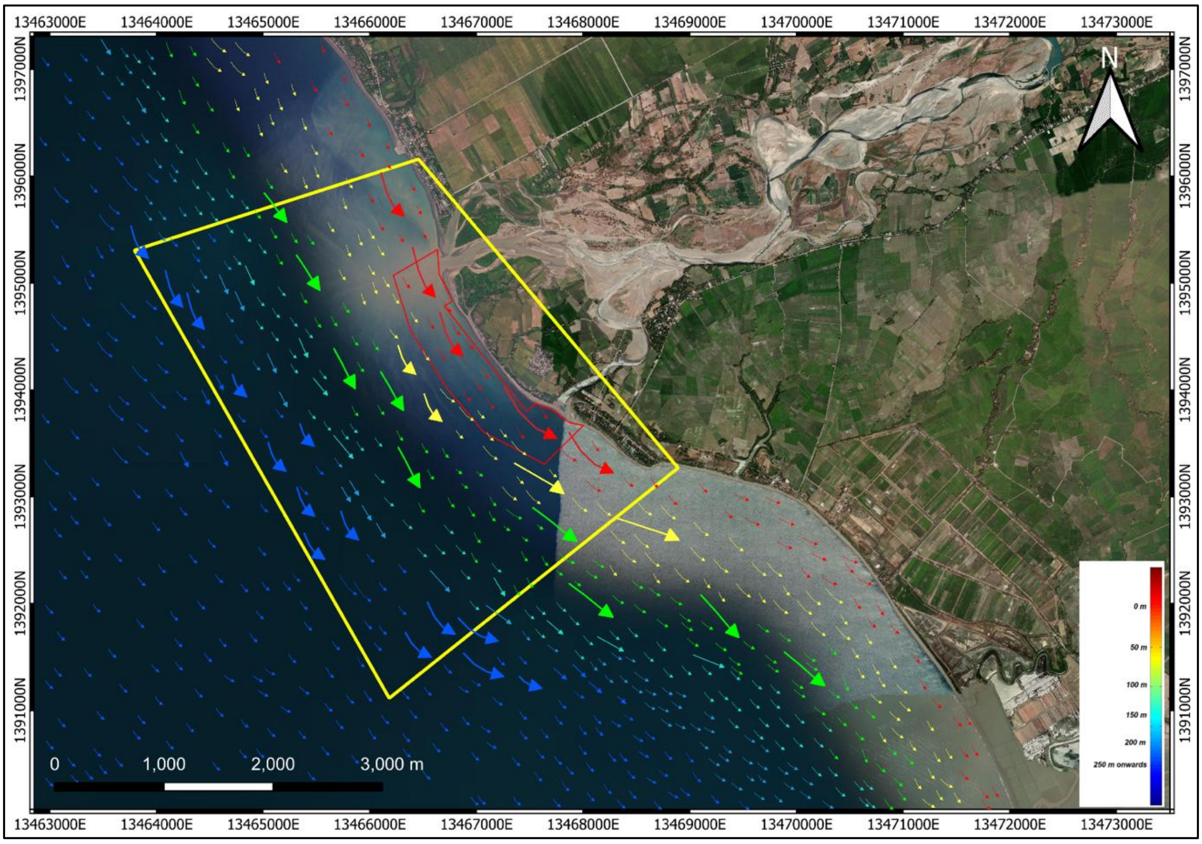


Figure 2.2.2-34. Predicted Currents (Average Velocity) in HIGH Tidal Condition in the Study Area during Amihan Wind Condition

In Scenario A-2, with the northeasterly wind forcing during low tides, the wind-induced surface water flows mean velocities range from 0.5 to 1.0 m/s while the sub-surface water flows mean velocities ranges from 0.10 to 0.20 m/sec the southeasterly direction along the coastlines of the study area (**Figure 2.2.2-35**).

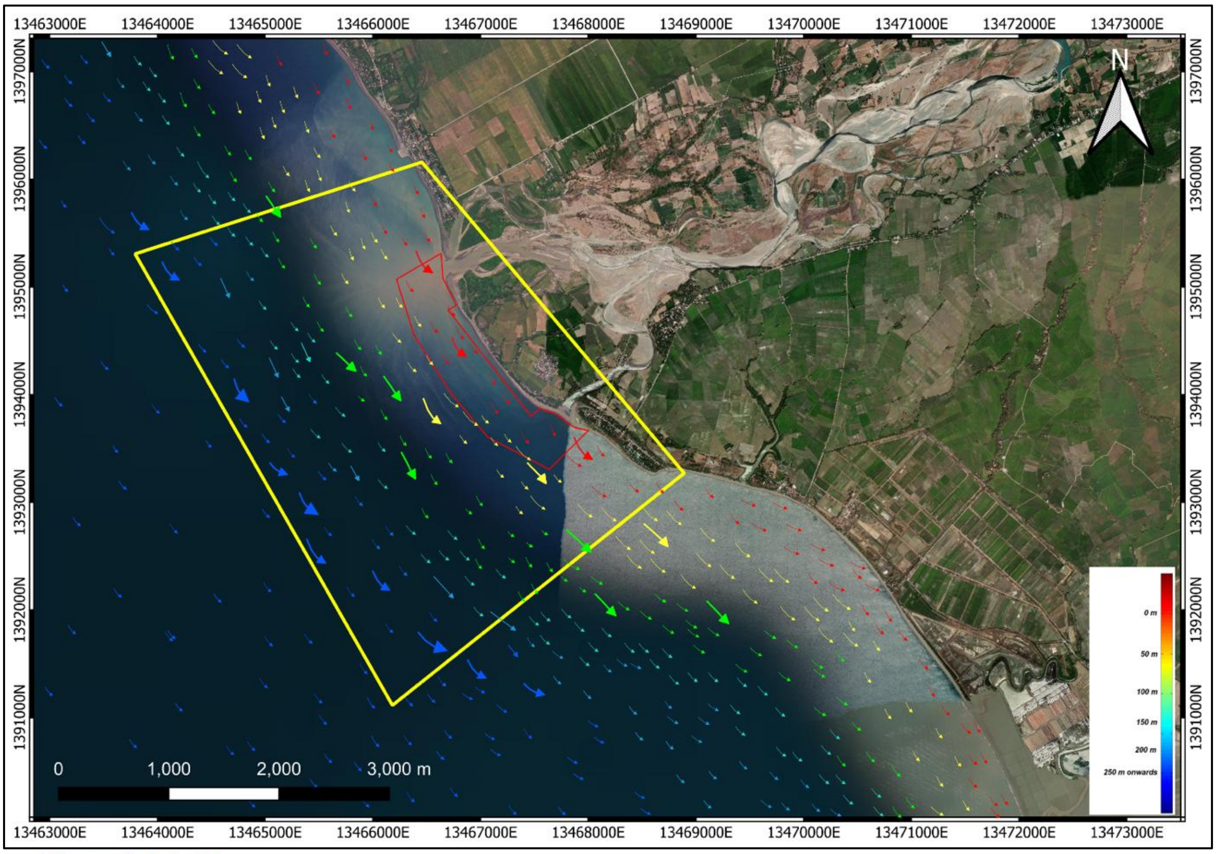


Figure 2.2.2-35. Predicted Currents (Average Velocity) in LOW Tidal Condition in the Study Area during Amihan Wind Condition

Generally, the model runs revealed that the general trend of water movement during Amihan or with the northeasterly winds forcing is to the southeast alongside the coastlines near the outfall and by the delta of Busuanga River as it flows continuously down to the coastlines of neighboring municipalities down south. The water current movement during high tides is relatively stronger than that during low tides.

For wind driven flow, using a gentle wind breeze blowing from the northeast (the so-called Amihan wind), the velocity field near the proposed project area or near the lower portion of Busuanga River ranges from 1.5 to 2.3 m/s which is lower than what is predicted in the open area offshore (western portion) or towards the open sea away from the proposed project area. This range of values is consistent with the result of current trajectory observations conducted in the study area.

Near the shore, the direction of longshore currents follows more or less the direction the wind is blowing to, which is towards the southeast and is flowing parallel to the configuration of the coast running down in the southeast direction.

During neap tides, as well as the flow transition from high tide to low tide, the flow velocity field is rather weak, with velocity ranges from 0.2 to 0.5 m/s. During these occurrences, the predicted flow magnitudes hardly exceed 0.5 m/s on the areas within the proposed project area or along the shorelines, especially at the outfall and delta of Busuanga River.

During low tidal events, where the water is at its lowest levels, the flow magnitude is slightly weaker than what is predicted during high tides. The general path within the proposed project area of the proposed dredging project remains the same as the flow passes out of the waters near the shorelines in the southeasterly direction. The formation of small-scale circular gyres near the delta of the Busuanga River remains visible during low tides, as a result of flow separation of alongshore current flowing southeast and the out-flowing water of the Busuanga River that flows in the southwest direction.

In scenario B-1, with the southwesterly wind forcing during high tides, the wind-induced surface water flow means velocities range from 2.5 to 3.0 m/s while the sub-surface water flow mean velocities range from 0.75 to 1.2 m/s both in the northwesterly direction along the coastlines of the study area (Figure 2.2.2-36).

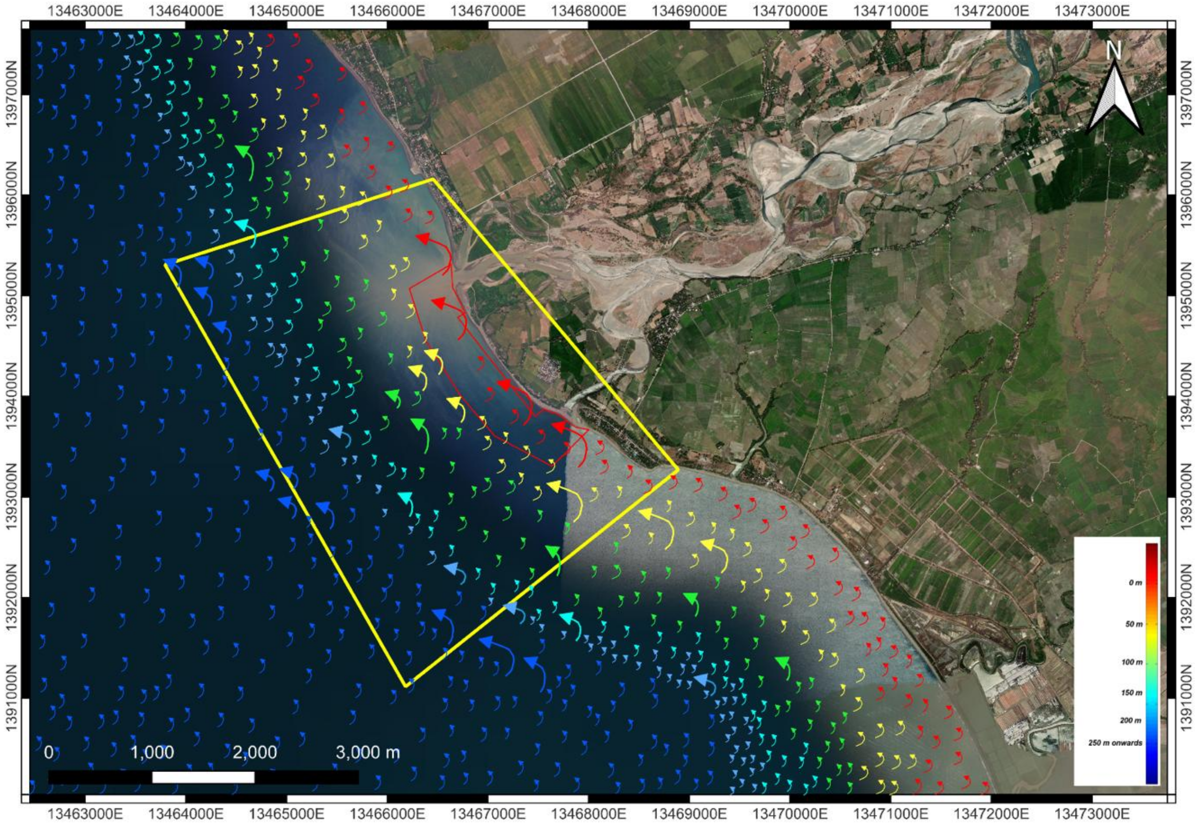


Figure 2.2.2-36. Predicted Currents (Average Velocity) in HIGH Tidal Condition in the Study Area during Habagat Wind Condition

In Scenario B-2, with the southwesterly wind forcing during low tides, the wind induced surface water flows means velocities range from 1.5 to 2.2 m/s while the sub-surface water flows mean velocities ranges from 0.40 to 0.70 m/s both in the northwesterly direction along the coastlines and on the westerly direction offshore to the open sea of the study area (Figure 2.2.2-37).

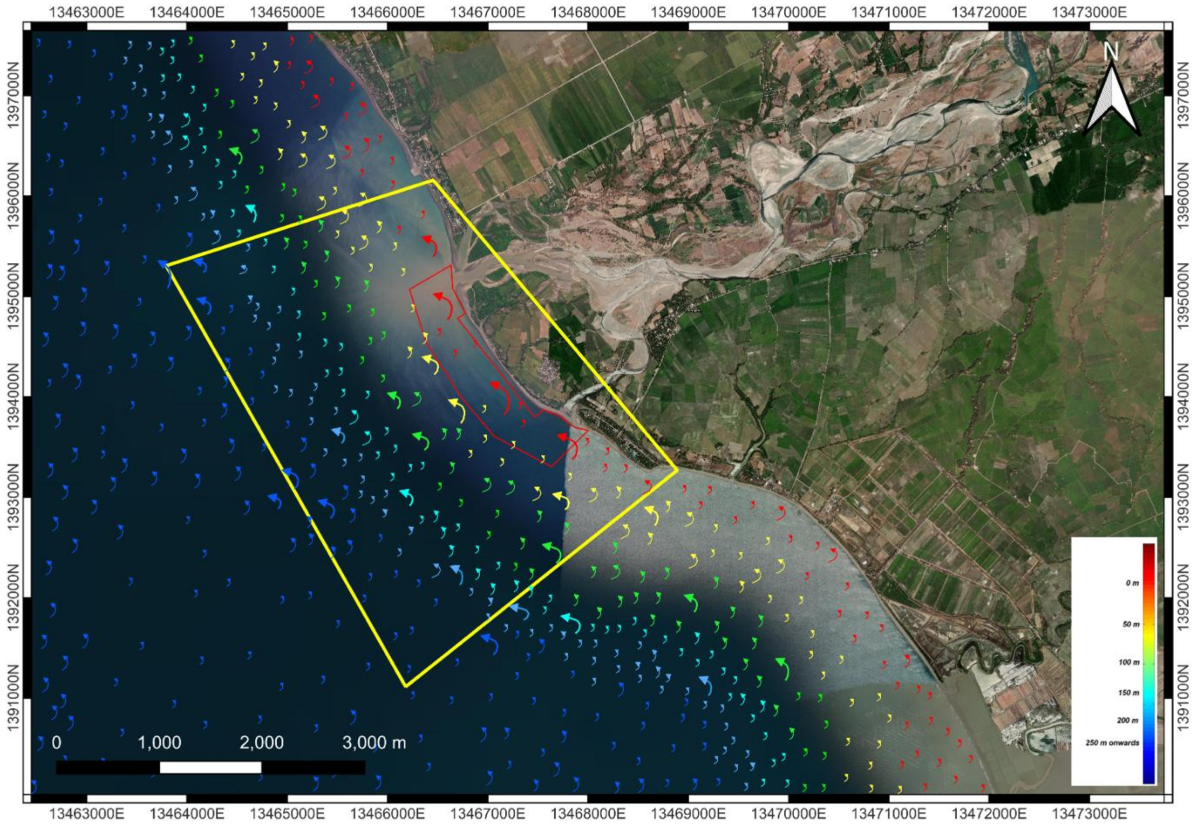


Figure 2.2.2-37. Predicted Currents (Average Velocity) in LOW Tidal Condition in the Study Area during Habagat Wind Condition

For Habagat wind conditions scenario using moderate wind velocity input of 4m/s and blowing from the southwest and using predicted tidal events of the same simulation period, the model results revealed that the general wind flow direction along the shorelines of the project area is north-westwards during high tides and slightly weakens in magnitude towards the northwest during low tidal events. The most noticeable flow pattern for these two wind events is that lower flow magnitudes occur at the northwestern side of the Busuanga River (delta) where the proposed larger area of the project is situated. In that area, flow velocity fields are in the range of 0.25 to 0.50 m/s, while near the Busuanga River (delta), the depth-averaged flow is somewhat sustained to vary between 0.3 to 0.60 m/s. The wind-induced flow is predicted to manifest along the coast, where weak circular gyres are formed due to the differences in flow magnitudes far offshore and near the coast.

During tidal ebbing, the model predicts that the range of flow magnitudes is almost the same as to what was predicted during high tides. The general direction is towards the northwest as the water flows out of the open areas of the sea wherein the flow is westerly in direction.

From examination of the predicted currents in the study area during these two wind conditions, and tidal fluctuation for the representative month, it follows that tidal fluctuations dictate the direction of current at the project site by the lower portion of Busuanga River and the surrounding areas of nearby municipalities.

In the coastal areas of Barangays Adela and San Agustin, especially at the outfall and delta of the Busuanga River and its nearby waters where the proposed dredging project is located, the predicted currents are generally about 0.25 to 0.50 m/s for both Amihan and Habagat wind conditions for a wind speed of 4 m/s. For higher wind magnitude, it is expected that high flow velocities would occur, but for tracer plume and sediment dispersal prediction, for which this tide and wind-generated flows are needed, low magnitude winds are used to derive more conservative estimates.

- **Predicted Change in Water Circulation due to the Project**

The proposed dredging project would alter the physical configuration of the coast, especially the delta part of the Busuanga River, which will inevitably have minimal changes in the prevailing water circulation and movement in the immediate coastal vicinity of Barangays Adela and San Agustin, and nearby waters.

The figure sets shown below are side-by-side comparisons of tidal and wind-induced flow patterns for "WITHOUT" and "WITH" project scenarios during the Amihan and Habagat wind fields. The dredging project considered in the simulation, "WITHOUT" and "WITH" the project scenarios considers the current physical attributes of the proposed project area. All other model inputs remain unchanged to ensure that whatever differences in the computational outputs of the "WITHOUT" and "WITH" project scenarios can only be attributed to the proposed dredging project.

As can be seen in the various results comparing the maps of the same time step outputs, almost no significant changes in flow patterns can be seen. Under the baseline or without the project scenario, alongshore currents at the coast of Barangays Adela and its nearby areas flow by the project area at the same time as characterized by the prevailing wind conditions at the project area. As a result of the dredging project, the water flow directions towards the original coast of Barangays Adela, San Agustin, and nearby Barangays would have no significant changes. Minimal changes in the magnitude of water flow velocities along the coasts would be evident because the dredging operations will eventually increase the depth of the sea floor bottom near the coastlines of the project area and clear material obstructions that impede the inflow and outflow of the waters at the outfall of the Busuanga River.

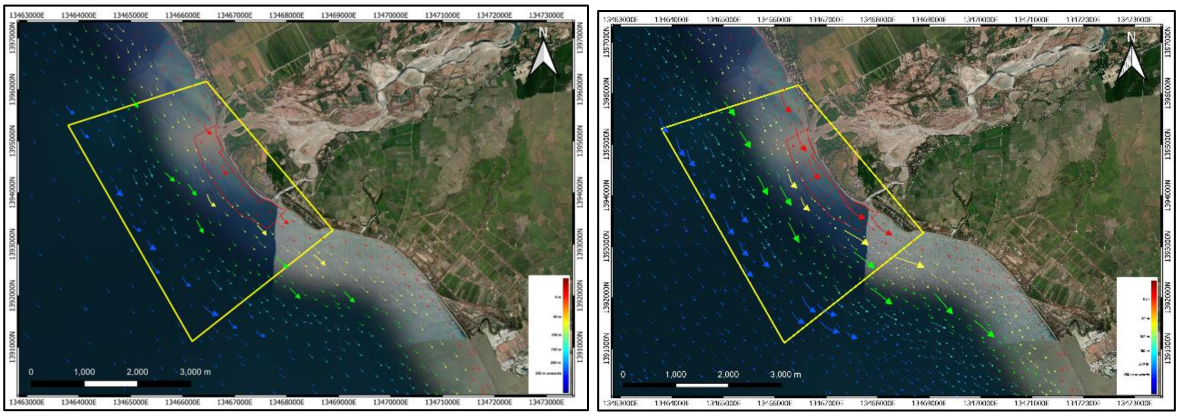


Figure 2.2.2-38. Average Water Flow Velocities in the Study Area during Amihan Wind Condition

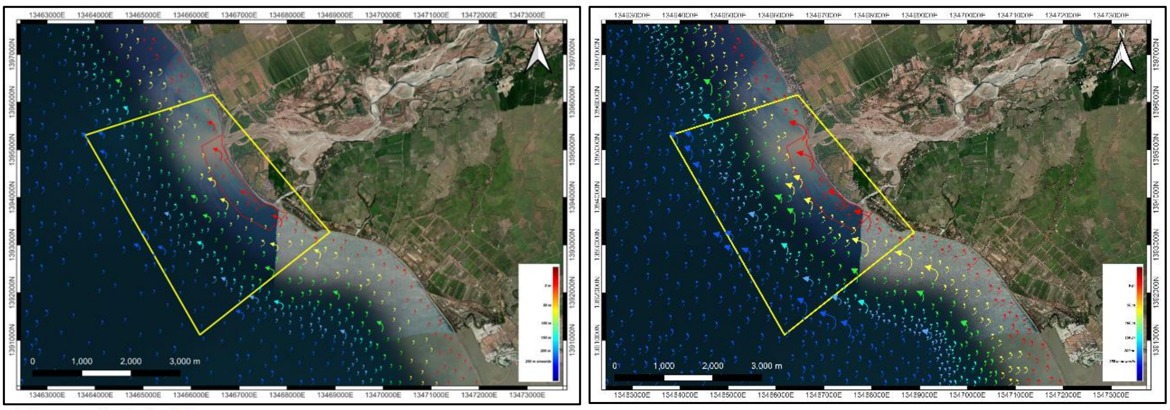


Figure 2.2.2-39. Average Water Flow Velocities in the Study Area during Habagat Wind Condition

D. PARTICLE TRACKING THROUGH TRACER PLUME DISPERSAL AND TRANSPORT MODELING

This section assesses the transport and behavior of water quality pollutants, in this case, represented by the plume of conservative tracer released at the proposed project area. In particular, the dispersal, dilution, and accumulation patterns of tracer plume as it is transported by the ambient current circulations were investigated.

The model considered the influx of a tracer within the proposed project area, which represents the continuous discharge of disturbed topography both onshore and offshore and accidental spillages, to visualize and quantify the dispersion patterns in the area for both the “without” (baseline)and the 'with' project scenarios. The delta of the Busuanga River where the proposed project area is located is also considered to represent natural influx and material transport in the project area.

Aside from tidal fluctuations, scenarios incorporating the effect of north-easterly (amihan) and south-westerly (Habagat), to investigate the propagation and dispersal of the tracer plume as wind-induced current, particularly near the coastlines. The dispersal patterns of tracer were assessed with the end in view of determining how the proposed dredging project will potentially impact the existing coastal water quality process.

A constant tracer level of zero milligram per liter (mg/L) has been used for the open waters of Barangays Adela and San Agustin while at the release points by the delta of the Busuanga River within the proposed project area, an assumed constant load of 1 kg/s for the tracer is used for the whole simulation period (or a discharge rate of 0.10 m3/s with 10,000 mg/L concentration) representing a water quality pollutant. The hydrodynamic data necessary for the analysis of the dispersion of tracer plume were generated with the detailed hydrodynamic model set-up as discussed in the preceding sections. The transport and dilution of continuous tracer release near the project were simulated for 31 days in the model, to allow build-up of the far field tracer plumes over many tidal cycles. Results were examined over a spring and neap cycle using tidal data from months of transition from dry to wet season for the two wind condition scenarios – amihan and habagat.

The results of the model runs are shown in the next figures. Some of the results of the 31-day simulation of the tracer plume incorporating the effects of surface winds and the rise and fall of tides are presented. Therefore, the snapshots cover most of the interesting patterns that may be expected during flooding and ebbing.

Scenario A–Northeasterly (Amihan) Wind Condition for 'Without' and 'With' Project Scenario

This scenario incorporated the influence of wind on coastal current circulation and transport and movement of tracer plume in the study area. This was accomplished with the use of a north-easterly wind (Amihan), with a moderate speed of 4m/s, representative of the summer monsoon conditions.

For Amihan wind conditions, the model predicts that the extent of the changes in tracer concentrations due to the influx of tracer into the coastal waters (see differences in colors, with units of mg/L in the figures), after a few days of continuous tracer discharges are already noticeable. Higher than 50 mg/L near the release point is likewise visible (shown as a pinkish to the dark red area), of which its coverage area moderately shrinks or spreads consistent with the rise and fall of the tide. As the flow within the project area is tidal-dominated, coupled with the influence of wind fields, the tracer plume generally moved towards the open waters of Mindoro Strait in a southwesterly direction. The immediate coastline of Barangays Adela and San Agustin and the delta area of the Busuanga River with higher concentrations during tidal ebbing and then diluted as water from the open sea rushes into the Busuanga River during tidal flooding. As the concentration of the tracer is 10,000 mg/L at the source, the area by the mouth of the Busuanga River and the southern coastal area of Barangays Adela and San Agustin is predicted to be marginally affected by the tracer, with tracer plumes dropping from about 50 mg/L near the source to less than 10 mg/L a few hundred meters from the source due to dilution and mixing. At the open sea portion, a few hundred meters away from the coasts of Barangays Adela and San Agustin in the southwesterly direction, low tracer levels are

predicted due to water exchanges and relatively higher flows as higher magnitudes is apparent in open seas.
The next series of figures (Figure 2.2.2-40) show a side-by-side comparison of 'without' project or baseline and 'with' project or post-development scenarios and illustrates the propagation of continuous tracer influx into the Bay for the various timesteps to visualize and quantify how the tracer plume responds to dynamic temporal (and spatial) changes in the water movement as influenced by tidal fluctuations and moderate Amihan wind breeze.

Scenario B–Southwesterly (Habagat) Wind Condition for 'Without' and 'With' Project Scenario

All the input parameters of the previous ones were made similar to this present scenario except for wind direction which involved the influence of Habagat wind, on coastal current circulation and tracer plume transport and movement in the study area. A uniform wind forcing (south-westerly wind, ranging from 170 to 260 degrees from the north, with a speed of 4 m/s), representative of the southwest monsoon conditions was used as one of the model inputs to simulate hydrodynamic and tracer plume dispersion in the coastal area of the proposed project.

Because of the additional push of winds blowing towards the open sea, the tracer movement inside the project area is directed towards the coastal areas, northwest of the project area such that the distribution of tracer plume extends farther northwest into the coastal areas of northwest of Barangays Adela and San Agustin. The increase in tracer concentration due to the dredging project, however, is not noticeable, implying that changes in water movement and transport are insignificant once the project is in place, see the differences in colors of the figures for 'without' and 'with' project.

The spreading of the low-concentrated tracer plume reached a greater distance during Habagat than during Amihan winds, and that the coverage of the tracer without and with the project in place is predicted to be almost the same. The coverage of low-concentrated plumes during the transition of tides from low to high and vice versa also changes and responds to the general direction of the tides.

The next series of figures (Figure 2.2.2-41) illustrate the propagation of the tracer plume for 31 days of continuous tracer releases for the various time steps to illustrate how the tracer plume responds to dynamic temporal changes in the water movement as influenced by tidal fluctuations and gentle southwesterly wind breeze.

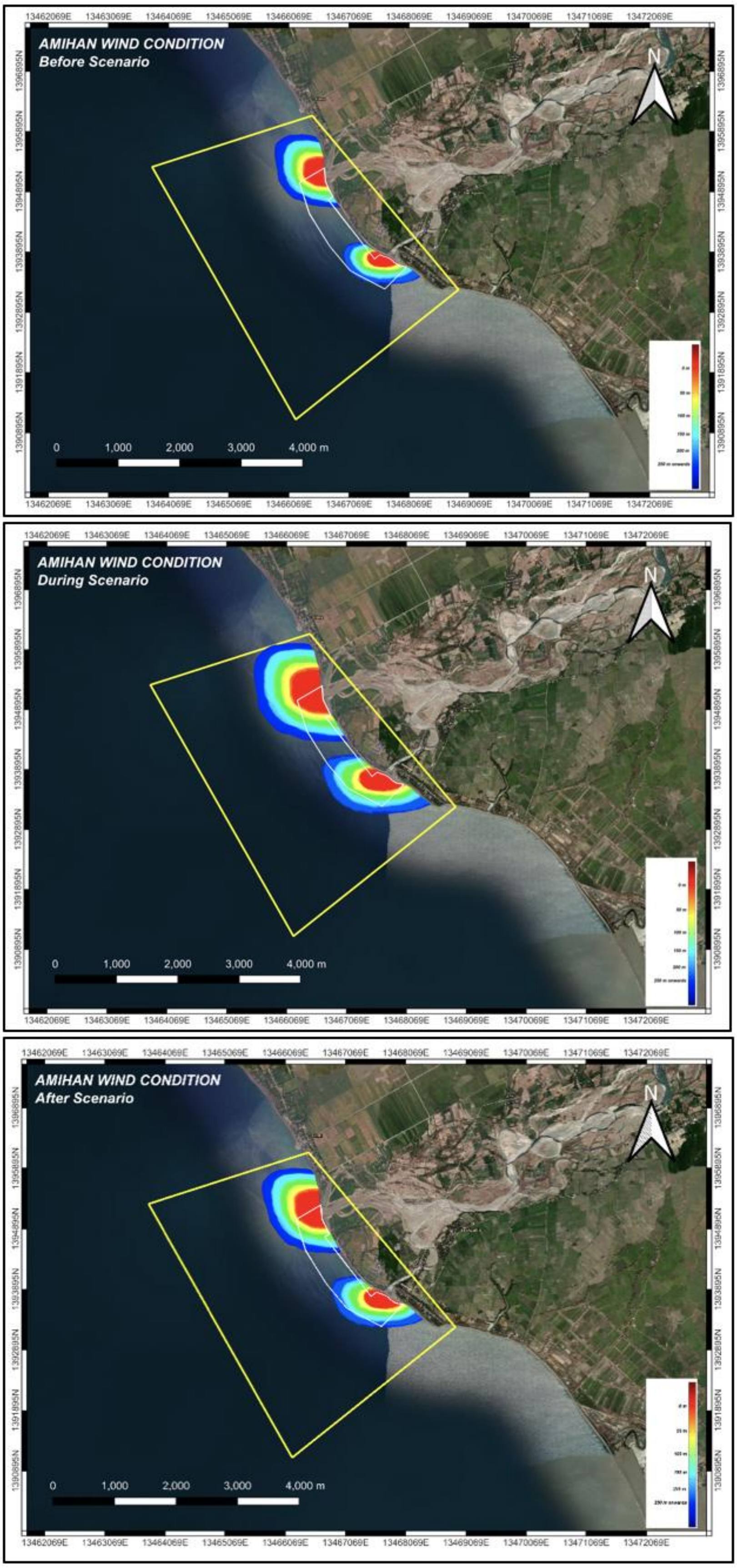


Figure 2.2.2-40. Predicted Trajectory of Tracer Plume Before, During, and After Continuous Dredging Operations under Amihan Wind Condition (Top to Bottom)

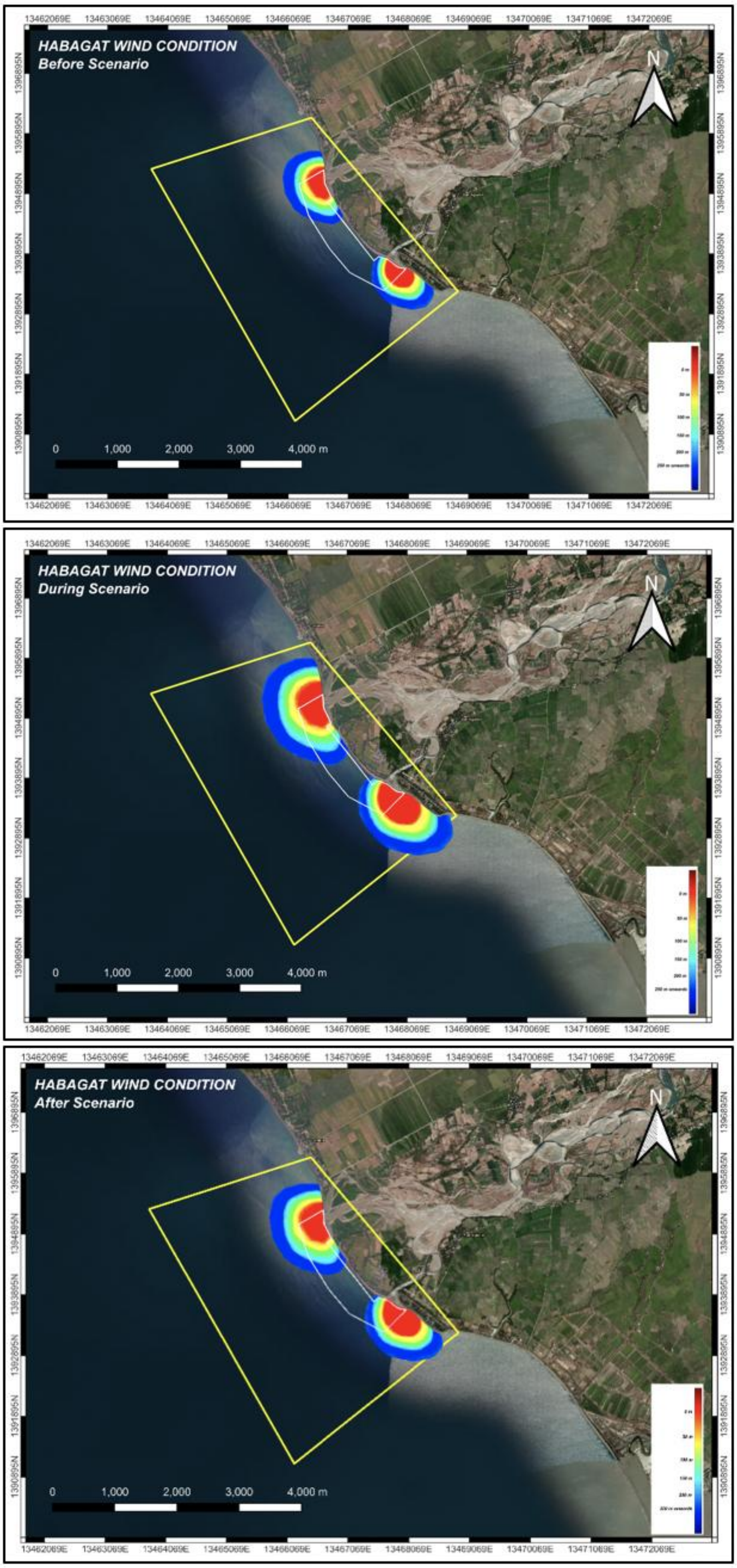


Figure 2.2.2-41. Predicted Trajectory of Tracer Plume Before, During, and After Continuous Dredging Operations under Habagat Wind Condition (Top to Bottom)

Impact Assessment and Mitigating Measures for Accidental Releases

For a long time, the environmental effect of dredging and quarrying activities has been a source of contention. Different stakeholders have placed a greater emphasis on sustainability in recent years in response to the repercussions of climate change, such as pollution, scarcity of resources, stress on ecosystems, and as a result, an imbalance in the overall system.

Scenario simulations revealed that the continuous release of tracer plume at the proposed dredging area was transported and covered the surrounding area albeit with low concentrations depending on wind conditions. The more extensive the dredging hours within the project area would marginally increase the concentration of tracer, or potential water quality pollutants that may flow in that area, only at the area immediate of the source and that the predicted area coverage of low-concentrated plumes remains to be the same regardless of if the project is in place or not.

Finally, the predicted tracer concentration is based on the moderate wind breeze of 4 m/s regardless of wind conditions (amihan and habagat) which is imposed for the whole 31-day simulation period. The fact that moderate concentrations occur with the gentle winds occurring for 31 days, which is highly unlikely, therefore, the extent of the plume presented in the map may be higher than what is to be expected during the actual accidental releases of water pollutants. Gentle winds to strong gales might provide significant mixing in the area that is by the mouth of the Busuanga River which may significantly reduce the extent of the tracer plume predicted by this study.

As mitigating options, given that the location of the proposed dredging area(offshore) at/or near the shore, with potential sources of pollutants from vessels, as well as dredgers, barges, and heavy equipment that will be used during dredging of the area and the transport of dredged materials into barges/vessels, the project proponent might wish to consider during the dredging operation of the project to provide standby spill boom (for oil spills) or silt curtains (for accidental spillages of fine materials) to prevent spreading of such plumes in the nearby areas.

Simulations also revealed that the sediment being released or disturbed during the dredging operations has higher concentrations within the project area immediately of containment structure such as silt curtain where spillages may occur that may lead to an increase above the range of 50 to 150 mg/L TSS concentrations in those areas. This is especially more likely to happen if there are no mitigating measures in place like the installation of silt curtains to arrest the spread of the dredged or backfilled materials outside of the project area. The model scenarios presented here consider the mitigating measures of putting up a silt curtain but with its height limited up to the mean sea level to consider accidental spillages, especially during high tidal events.

The following are the suggested actions to minimize the TSS levels during the dredging and transporting operations:

1. Proper mitigating measures are strongly recommended to be set in place to ensure the confinement of the suspended material to prevent accidental spillage during the operational phase of the project (or during transport and hauling of dredged materials) for maintaining the environmental integrity of the coast zone.
2. Individual dredgers should not be deployed near each other to lessen the concentration of suspended sediments. The ideal deployment is that smaller-capacity TSHD should be deployed in the project area that is near the shore, while larger-capacity TSHD should be assigned far offshore. The larger the capacity, the higher it can generate suspended solids, and deploying them in deeper waters lessens the concentration due to the high mixing potential in those areas.
3. The dredging track of TSHD should be north-south and vice versa and as much as possible, should not run parallel to the shore as this area has shallower depths. Note that the deeper the water, the lesser the concentration of TSS. This is due to the deeper water column that helps in minimizing the concentration levels. This is due to the deeper water column that helps in minimizing the concentration levels.

4. Limit the dredging or reclamation activities in project areas near the shore especially during periods of calm wind or during low water levels.

In summary, the predicted TSS concentrations from dredging and hauling activities might not exceed the Department of Environment and Natural Resources threshold limit a few hundred meters from the dredging project's boundary if mitigating measures are in place and are working as intended. However, as the area may be influenced by a significant amount of suspended sediment influx from the watershed, especially during the rainy season, this additional increase in TSS due to the operation phase of the project might exceed the present water quality guidelines for suspended solids, especially if the proposed mitigating measures and ideal operations recommended above are not followed. Therefore, the results could be interpreted as extreme instances wherein the silt curtains and other mitigating measures that were put in place failed or became inadequate.

E. STORM SURGE INUNDATION MODELING

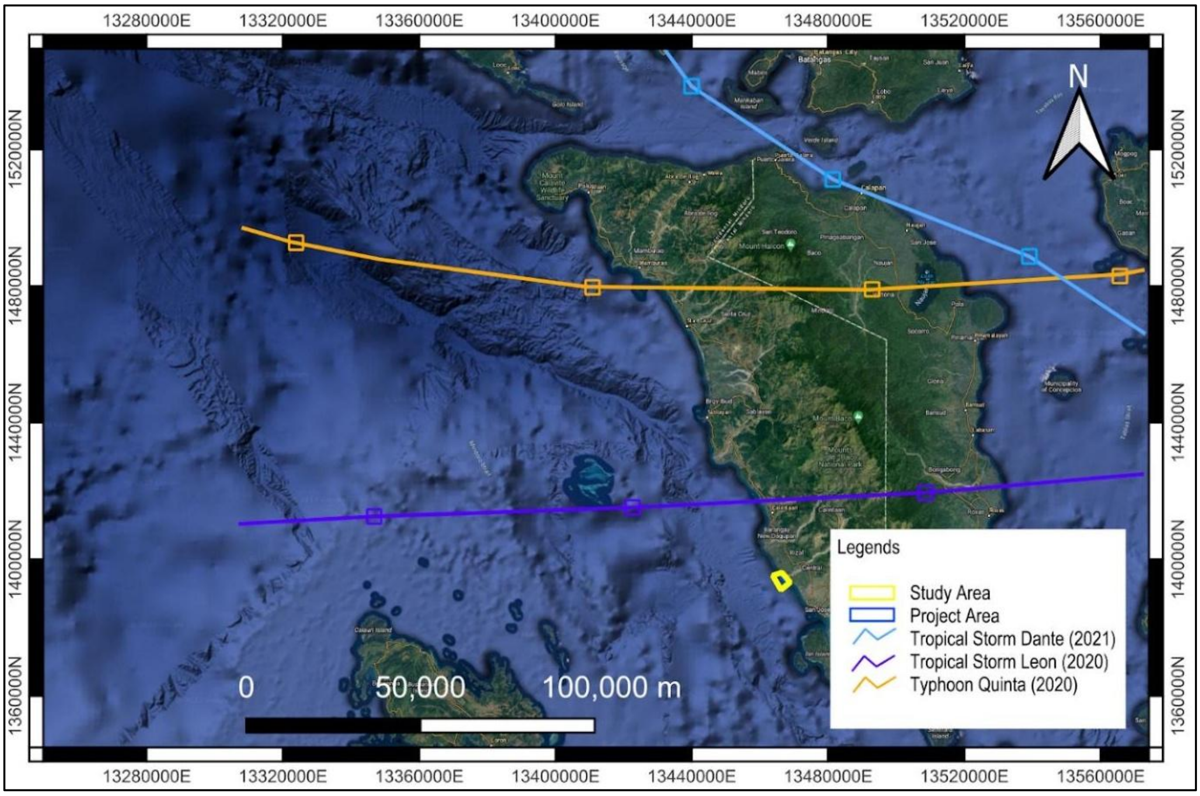
Storm surge is an important issue because our country is located at the typhoon prone area and surrounded by the Pacific Ocean and the West Philippine Sea. Coastal development, as well as people living near the coast needs to pay attention to the damages of storm surge, especially the inundation during typhoon’s duration. Therefore, storm surge modeling is needed for this proposed Dredging Project to provide not only the information of storm-induced water elevations but, also potential inundation areas.

It was recorded that from the year 2020 up to the present that Typhoon Quinta (October 2020) was one of the most recent typhoons that traversed nearest the project area. Also, Tropical Storms Leon (September 2020) and Dante (June 2021) were among the most recent tropical storms that passed by Mindoro Island. The characteristics and path of these extreme weather phenomena were considered and reconstructed as its path traverses very near the project area during that time.

- On September 15, 2020, Tropical Storm Leon hit Mindoro area with wind speed ranged from35 km/h to 55 km/h.
- On October 26, 2020, Typhoon Quinta (Molave) hit Mindoro area with wind speed ranged from 145 km/h to 150 km/h.
- On June 2, 2021, Tropical Storm Dante hit some water areas of Mindoro with wind speed of 55 km/hr.

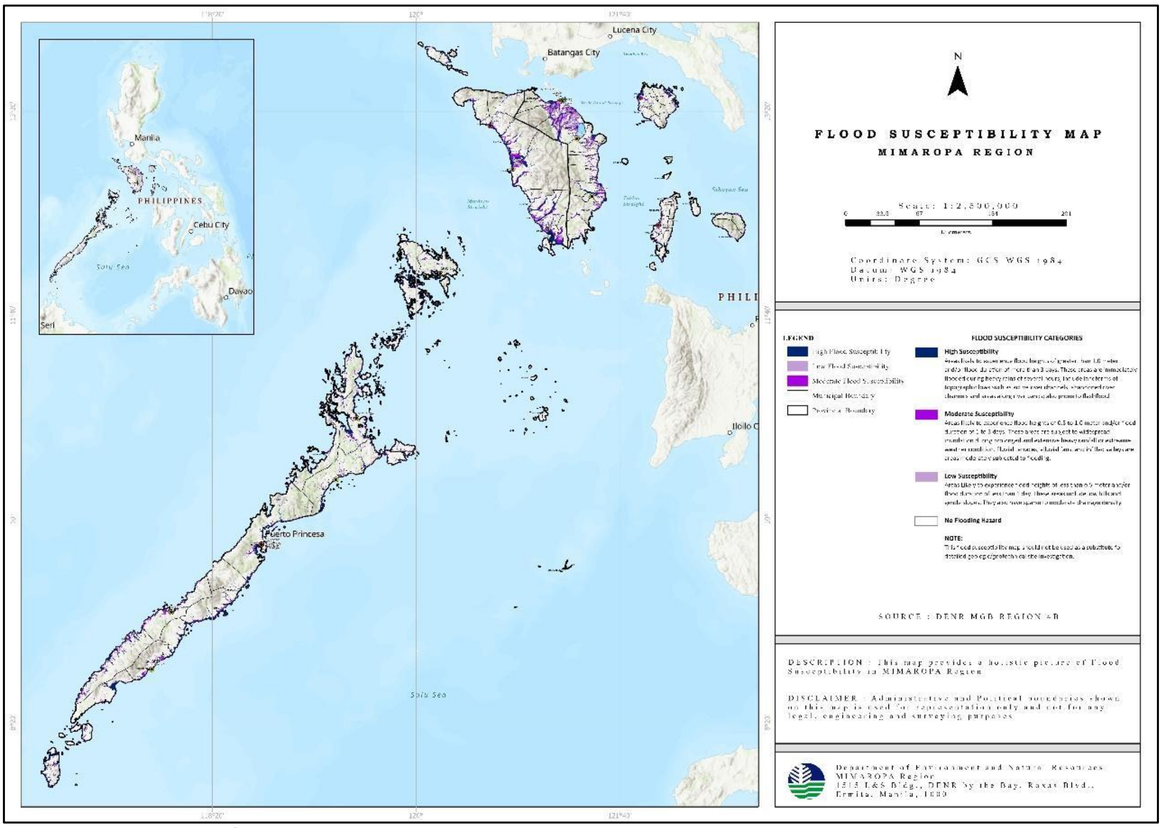
Spatially varying wind and pressure fields of a hypothetical typhoon with similar characteristics as typhoon alert level 5 where derived, although the actual path of storm positions was modified to ensure that the modeled storm would pass near the project area to make the tide and storm-induced water levels predicted by the model is at its peak. The figure shown below is the snapshot of the typhoon track used for storm surge modeling.

Typhoons that Passed Over the Study Area



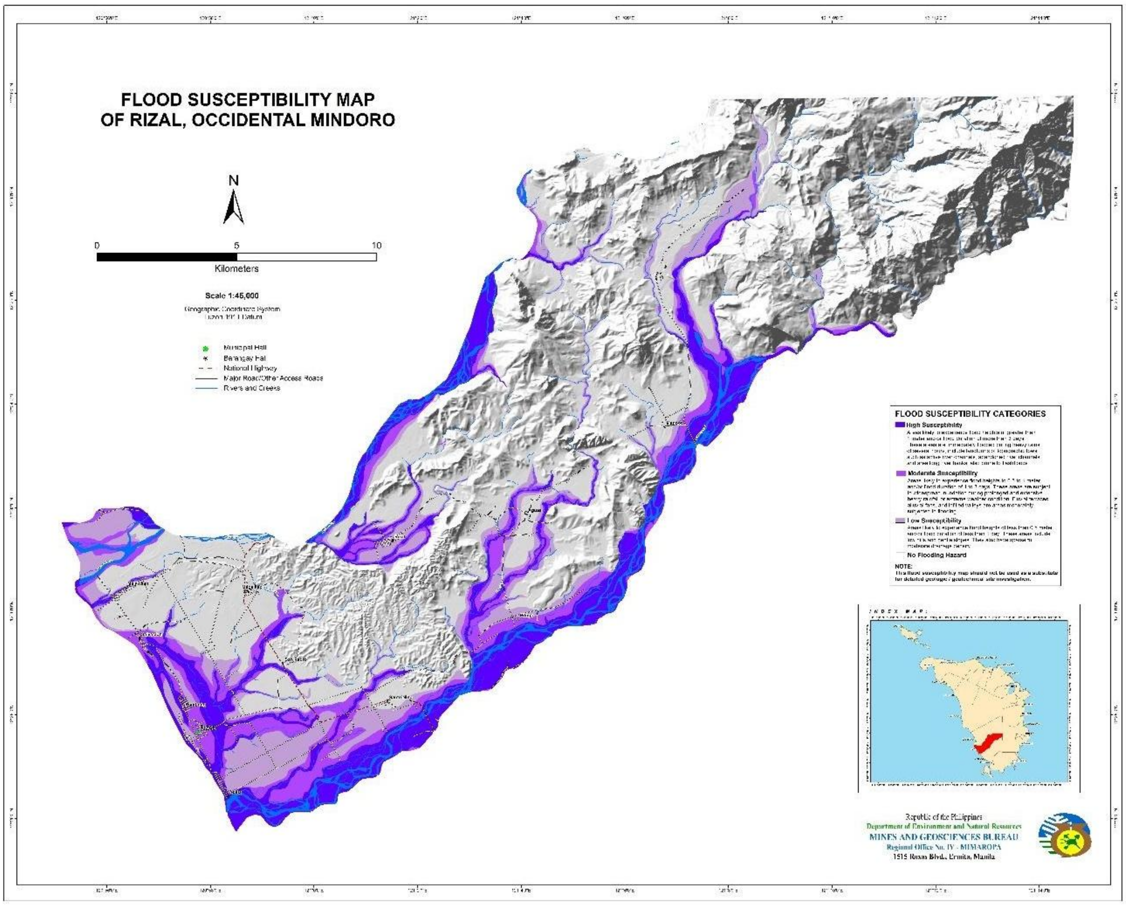
Source: PAGASA and Zoom Earth

Figure 2.2.2-42. Historical Typhoon Track that Passed Through Mindoro



Source: DENR-MIMAROPA Region

Figure 2.2.2-43. MIMAROPA Flood Susceptibility Map



Source: MGB-4B

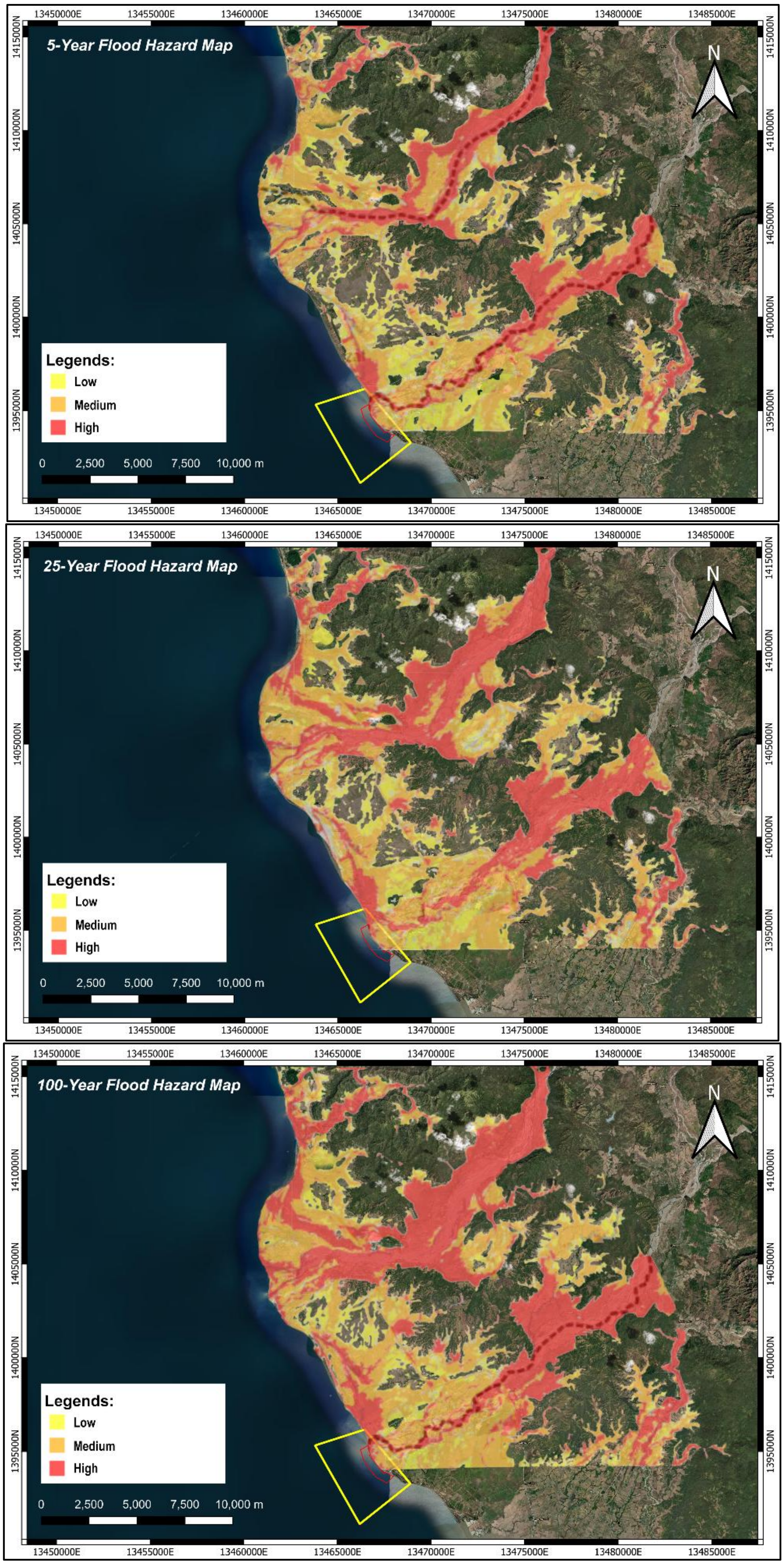
***Figure 2.2.2-44.** Rizal, Occidental Mindoro Susceptibility Map*

Results and Discussion

The series of figures (Figure 2.2.2-45) show the results of predicted water level or the extent of flooding due to different typhoon levels (i.e., storm surges) passing through the project area. The color variations overlaid in the figures represent the extent of the flooding due to the typhoon, while the maximum predicted high-water levels are assumed inputs for these different typhoon-level scenarios.

The water levels predicted during this period fluctuate less than one meter below the mean sea level (low tide levels), with the hypothetical storm now starting to influence the water movement as the eye approaches the project area.

1. *During the Passage of the Storm in the Study Area*



Source: LiDAR Portal for Archiving and Distribution

Figure 2.2.2-45. Study Area Flood Hazard Maps in various Periods – 5, 25, 100-Year

A time series plot of simulated water levels at San Jose Port, the nearest tidal benchmark for the project area is shown Figure 2.2.2-46. The predicted tidal fluctuations in the area were simulated under normal conditions (i.e., without typhoon wind inputs) is shown as a blue line, which was then compared with the hypothetical storm scenario to assess the impact of wind-induced water levels or potential storm surge event in the project area (shown as the red line in the graph).

From this graph, as the eye of the storm passes from the eastern side of the project area and moves westward offshore, the water levels inside the Bay started to pile up as the wind shifted its direction northwards thereby pushing the water frothed open sea against the coastal area of the project. As the eye of the storm makes its landfall in the project area, the water level maintains its increasing height as the waters from the open sea push and pile up toward the area. This sudden rise in water level constitutes the storm surge event. On the opposite side of the sea however, specifically in the coastal areas southwest of the project site, the sudden fall in water level may be expected due to the wind-induced push of water from the coast towards the opposite side of the project area or inwards by the Busuanga River. The reversal of the wind direction after the passage of the eye of the storm would then push the water from the opposite direction and into the other side.

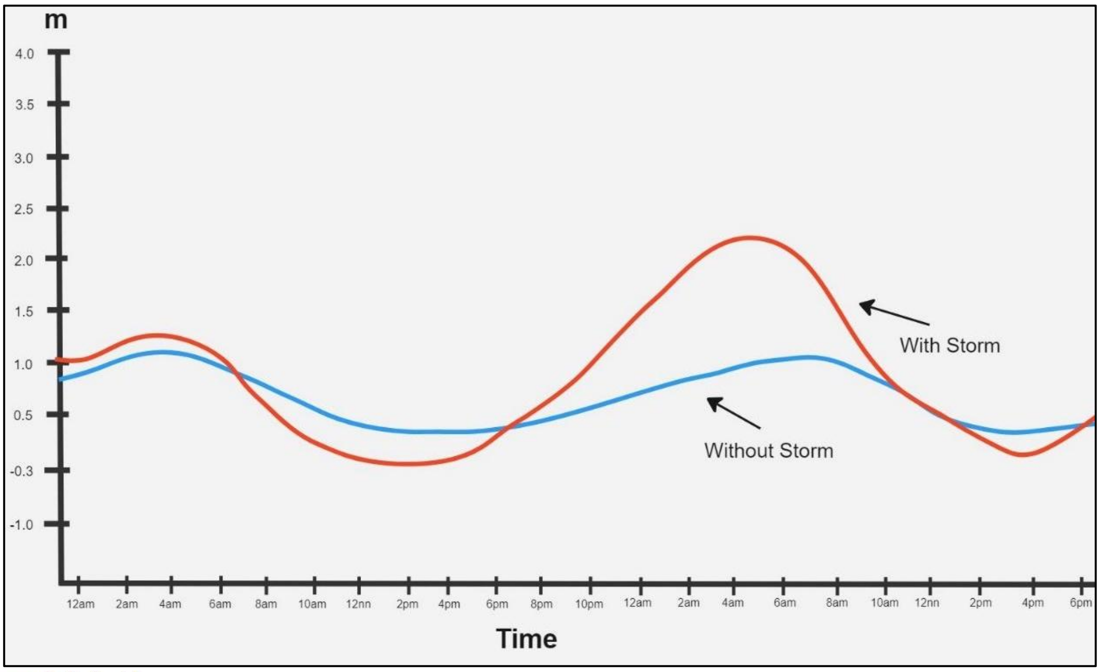


Figure 2.2.2-46. Time Series Predicted Level 4 Storm (Red Line) and the Simulated Tidal Fluctuation Without the Storm (Blue Line)

In summary, the project area is extremely vulnerable to storm surges due to its natural topography, especially when the wind is blowing from the south. The water that would otherwise flow freely to other areas inland due to the natural low topography of the land area, where the wind-induced water movement from the open sea rushes and pushes towards the coastal areas of the project area, causing storm surges. Note that this storm surge phenomenon may occur in the project area, regardless of whether the project is in place or not.

2.2.2.3 Water Quality

Ambient water quality sampling was first conducted on May 16 to 17, 2022 in the Municipalities of Rizal and San Jose, Occidental Mindoro. This was commissioned by the proponent (RC-GPC consortium). On October 10-11, 2023, another round of sampling was conducted in the area to supplement the earlier baselining.

Collection and characterization of water samples and sampling sites were done to establish baseline information and to recommend mitigating measures for the identified potential impacts of the project on the quality of the groundwater, surface freshwater and marine waters in the project area and its surrounding.

Pursuant to RA 9275, also known as the "Philippine Clean Water Act of 2004", the DAO 2016-08 and DAO 2021-19[1], and DOH AO 2017-001[2] were used for characterization of the water bodies that are likely to be affected by the proposed river dredging project.

Methodology
A total of five surface freshwater quality stations were established by the Proponent within Busuanga River on May 16-17, 2022 sampling. Data were gathered by conducting onsite or grab sampling. The river characteristics were derived from the Digital Surface Model obtained from the JAXA Earth Observation Research Center (EORC). The collected samples were submitted by the Proponent to CRL Environmental Corporation (a DENR accredited laboratory) in Clark Freeport Zone (CFZ), Pampanga for pH and Biological Oxygen Demand (BOD) analysis.

An additional ten (10) water quality sampling stations were established during the October 10-11, 2023 sampling: 1 groundwater station, 4 surface freshwater and 5 coastal marine water stations. The groundwater sample was taken in Brgy. Adela - the local community covering the proposed navigation zone (delta) and the estuarine portion of Busuanga River. The surface freshwater stations were collected along the stretch of Busuanga River within the project area, representing its upstream, midstream and downstream portions. The marine water stations shall represent the coastal marine water quality of the navigation zone.

Water quality collection and handling procedures were based on the procedures prescribed in the DENR-EMB's Water Quality Monitoring Manual (Volume I) - Manual on Ambient Water Quality Monitoring issued through Memorandum Circular 2008-08. The analysis method was adopted from Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, American Water Works Association, and the Water Environment Federation.

Grab samples were collected manually from the selected sampling locations using clean containers (Plates 2.2.2-1 to 2.2.2-10), and were chilled using ice packs in a closed container- styro box for submission to Elarsi Inc., a DENR accredited laboratory for analysis.

The pH, temperature and conductivity were measured in-situ employing a portable Milwauukee pH meter and a digital ECC meter, respectively.

The table below presents the details of the sampling stations for all the water quality sampling conducted for this project to date. On the other hand, **Figure 2.2.2-47** illustrates the location of each station.

Table 2.2.2-8. Water Quality Sampling Stations for the Busuanga River Dredging Project

Station ID	Latitude	Longitude	Location	Description	Weather Condition	Season
May 16-17, 2022						
Surface Freshwater						
Sample 1	12°26'04.56"	120°58'25.30"	Brgy. Adela, Rizal	Downstream, estuary		Dry
Sample 2	12°26'07.76"	120°59'31.99"	Brgy. Adela, Rizal	Downstream		Dry

[1] The DENR Administrative Order, DAO 2016-08 "Water Quality Guidelines and General Effluent Standards of 2016" and DAO 2021-19 "Updated Water Quality Guidelines and General Effluent Standards for Selected Parameters" serves as guidelines and standards to protect and preserve the quality of all water bodies in the country: fresh surface water, marine waters and groundwater.

[2] The Department of Health (DOH) Administrative Order 2017-001, "Philippine National Standards for Drinking Water of 2017", has been established to provide standards and procedures for drinking water quality to protect public and consumer health.

Station ID	Latitude	Longitude	Location	Description	Weather Condition	Season
				(upstream of junction)		
Sample 3	12°26'00.51"	120°59'02.25"	Brgy. Adela, Rizal	Downstream		Dry
Sample 4	12°27'31.50"	121°01'34.19"	Brgy. San Pedro, Rizal	Upstream of Sta 9+000		Dry
Sample 5	12°27'52.65"	121°02'11.43"	Busuanga Bridge	Upstream		Dry
Oct 10-11, 2023						
Surface Freshwater						
FW1	12°27'56.95"	121°02'13.27"	Busuanga Bridge	Upstream	Sunny	Wet
FW2	12°26'42.94"	121°00'32.49"	Brgy. Sto. Niño, Rizal	Midstream	Sunny	Wet
FW3	12°26'09.46"	120°58'26.36"	Brgy. Adela, Rizal	Downstream, estuary, main channel	Sunny	Wet
FW4	12°25'18.98"	120°59'01.62"	Brgy. San Agustin, San Jose	Downstream, estuary, branch	Sunny	Wet
Groundwater						
GW1	12°26'21.55"	120°58'25.22"	Brgy. Adela, Rizal	A manual water pump (~ 15 ft depth) used by locals for domestic water (e.g., cooking and washing dishes) during wet season only. Salty during months of April - May.	Sunny	Wet
Marine (Coastal)						
MW1	12°26'33.47"	120°57'48.47"	Nearshore, Mindoro Strait	Proposed Monitoring Station during project implementation. Located near the shores of Brgy Adela	Sunny	Wet
MW2	12°25'56.85"	120°58'17.29"	Nearshore, Mindoro Strait	Within the proposed navigation zone	Sunny	Wet
MW3	12°25'28.33"	120°58'33.04"	Nearshore, Mindoro Strait	Within the proposed navigation zone	Sunny	Wet
MW4	12°25'12.27"	120°58'54.99"	Nearshore, Mindoro Strait	Within the proposed navigation zone	Sunny	Wet
MW5	12°25'00.75"	120°59'00.19"	Nearshore, Mindoro Strait	Proposed Monitoring Station during project implementation. Near the existing fishing ground area	Sunny	Wet

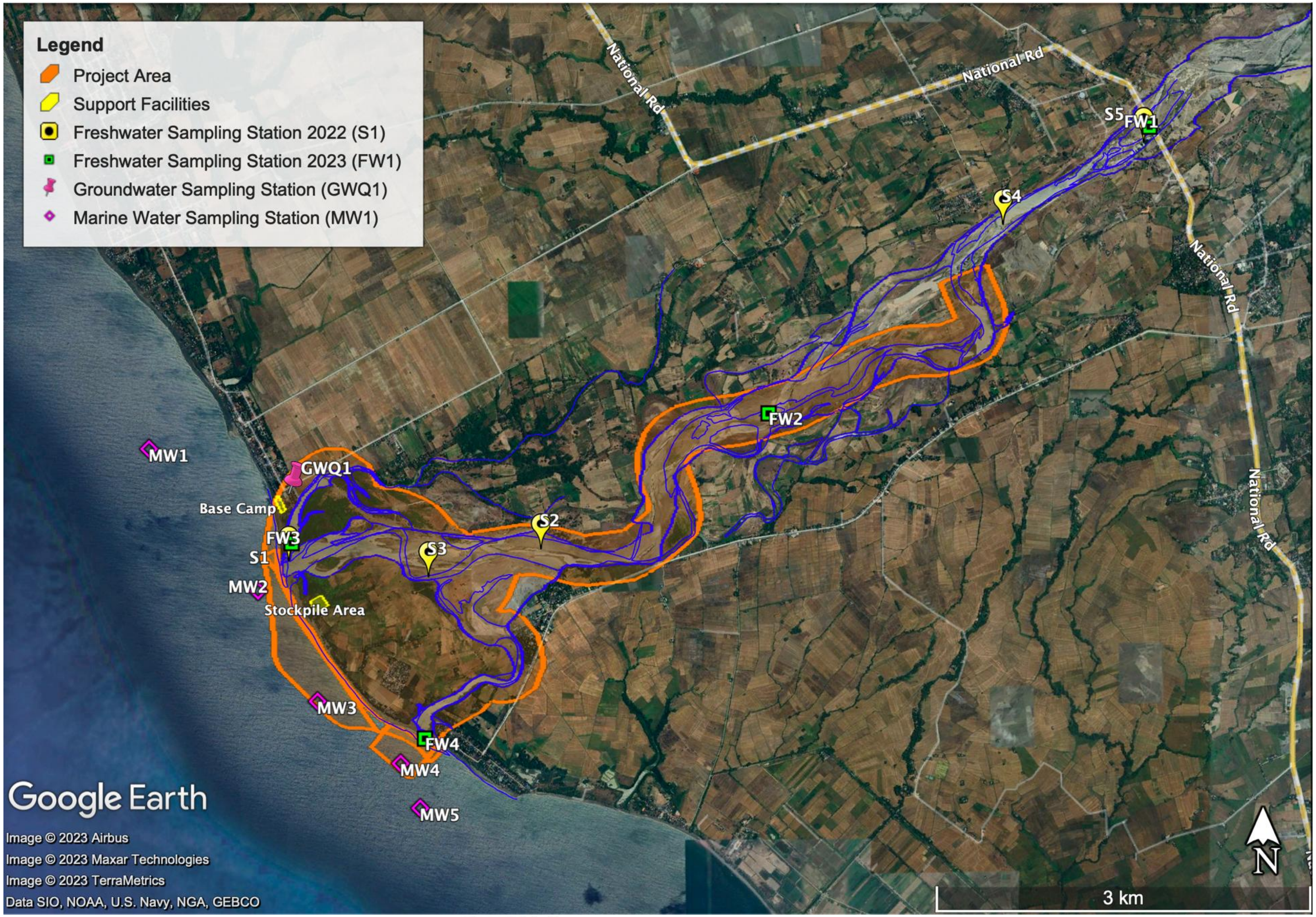


Figure 2.2.2-47. Water Quality Sampling Stations Location Map

Plate 2.2.2-4. Station GW1

Plate 2.2.2-5. Station FW1

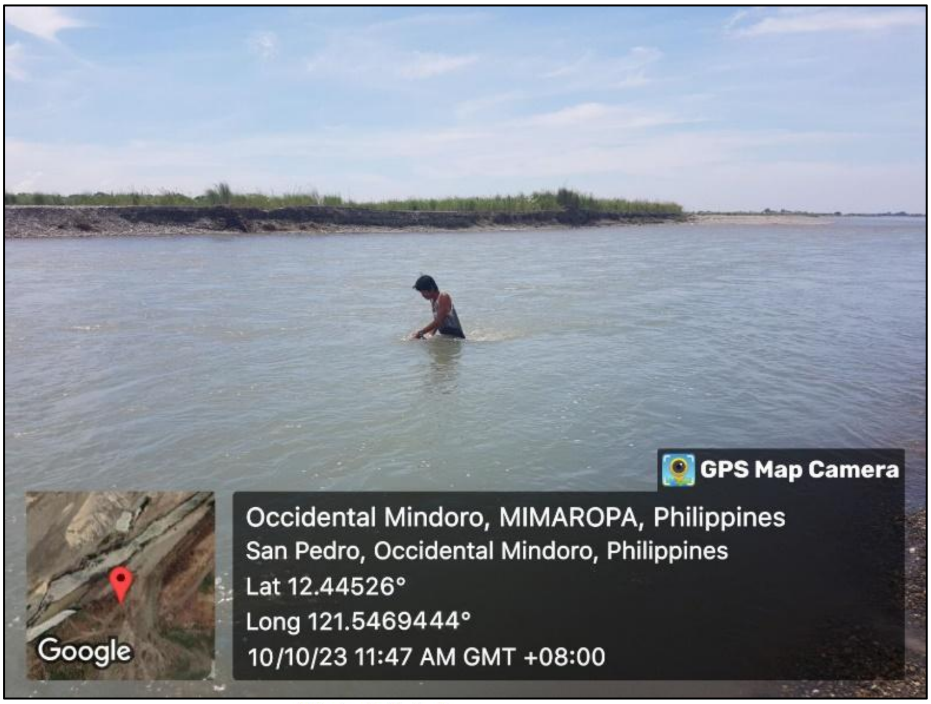


Plate 2.2.2-6. Station FW2

Plate 2.2.2-7. Station FW3

Plate 2.2.2-8. Station FW4

Plate 2.2.2-9. Station MW1

Plate 2.2.2-10. Station MW2

Plate 2.2.2-11. Station MW3

Plate 2.2.2-12. Station MW4

Plate 2.2.2-13. Station MW5

2.2.2.3.1 Degradation of Groundwater Quality

Groundwater Quality Baseline

Table 2.2.2-9 presents the results of laboratory analysis of groundwater sample and compared with the DAO 2016-08 and DAO 2021-19 for Class A[3]. As stated in DAO 2016-08 Section 6.2, Table 7 “Groundwater Quality Guidelines” groundwater sources should adopt Class A WQG (except for BOD and DO) for the source of potable water and other domestic use.

The potability of the sample was characterized using PNSDW 2017.

Table 2.2.2-9. Groundwater Analysis Results (October 2023)

Parameter	Analysis Method	DAO 2016 - 08 Class A	DAO 2021 - 19 Class A*	DOH PNSDW 2017	GW1
pH	In-situ sampling/Portable pH Meter	6.5 – 8.5	--	6.5-8.5	8.4
Temperature, °C	In-situ sampling/ Portable Temperature Meter	26 – 30	--	--	31
Conductivity, uS	In-situ sampling/Portable Conductivity Meter	--	--	--	726
TSS, mg/L	Gravimetric	50	--	--	<4
Fecal coliform, MPN/100mL	Multiple Tube Fermentation	--	50	<1.1	1.3×10^3
Total coliform, MPN/100mL	Multiple Tube Fermentation	--	--	<1.1	1.3×10^3

**Note : DAO 2021-19 Updated Standard for Selected Water Quality Parameters*

<u>pH</u> – The groundwater sample has a pH level within the PNSDW allowable limits.

<u>Temperature</u> – A slight increase in temperature reading was detected in the groundwater sample relative to Class A limit.

The elevated temperature in groundwater can be affected by ground surface temperature, weather condition and time of sample collection. The sample was taken in the morning with a ground temperature of 31.08 °C.

<u>Total Suspended Solids</u> - The TSS value is below the laboratory detection limit.

<u>Coliform</u> - The groundwater sample was tested positive for both fecal and total coliform, with exceedance to PNSDW standard of less than 1.1 MPN/100 ml. With such high levels of coliform, this groundwater resource is unfit for drinking and may be used for domestic purposes only, as is the case.

In groundwater, the elevated coliform contamination may be attributed to decaying matter (i.e., plants), human and animal wastes from the community that was carried through surface runoff and percolate to the groundwater. The presence of households and animals were observed within the sampling point of groundwater.

[3] DAO 2016-08 Section 5 – Table 1: Class A “Public Water Supply Class II – Intended as a source of water supply requiring conventional treatment to meet latest PNSDW

Impact Analysis, Mitigating Measures and Monitoring

Considering that the dredging project will be confined only in the regime of Busuanga River (based on the approved DMP) and its delta (navigation zone), the project impacts on groundwater resources will be insignificant. With respect to project activities, there will be no extraction of aquifer resources in the area.

Based on the actual interviews of the locals and the detected conductivity (720uS) in the groundwater sample during baselining indicate that potential saltwater intrusion is already present in the aquifer.

Still, the proponent should ensure that their heavy equipment and vehicles are well maintained to minimize possible leaks and seepage into the water table. In the event that the proponent should consider groundwater extraction in the future, monitoring of conductivity and salinity should be done to minimize excessive pumping as it will aggravate the saltwater intrusion in the area. Moreover, the depth of the groundwater should be ascertained before dredging operation and a buffer depth should be maintained.

2.2.2.3.2 Degradation of Surface Water Quality

Baseline Surface Freshwater Quality
Busuanga River has been classified by DENR as Class C, therefore, the results of laboratory analysis (**Tables 2.2.2-10** and **2.2.2-11**) were compared with the guideline values prescribed in DAO 2016-08 for Class C[4].

Table 2.2.2-10. Freshwater Quality Analysis Results (May 2022)

Parameter	Analysis Method	DAO 2016-08 Class C	DAO 2021 -19 Class C*	S 1	S 2	S 3	S 4	S 5
pH	Electrometric	6.5 – 9	--	7.6	7.4	7.8	7.9	8
BOD, mg/L	5 - Day BOD test	7	--	1	1	1	<1	1

Table 2.2.2-11. Freshwater Quality Analysis Results (October 2023)

Parameter	Analysis Method	DAO 2016 -08 Class C	DAO 2021 -19 Class C*	FW1	FW2	FW3	FW4
pH	In-situ sampling/Portable pH Meter	6.5 – 9	--	8.9	8.7	8.7	8.7
Temperature, °C	In-situ sampling/ Portable Temperature Meter	25 – 31	--	29.9	30.6	31.4	26.2
Conductivity, uS	In-situ sampling/Portable Conductivity Meter	--	--	290	304	407	396
Oil and Grease, mg/L	Partition - Gravimetric	2	--	<2	<2	<2	<2
TSS, mg/L	Gravimetric	80	--	18	19	56	53
Fecal coliform, MPN/100mL	Multiple Tube Fermentation	--	200	3.5×10^3	5.4×10^3	2.4×10^3	9.2×10^3
Total coliform, MPN/100mL	Multiple Tube Fermentation	--	--	1.7×10^5	5.4×10^4	3.5×10^4	1.6×10^5

**Note : DAO 2021-19 Updated Standard for Selected Water Quality Parameters*
Note: MPN-Most Probable Number

[4] DAO 2016-08 Section 5 – Table 1: Class C "1. Fishery Water for propagation and growth of fish and other aquatic resources
2. Recreational Water Class II – For boating, fishing, or similar activities
3. For agriculture, irrigation, and livestock watering

pH - the pH level of surface freshwater samples are all within the limits for Class C waters although the 2023 sampling yielded values showing that freshwater in the area is slightly basic.

Temperature - temperature readings in all freshwater stations are within the allowable range of Class C waters.

BOD – the BOD concentration of freshwater samples are way below the limit for Class C waters (7mg/L).

Oil and Grease – the concentration of oil and grease for all freshwater samples are less than the limit for Class C waters (2mg/L).

Total Suspended Solids – the levels of TSS are low as compared with the prescribed limit of 80mg/L for Class C waters.

Coliform - Laboratory results show that all surface freshwater stations were tested positive and with exceeding counts of fecal and total coliforms.

The elevated coliform contamination of surface freshwater of Busuanga River are mainly caused by human and animal wastes discharged from the households located near the riverbanks. The presence of populated households with livestock animals were observed especially in the midstream and downstream portions of the river.

Impact Analysis, Mitigating Measures and Monitoring

Siltation will be the major impact of the dredging operations on the quality of the surface water of Busuanga River and the nearby coastal waters. Sediment disturbance in the active dredging zone is unavoidable during operation, which can affect fish production and growth, hence, may affect the livelihood of the local fishers in the area. To prevent this impact, the proponent should confine the activities within the approved area of operation, confined within a small area at a time, and prepare a scheduled implementation during rainy seasons (considering that the surface water flow and silt movement is at maximum).

Installation of containment structures or silt curtains during operation in the active area will also help prevent spread of silt, sediments and other suspended particles along the waterways. The removal of containment enclosures should be made only if the TSS concentrations become consistently less than the DENR allowable limit for Class C standard. Moreover, the suction pipe should be placed as close to the bottom as possible in order to minimize sediment disturbance.

If the proponent will consider stockpiling of the dredge materials, the stockpile should be fenced with drainage canals in the perimeter and properly covered if hauling will not be available for a prolonged period.

Water Quality Parameters on Soil Fertility and Impacts of Dredging in the Farmlands

Based on the article[5] *"A Tool for the Evaluation of Irrigation Water Quality in the Arid and Semi – Arid Regions"*, the relevant water quality parameters for irrigation that will be suitable for soil fertility and production of agricultural crops are the following:

- *pH* – influences soil microorganisms and nutrient condition. The nutrient availability once affected by pH has an impact on crop growth and production;
- *Electric Conductivity* – elevated conductivity levels can be associated to increase water salinity. Once salinity increased, it reduced the crops and plant's growth, water uptake and force to absorb more water. It also affects the soil condition and crop yields;

[5] Researchgate.net/publication/32334

- *Sodium Adsorption Ratio* – is one of the most important parameters to evaluate the characteristics of irrigation water. It is the expression of irrigation water toxicity and soil fertility degradation in terms of sodium ions present;
- *E. Coli;*
- *TSS* – high suspended solids levels can affect the operation in the irrigation systems through clogging issues and production quality due to deposition of sands and solid particles;
- *Bicarbonate (HCO3);*
- *Fe;*
- *Mn; and*
- *H2S*

The proposed dredging operation will have a sufficient buffer zone as indicated in its DMP that the proponent will maintain, hence, siltation in the agricultural lands upstream will not be caused by the dredging itself. Moreover, this will minimize the flooding in the area, which have a huge positive impact on the rice and other crops in the area, albeit not immediately.

2.2.2.3.3 Degradation of Coastal/Marine Water Quality

Baseline Marine Water Quality
Samples of marine water were taken from the identified river delta or navigational lane located along Mindoro Strait in which the applicable marine water in the area is not yet classified. The results of laboratory analysis of marine samples were compared to its current beneficial usage as Class SC[6] standards.

Table 2.2.2-12. Coastal Marine Water Analysis Results

Parameter	Analysis Method	DAO 2016-08 Class SC	DAO 2021 -19 Class SC*	MW1	MW2	MW3	MW4	MW5
pH	In-situ/Portable pH Meter	6.5 – 8.5	--	9.2	9.2	8.9	9.2	9.3
Temperature, °C	In-situ/ Portable Temperature Meter	25 – 31	--	29	29	30.7	29	29
Oil and Grease, mg/L	Partition - Gravimetric	3	--	<2	<2	<2	<2	<2
TSS, mg/L	Gravimetric	80	--	48	54	52	72	82
Fecal coliforms, MPN/100mL	Multiple Tube Fermentation	--	200	2.3×10^2	1.3×10^2	2.3×10^2	23	23
Total coliforms, MPN/100mL	Multiple Tube Fermentation	--	--	1.7×10^5	2.4×10^3	3.3×10^2	2.3×10^2	1.3×10^2

**Note : DAO 2021-19 Updated Standard for Selected Water Quality Parameters*
Note: MPN-Most Probable Number

pH – detected pH levels exceeded the maximum allowable limit range of 6.5 to 8.5 for Class SC waters.

High pH levels or alkaline pH are common for marine waters and caused by naturally-occurring dissolved minerals. Surface runoffs containing agricultural products from the upstream agricultural activities can also increase the marine water pH once it reaches the coastal area.

Temperature - Temperature readings are within the allowable range for Class SC waters.

[6] DAO 2016-08 Section 5 – Table 1: Class SC Class SC 1 Fishery Water Class III – for the 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
3. Marshy and/or mangrove areas declared as fish and wildlife sanctuaries

Oil and Grease – The concentration of oil and grease for all marine samples are way below the maximum allowable limit for Class SC waters.

Total Suspended Solids – Exceedance in TSS level was observed in station MW5. All TSS levels of the remaining marine water stations are within the limit of Class SC waters.

Increase in the TSS levels were brought by the heavily silts deposited in the river and river delta caused by strong river flow from upstream to downstream and river flooding especially during rainy periods. Continuous coastal wave actions and river stream flows can highly affect the movement of sediments in the area. The MW5 station is near the fishing area (outside the proposed project area).

Coliform – Total coliform counts in all marine water stations exceeded the maximum allowable Class SC coliform counts. The fecal coliform counts of marine samples exceeded the Class SC standards except for the samples taken from stations MW4 and MW5, or the stations near the mouth of the river branch (southern side of project area in Brgy. San Agustin, San Jose).

Human and animal wastes discharged from the community towards the river could be carried towards the marine waters leading to increase in coliform counts of the coastal area. Presence of households and livestock were observed in Barangay Adela near the coastline.

Impact Analysis, Mitigating Measures and Monitoring

Increase in sediment loads due to disturbance of existing marine sand will be the main impact of the river delta dredging as this is necessary for the vessels to enter the river itself.

This will also contribute to the turbidity rise within the navigational area and may surpass levels that can harm the marine species. The sediment disturbances and murkiness of water may spread to the coastal areas through currents and flow movements. Increased sediment loading in water can reduce the productivity of aquatic resources mostly fishes, in effect, the livelihood of fishermen and coastal barangays may also suffer.

Potential leaks of the heavy equipment and accidental oil spills from vessels entering the river delta can also damage and affect the coastal marine quality.

The proponent should ensure that the operation will be confined in the project area only with proper monitoring of suspended solids, oil and grease, discharges, and potential leaks in their equipment. Monitoring of TSS concentration should be done regularly in the area where dredging activities occure.

Containment structures or silt curtains should be installed along the perimeter of active dredging area to prevent the spread of silt and other suspended particles. The removal of containment enclosures should be made only if the TSS concentrations become consistently less than the DENR allowable limit for Class SC standard.

Annex 2-F contains the certificates of laboratory analysis for water quality assessment as well as the chain of custody documents..

2.2.2.4 Freshwater Ecology

The Busuanga River system is the major fresh surface water system that traverses the municipalities of Rizal and San Jose in Occidental Mindoro. The Busuanga River's headwaters emanates from the Mount Iglit-Bato mountain range, meanders for about 70 km kilometers across the plains of San Jose before emptying in an estuary in the Mindoro Strait in Brgy. Adela, Rizal. The river flows through low gradient meadows, most of which are barren and without dense households and settlements. The Busuanga River is relatively wide, measuring between 60 to 300 meters in most portions but the river itself is low and narrow; broken up into several flowing waterways in many portions, many of which are constricted by sand bars and sediment accretions all throughout, with the estuary itself broken up into two outfalls separated by sand bars (**Figure 2.2.2-49; Plate 2.2.2-14**).

Plate 2.2.2-14. Portions of Busuanga River with sand quarrying in the upstream section

The widest river width is about 300 meters but only about half is inundated with water while the rest of the riverbanks are accumulated with sand accretions and colonized with grass and shrubs. The widest section is in the estuary which split into two outfalls (**Figure 2.4.48**). River substrate is constantly disturbed and suspended by the strong river current flowing at an east-northwest direction.

The upstream and midstream stations investigated are relatively similar in morphology but only large portions are actually with flowing river water, broken in several waterways. Lengthy sand banks and accretions are pervasive all throughput the length of the river, some of which are being quarried for sand deposits. The survey stations are characterized by low relief riverbanks regularly inundated by high flood water with few trees. Riverbanks in stations 1, 2 and 3 have been invaded by extensive shrubs and grassy vegetation. The depth in the survey stations is not consistent, some portions on the sides are 30 to 60, but the middle portions can be as deep as 130 cm. Small rocks and gravel are found in many sections and some sections, on the other hand, are eroded and embedded by silt in their lower margins (Plate 2). There is a marked absence of riparian natural vegetation. Running river water is usually split into several branches and surface water velocity is strong in the wider channels. Stream pools - areas normally frequented by fish and macro-invertebrates for grazing and nesting, are few and far between. According to the retired MAO of San Jose, upland erosion and pollution from both domestic and agricultural wastes has contributed immensely to the deterioration of river water quality and deforestation in the slopes of Mt. Iglit-Baco where the river’s headwaters emanate has allegedly caused extreme reduction in water discharge. Portions of the river are being tapped for irrigation; many portions with gravel and sand deposits are being quarried.

Plate 2.2.2-15. Freshwater ecology survey stations– estuary (left) and midstream (right).

Similarly, the estuary is constricted by sand banks in the mouth of the river, and sand accretions and deposits have rendered portions of the river shallow such that fishers using cast nets are able to operate even in midstream sections. There are no mangroves and significant vegetation in the estuary banks; only aroma trees were observed and even these trees were not dense. Even in the absence of corals and seagrass meadows, the estuary is a favored fishing ground as many fish species that spend most of part of their life cycles in brackish water environs have been traditionally captured in the estuary.

Figure 2.2.2-48. The Busuanga River and Dredging Site in San Jose and Rizal, Occidental Mindoro

Objectives
Freshwater ecology surveys were conducted generally in three (3) stations along the Busuanga River from 16-17 October 2023 consisting of upstream, midstream and estuary stations in about three kilometers of the river system (**Figure 2.2.2-49**). The objective of the aquatic ecology baseline study is to determine the presence and species distribution of important aquatic biota, macro-invertebrates, define plankton community structure, and determine fisheries resources and practices that can be susceptible to anthropogenic issues arising from river dredging.

The objective of the assessment is to account and describe the presence and species distribution of river life forms that can be potentially disrupted or impaired by project establishment, or be subjected to stresses associated with potential anthropogenic environmental impacts attributable to the Project's implementation. The underpinning goal of the assessment is mainly to document current fish biota in the project's primary impact areas so that these can be comparatively viewed in the future when the project is already operating. By obtaining data and variables of the same types and employing consistent survey protocols, susceptible end points and critical aquatic resources and habitats can be characterized in their current state and identification of potential causes and pathways of stressors can be identified for future monitoring purposes. Ultimately, the baseline profile will serve as the principal tool in crafting appropriate response measures to ensure that such project impacts, if any, are mitigated over the long run and in the most effective manner.

Sampling Methodology

1. Fish Biota

Freshwater and estuary fish species specimen documentation was undertaken through actual fishing and opportunistic observations in river pools, supplemented by actual observation of fishing operation in the estuary station where groups of fishers were encountered during the time of the survey in actual fishing operations. Actual fishing for catch composition was undertaken in three (3) stations shown in Figure 2.2.2-49. On the other hand, fish identification was not viable in deep and fast flowing portions of the river but only in shallow pools where river depth is viable and water is clear. Sizeable information on fish species present in the river was also derived through key informant interviews, principally amongst community members in Barangay Adela. Three (3) stations were investigated for freshwater fish biota with the coordinates listed in Table 2.2.2-13. Basic river attributes were also defined in the same stations. The locations of the stations are shown in Figure 2.2.2-49 (please also see Plate 2.2.2-14)

Table 2.2.2-13. Sampling Stations for Actual Fishing, Fish Biota, Macrobenthos Community Diversity and River Parameters Observations

WP Code	LATITUDE	LONGITUDE	Location and Description	Remarks
RVR/FMAC 01	N 12.454309°	E 121.020600°	Located north of the upper outlet along a sandy/muddy patch 5.5 km from river mouth.	Upstream portion with depth at 1.5m and sand/mud as substrate. Several sand blocks altering the flow of water into streams
RVR/FMAC 02	N 12.444187°	E 121.008534°	Located in midstream section about 4 km from river mouth; with sandy/muddy riverbank.	Midstream portion with depth at 1.7m and sand/mud as substrate. Several sand blocks altering the flow of water into streams
RVR/FMAC 03	N 12.435344°	E 120.980443°	Located in the estuary below the northern outlet along a sandy/muddy patch near the coastline.	Downstream portion with depth at 2.0m and sand/mud as substrate. Several clearing and sand blocks are slowly removed by heavy equipment

Note: All samples were photographed and returned to its source

2. Macro-invertebrates

Investigation of macro-invertebrates present in the river was undertaken through random independent actual gleaning activities of two women engaged for the survey in collection areas around the same stations for fish biota investigations. Benthic macrobenthos were collected through core sampling and hand gathering by the two women gleaners. This was supplemented by opportunistic gathering of epibenthic benthos using a scoop net, trowel and sieve in the vicinity of the same stations as fish biota sampling. Identification of other macro-invertebrates, particularly those with significant economic value for food and trade was supplemented through opportunistic surveys along the riverbanks of the estuary. The coordinates of the principal stations for macrobenthos sampling are listed in Table 2.2.2-13; the location of the benthos stations is presented in Figure 2.2.2-49. Only macro benthos visible to the naked eye were collected and identified. Photographs of women gleaners and macro-invertebrates collected are shown in Plate 2.2.2-16. Photographs of species gathered are also presented in Plate 2.2.2-18.

Plate 2.2.2-16. Survey team and women macro-invertebrate collectors.

Figure 2.2.2-49. Location of Stations Where Actual Fishing, Fish Biota, River Parameters and Macroinvertebrates Observations Were Undertaken

3. Plankton community structure

Plankton community structure was determined from water samples taken in three stations – upstream, midstream and downstream stations; with station coordinates listed in listed **Table 2.2.2-14** and locations shown in **Figure 2.2.2-50**. Composition, abundance and density of phytoplankton communities were determined using standard methodologies particularly the Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics. Plankton community quantitative and qualitative analysis was undertaken through water samples collected at the sampling sites by filtering ten 1 liter samples into a composite sample. Phytoplankton samples were then fixed using Lugol's solution; zooplankton samples were fixed with 10% buffered formalin. Samples were then sent to the CLSU laboratory for counting and identification. Counting and identification of organisms were conducted using a Sedgwick-Rafter plate. For phytoplankton, a compound light microscope was used, while for zooplankton, a dissecting microscope. Phytoplankton were counted and identified to the lowest taxonomic level (genera) possible while zooplankton were identified to major groups using available references. Phytoplankton and zooplankton densities are presented as number of cells or organisms per liter.

Table 2.2.2-14. Survey Stations for Plankton Community Sampling

WP Code	LATITUDE	LONGITUDE	Remarks
PLK1	N 12.454299°	E 121.021453°	Located more than 4 kilometers from river mouth near sand quarrying areas
PLK2	N 12.444187°	E 121.008534°	Located in the midstream section about 3 km from river mouth
PLk3	N 12.444187°	E 121.008534°	Located in the estuary about 1 km from river mouth in sandy-muddy area


Plate 2.2.2-17. Plankton community sampling being undertaken

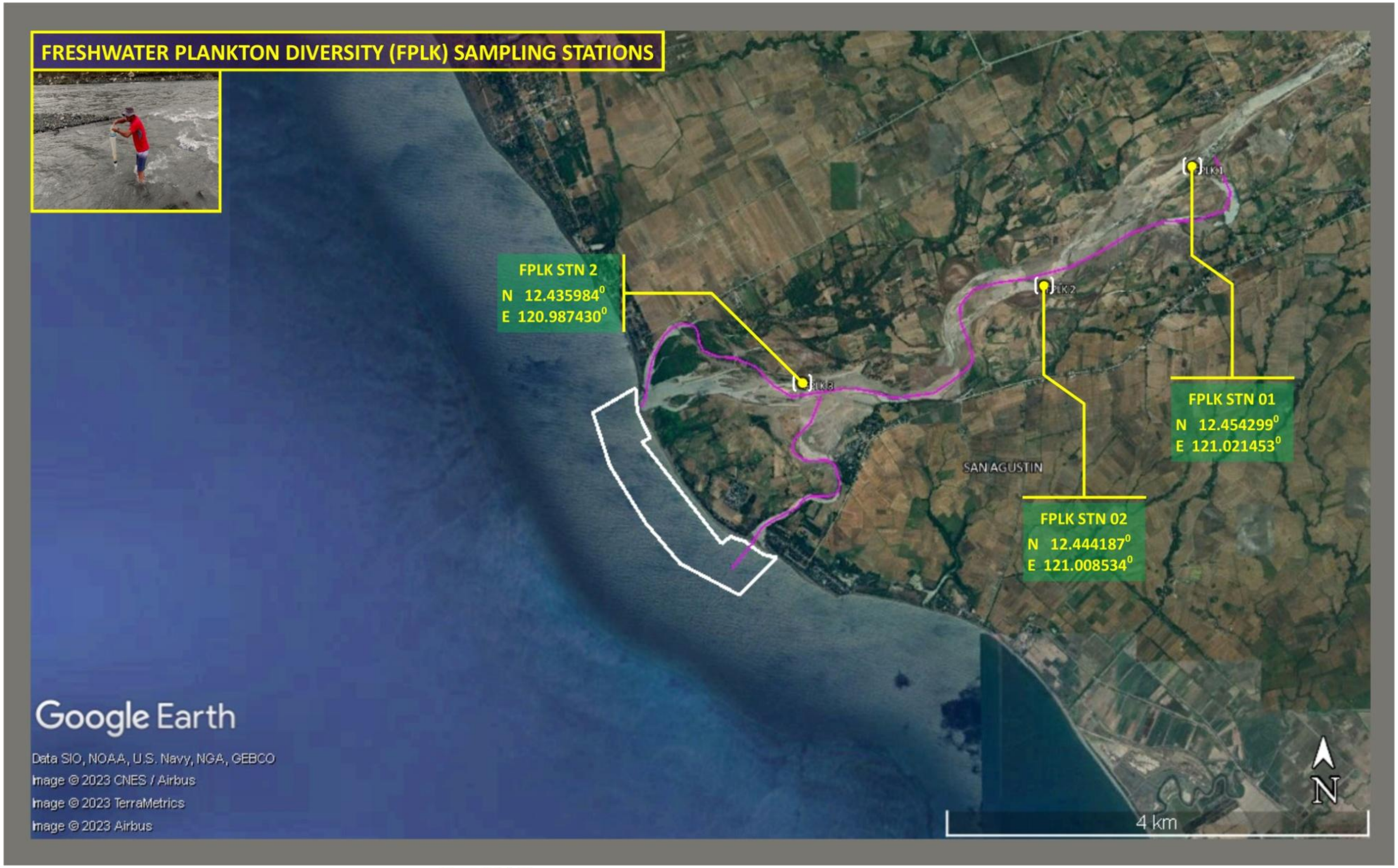


Figure 2.2.2-50. Location of Plankton Community Sampling Stations in Busuanga River

Survey Results and Discussion

1. **Freshwater Aquatic Biota**

Fish biota (by family and species name) observed in Stations 1, 2 and 3 are tabulated in **Table 2.2.2-15** and shown in actual *in-situ* photographs in **Plate 2.2.2-18**.

At the time of the survey, there were no fishing operations observed in river stations 1, 2 and 3 and the San Jose MAO official claim that fishers rarely operate in the upstream river due to poor catch rate and species composition. Most fishers in Brgy. Adela allegedly operate in the river estuary and nearshore marine fishing grounds, employing gill nets, hook and line, fish pots and cast nets. But in spite of the absence of fisheries uses upstream, key informants declare that some fish species still exist in the Busuanga River. Residents of Brgy. Adela confirmed that there are no longer fisheries practices occurring in the upstream stations due to unprofitable catch rates. Nevertheless, the presence of species of fish was detected in three stations, however most consisted of tilapia and gobies upstream, and mullets in the estuary. Residents and key informants of Brgy. Adela further alleged that clandestine *electrofishing* (an illegal method) is being undertaken in the river mainly to catch Tilapia, Dalag (Chanidae) and Hito (Claridae). Except for quarrying there were no other domestic uses (e.g. for clothes washing or bathing) nor fish culture (e.g., fish pens or cages) activities seen in the river at the time of the survey. But in spite of the absence of fisheries practices upstream, tilapia, gobies and small shrimps were observed in the river, and theraponids and mullets in the estuary.

Actual fishing in the river by a fisher engaged in the survey yielded about 1.50 kg of five species – tilapia, goby, theraponid, mullet and glass perchlet in two hours fishing time (**Plate 2.2.2-18**). Four specimens of the greasy-backed shrimp *Metapenaeus ensis* were also caught. The CPUE of the actual fishing operation is 0.75 kg per fishing hour. Few small fish species (mostly Gobidae) were also observed in calm pools and riversides where plant roots are protruding. Small freshwater shrimps (*Nematopaleomon tenuepsis)* were observed in the upstream and midstream stations but no fishers were encountered. Mullets (Mugilidae) were caught in actual fishing in the estuary by a contracted fisher, with only three (3) specimens of about 500 grams total eight were caught in three (3) hours. The giant freshwater prawn *Macrobrachium* sp was not seen but the spotted shrimp *Metapenaeus ensis* (suahe) was seen to be caught by fishers in the estuary. The prawn is omnivorous- feeding on plants, algae, molluscs, worms. The prawns observed in the Busuanga River are all juveniles and adult prawns were not seen. Likewise, there were no fishers encountered upstream that seek to catch the lucrative shrimps exclusively employing nets and pots. The fast-flowing river water in portions of the river has restricted the grazing grounds of the prawns, as well as feeding areas of tilapia and gobies that normally seek calmer river pools. The absence of a sizeable stock of fish in a freshwater system like the Busuanga River is unusual as species of the *Channidae* and *Clariidae* families (native Dalag and Hito) are normally tolerant of spoiled conditions in muddy substrate. Also, due to the absence of riverbank vegetation, it is evident that periphyton are limited. Moreover, quarrying operations has presumably already disturbed many habitats and shelters of fish and shrimps in the river. Compared to fisheries in the estuary and nearshore marine environment, the dearth in fish specimens observed signifies poor fisheries profile in the Busuanga River. It is presumed by the survey team that sediment blanketing of riverbed have significantly inhibited existence of fish species. Moreover, the absence of fish and crustacean species partly supports allegations that electrofishing has caused extensive loss in recruitment of local fish populations.

Nevertheless, the survey observed that the river's estuary is an important habitat and nursery for various species of fish and crustaceans that normally seek brackishwater shelters and feeding grounds. Aggregations of the mangrove snapper (Mangagat; *Lutjanus argentimaculatus*) and small groups of the convex-lined Theraponid (*Therapon jarbua*) were seen in the estuary of the Busuanga River and fishers claim that these species aggregate during episodes of grazing during the rainy season. Key informants also claim that lucrative eels (*Anguila* sp), shrimps (mainly *Nematopaleomon sp*; pasayan) and juveniles of the seabass (apahap, *Lates calcarifer*) are being caught in the river, albeit infrequently. All in all, information from key informants and results of actual fishing documentation indicate that sixteen (16) species of foodfish and three (3) species of crustaceans exists in the Busuanga River, mostly in the estuary and downstream sections. The midstream and upstream sections of the project site are populated mostly of gobies and tilapia. The species profile includes *bangus* fry which are seasonally harvested in the estuary. The fish species, and their respective IUCN ratings, are listed in **Table 2.2.2-15** below. Dominant species observed in the river stations are displayed in **Figure 2.2.2-50**; please also see **Plate 2.2.2-18**.

Table 2.2.2-15. List of Fish Species Caught in the Busuanga River and IUCN Status

English Name	Local Name	Scientific Name	IUCN Status
Snakehead mudfish	Dalag	*Channa striata*	Least concern
Square-tail mullet	Banak	*Ellochelon vaigiensis*	Least concern
Largescale mullet	Banak	*Chelon macrolepis*	Least concern
Philippine eel	Igat/Palos	*Anguilla luzonensis*	Least Concern
Freshwater catfish	Hito	*Ictalurus punctatus*	Least concern
Whipfin silver-biddy	Latab	*Gerres filamentosus*	Data deficient
Spotfin river goby	Biya	*Awaous ocellaris*	Not assessed
Freshwater prawn	Ulang	*Macrobrachium rosenbergii*	Least Concern
Nile tilapia	Tilapia	*Oreochromis niloticus*	Least Concern
Philippine catfish	Pantat	*Clarias batrachus*	Least Concern
Endeavor shrimp	Pasayan/hipon	*Nematopalaemon tenuepsis*	Not assessed
Glass perchlet	Ibis	*Ambassis buruensis*	No data
Spotted shrimp	Suahe/hipon	*Metapenaeus ensis*	Least Concern
Some species observed in the estuary that enters the river system			
Siganid	Samaral	*Siganus spp*	Least concern
Trevally	Talakitok	*Caranx spp*	Least concern
Ponyfishes	Sap-sap	*Leiognathidae*	Least concern
Convex-lined theraponid	Bugaong	*Therapon sp*	Least concern
Brackishwater snapper	Mangagat	*Lutjanus argentimaculatuss*	Not assessed
Square-tail mullet	Banak	*Ellochelon vaigiensis*	Least concern
Largescale mullet	Banak	*Chelon macrolepis*	Least concern

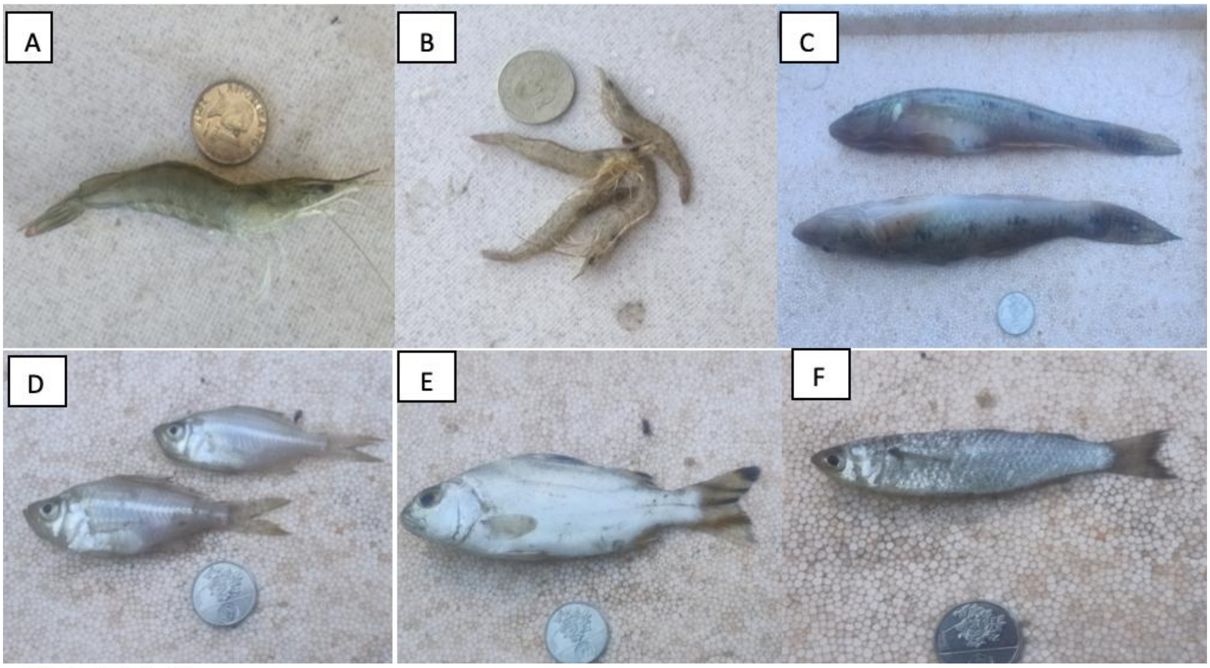


Plate 2.2.2-18. *Some species of fish and crustaceans caught through actual fishing operation: (A) spotted shrimp Metapenaeus ensis; (B) freshwater shrimp Nematopaleomon tenuepsis; (C) spotfin goby Awaous ocellaris; (D) glass perchlet Ambassis buruensis; (E) convex-lined therapon Thera[pon jarbua; (F) flathead mullet Mugil cephalus.*

Compared to the inner reaches of the river, the catch rates for hook and line and gill net operation from actual fishing encounters in the estuary yielded better catch rates and more lucrative species. Documentation of actual fishing of two gill net fishers encountered fishing near the Busuanga River estuary revealed a catch rate of about 4.5 kg of assorted fish and lucrative shrimps (*Nematopaleomon tenuepsis)*. The fishers operate an average of 6 hours per day with three net settings. Finfish included mullets (Mugilidae), small "Talakitok" (*Caranx* sp), and ponyfish (Sap-sap; *Leiognathidae*). Cast nets, operated by fishers from sand bars, yielded a catch composition of only 2 kilograms assorted species in nine (9) hours fishing time, or a meager CPUE of 0.22 kg per fishing hour (key informant interview - **Plate 2.2.2-19**). Catch per unit effort (CPUE) ranged from 0.22 kg/hour for hook and line and about 0.75 to 1 kg/hour for bottom set gill net. On a per day basis, the catch rate for hook and line fishing will translate about 2 to 4 kilograms per day.

Plate 2.2.2-19. Fishers being interviewed on catch composition in river fishing operations

Figure 2.2.2-51. Species caught during actual fishing and fish biota observations in Busuanga River

Figure 2.2.2-52. Species of Macro-invertebrates Observed in Busuanga River

2. Macro-invertebrates

Benthic or bottom dwelling mollusks constitute a major part of the diet of many benthic and bottom dwelling fishes and crustaceans. Many of the gastropods and bivalves in river and estuarine systems are also normally edible invertebrates collected for food and sustenance trade. Benthic and epibenthic macro-invertebrate fauna (or macrobenthos) serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Due to their filter-feeding nature, macro-invertebrates are good indicators of environmental conditions over time and can be used as indicators of water quality and the degradation of the aquatic environment. In river areas, most macro-invertebrates are commonly comprised of gastropods.

Benthic macrobenthos were collected through core sampling and hand gathering by two women gleaners engaged for the survey. This was supplemented by opportunistic gathering of epibenthic benthos using a scoop net and trowel and sieve in the same stations as plankton community sampling. Identification of other macro-invertebrates, particularly those with significant economic value for food and trade was supplemented through opportunistic surveys along the riverbanks of the estuary.

Macro-invertebrates, as indicator of ecosystem health, can be categorized based on their tolerance to pollution conditions (IOWATER, 2012). Group 1 (sensitive) are organisms that cannot survive under polluted conditions thus their presence indicates good water quality. Group 2 (facultative) are organisms that can exist under a wide range of water quality conditions than sensitive organisms can. Group 3 (tolerant) are organisms that are tolerant of pollution, in large amounts; they point to poor water quality conditions but can also be present in good and fair water quality (IOWATER, 2012). In this survey, most of the macro invertebrates fit in Group 1 and 2 categories.

Results of macro-invertebrate gleaning by two women fishers resulted to a hefty catch of almost two basins of shellfish. Nerith shells – ***Nerita costata, Nerita turreta*****,** and ***Neritina undata*** dominated the macro-invertebrates collected (**Plate 2.2.2-20; Figure 2.2.2-51**). Together with neriths, the swamp cerith ***Terebralia sulcata***, the lucrative common geloina ***Polymesoda erosa****,* the rare red racer nerith ***Vittina waigiensis*** (collected for the aquarium trade) and the thiarid ***Stenomelania funiculus*** were also collected***.*** Near the estuary, key informants claim that the freshwater shrimp ***Nematopaleomon tenuepsis****,* the gastropod *Thiaridae* are also present in the upstream river pools and in the river mouth in substrates where freshwater nerith (*Nerita sp*) also exist. Thiarids snails are considered invasive herbivores and bioturbators. In terms of conservation status, it is categorized as “least concern” according to the IUCN red list of threatened species indicating that that no conservation action is needed. Ecologically, neriths and thiarid species are very adaptable and resilient in various environmental conditions with species commonly found in rivers including tidal areas, and lakes, and a wide variety of anthropogenic habitats including pools, and canals. See **Table 2.2.2-16**.

Plate 2.2.2-20. Macro-invertebrates in the Busuanga River: (A) Nerita costata (waved nerith); (B) Terebralia sulcata (swmp cerith); (C) Stenomelania funiculus (Thiarid snail); (D) Vittina waigiensis (red racer nerith); (E) women gleaner showing a basinfull of macro-invertebrates; and (F) the lucrative bivalve Polymesoda erosa on top of nerith shells.

The assessment reveals a diverse and abundant macro-invertebrate community in all stations sampled. The macro-invertebrates collected by women gleaners consisted approximately four (4) kilograms of eight (8) species – six (6) gastropods, one (1) bivalve and one penaeid crustacean. In terms of richness, the highest recorded number of species was found in the downstream station. The list of macro-invertebrates is shown in **Table 2.2.2-16**; with some species shown in **Plate 2.2.2-20** and displayed in **Figure 2.2.2-52** above.

Table 2.2.2-16. Macro-invertebrates Catalogued in the Busuanga River System

Species Name	Common Name	Habitat	Group
Nerita costata	Costate nerith	Muddy estuarine flats	Gastropod
Nerita undata	Waved nerith	Sandy riverbeds	Gastropod
Neritina turreta	Turreted nerith	Sandy riverbeds	Gastropod
Tarebia granifera	Mud creeper	Sandy shelves in estuary	Gastropod

Species Name	Common Name	Habitat	Group
Vittina waigiensis	Red racer cerith	Sandy riverbeds	Gastropod
Stenomelania funiculus	River thiarid	Sandy-muddy riverside	gastropod
Polymesoda erosa	Common geloina	Muddy estuarine flats	Bivalve
Nematopaleomon tenuepsis	Freshwater shrimp	Brackishwater	Crustacean

Based on a simple scoring system of the National Water Council (table below) using abundance of macro-invertebrates as an indicator of water quality in the river, the Busuanga River can be rated as 'Good"

Table 2.2.2-17. BMWP Score Categories Based on National Water Council, 1981

BMWP Score	Category	Interpretation
0-10	Very poor	Heavily polluted
11--40	Poor	Polluted or impacted
41-70	Moderate	Moderately impacted
71-100	Good	Clean but slighty impacted
>100	very Good	Unpolluted/unimpacted

3. Planktons

Plankton are free-drifting organisms typically found in the upper layers of the water column. They are often important components at the lower base of marine and aquatic food webs. However, planktons are not known to proliferate in fast moving lotic environs and the sampling stations chosen were areas of relatively slow current. Changes in ecological conditions in a stream often lead to changes in the community structure of planktons and benthic animals. Epibenthic fauna (macro-invertebrates or macrobenthos), on the other hand, serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Due to their filter-feeding nature, macro-invertebrates are good indicators of environmental conditions over time and can be used as indicators of water quality and the degradation of the aquatic environment. Benthic or bottom dwelling animals constitute a major part of the diet of many benthic and bottom dwelling fishes and crustaceans. Many of the bivalves in riverine and estuarine systems are also edible invertebrates collected for food and sustenance trade.

Plankton community sampling documentation is shown in the plate below.

Plate 2.2.2-21. Plankton sampling and freshwater fisheries station in the upstream and midstream stations in Busuanga River.

Phytoplanktons

A summary of the phytoplankton genera identified in three stations sampled along Busuanga river is tabulated below. Station PLK1 is located in the upstream area of the river while stations PLK2 and PLK3 are located midstream and downstream respectively.

Table 2.2.2-18. Phytoplankton Composition, Abundance (cells/m^3), Diversity and Distribution in Three Sampling Stations in Busuanga River

TAXA	STATION			Grand Total	Rel. Abundance (cells/m^3)
	PLK1 (Upstream)	PLK2 (Midstream)	PLK3 (Downstream)		
Cyanobacteria			298,500	298,500	3.32
Merismopedia			298,500	298,500	3.32
Diatoms	1,286,667	520,000	729,800	2,536,467	28.18
Chaetoceros		20,000	19,900	39,900	0.44
Coconeis	53,333	73,333	13,267	139,933	1.55
Diploneis			19,900	19,900	0.22
Fragillaria	326,667	26,667	331,667	685,000	7.61
Gomphonema	273,333	53,333		326,667	3.63
Melosira	26,667	13,333		40,000	0.44
Navicula	253,333	180,000	33,167	466,500	5.18
Nitzschia	313,333	33,333	26,533	373,200	4.15
Pinnularia	13,333			13,333	0.15
Pleurosigma			6,633	6,633	0.07
Rhabdonema	26,667	73,333	26,533	126,533	1.41
Surirella		40,000	152,567	192,567	2.14
Synedra			26,667	26,667	0.30
Terpsinoe		6,667	72,967	79,633	0.88
Dinoflagellates	1,150,000	1,560,000	3,004,900	5,714,900	63.49
Peridinium	1,150,000	1,560,000	3,004,900	5,714,900	63.49
Euglenoid		6,667	6,633	13,300	0.15
Phacus		6,667	6,633	13,300	0.15
Green Algae	173,333		265,333	438,667	4.87
Closterium			13,267	13,267	0.15
Cosmarium			33,167	33,167	0.37
Scenedesmus	13,333			13,333	0.15
Spirogyra	66,667		132,667	199,333	2.21
Stauroneis	93,333		86,233	179,567	1.99
Grand Total	**2,610,000**	**2,086,667**	**4,305,167**	**9,001,833**	**100**
Richness	**14**	**12**	**17**		
Evenness (J')	**0.72**	**0.43**	**0.44**		
Diversity (H')	**1.78**	**1.07**	**1.28**		

Overall, dinoflagellates dominated the phytoplankton community constituting 64% of the total density. This was followed by diatoms with 28% and other groups (cyanobacteria, euglenoids and green algae) contributing 8% of relative abundance. Results of the analysis showed that phytoplankton density was high yet the diversity was low (<1), due to the high density of the dinoflagellate *Peridinium sp.* Total cell densities varied from 2.1 x 10^6 cells per m^3 in station PLK1 to 4.3 x 10^6 cells per m^3 cells in station

Ph3. In terms of taxa richness, station PLK3 had the highest number of genera with seventeen (17) while station PLK2 only had twelve (12) genera.

Diatoms and dinoflagellates were commonly present in all stations while other groups were only found in some stations. Overall, twenty-two (22) phytoplankton genera were identified. The only genus of dinoflagellate present during the sampling period was *Peridinium* spp. which recorded a total of 5.7 x 10^6 cells per m^3. Blooms of this species are commonly recorded in other countries such as Mexico and Israel but have not been reported to cause major fisheries damage. Among the diatoms, the pennate chain forming taxa *Fragillaria* spp. was the most abundant with a total recorded density of 685,001 cells per m^3 (8% of the total composition). These species are quite common in tropical waters and has a cosmopolitan distribution. These taxa provide significant influences in the overall primary productivity in such aquatic environments. Among the green algae, *Spirogyra* spp. was the most abundant with total cell density of 199,334 cells per m^3 (2% of the total composition). Other phytoplankton taxa with relatively relative abundance were *Navicula* sp. (5%) and *Surirella* sp. (2%) and the rest of the phytoplankton taxa accounted less than 8% of the total abundance. There is no toxic phytoplankton species identified during this sampling.

Diversity Index (H) at the sampling locations showed values as low as 1.07 (site PLK2) to as high 1.78 (site PLK1). The Evenness index was variable with values ranging from 0.43 (PLK2) to 0.72 (PLK1). The low species diversity and evenness was due to the high concentration of *Peridinium* spp. which totally dominated other taxa.

<u>*Zooplanktons*</u>
A summary of zooplankton groups recorded in three stations sampled along Busuanga River is tabulated below. Station PLK1 is located in the upstream area of the river while stations PLK2 and PLK3 are located midstream and downstream respectively.

Table 2.2.2-19. Zooplankton Composition, Abundance, Diversity and Distribution in Three Sampling Stations in Busuanga River

TAXA	STATION			Grand Total	Rel. Abundance *(ind/m³)*
	PLK1 (Upstream)	PLK2 (Midstream)	PLK3 (Downstream)		
Cladocera		933		933	3.51
Copepoda	300	5,133	2,600	8,033	30.22
Copepod calanoid	300		400	700	2.63
Copepod nauplius		5,133	2,200	7,333	27.59
Insecta		3,033	400	3,433	12.92
Chaoboridae		233		233	0.88
Mayfly Larvae		1,867	400	2,267	8.53
Midges Larvae		933		933	3.51
Mollsuks			800	800	3.01
Bivalve veliger			800	800	3.01
Polychaete			400	400	1.50
Polychaete trophocore			400	400	1.50
Protozoan	900			900	3.39
Arcellidae	900			900	3.39
Rotifer	4,050	4,433	3,600	12,083	45.45
Bdelloid rotifera			1,200	1,200	4.51
Lecane sp.	1,950	1,633	2,400	5,983	22.51
Ploesoma sp.	2,100	2,800		4,900	18.43
Grand Total	5,250	13,533	7,800	26,583	100.00

TAXA	STATION			Grand Total	Rel. Abundance *(ind/m³)*
	PLK1 (Upstream)	PLK2 (Midstream)	PLK3 (Downstream)		
Evenness (J')	**0.80**	**0.77**	**0.70**		
Diversity (H')	**1.11**	**1.50**	**1.36**		

Overall, rotifers were the most dominant group accounting 45% of the total zooplankton abundance. This was followed by copepods which contributed 30% and insects with 13%. Furthermore, results of the analysis showed that density, richness and diversity were generally low in all sampling locations. Zooplankton density varied from 7,800 individuals per m^3 at PLK3, to 13,533 individuals per m^3 at PLK3. The most taxa-rich station were observed in stations PLK2 and PLK3 with 7 while the lowest was observed in station PLK1 with 4.

Rotifers were commonly encountered in all stations whereas other groups (insects, mollusks, cladocerans, annelids, protozoans) were only present in one or two stations. Overall, eleven (11) zooplanktons were identified belonging to the aforementioned groups. Among the rotifers, *Lecane* sp. recorded the highest abundance with total density of 5,983 individual per m^3 (28% of the total composition). It was observed at highest density in station PLK3 with 3,200 individuals per m^3. Ecologically, they are beneficial in stabilizing organic wastes, stimulating microfloral activity and decomposition, enhancing oxygen penetration, and recycling mineral nutrients. Among the copepods, copepod nauplii recorded the highest abundance particularly in the downstream area of the river with 7,333 individuals per m^3 (28% of the composition) and followed by calanoid copepod with 700 individuals per m^3 (3% of the composition). Other zooplankton taxa that recorded relatively higher density were protozoans (3 %) and mayfly larvae (9%). There were no fish larvae and decapod zoae recorded in all the station sampled during this survey.

Diversity Index (H) at the sampling locations showed values as low as 1.11 (site PLK1) to as high as 1.50 (site PLK2). The Evenness Index was almost similar in all stations ranging 0.70 to 0.80. These indices indicate relatively balanced zooplankton community in the area.

Photomicrographs of some of the plankton species identified are shown in the plate below.

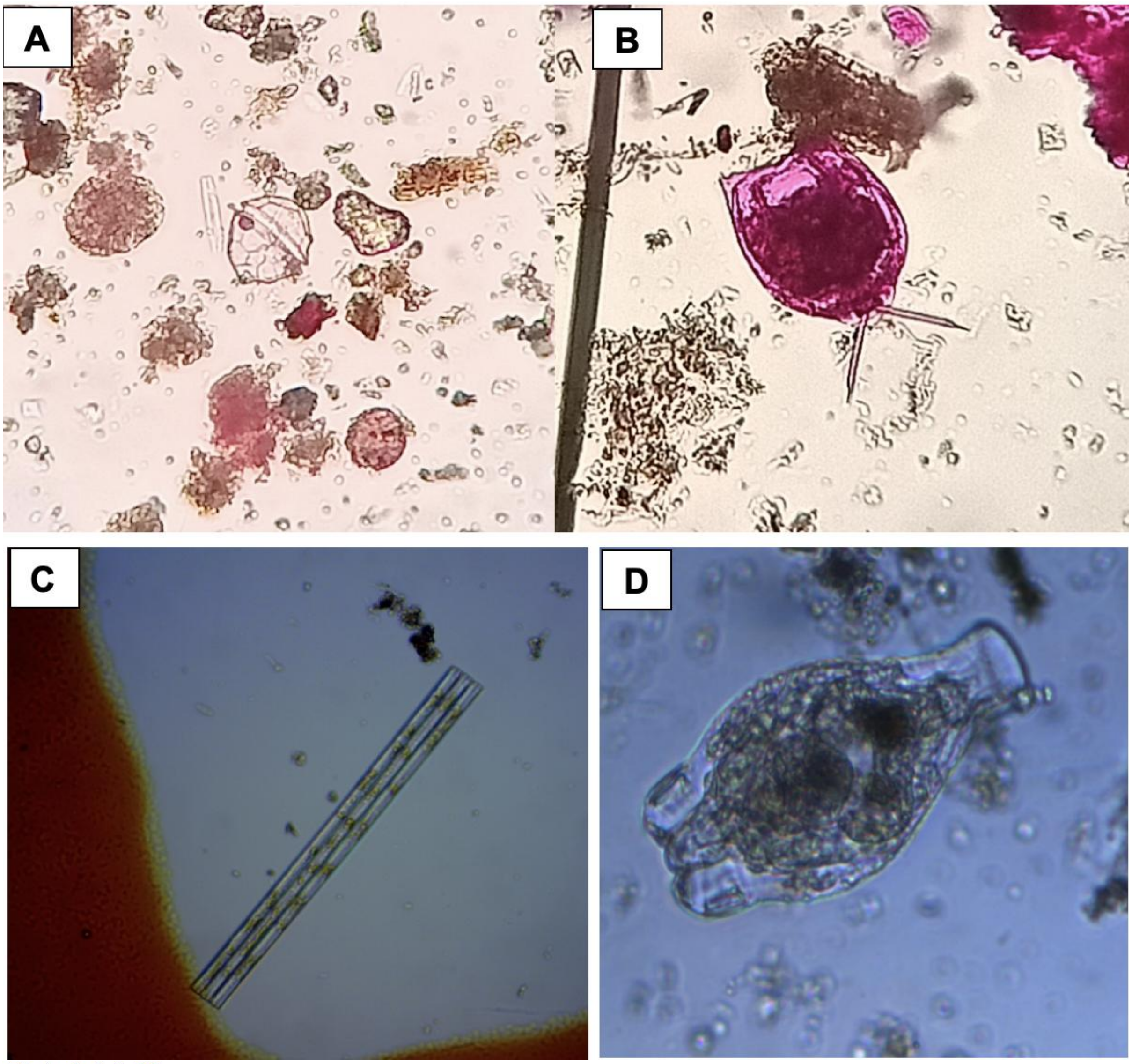


Plate 2.2.2-22. Common planktons identified in Busuanga River: A. Peridinium sp., B. Rotifer Lecane sp., (C) Fragillaria, (D) Bdelloid rotifer

2.2.2.4.1 Threat to Existence and/or Loss of Species of Important Local Species and Habitat and Threat to Abundance, Frequency and Distribution of Species

Summary of Endemicity/Conservation Status

The freshwater prawn and brackish water fishes and macro-invertebrates documented in Busuanga River are of high conservation value, although they are not reported as threatened and endangered. None of the species catalogued are endemic. These species, however, are of important commercial value as fish food, particularly the freshwater prawn in upstream and estuary stations. Mudfishes and catfishes, as well as the lobed river mullet (*Mesopristes cancellatus*) were reported to inhabit Busuanga River many years ago but were not seen during sampling activities and observation of actual test fishing.

Abundance of Ecologically and Economically Important Species (fishes, benthos, planktons)

All of the fish observed to be caught in Busuanga River including those captured by fishers in the estuary are food fishes but most are of juvenile sizes, indicating growth overfishing most probably caused by extensive use of fine mesh nets and alteration of riverbed habitats. In spite of the diversity of fish caught in the estuary, the low species density and abundance of fish and crustaceans is indicative of a deteriorating habitat condition and diminishing standing stocks, evidently brought about by increasing sediment loads and loss of habitats and shelters for fish reproduction and grazing. The low number of plankton species and taxa identified in the plankton surveys are indicative of low diversity and unfavorable environmental conditions.

Presence of Pollution Indicator Species
Freshwater fish and shellfish species have not been used as indicators of pollution, except where biotoxins are involved (e.g. plankton-filtering fish species in PSP-affected areas). Apart from the few bivalves observed, there were no species of fish or shellfish encountered in the sampling stations that can be employed as indicators of pollution. In particular, neriths and ceriths can be susceptible to plankton blooms that can trigger paralytic shellfish poisoning.

Plankton blooms as indicators of hyper-organic nutrient loading, pollution, records show that the occurrence of harmful algal blooms (HABs) in the Philippines has been associated with the onset of the southwest monsoon but there has been very little evidence attributing extensive siltation as a primary and sudden trigger of HABs. In many cases, increased nutrient loading through sediment transport has been observed to be a more likely pathway for occurrence of HABs in coastal areas if the suspended organic matter (OM) causes hyper-nutrient levels and euthrophication. The pollution of coastal waters is believed to stimulate bursts in populations of microscopic and macroscopic algae as various pollution-supplied substances fertilize the water column and bottom substrate and provide the nutrients that trigger algal bloom proportions. Because of this, harmful or toxic algal species become more abundant and more noticeable. Currently, the densities of plankton groups observed in the coastal area within the vicinity of the project site do not indicate proportions that can risk the occurrence of HABs. Nevertheless, constant monitoring of the cell counts of bio-toxin carrying species needs to be undertaken.

The overall impression from results of the phytoplankton survey is that the plankton community in the river ecosystem based on overall diversity, richness and total abundance is relatively low. A threshold of algal blooms, especially harmful algal bloom-causing organisms was not detected as the population of a species of *Nitzchia and Fragilaria* was relatively low. *Fragillaria* is a freshwater diatom that forms an important component of the food chain, especially in the production of primary organic material. Excessive diatom blooms, however, are known to cause euthrophic conditions and the free flowing nature of the river system needs to be sustained in this regard. In conclusion, the present plankton community in the project area signifies normal but poor levels of these organisms in the river. The likelihood of algal blooms is ruled out by the findings in the study, due to the extremely low number of HAB-causing plankton.

Similarly, it is important to note that zooplankton community in three sampling stations was generally low in terms of abundance, richness and diversity and potential threat/impacts would be minimal but the project should adopt measures that will not significantly obstruct the free flow of the river. No fish larvae were seen in three stations surveyed.

Epibenthic fauna (macro invertebrates or macrobenthos), on the other hand, serve a number of ecosystem roles at various levels of the food chain, ranging from consumers of plant material to prey for fish. Macro-invertebrates are good integrators of environmental conditions over time and can be used as indicators of heavy metal pollution, especially sessile, filter-feeding macro-invertebrates. Shellfish species such as oysters and epibenthic bivalves can be utilized for biotoxin analysis, including detection of cyanide in bivalve tissue. However, the low diversity of epibenthic and infaunal benthos in the sampling areas already indicate a stressed riverine environment.

Predicted Impacts of the Project on the Freshwater Ecology

1. *Sediment spills and degradation of freshwater quality in the river system due to quarry and operations.*

It is important that protection of the integrity, enhancement of aquatic species and promotion of improvement and maintenance of water quality in Busuanga River be pursued.

Sand dredging and moving will result to sediment spills into the river system and widespread modification of riverbed, altering fish and crustacean habitats, nesting burrows, blockage of migration pathways of few freshwater shrimps, and fish feeding grounds; all of which will lead to significant decline in fish and crustacean populations and ultimately, loss of incomes of local fishers fishing in the river and estuary. The resulting changes and widening of the river can cause inadvertent changes in the river channel attributes, a process that result in stream bank erosion and river base scouring that will cause massive sediment loading of coarse and fine sediments in the river channel downstream. The estuary will likewise be disturbed with sediment streams enveloping the coastal shelf. Sediments carried down from soil erosion and earth moving due to facilities and operations, and construction-related activities such as land clearing and soil stock piling may end up as runoff to the river systems especially during storm and heavy rains. This may adversely cause water turbidity and stream flow obstruction and affect fish and the remaining few macrobenthos fauna. Sediment erosion in freshwater bodies can cause localized mortality of aquatic larval forms of bivalves and gastropods, as well as impair nesting grounds of fish. Larger sediment grains and loose soil can be retained in deeper portions of the river systems and this can disturb fish breeding and grazing areas for bottom dwelling biota. If erosion and loose soils cannot be effectively controlled, the effect will be progressive siltation in the river systems. Changes in ecological conditions in a stream often lead to changes in the community structure of benthic animals. It is presumed that previous quarry operations and flash floods have carried significant debris that altered the riverbed conditions resulting to a highly degraded macro invertebrate community. This poor condition of the fish and macro invertebrate community is likely related to sedimentation, erosion, and run-off from large upland areas that have been cleared of vegetation. The introduction of disturbances to which river organisms have had no previous exposure can significantly alter the habitat and behavior of river organisms and disrupt grazing and migration pathways leading to failure of recruitment or massive migration of fish species into areas of better water quality and lesser disturbance. Siltation may increase water turbidity, resulting in decreased light penetration and a decrease in photosynthetic function of primary producers such as phytoplankton and benthic algae and this will affect fish fry feeding regimens.

2. *Degradation of Water Quality from Wastewaters*

Increased human presence and settlements in the dredging area during operations can lead to river water pollution, and disrupt fish and crustacean life cycles and larval survival. Poorly-managed waste disposal and dust accumulation can lead to contaminants and infiltration of various waste streams generated during equipment mobilization, as well as domestic wastes generated in all phases of project development and operations. A poorly-managed waste disposal system can lead to solid and liquid wastewater contamination in the river or its tributaries, with waste streams generated during quarrying operations itself, construction and operation of facilities. This may include coliform and surfactants from disposed laundry soap due to the increase in personnel in the plant site. This may further adversely affect water quality in the river system surveyed. Domestic wastewater pollution can lead to hyper-nutrient loading and trigger algal blooms in time of high river water. Moreover, further water quality degradation may affect abundance and survival of zooplankton, macrobenthos and fish.

3. *Discoloration of River and Coastal Waters*

With the presence of suspended mud and sand in river waters during flooding events, the color or river water can drastically change from greenish to rusty brown. Discoloration destroys the aesthetic condition of the river and possibly even in coastal water, and may cause the displacement of both pelagic and demersal species of fish seeking refuge and feeding grounds in the estuary.

4. *Oil and Grease Contamination*

The risk of oil and grease contamination of the river can only occur if disposal of fuel-based wastes from dredging equipment is not undertaken properly and accidental spills near waterways that drain into the river happens. From portions of the river, oily sludge, processing slurry and hazardous wastes can be inadvertently carried to coastal waters if containment, recovery and treatment systems are not efficiently established and maintained. Such fugitive wastes will have far-reaching and irreversible impacts on benthic communities in the estuary, resulting to contamination of grazing areas that may depress fish growth and recruitment, and loss of fish habitats.

5. *Increased Exploitation of River Fish Species*

Increased human presence in the river dredging sites can lead to a commensurate increased demand and consumption of fish. An increase in fishing effort targeting river fish stocks that are already heavily exploited poses risks on standing stock resilience.

Mitigating Measures

To minimize or prevent sediment spills and degradation of the river, the following measures will be adopted:

1. *Sediment and Silt Sequestration*

The primary mitigation strategy to prevent fugitive sediments and disturbed riverbed materials from being carried into the estuary and in the coastal shelf is the establishment of a series of sediment mitigation structures, including catchment and sand/silt - filtering curtains, in strategic points to ensure that loose sand, silt and sediments will not wantonly flow into the estuary but are immediately collected and disposed into stock piles. Where necessary if river streams are flowing rapidly during the rainy season, the measures will include installation of catchment basins where sand-laden waters are diverted and contained for sediment extraction. Loose soil run-off and sediments from water run-off from riverside facilities will be sieved through filters and geotextile materials before water is discharged into project diversion waterways. Such loose soils will be piled up and re-used in reforestation areas in riverbanks. Sand accretions will be mechanically collected in portions where project trucks can be positioned adequately. This will be supported by erosion control measures that will include re-vegetation activities in open areas along the riverbanks. The stabilization of river water where dredging has occurred will be enhanced through improvement of river flow velocity through riverbed compacting and slope stabilization. Construction of sediment controls such as silt fencing or revetments that will prevent riverside scouring and to collect soil particles in loose river bends and in sluggishly flowing portions will be instituted where required.

2. *Restocking of Aquatic Fauna*

Fish and crustacean species in the dredging site should be collected (live) before project operation and re-stocked in undisturbed portions. Restocking of tilapia and the freshwater giant prawn can be adopted to enhance fish biota replenishment. Regular in-situ monitoring of river water quality and the state of habitats and diversity of aquatic fauna will be conducted.

3. *Construction stockpiles shall be covered and rigidly bundled away from areas where spillage onto the river systems can occur*

Sand stockpiles will be located away from the riverbanks and stabilized to prevent spillage. Construction stockpiles shall be covered and rigidly bundled.

4. *Containment of Slurry from Equipment and Stockpiles*

Heavy equipment areas will be located away from waterways where erosion control measures can be easily applied. As a precautionary approach, slurry walls will be built around areas where such slurries can emanate extensively.

5. *Avoiding Abstraction of River Water; Blocking and Congestion of Stream Flow*

There will be no abstraction of river water from the river and no materials will emanate from the project that can cause river blocking upstream. In upstream river sections past the project site, no freshwater fishes, habitats and migration pathways of fish and crustaceans will be affected.

6. *Control and Treatment of Liquid Wastewater*

Modern wastewater treatment facilities and a solid waste management plan will be implemented and strictly enforced as mitigation to potential waste disturbances. This will include the setting up of a system of regular septage collection in premises where project offices, personnel quarters and mess halls are to be located, and its proper disposal. State-of-the art modern sanitation facilities with 3-chambered septic tanks will be installed in all project latrines.

7. *Prevention of Oil and Grease Spills*

An oil and grease containment and oily waste containment and recovery plan will be formulated and enforced in all aspects of project operations. Remediation will include recovery and treatment of sludge. Carpools will be located farthest from river systems and all vehicle oil discards will be recovered and discarded in inland waste management systems.

2.2.2.5 Marine Ecology

Scope of Marine Ecology Baseline Assessment

The coastal waters fronting the proposed Busuanga River (Bugsanga River in Philippine Atlas map) Dredging Project is located in the general area within coordinates N 12.45066°/E 121.01681° and N 12.45066°/E 121.01681°. The headwaters of the Busuanga River are fed by the mountains of Mt. Iglit-Baco National Park in central Mindoro, meanders some 70 km in 5 barangays of Rizal and San Jose, and flows out in its estuary in the coastal waters of Brgy. Adela of Rizal and Brgy. San Agustin of San Jose. The marine waters in this area are part of the Mindoro Strait. The Sudlon MPA in Brgy Rumbang, Rizal lies 2.5 km northwest of the Busuanga River estuary.

The coastal shelf in front of the proposed dredging project is characterized by a narrow shelf and the seabed is typical of a steep sloping sandy-muddy shelf, with deep cuts followed by deep drop-offs in 30 meters of water about 1.5 km from the estuary. The estuary itself pours from two river mouths about 1 kilometer apart. There are no dense households in the sandy flats of the river mouth. The general coastal area of the project site is comprised of sandy deposits with aroma trees but no mangrove forests on both flanks of the estuary. Strong monsoon currents normally sweep the area from the southwest; and this brings moderately strong flushing events. The Busuanga River east of the marine project zone unloads huge amounts of sediments and silt into the coastal waters, carried ultimately to the shelf ledge by wind-driven currents.

Plate 2.2.2-23. The project site coastal waters and seaside area with aroma trees.

This section presents the results of marine ecology baseline assessment in the coastal impact area of the dredging project where a navigation zone is proposed. The coastal environment and fisheries assessments were conducted by a team of fisheries specialists and marine biologists in the coastal impact area and contiguous environs of the navigation zone project site on 16 -17 October 2023. The objective of the assessment is to generate an environmental profile and baseline data set of the coastal impact area, focusing on primary benthic habitats, its associated fisheries resources, resource use practices and ecological functions that can be potentially disrupted or impaired by river dredging or be subjected to stresses associated with potential anthropogenic environmental impacts attributable to the navigational zone establishment and operation.

The characterization of susceptible end points and critical benthic habitats in the Busuanga River's coastal area and identification of the causes and pathways that carry stressors will provide valuable data from where long term environmental management measures can be drawn. In spite of indications from nautical maps that notable coastal habitats like coral reefs, and therefore associated life forms, are not existing in the primary impact area, the conduct of the survey for typically susceptible coastal resources such as coral reefs, seagrass beds and associated demersal fish species was nevertheless undertaken extensively in order to ensure a significantly accurate characterization of the coastal area in front of the project. In the absence of coral reefs, the scope of the baseline assessment includes the following:

- Verification and, if present in significant quantity, determination of distribution and composition and coral cover and associated benthic life forms supported by analysis of present conditions of the coral reefs and the factors that lead to coral mortality if such are present in the impact area;
- Validation of the nature of the seabed fronting the proposed dredging project;
- Identification of commercially-important macro invertebrates in the inter-tidal areas of the proposed project;
- Rapid assessment of species composition, estimation of catch rates and catch per unit effort (CPUE) of fishing gears employed in the area primary and target species of fish through *in-situ* observation of actual fishing operations, documentation of catch landings and key informant interviews.

The figure bellow shows observed features in the study area.

Figure 2.2.2-53. Project Site and Survey Area Features

Ultimately, the baseline profile will serve as the principal tool in determining possible environmental impacts of the project in the nearshore marine environment and subsequently, in crafting appropriate response measures to ensure that such impacts are mitigated over the long term and in the most effective manner. By obtaining data and variables of the same types and employing consistent survey protocols in future monitoring events, the present condition of the coastal environment in the impact area can be compared to future monitoring data to discern changes.

The survey methods employed follow standard coastal resource survey techniques prescribed by English *et. al.* (1997) and modified in accordance with *in-situ* conditions employing prescriptions on rapid coastal assessment processes developed in the Coastal Resource Management Project (CRMP) and the Fisheries Improved for Sustainable Harvest (FISH) Project. Survey results give a snapshot of the current condition of the coastal environment and the marine biological resources present in the area at the time of sampling and cannot represent an irreversible situation. The data sets generated does not signify or denote that the resources and seabed under study are directly susceptible to potential negative impacts arising from the proposed project but only suggests the possibility of negative outcomes if stressor pathways and issues remain unaddressed. Given the open access nature of Philippine coastal environments, it is evident that the issues currently affecting coastal resources are already diverse and extensive and this is apparent in the proposed project site. The accumulation of more issues may exacerbate the current condition of the coastal environment in a short time after the study which may affect the data sets originally presented.

A total of ten (10) manta tow stations, five (5) underwater spot dives using scuba, three (3) plankton community sampling stations, three (3) actual fishing documentation, and three (3) macro invertebrate observation sites were undertaken in the baseline study. This was supplemented by extensive systematic snorkeling in various areas aimed to find patches of corals where they can viably exist.

Survey Methodology

The assessment methodology includes:

1. *Manta Tow Survey Method for Benthic Profiling*

Manta tow surveys were conducted in continuous stations in order to determine the presence of benthic life forms and validate the general substrate condition over a broad area of the seabed in the impact area. Manta tow is a useful method in generating a general profile of benthic resources as it permits observation of the condition, distribution and abundance of coral reefs, demersal fish species and other significant biotic and abiotic facets of the seabed at specific intervals over a long stretch of coastal area. If they occur, estimates of percentage distribution of coral reefs and associated benthos observed within the tow stations are recorded in accordance with standard categories to document distribution of coral life forms where they occur and the collective picture generated can show a fairly accurate description of the state of the coastal area under study. A total of fifteen (15) continuous manta tows were undertaken in front of the proposed river dredging project site, covering a total linear distance of 3.08 km (**Figure 2.2.2-54; Table 2.2.2-20; Plate 2.2.2-24**).

Table 2.2.2-20. Manta Tow Track Lengths and Total Tow Distance Surveyed

Track Segment ID	LATITUDE	LONGITUDE	Approx Distance (m)	Track Segment ID	LATITUDE	LONGITUDE	Approx Distance (m)
S00	12.417022°	120.989825°	231	T07-T08	12.427679°	120.975380°	231
S00-T01	12.418008°	120.987932°	216	T08-T09	12.429774°	120.974118°	216
T01-T02	12.418993°	120.986229°	244	T09-T10	12.431560°	120.972415°	269
T02-T03	12.420102°	120.984274°	238	T10-T11	12.433716°	120.971153°	271
T03-T04	12.421273°	120.982445°	271	T11-T12	12.435749°	120.970585°	276
T04-T05	12.422628°	120.980363°	256	T12-T13	12.438275°	120.970333°	233
T05-T06	12.424106°	120.978534°	251	T13-T14	12.440493°	120.970143°	281
T06-T07	12.425770°°	120.976957°	274	T14-T15	12.442711°	120.969450°	245
Accumulated Distance Covered = 3.08 km (15 tows)							

Plate 2.2.2-24. Manta tow survey and spot dives being undertaken in the coastal impact area of the proposed Busuanga River Dredging Project

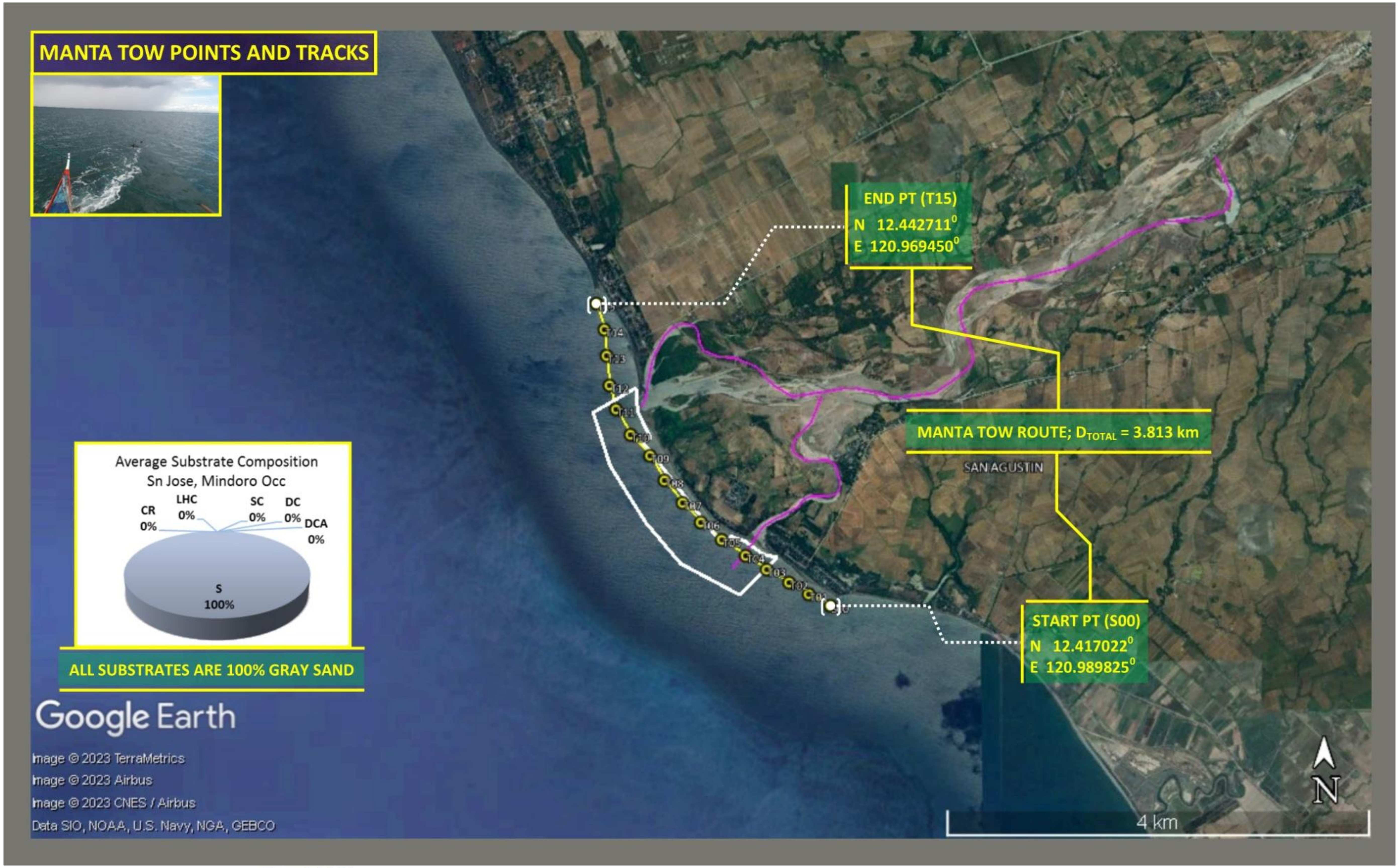


Figure 2.2.2-54. *Manta Tow Pathways for Broad Area Benthic Profiling in the Coastal Impact area of the Proposed Busuanga River Dredging Project*

2. *Spot Dives*

In the Busuanga River Dredging Project baseline assessment, the complete absence of live coral cover in the sandy shelf in front of the project site and even in offshore sandy shoals rendered the conduct of coral line intercept (LIT) surveys impractical. In lieu of the LIT method, a total of six (6) spot dives to validate the absence of corals and determine the nature of the seabed on both flanks of the navigational zone site. The coordinates of the spot dive stations are listed in the table below while locations are shown in **Figure 2.2.2-55.** Also please see **Plate 2.2.2-25** above.

Table 2.2.2-21. Coordinates of Spot Dive Stations in the Coastal Impact area of the Proposed Busuanga River Dredging Project

WP Code	LATITUDE	LONGITUDE	Location/Depth (m)
SPD 01	N 12.440461°	E 120.953797°	Outside of proposed navigation zone, west of the north outlet of Busuanga River about 3 km Northwest of river mouth; very deep water more than 100m
SPD 02	N 12.432263°	E 120.960493°	Located southwest of the upper outlet and west of the lower outlet of Busuanga River Inside of proposed navigation zone, about 1.5 km Northwest of river mouth; deep water of 100m+
SPD 03	N 12.417165°	E 120.958101°	Located southwest of the upper outlet and west of the lower outlet of Busuanga River outside of the navigation zone, about 2.2 km Northwest of river mouth; deep water of 100m+
SPD 04	N 12.413622°	E 120.972375°	Located southwest of the lower outlet of Busuanga River within the navigational zone; Outside of proposed navigation zone, about 3 km Northwest of river mouth depth of 80.0 meters
SPD 05	N 12.408114°	E 120.983178°	Located south of the lower outlet of Busuanga River outside the navigational zone; depth of 75.0 meters outside of proposed navigational zone, about 3 km Northwest of river mouth.
SPD 06	N 12.422154°	E 120.982221°	Located west of the lower outlet of Busuanga River within the navigational zone The survey conducted was shallow along a 10 meters radius at a depth of 3.9 meters

3. *Assessment of Demersal Fish Communities Employing Fish Visual Census (FVC)*

In the absence of coral line intercept surveys, fish visual census in transect lines were no longer undertaken. Fisheries productivity and catch composition in nearshore fisheries was investigated through documentation of actual fishing operations encountered during the survey. The fisheries survey is discussed below.

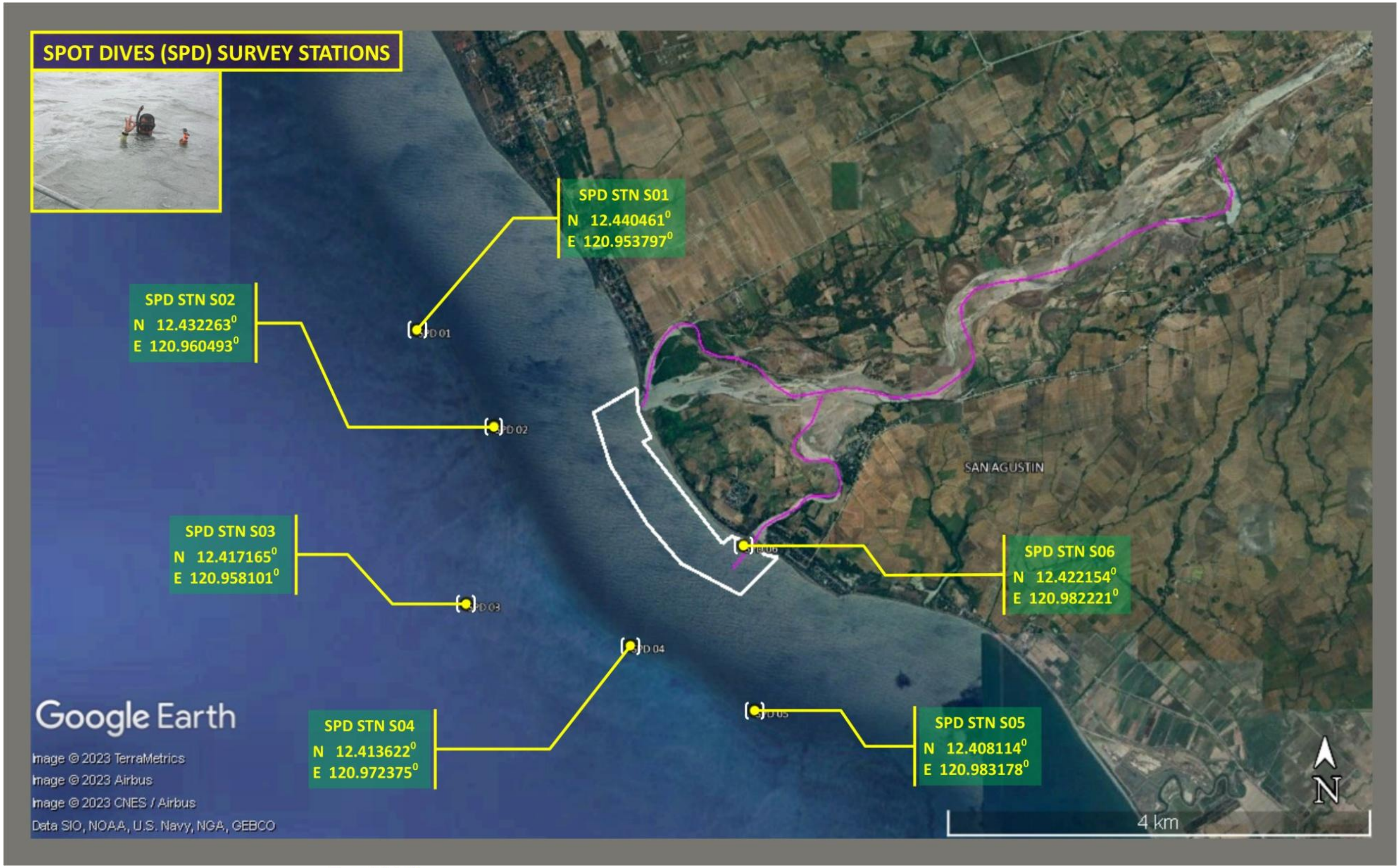


Figure 2.2.2-55. Location of Spot Dive Stations in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

4. Rapid Fisheries Appraisals

The primary issues that beset sustainable management of the coastal resources of Rizal and San Jose include overfishing, prevalence of illegal fishing practices, pollution from domestic wastes, and encroachment of migrant fishers ("dayo") in communal fishing grounds. In the last decade, siltation in coastal waters has been the cause for significant alteration of the coastal shelf. Local fishers target tunas and large pelagics in both nearshore and offshore fishing. At the time of the survey, it was the season for moonfish (*Mene maculata*) and hairtails (*Trichiurus lepturus*). The rapid appraisal consisted mainly of key informant interviews to determine (i) fishing gears used, (ii) catch composition, and (iii) catch rates. Actual fishing operations of three (4) local fishing boats were documented in order to obtain fresh data on species catch composition and catch per unit effort (CPUE). The coordinates of actual fishing stations observed are listed in **Table 2.2.2-22**; locations are shown in **Figure 2.2.2-56** (please see **Plate 2.2.2-25**). In addition, six (6) fishers aboard three fishing boats were also interviewed for additional fisheries data.

Plate 2.2.2-25. Actual fishing operations being documented in coastal waters in front of the Proposed Busuanga River Dredging Project to determine real time CPUE.

Table 2.2.2-22. Coordinates of Actual Fishing Operations Documented in-situ During Marine Ecology Baseline Assessment

WP Code	LATITUDE	LONGITUDE	Remarks
AFO 01	N 12.418159°	E 120.974209°	Encountered 1 fisher utilizing multiple hook & line fishing gear with a catch of approximately 0.75 kg of Moonfish in 4 hours; CPUE = 0.19 kilogram per fishing hour.
AFO 02	N 12.419281°	E 120.976885°	Encountered 2 fishers; offshore fishing with troll lines to capture large pelagic species including marlin with a catch of approximately 1.2 kg of assorted fish species plus Moonfish in 4 hours; CPUE = 0.3 kg/ fishing hour.
AFO 03	N 12.416604°	E 120.977559°	Encountered 1 fisher utilizing multiple hook & line fishing gear operating near shore abut 3km from estuary using gill net with hairtail as target species; a catch of approximately 3 kg of assorted fish species plus Indian Mackerel in 4 hours; CPUE = 0.75 kg/ fishing hour.

5. Assessment of Seagrass

The survey plan called for the assessment of seagrass beds and associated macrobenthic algae using the Saito-Atobe transect-quadrat method *(English et. al., 1994)*. However, manta tow surveys did not reveal any seagrass community in the survey site and therefore, the establishment of seagrass survey stations was deemed no longer necessary.

6. Mangroves

No mangrove trees as well as mangrove associates occur in the stretch of coastline approximately one kilometer left and right of the project site's estuary. Other beach vegetation consisting of aroma trees was observed.

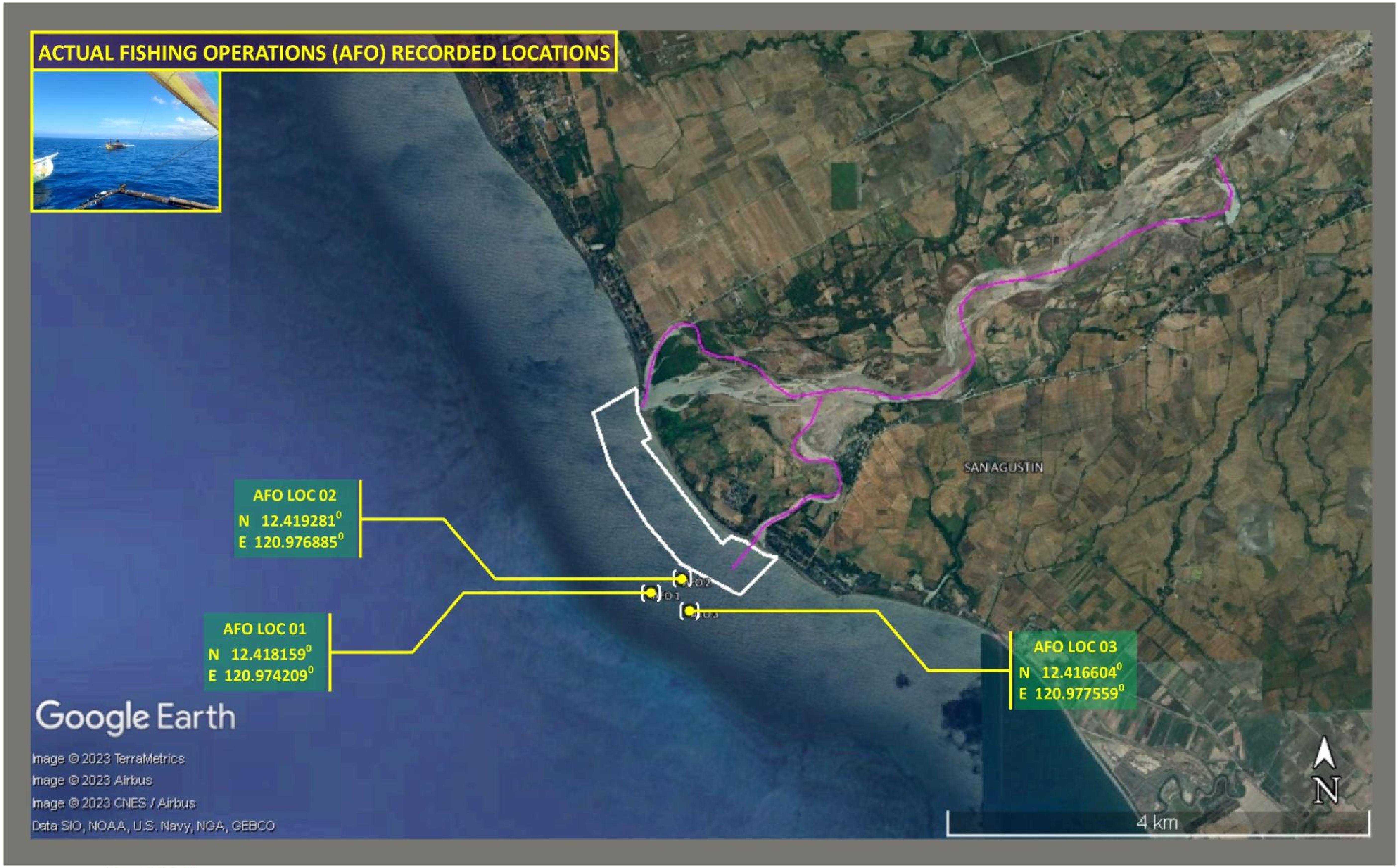


Figure 2.2.2-56. Location of Actual Fishing Operations Documented In-situ During the Marine Ecology Baseline Assessment in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

7. Plankton Communities

Species composition, abundance and density of phytoplankton and zooplankton communities were determined using plankton net vertically lowered and towed from sub-surface depths. Shannon-Weaver Diversity/Evenness Indices and bio-assessment metrics are then derived from the results of the sampling. Identification of phytoplankton species that can enrich to become harmful algal blooms which may potentially cause paralytic shellfish poisoning (PSP) was also undertaken as algal blooms normally indicate hyper-nutrient levels in the sea sometimes triggered by problems of anthropogenic origin. Sampling stations were strategically chosen so that the stations are focused in the vicinity of the Busuanga River Dredging Project site. Three (3) plankton sampling stations were employed during the survey (**Figure 2.2.2-57** and **Table 2.2.2-23**; please also see Plate below).

Table 2.2.2-23. Coordinates of Plankton Community Sampling Stations in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

WP Code	LATITUDE	LONGITUDE	REMARKS
MPLK1	N 12.440461°	E 120.953797°	Outside the proposed navigation zone about 2 km NW of Bgy Adela proper; depth at 80 m
MPLK2	N 12.417267°	E 120.958131°	Outside the proposed navigation zone about 1.6 km west of the estuary shoreline; depth at 90 m
MPLK3	N 12.413699°	E 120.972187°	Outside the proposed navigation zone about 2 km west of the estuary shoreline, depth 30m

Plate 2.2.2-26. Plankton community sampling (left) and a female fisher being interviewed on macro-invertebrates collected (left)

8. Macro-Invertebrates Survey in Intertidal Flats

A survey for the presence of macro-invertebrates was conducted in random stations in the intertidal flats in front and beside the Busuanga River estuary. A local female fisher was engaged to do specimen collection. However, due to the intense sand deposition from the river, only a few bivalves and gastropods were seen to inhabit the tidal flats. The alteration of the inter-tidal seabed has led to loss of food source for the macro-invertebrate community and it is presumed that the macro-invertebrates have migrated to other areas. No gleaning for shellfish was observed during ebb tides and key informants claim that the absence of a viable community of macro-invertebrates has caused shellfish gleaning to cease in the last few years. Macro-invertebrate inspection was undertaken in three general locations in the estuary coastline shown in **Figure 2.2.2-58**.

9. Information gathering on occurrence of Megafauna

Key Informant Interviews (KII) for marine megafauna occurrence can generate important information on potential impacts of the project on unique marine fauna. For the baseline survey, the information gathering focused only on commonly encountered megafauna – marine turtles and dolphins. Key respondents were requested to divulge personal observations of the presence of any of the five marine turtle species known to be present in the Philippines, i.e., the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*) and leatherback turtle (*Dermochelys coriacea*). The key respondents claimed that there have been no sightings of these marine animals in the stretch of sandy beach in front of the Busuanga River in the last five years.

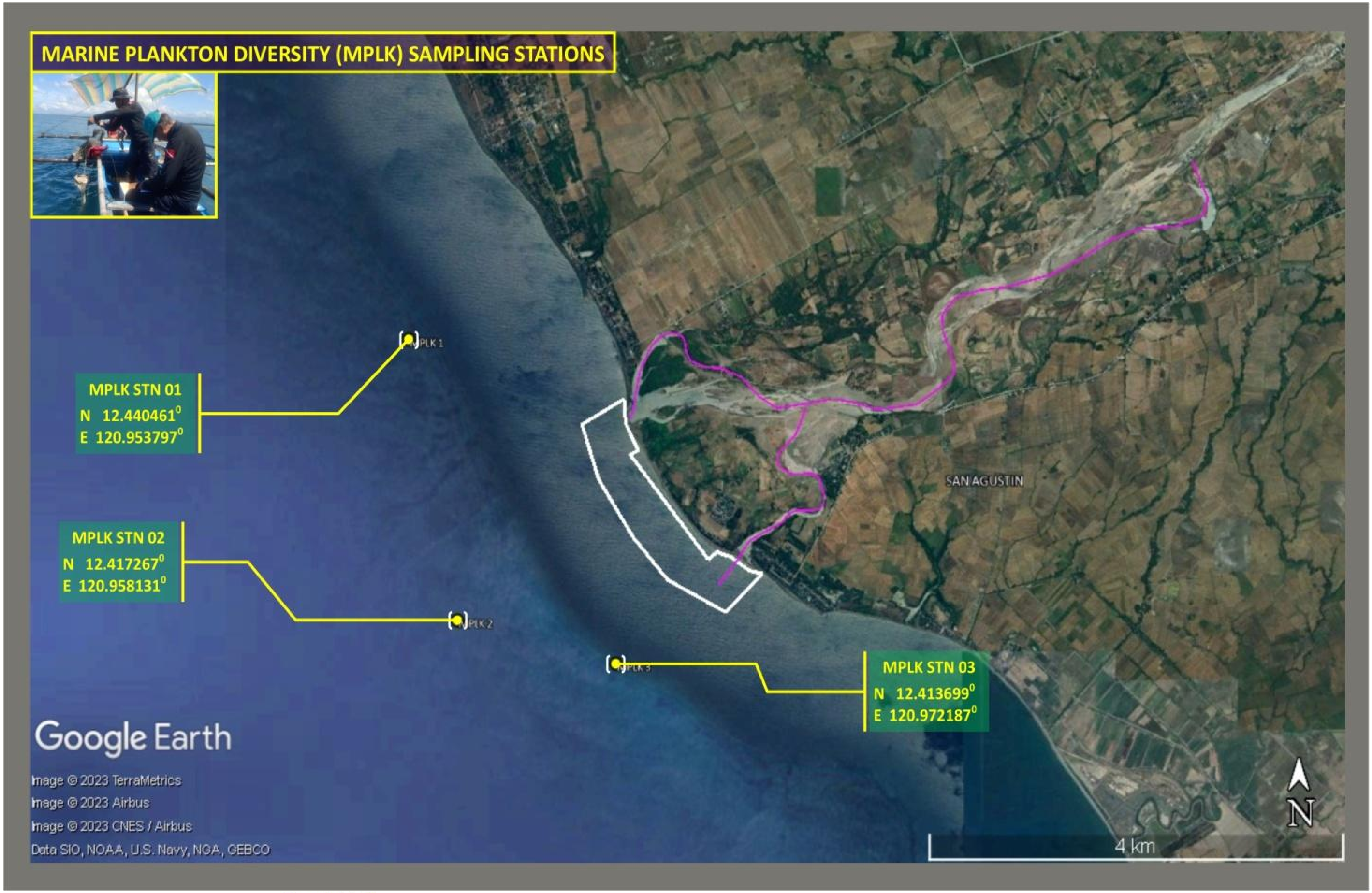


Figure 2.2.2-57. Location of Plankton Sampling Stations in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

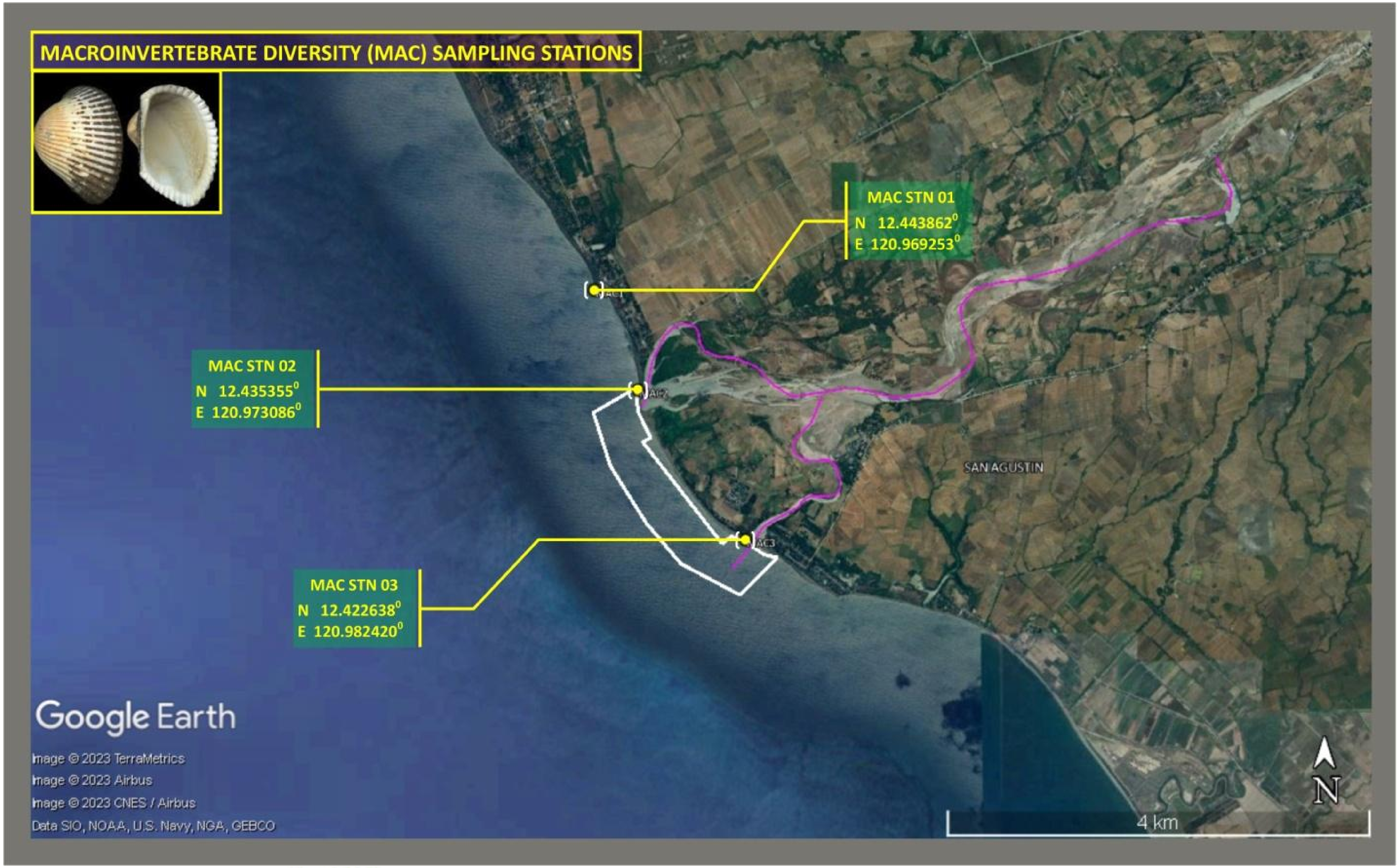


Figure 2.2.2-58. Location of Macroinvertebrate Investigations in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

2.2.2.5.1 Threat to Existence and/or Loss of Species of Important Local Species and Habitat

Characterization of benthic environment in the coastal impact area of the proposed dredging project - Corals and benthic morphology – results of broad area profiling through manta tows and spot dives

RESULTS OF MARINE ECOLOGY BASELINE ASSESSMENT

Results of Coral Assessment from Manta Tows and Spot Dives
The coastal impact area of the proposed Busuanga River Dredging Project is dominated by a short sandy shelf that opens up to deep waters with depth ranging from 30 to 100 meters about 800 meters from the shore. Key respondents and boat guides declared there are no coral reefs in the Adela shelf, the nearest prominent reef formations are found in the Sudlon MPA in Brgy Rumbang, Rizal 2.5 km northwest of the Busuanga River estuary. Fifteen manta tows plus the conduct of exhaustive systematic snorkeling in shallow waters did not show any existence of coral reefs, coral rubble or dead standing corals in both the primary and secondary impact areas of the dredging and navigational zone Project. Results of the tows, shown in **Table 2.2.2-24** and **Figures 2.2.2-59** to **2.2.2-60** indicate that the seabed fronting the project site is composed of sand and silt, extending to an estimated distance of 1 kilometer from the shoreline. Manta tows and spot dives undertaken during the assessment also indicate the absence of coral rubble, macroalgae, seagrass beds and rocks in the seabed of the primary impact area. The coastal waters are slightly turbid and visibility in the water column and in the bottom is very poor (**Plate 2.2.2-27**). The bottom substrate is undulating but relatively firm, with only the upper silt layer being disturbed by wave and currents. Sediment plumes come mainly from the river and spillage of sandy materials from the project's stockpile. Wave action is usually heavy in the shelf slope and undercurrents obviously sweep sandy materials into deeper portions of the seabed. Sand with larger grains has sunk into the seabed, in effect blanketing macrobenthos habitats that previously existed in the area. In the same manner, exhaustive manta tows and snorkeling along shallow waters failed to reveal any existence of seagrass communities. Sand and silt sediments covered much of the areas suspected to have otherwise hosted seagrass resources.

Plate 2.2.2-27. Sandy substrate dominates the coastal shelf in front of the proposed Busuanga River Dredging Project

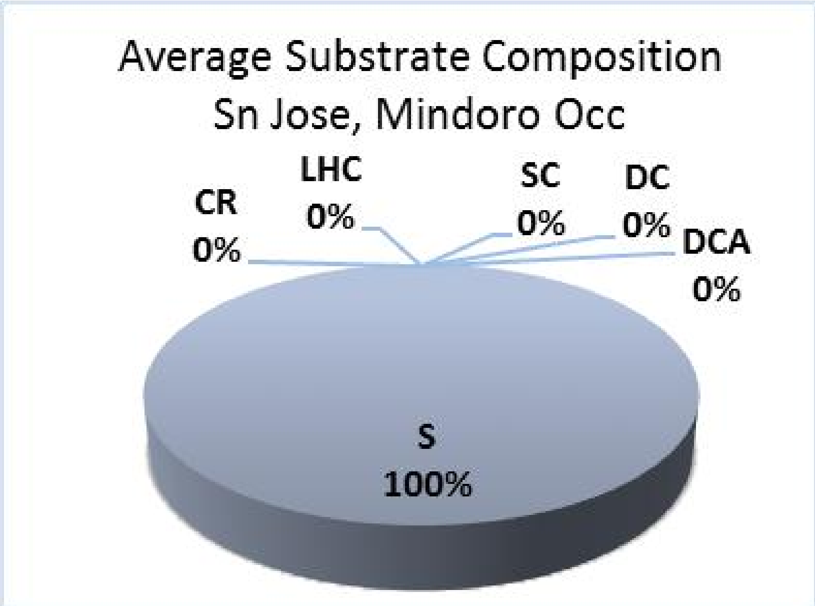
Table 2.2.2-24. Results of 15 Manta Tow Benthic Observation Pathways in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

WCR	Location	LHC	SC	DC	DCA	R	S	Remarks
S00	N 12.417022° E 120.989825°	0	0	0	0	0	100	Start of Tow
S00-T01	N 12.418008° E 120.987932°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T01-T02	N 12.418993° E 120.986229°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T02-T03	N 12.420102° E 120.984274°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T03-T04	N 12.421273° E 120.982445°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T04-T05	N 12.422628°	0	0	0	0	0	100	Fine gray sand is 100% the

WCR	Location	LHC	SC	DC	DCA	R	S	Remarks
	E 120.980363°							dominant substrate
T05-T06	N 12.424106° E 120.978534°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T06-T07	N 12.425770° E 120.976957°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T07-T08	N 12.427679° E 120.975380°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T08-T09	N 12.429774° E 120.974118°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T09-T10	N 12.431560° E 120.972415°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T10-T11	N 12.433716° E 120.971153°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T11-T12	N 12.435749° E 120.970585°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T12-T13	N 12.438275° E 120.970333°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T13-T14	N 12.440493° E 120.970143°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate
T14-T15	N 12.442711° E 120.969450°	0	0	0	0	0	100	Fine gray sand is 100% the dominant substrate; End of Tow
Average Reef and Substrate Composition		0	0	0	0	0	100	
Site name:		Western coastal waters of the Project Site						
Time / Date:		1117H-1255H / 18 October 2023						Observers 1. Benjamin S Francisco 2. Ernie P Fontamillas 3. Jose Rene F Villegas
Tow Speed:		3.0 kmh (ave)						
Visibility:		Varying from turbid to clear at ±10m						
Weather:		Fair to Sunny						
Wave:		Mild wave action of approx. ±1.0m wave crests						
Current:		Calm/Moderate						
Tide:		Rising from 0.45m to 0.57m as ref from Sablayan Station (WXTIDE32)						
Water Temp:		Approx. ±28°C						
Wind Speed:		Beaufort Scale #1						
Cloud Type(s):		Cumulus Clouds						

- *Tow points are expressed in Decimal Degrees WCS notation with reference to WGS84 Map Datum*
- *Reef and Substrate composition are expressed in (%) and described as follows:*

Live hard coral (LHC) - coverage of stony or hard corals on the bottom or part of the bottom
Live soft coral - (SC) - coverage of soft corals attached to the bottom
Dead coral (DC) - recently dead coral still attached and recognizable at the bottom in original upright position, color usually white with no living tissue
Dead coral with algae (DCA) - corallites still visible, skeletal structure can still be seen but algae dominate the structure (often appears greenish to brownish)
Coral rubble/rock (CR) - loose broken fragments of stony corals, consolidated hard bottom or large blocks of hard reef materials not attached or easily moved around
Sand/silt (S)



CR – Coral rubble; LHC – Live Hard Coral; SC – Soft Corals; DC – Dead Corals; DCA – Dead Corals with Algae

Figure 2.2.2-59. Results of Manta Tow Surveys in the Coastal Area of the Proposed Busuanga River Dredging Project

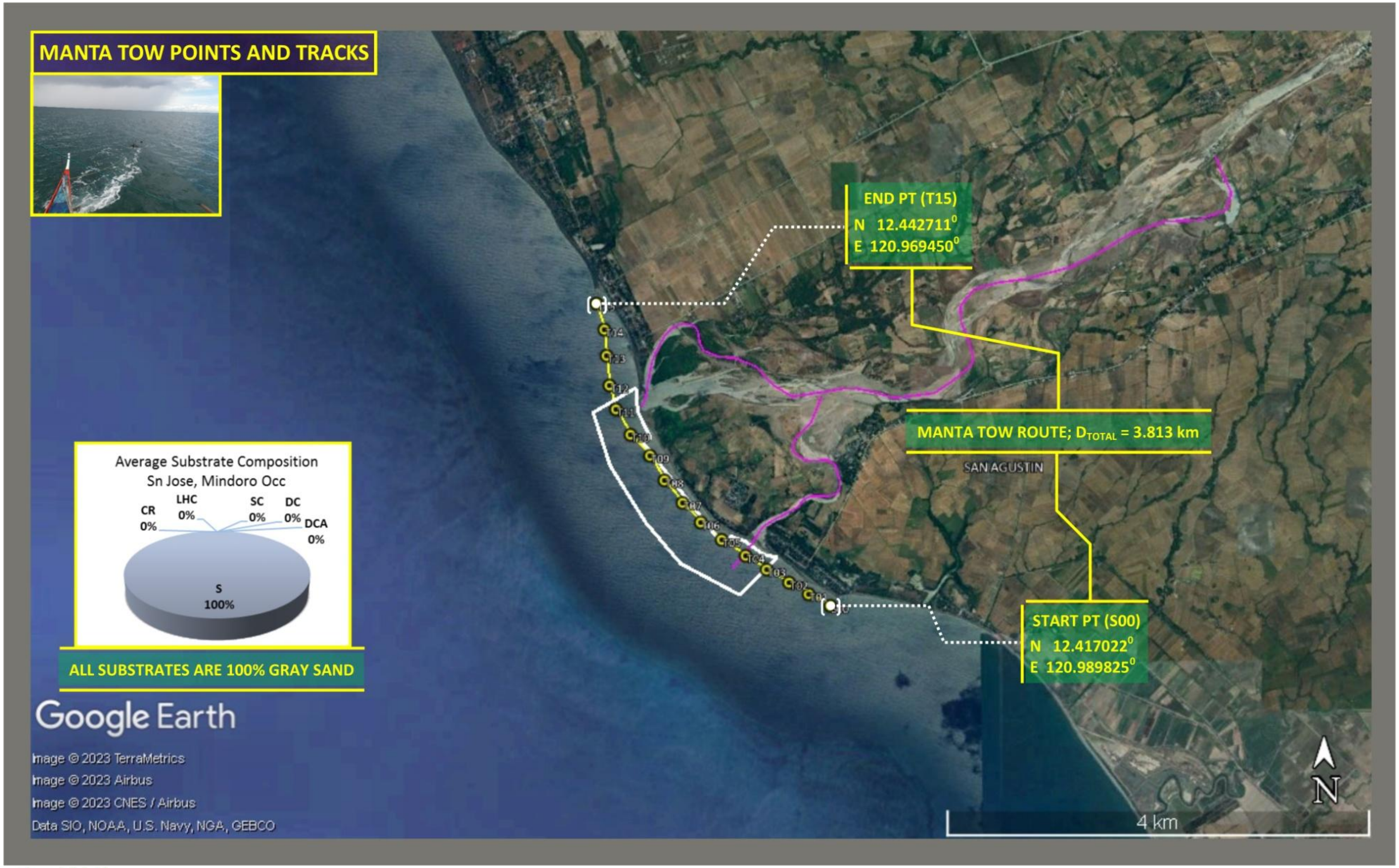


Figure 2.2.2-60. Results of 10 Manta Tow Survey Tracks in the Coastal Area of the Proposed Busuanga River Dredging Project Showing Complete Absence of Coral Formations and Dominance of Sandy Substrate Throughout All the Surveyed Benthic Pathways

Results of Spot Dives

The spot dives were particularly undertaken in lieu of the inability to conduct detailed benthic life form surveys employing Line Intercept Transects *due to the absence of coral reef resources even as exhaustive manta tow surveys and snorkeling were already undertaken* by the survey team. The spot dives were also resorted to with the objective of finding demersal fish communities as well as to conduct an investigation of the presence of seagrass. The overall result of the assessments indicate that the primary coastal impact area of the proposed Busuanga River Dredging Project Navigational Zone in Rizal and San Jose, Occ. Mindoro is largely devoid of significant habitats and resources that can be negatively impacted by sediment blanketing and vessel maneuvering. Five (5) spot dives conducted inside and outside the proposed navigational zone in the coastal impact area in front of the river estuary revealed the same sandy substrate seen in manta tows in both flanks of the project site (**Plate 2.2.2-28**). In the same manner no coral rubble, dead seagrass blades and macro-invertebrate carapace were not seen in the spot dives.

Plate 2.2.2-28. Spot dives conducted in the coastal impact area of the proposed Busuanga River Dredging Project also revealed the complete dominance of sandy material in the seabed and the absence of corals, coral recruits and macro-algae.

The absence of coral reef formations and associated benthic life forms was confirmed by interviews with fishers who claimed that the nearest reefs are found approximately about 3 km west of the project site. The nearshore area in front of the proposed navigational zone itself is also barren, and hosts little benthic fauna of significant ecological niche and the survey team suspects that constant sediment loading and modification of the seabed have decimated whatever little benthic life forms existed in the area previously, including macro-algae. In view of such deficiency, demersal fish stocks are correspondingly insignificant and the few fish species observed do not indicate diversity and permanence. The highlights of the spot dive investigations are presented in **Table 2.2.2-25** and depicted in **Figure 2.2.2-61.**

Table 2.2.2-25. Summary of Results in 5 Spot Dive Surveys in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

WP Code	North LATITUDE	East LONGITUDE	Findings
SPD 01	12.440461°	120.953797°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks
SPD 02	12.432263°	120.960493°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks
SPD 03	12.417165°	120.958101°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks
SPD 04	12.413622°	120.972375°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks
SPD 05	12.408114°	120.983178°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks
SPD 06	12.422154°	120.982221°	Seabed is comprised 100% of sand; no dead corals, dead corals with algae, coral rubble and rocks

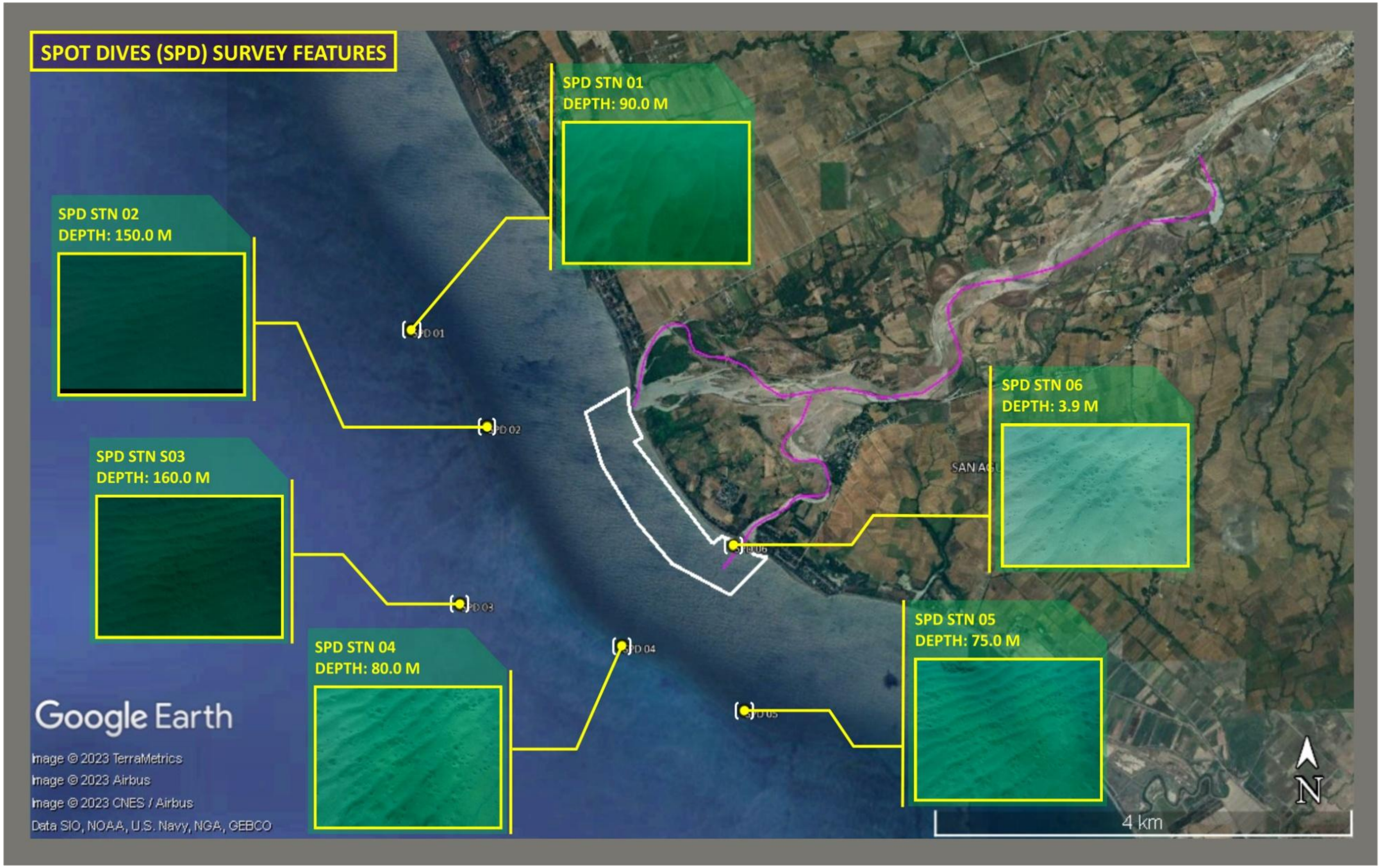


Figure 2.2.2-61. Highlights of Results in Six Spot Dive Stations in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

Fisheries

There are more than 100 full time and part-time fishermen in Bgys Adela and Bgy San Agustin that either uses motorized or non-motorized bancas (pers com). According to MAO staff of San Jose, there are fifteen (15) common fishing gears identified to be used by the fisherfolk. The popular gears include simple hand line, gill nets (surface and bottom set), drift gill net, cast net, multiple hook and line, spear, squid jigs, push net, troll lines, fish and crab pots, and surrounding nets. Fishers who were interviewed claim that present catch rates range between 2 to 10 kilograms per boat per day with a diverse catch composition that includes trevallies (*Carangoides spp*), Snappers (Maya-maya; *Lutjanus spp*), Rabbitfish (*Siganus spp*), big-eye scads (Matanga Baka – *Selar boops*), dolphinfish (Dorado; *Coryphaena hipporus*), frigate mackerel (Tulingan, *Auxis thazard*), Hairtail (Espada; *Trichiurus sp*), and blue crabs (Alimasag; *Portunus armatus*). Fishing grounds for these species are located at least three kilometers from the estuary. Four other fishermen respondents claimed that the catch rate per boat powered by a 16 HP gasoline engine fishing offshore in the Mindoro Strait average 5 kilograms to a high 25 kg consisting of large pelagics (Spanish mackerel, dolphinfish, blue marlin) with the use of “payao” or fish aggregating devices.. In nearshore fishing grounds 1 km from the estuary, fish catch are in most cases, comprised of schooling pelagic species, e.g., mackerel, and slipmouth. Bottom set gill nets and trammel nets are frequently used nearshore, averaging 1000 meters in length with rabbitfishes, penaeid shrimps and fusiliers allegedly captured.

The fisheries in the coastal waters in front of the proposed dredging project are largely of pelagic nature as no benthic structures for cryptic species exists in the seabed. Pelagic fishes such as mackerels and anchovies are known to swim close to the shore in search of richer feeding areas. The presence of the Busuanga River is contributing sand that somehow alters the nearshore seabed but the discharge of organic nutrients also enable periodic surges in phytoplankton populations that serve as food for small pelagics. The catch and effort ratio of four (4) actual fishing observations nearshore is low, ranging from 0.20 to 0.75 kilograms per fishing hour (**Table 2.2.2-26; Figure 2.2.2-62**). In all cases, most of the catch is composed of juvenile fishes. Fishers claim that the deterioration of catch rates is caused mainly by the use of dynamite in fishing for small pelagic fishes in previous years. The immediate inference is that the fisheries in the study area are already over-fished and environmental disturbances such as sediment intrusion has exacerbated declines in yields. The IUCN rating for the common species of fish caught in the fishing grounds offshore of the navigational zone is shown in **Table 2.2.2-27.**

Twelve (12) fishers, including women on fisheries, were interviewed for catch composition (**Plate 2.2.2-29**). A total of twenty-nine (29) pelagic and demersal species of fish are allegedly caught in both nearshore and offshore fishing grounds (**Table 2.2.2-27; Plate 2.2.2-30**). At the time of the survey, it was the season for hairtails (espada), barracuda and bullet tuna. The regular species caught include hasa-hasa (mackerel), talakitok (cavalla), pating (shark), barakuda (barracuda), silinyasi (scad), sapsap (ponyfish), salay-salay (yellowtail scad), alumahan (mackerel scad), tulingan (frigate tuna), tanigue (Spanish mackerel), mangagat (bream), bugaong (theraponid), malasugui (blue marlin), pusit and pugita (squids), mataan (big-eye emperor), biong-bilong (moonfish), malakapas (mojarras), asohos (common whiting), bisugo (threadfin bream), bonito (eastern little tuna), bitilya (emperor), and borador (flying fish).

Table 2.2.2-26. Results of Actual Fishing Catch Documentation in the Coastal Impact Area of the Proposed Busuanga River Dredging Project

WP Code	LATITUDE	LONGITUDE	Remarks
AFO 01	N 12.418159°	E 120.974209°	Encountered one (1) fisher utilizing multiple hook & line fishing gear with a catch of approximately 0.75 kilogram of Moonfish in four (4) hours; CPUE = 0.19 kilogram per fishing hour.
AFO 02	N 12.419281°	E 120.976885°	Encountered two (2) fishers utilizing multiple hook & line fishing gear with a catch of approximately 1.2 kilograms of assorted fish species plus Moonfish in four (4) hours; CPUE = 0.3 kilogram per fishing hour.
AFO 03	N 12.416604°	E 120.977559°	Encountered one (1) fisher utilizing multiple hook & line fishing gear with a catch of approximately 3.0 kilograms of assorted fish species plus Indian Mackerel in four (4) hours; CPUE = 0.75 kilogram per fishing hour.

Plate 2.2.2-29. Fishers, including women, being interviewed for catch composition and CPUE in the coastal impact area of the proposed Busuanga River Dredging Project

Table 2.2.2-27. Species Diversity and IUCN Status of Catch Composition of Nearshore and Offshore Fisheries Observed in the Proposed Busuanga River Dredging Project

Family	Species Name	Local Name	Common Name	IUCN Red List Status
1. Carangidae	*Alepes vari*	Salay	Herring scad	Least concern
2. Carangidae	*Selar boops*	Matang baka	Ox-eye scad	Least concern
3. Theraponidae	*Therapon jarbua*	Bugaong	Convex-lined therapon	Unknown/Not assessed
4. Leiognathidae	*Leiognathus equulus*	Sap-sap lawayan	Common slipmouth	Least Concern/Data deficient
5. Scombridae	*Makaira mazarra*	Malasugui	Marlin	Least concern but decreasing
6. Mugilidae	*Chelon macrolepis*	Banak/Gusaw	largescale mullet	Least concern
7. Mugilidae	*Valamugilcunnessius*	Banak/Aligasin	Long-arm mullet	Not assessed
8. Gerridae	*Gerresfilamentosus*	Malakapas	Spotted mojarras	Least concern
9. Trichiuridae	*Trichiurus lepturus)*	Espada	Hairtail	Unknown /Not assessed
10. Penaedae	*Metapeneus ensis*	Suahe/ pasayan	Spotted shrimp	Unknown /Not assessed
11. Carangidae	*Atule mate*	Salay	Yellowtail scad	Least concern
12. Carangidae	*Pseudocaranx dentex*	Salay ginto	scad	Least concern
13. Loliginidae	*Uroteuthis spp,*	Pusit tulis	Swordtail squid	Not assessed
14. Nemipteridae	*Nemipterus spp.*	Bisugo	Threadfin bream	Least concern
15. Mugilidae	*Mugil cephalus*	Banak	Big head Mullet	Least concern
16. Mugilidae	*Valamugil cunnensis*	Banak/Aligasin	Long-arm mullet	Least concern
17. Mugilidae	*Chelon macrolepsis*	Banak/gusaw	Large scale mullet	Least concern

Family	Species Name	Local Name	Common Name	IUCN Red List Status
18. Carangidae	*Rastrelouger kangurta*	Alumahan	Indian mackerel	Not assessed
19. Sillaginidae	*Sillago sihama*	Asohos	Common whiting	Least concern
20. Letrinidae	*Letrinus sp*	Kanuping	Jobfish/emperor	Least concern
21. Carangidae	*Caranx sp*	Talakitok	Trevally	Least concern
22. Coryphaenidae	*Coryphaena hippopus*	Dorado	Dolphinfish	Data deficient
23. Scompbridae	*Scomberomorus commerson*	Tanguigi	Narrow-barred Spanish mackerel	Near threatened
24. Pomacentridae	*Hemiglyphidodon plagiametapon*	Palata	Damselfish	Least concern
25. Nemipteridae	*Scolopsis sp*	Silay	Monocle bream	Least concern
26. Lutjanidae	*Lutjanus argentimaculatus*	Mangagat	Mangrove snapper	Least concern
27. Carangidae	*Selaroides leptolepis*	Salay	Yellow-striped trevally	Not assessed
28. Scombridae	*Auxis thazard*	Tulingan	Frigate tuna	Least concern
29. Sphyraenidae	*Sphyraena jello*	Torcillo	Barracuda	Least concern

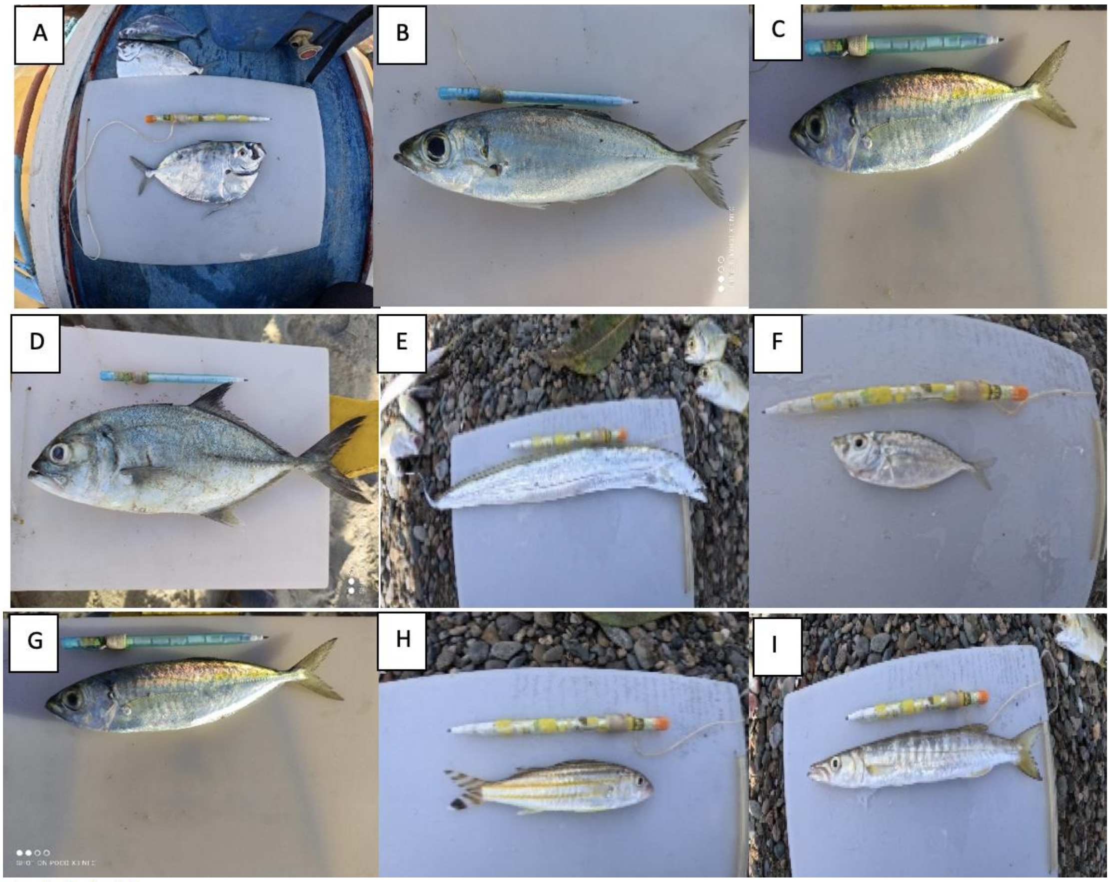


Plate 2.2.2-30. Some species of fish caught by small-scale fishers in the fishing ground offshore of the proposed Busuanga River navigation zone: (A) Moonfish (Mene maculata); (B) oxe eye scad (Selar boops), (C) yellow striped scad (Selaroides leptolepis); (D) brassy trevally (Caranx papuensis); (E) hairtail (Trichiurus lepturus); (F) common slipmouth (Leiognathus equulus); (G) mackerel scad (Selar crumenapthalmus); (H) Yellowstripe goatfish (Mulloidichthys flavolineatus) (I) barracuda (Sphyraena jello).

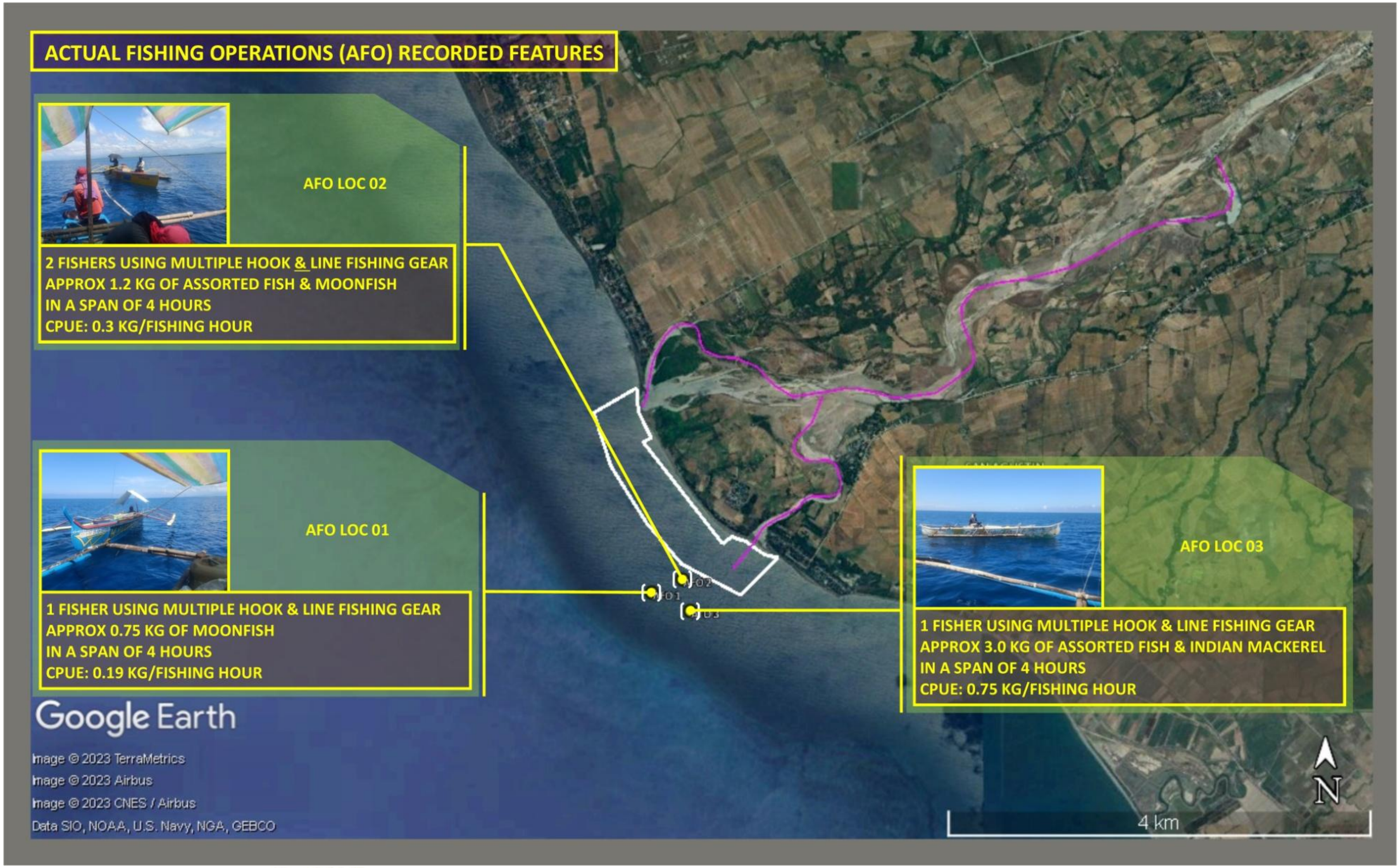


Figure 2.2.2-62. Highlights of In-situ Actual Fishing Documentation in the Coastal Impact Area of the Proposed Busuanga River Dredging Project;

Macro-invertebrates of commercial significance for food and trade

Sandy intertidal flats are generated in areas where wave action is moderate and river inputs are extensive. Many of such areas are often components of estuaries and their sediments are mostly muddy to sandy, sometimes interspersed with rocky substrates. Stable intertidal flats normally hosts soft-bottom substrates rich in dissolved nutrients, plankton, and organic debris, and sustain communities of in-faunal and benthic invertebrates, including mollusks and edible shellfish that area collected for food and trade. Unfortunately, the constant alteration of the intertidal flat due to invasion of sand and mud from the river has presumably led to the movement of macro-invertebrates away from the estuary zone. In spite of information from key informants that no macro-invertebrate communities exists in the estuary tidal area, opportunistic survey for presence of macro-invertebrates in three (3) stations were investigated more closely in random sampling. Macro-invertebrates are unimpressive in the sampling sites investigated in front of the project site's estuary, consisting of six taxa of one specimen/taxa. Similarly, other mollusks and crustaceans were absent in the seabed that were investigated during spot dives. Most of the substrate samples collected featured only sand and small pebbles. Even shellfish carapace was not seen in the core samples.

Core samples collected in the sampling stations north of the mouth of Busuanga River showed the only organisms isolated from the dominantly sandy area are the bottom dwelling crablets, *Telescopium sp,* gastropod which is not harvested for trade by the community and one specimen each of the common geloina *(Polymesoda erosa; "Tuway",)* one conch *Strombus mutabilis,* three ark shell *Anadara sp,* and one spider shell *Lambis lambis;* (**Table 2.2.2-28; Figure 2.2.2-63**). The latter species is a lucrative seafood fare and commands a relatively high price (see Plate 2.2.2-31). The edible sea urchin *Tripnuestes gratilla* was conspicuously absent in the sandy seabed. The absence of a significant population of mollusks or other macro-invertebrate species may be attributed to the constant movement of sandy deposits.

Table 2.2.2-28. List of Macro-invertebrate Species Observed in Busuanga River

Species Name	Common Name	Habitat	Group
Anadara sp	Ark shell	Sandy substrate	Bivalve
Lambis lambis	Spider shell	Sandy substrate	Gastropod
Strombus mutabilis	conch	Sandy substrate	Gastropod
Telescopium sp	Swamp cerith	Muddy substrate	Gastropod
Polymesoda erosa	Common geloina	Sandy substrate	Bivalve

Plate 2.2.2-31. Two macro-invertebrates species collected in Busuanga River Estuary. L-R: Ark shell (Anadara sp) "Litob", and Common geloina (Polymesoda erosa) "Tuway".

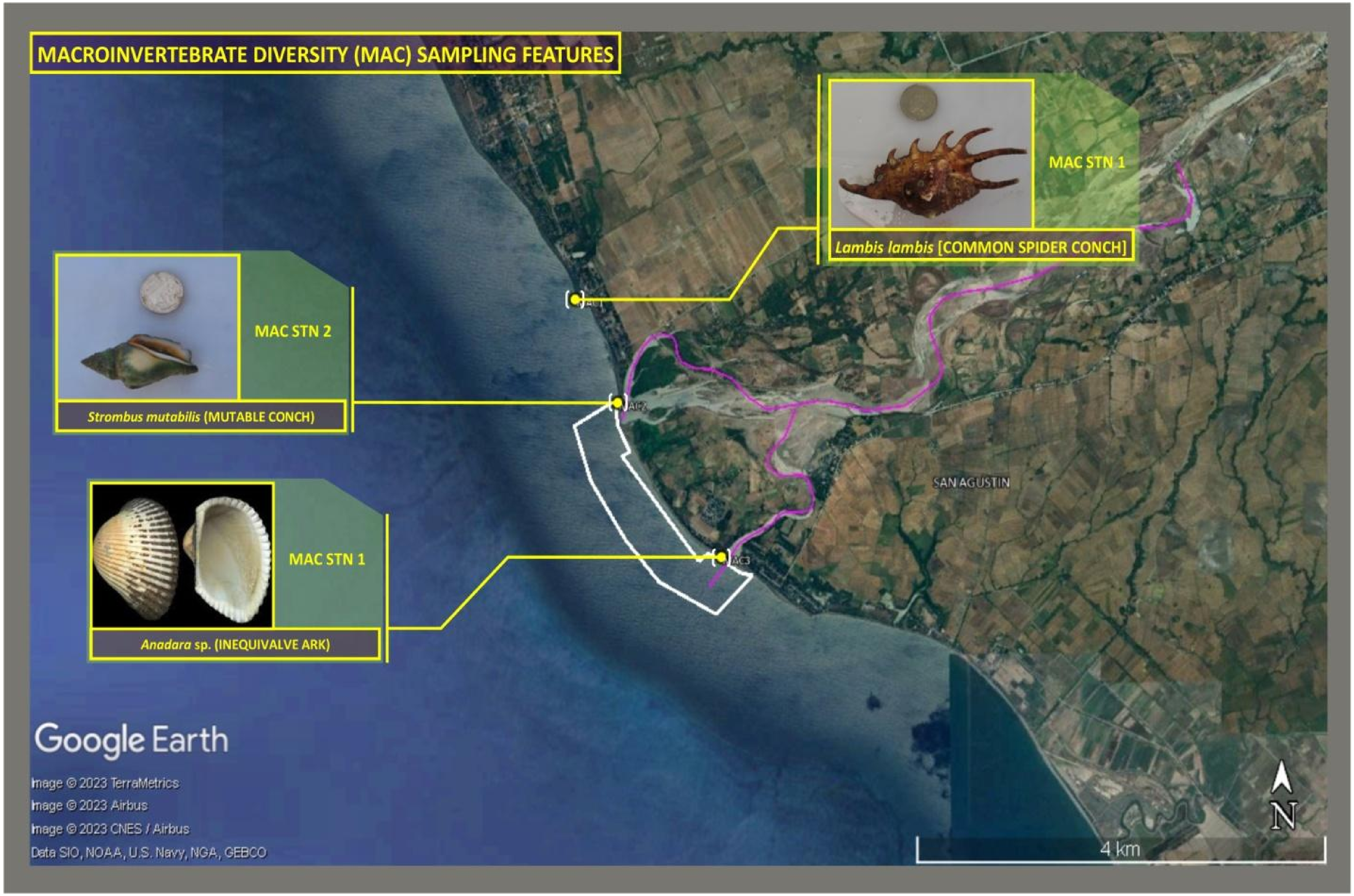


Figure 2.2.2-63. Macro-invertebrates observed in three stations in the coastal impact area of the proposed Busuanga River Dredging Project

Seagrass Communities

Manta tow surveys in 10 stations, spot dives and systematic snorkeling over shallow waters did reveal that seagrass meadows exist in the area. .

Planktons

Phytoplankton

A summary of the phytoplankton genera identified in three sampling points located within the coastal waters fronting Busuanga River Dredging Project is tabulated below. Stations PH1 and PH2 are the impact areas while station PH3 is located outside and treated as the control.

Table 2.2.2-29. Phytoplankton Composition, Abundance, Diversity and Distribution in 3 Sampling Stations Within and Near the Coastal Waters of the Proposed Busuanga River Dredging Project

TAXA	STATION			Grand Total	Rel. Abund. (cells/L)
	PH1	PH2	PH3		
Diatoms	**275,644**	**222,933**	**457,533**	**956,111**	**97.12**
Amphora	600			600	0.06
Bacteriastrum		5,933	15,600	21,533	2.19
Chaetoceros	264,444	208,000	434,667	907,111	92.14
Corethron		867		867	0.09
Coscinodiscus	733	1,000	867	2,600	0.26
Cymbella	933	867	933	2,733	0.28
Ditylum	1,533			1,533	0.16
Leptocylindrus	867	1,533	1,467	3,867	0.39
Melosira	1,000			1,000	0.10
Navicula		533		533	0.05
Odontella	600	1,200		1,800	0.18
Pleurosigma	600			600	0.06
Proboscia		267		267	0.03
Pseudoniztchia	1,400			1,400	0.14
Rhizosolenia	1,333	600	533	2,467	0.25
Skeletonema		333	1,200	1,533	0.16
Synedra		133	133	267	0.03
Tabellaria		533	600	1,133	0.12
Thalassionema	1,067	267	1,133	2,467	0.25
Thalassiosira	533	867	400	1,800	0.18
Dinoflagellates	**9,133**	**1,933**	**1,133**	**12,200**	**1.24**
Ceratium	2,733	267	267	3,267	0.33
Alexandrium	400			400	0.04
Diplopsalis	1,067			1,067	0.11
Gonyaulax	733			733	0.07
Prorocentrum	2,200	733	133	3,067	0.31
Protoperidinium	1,067	933	733	2,733	0.28
Scripssiella	933			933	0.09
Cyanobacteria	**600**	**6,667**	**8,933**	**16,200**	**1.65**

TAXA	STATION			Grand Total	Rel. Abund. (cells/L)
	PH1	PH2	PH3		
Trichodesmium	600	6,667	8,933	16,200	1.65
Grand Total	285,378	231,533	467,600	984,511	100
Richness	21	19	15		
Evenness (J')	0.16	0.19	0.14		
Diversity (H')	0.47	0.56	0.37		

Overall, diatoms totally dominated the phytoplankton community accounting 97% of the total counts, followed by cyanobacteria with 2% and dinoflagellates with 1%. Results of the microscopy analysis showed that phytoplankton density was high but the diversity was low (<1) due to the bloom of *Chaetoceros* spp. Total cell densities varied from 231,533 cells per liter in station Ph2 located inside the proposed project to 467,600 cells per liter at station Ph3 located outside the impact area (control). In terms of taxa richness, station PH1 had highest number of taxa with 21 while station PH3 was the lowest with 15.

All the sampled stations showed the presence of diatoms, dinoflagellates and cyanobacteria. A total of twenty-three (23) genera were identified. Among the diatoms, the pennate chain forming taxa *Chaetoceros* spp. was the most abundant with a total recorded density of 907,111 cells per liter (92% of the total composition). It was observed at highest density in stations PH3 at 434,667 cells per liter. This species is quite typical of tropical marine waters and has a cosmopolitan distribution. Commonly found in warm tropical waters, these 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 only cyanobacteria species present during the sampling period was *Trichodesmium* sp. which contributed 2% of the total phytoplankton abundance. Among the dinoflagellates, *Ceratium* spp. was the most abundant with total cell density of 3,267 cells per liter (0.31% of the total composition).

The species identified in this sampling listed in IOC-UNESCO Reference List of Harmful Microalgae (Moestrup et. al 2009) was *Alexandrium* spp. Many species of *Alexandrium* species are capable of producing potent toxins that can get accumulated in shellfish causing Paralytic Shellfish Poisoning (PSP) when consumed (FAO, 2004). In the Philippines, blooms of *Alexandrium* associated with PSP cases were so far reported in Bataan and Pangasinan and no history of PSP attributed to *Alexandrium* was reported in Occ. Mindoro. *Pyrodinium bahamense* var. *compressum*, the most notorious phytoplankton species to historically cause Paralytic Shellfish Poisoning (PSP) cases and deaths from contaminating shellfish in many coastal areas in the Philippines including Masinloc Occ. Mindoro was not observed in this survey. Furthermore, *Alexandrium* was recorded at low density of 400 cells per liter (0.04% of the total composition). Photomicrograph of dominant and common phytoplankton is shown in **Plate 2.2.2-32**.

Diversity Index (H) at the sampling locations showed values as low as 0.37 (site PH2) to a as high 0.56 (site PH2). The Evenness of index was very low with values ranging from 0.14 (PH3) to 0.19 (PH1). The low species diversity and evenness was due to the high concentration of *Chaetoceros* spp. which totally dominated other taxa.

Zooplankton
A summary of zooplankton groups recorded in three sampling points for the proposed dredging project is tabulated below. Stations ZP1 and ZP2 are the impact areas while station ZP3 is located outside and treated as the control. See Plate 2.2.2-33.

Table 2.2.2-30. Zooplankton Composition, Abundance, Diversity and Distribution in 3 Sampling Stations Within and Near the Coastal Waters of the Proposed Busuanga River Dredging Project

TAXA	STATIONS			Grand Total	Rel. Abund. (ind/m^3)
	ZP1	ZP2	ZP3		
Adult forms	**293,627**	**444,444**	**443,110**	**1,181,181**	**55.56**
Calanoid copepod	22,689	149,483	165,499	337,671	15.88
Chaetognaths		12,012	8,008	20,020	0.94
Cyclopoid	265,599	222,890	252,252	740,741	34.84
Harpacticoid	5,339	17,351	8,008	30,697	1.44
Larvacean		5,339	0	5,339	0.25
Mysiids		18,685	9,343	28,028	1.32
Salps		18,685	0	18,685	0.88
Larval forms	**276,276**	**360,360**	**308,308**	**944,945**	**44.44**
Balanus nauplius	32,032	10,677	12,012	54,721	2.57
Bivalve veliger	25,359	4,004	14,681	44,044	2.07
Cnidarian larvae	5,339			5,339	0.25
Copepod Nauplius and Copepodites	194,862	326,994	268,268	790,123	37.16
Gastropod veliger	8,008	10,677	9,343	28,028	1.32
Polychaete Trochophore	10,677	8,008	4,004	22,689	1.07
Grand Total	**569,903**	**804,805**	**751,418**	**2,126,126**	**100**
Richness	**9**	**12**	**10**		
Evenness (J')	**0.63**	**0.63**	**0.63**		
Diversity (H')	**1.37**	**1.57**	**1.44**		

Overall, adult forms dominated the zooplankton community which accounted 56% of the total counts while larval forms on the other hand accounted 44%. Furthermore, results of the analysis showed that density was relatively high but diversity was low. Zooplankton density varied from 569,903 individuals per m^3 at ZP1, to 804,805 individuals per m^3 at ZP2. Taxa richness were low ranging from 9–12 taxa.

A total of thirteen (13) zooplankton were recorded. Zooplankton groups identified include copepod, larvacean, polychaete, larvacean, chaetognaths, mysiids, bivalve larvae, cnidarian gastropod larvae and *Balanus* larvae Among the larval forms, copepod nauplius and copepodite recorded the highest abundance with total density of 790,123 individual per m^3 (37% of the total composition). It was observed at highest density at station ZP2 with 326,994 individuals per m^3. Among the adult forms, cyclopoid copepod recorded the highest abundance with total density of 740,741 individual per m^3 (35% of the composition) and followed by calanoid copepod with 331,367 individuals per m^3 (16% of the composition). Ecologically the planktonic copepods provide functionally important links in the aquatic food chain feeding on the microscopic algal cells of the phytoplankton and, in turn, being eaten by juvenile fish and other planktivores like sardines. Other zooplankton taxa that recorded relatively higher density were Bivalve veligers (2%) and Balanus nauplius (3%). There were no fish larvae and decapod zoea recorded in all the station sampled during this survey.

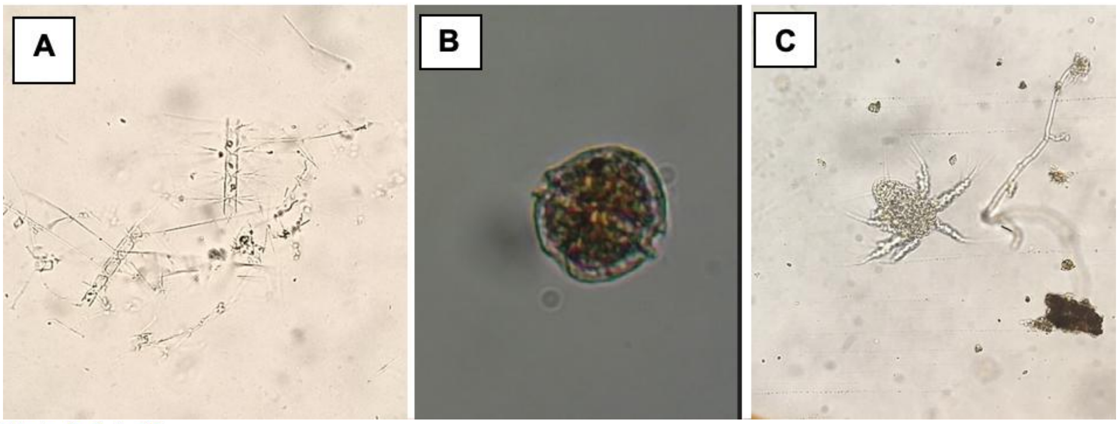


Plate 2.2.2-32. Common plankton identified within and near the coastal waters of the proposed project: (A) Chaetoceros sp. (B) Alexandrium sp. (C) Copepod nauplius;

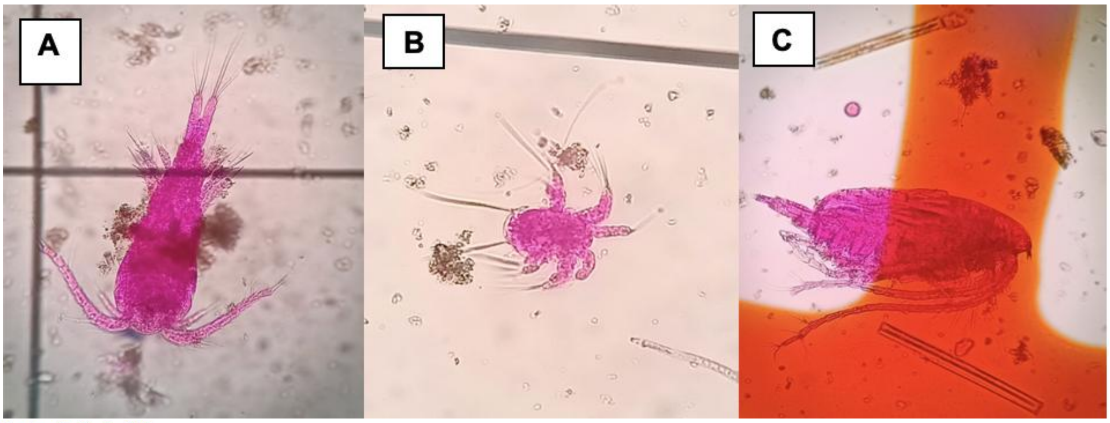


Plate 2.2.2-33. Photomicrographs of common zooplankton group during the sampling period (A) Cyclopoid copepod (B) Copepod Nauplius (C) Calanoid copepod.

2.2.2.5.2 Threat to Abundance, Frequency and Distribution of Species

Presence of Megafauna
Key informants in the Barangay reported that there had been no sightings of marine turtles in the areas during the last five years. Ocular observations also revealed no nesting or crawl marks on the sandy beach in front of the project site. Fishers claim that pods of dolphins have been observed in the offshore open waters this is seldom seen and closer observations have not been undertaken. No anecdotal accounts of accidental or purposeful capture of these species have been reported.

Presence of Pollution Indicator Species
Fish - Marine fish species have not been used as indicators of pollution, except where biotoxins are involved (e.g. plankton-filtering fish species in PSP-affected areas). On the contrary, some species of fish have been used as “indicators” of a relatively good coral reef habitat and its ecosystem functions including at least three (3) species of the butterfly fish *Chaetodontidae,* the Moorish Idol. These animals are characteristically indicative of a bio-diverse marine environment. The loss of these species over time, on the other hand, is indicative of a degrading benthic ecosystem. However, there are no coral-associated fish species in the impact area. However, these species are coral-dwelling and there are nocorals inn the coastal area of the Busuanga River.

Corals – Corals thrive well in clear waters as their symbiotic relationship with a host alga requires that sustained sunlight penetration for food production is ensured. In this aspect, coral reefs are therefore sensitive to turbid waters that can be brought about by the introduction of sediment plumes. However, there are no corals in the impact area of the proposed Busuanga River Dredging Project site.

Plankton – No plankton blooms of significant proportion was observed in the survey although the presence of *Pseudonitzschia* spp. which is listed in the IOC-UNESCO Reference List of Harmful Microalgae (Moestrup et al 2009). The species identified in this sampling listed in IOC-UNESCO Reference List of Harmful Microalgae (Moestrup et. al 2009) was *Alexandrium* spp. Many species of *Alexandrium* species are capable of producing potent toxins that can get accumulated in shellfish causing Paralytic Shellfish Poisoning (PSP) when consumed (FAO, 2004). In the Philippines, blooms of *Alexandrium* associated with PSP cases were so far reported in Bataan and Pangasinan and no history of PSP attributed to *Alexandrium* was reported in Occ. Mindoro.

Historical Occurrences of Red tide, Fish Kill or Any Related Event
No red tide episodes or fish kills triggered by harmful algal blooms were experienced in the vicinity of the project site in the last ten years.

Impact Assessment
To a significant extent, the existing environmental conditions in the coastal waters and contiguous environs fronting the proposed river dredging site is unlikely to improve during dredging operations. The influx of sediment plumes from the river, as well as silt and soil run-off from inland waterways that eventually end up in the sea can be anticipated to enhance degradation of seawater quality and reduce primary productivity in extreme events of turbidity. The settlement of coral planulae and seagrass shoots are unlikely to occur in view of the absence of firm substrates for attachment and colonization and the strong wave action that creates incessant disturbance in seabed conditions. Consequently, fisheries productivity is expected to remain largely unprofitable due to superfluous fishing effort and the absence of benthic habitats for demersal species. With this bleak scenario, coastal ecosystem integrity and fisheries productivity is foreseen to improve slowly.

The future scenario, with the completion of the Busuanga River Dredging Project, will likely lead to reduced sand intrusion and improvement in ecological integrity of intertidal and sub-littoral habitats around the area. Coral planulae and seagrass shoots can viably settle with firm substrates in place like concrete “artificial reef” structures. The Project is also seen to increase employment opportunities for skilled labor and provide certain food supply-based livelihood to local fishers and residents.

The predicted environmental impacts include:

Construction Phase
The support facilities to be utilized are existing houses in Brgy. Adela that can be rented. Therefore, there will be no major construction activities except perhaps for minor repairs or improvements.

Operation Phase

(i) Sediment fluxes in coastal waters
Notwithstanding the absence of critical and fragile coastal habitats in the project’s coastal impact area, the possibility of enhanced sediment loading emanating from dredging in the river and navigation zone will likely contribute to coastal water turbidity, in the form of total suspended solids (TSS), silt and sediment plumes. Such sediment invasion can cause further sand and mud blanketing of the seabed and alter the broader benthic environment. The impairment can lead to disruption of fish and crustacean feeding behavior and lead to poor prey visibility. Reproductive performance of fish and crustaceans, which may include disturbance to burrowing macro-invertebrates such as crabs and bivalve mollusks burrowed in the muddy substrate farther offshore. In conditions of extreme turbidity, pelagic fishes will evade coastal waters contiguous to the project, in effect reducing fisheries output. Such a condition can also impair fish larvae output and result to reduced recruitment capacity of pelagic fish species. Grazing areas of demersal species of fish and crustaceans, already few in numbers as indicated in the surveys, can be lost. Extreme turbidity will further exacerbate reduced photosynthetic function which can affect microscopic primary producers of phytoplankton and dependent zooplankton communities, depress macrobenthic algae settlement, and further deteriorate dissolved seawater oxygen content. Even as there are no corals in front of the project site, as well as cryptic fish habitats, the objective is to reduce, or altogether prevent, sediment invasion to the highest degree possible. Sediment streams from project dredging activities, earthworks, road construction, or in cases of inadvertent spillage of materials being handled in the land-sea interface that have the

potential to intrude into the sea can be prevented first and foremost by ensuring that any plumes or spillages are effectively captured and stockpiled away from the coast. This will involve the placement of silt curtains and other silt and sediment weirs around the dredging area and estuary. All activities and structures that can potentially generate loose or fugitive soil and sediments will be subjected to silt curtains and geo-textile sediment filters for effective recovery which will then be disposed of in containment stockpiles inland for re-use. During the rainy season, escape of silt will be curtailed especially focusing on potential spill points of terrigenous materials that can end up in coastal waters near the estuary. This will be reinforced by the construction of sediment entrapment screens in drainage canals. Periodic environmental monitoring of TSS will be undertaken and results of monitoring are periodically fed into strategic improvement plans. However, enhanced siltation and sedimentation from the project's operation is evidently a temporary and localized event and that such wastes streams can be readily prevented or reduced in intensity though standard engineering safety practices.

(ii) Macrobenthos suffocation in cases of extreme episodes of sediment intrusion
The overall impression from the macroinvertebrate diversity assessment in the survey area is poor as indicated by the poor abundance of the animals in sampling stations. The absence of dense macrobenthos as revealed in the survey indicates that there will be no significant population of macroinvertebrates that can be dislocated in the project site itself. Nevertheless, river and coastal earth moving activities and shoreline modification will result to a significant increase in sediment deposition and re-suspension, particularly in the immediate vicinity of the port construction site. Alteration of the inter-tidal zone can result to loss of whatever infaunal benthic mollusks that can otherwise settle in the area. Bivalve veligers in the inter-tidal area of the project site can be susceptible to sediment blanketing particularly during onshore project establishment activities. However, the community of larger gastropods and bivalves in deeper waters can move out to undisturbed areas. Also, it is noted that few other macro-invertebrates were seen in the project site area. Any disturbance to the few benthic stocks of mollusks will be temporary and will have no lasting, far-reaching effects on macro-invertebrate growth and recruitment as shelf is deep and sediment plumes will be readily swept into deeper slopes. Moreover, any macrobenthic community is also known to be resilient as some groups would migrate to less stressful areas, while a few tolerable organisms remain in the affected area; or replenishment of the community will occur with either the existing or new species establishing their population and niches through time.

(iii) *Accidental oil spills; ship bilge and ballast discharge*.
Accidental spillage of oil and grease from project sea vessels, disposal of ship bilge, as well as spills of materials from ships can cause seawater pollution that can end up in substrates within the shelf. Such episodes can potentially contaminate benthic invertebrate populations, macrobenthos and fish larvae in the area, even if such communities are few in the area fronting the project site. While these issues are to be strictly controlled so that such will not take place, oil slicks caused by unintentional spills in the project wharf or from shipboard dispensing may remain sequestered in coastal waters and can be dispersed in small blotches towards the direction of tidal movement affecting benthic niches far from the project site and thereafter pollute coral colonies within its pathway, as well as fish nurseries and habitats for sedentary marine animals. On the other hand, the introduction of exotic species in a particular environment can also be caused by the disposal ship ballast water and this will be prevented as a major operational policy of the Project.

The operation of the project may contribute to increased solid waste and domestic wastewater contamination of nearshore waters, as well as accidental oil and grease spills from shipboard wastes and bilge water. Organic wastes and nutrients, disposed from the project facilities can possibly find their way into coastal waters through drainage facilities if not properly contained. Pollution and degradation of sea water quality have far reaching impacts on plankton communities and fish recruitment events. The risk of oil and grease contamination on nearshore waters can occur if disposal of fuel-based wastes is not undertaken properly, e.g., from the project's day-to-day dispensing of fuel and oil storage in the port and within ships. While the issue is not anticipated to be severe, oil slicks caused by inadvertent disposal may remain sequestered in waterways and drainage facilities or be carried by rainwater run-off to coastal waters and dispersed in small blotches towards the direction of tidal movement. During high tides and particularly during the southwest monsoon season, such slicks may be definitely carried extensively towards the coastline where contaminants become mixed with various sediments. During heavy rainfall, fuel contaminated topsoil is normally carried by run-off, and eventually contaminates coastal waters.

Decommissioning Phase
Abandonment of the project, with development works already in place, is not expected to produce any impacts to the marine environment and associated biota.

Proposed Mitigation Measures

Prevention of siltation and sedimentation
The long-term objective of the Project in crafting its coastal environmental management regime is to improve the quality of coastal waters fronting the project site both for biodiversity and aesthetic values. The maintenance of a cleaner seawater condition will be an inherent and recurrent strategic initiative.

The possibility of sediment streams spilling into coastal waters can be prevented first and foremost by controlling erosion and spillage of sand at source and diverting and retrieving all loose or fugitive soil and sediments into sediment filters. During dredging, silt curtains are to be installed whenever possible to filter the sediments in the seaward side of the estuary. Loose materials shall be stockpiled in a landward area where control measures can easily be applied to prevent unnecessary dispersion. Replanting of beach vegetation, as well as enhancing vegetation cover in open areas will help significantly to minimize soil erosion and freshwater runoff. The planting of mangrove trees along the estuary of the river can be a worthy project of the firm.

Prevention of domestic wastewater pollution
The use of 3-chambered septic tanks shall be installed in all land-based project facilities where wastewaters are generated. Waste minimization will be practiced in all aspects of project operation.

To prevent intermittent oil spills from project facilities and from shipboard dispensing, strict measures against wanton and irresponsible disposal of used oil will be undertaken properly and cleanup activities that focus on removing oil and oily debris from the project area will be undertaken forcefully, if such spills accidentally occur. Clean practices will be an underpinning responsibility in all aspects of project operations and instituted within all sea vessels managed by the firm.

Improving fisheries productivity
The Project will address dislocation of traditional fishing practices due to potential limitations brought about by the designation of navigation lanes and berthing areas. While fisheries productivity and long-term viability is not an issue that should be directly addressed by project operations, the Project will nonetheless support fisheries management and stock enhancement measures through collaboration with the local governments of Rizal and San Jose and their respective Municipal Fisheries and Aquatic Resources Management Council, drawing strategic support from its Integrated Coastal Resource Management Plan. The objective is to make fisheries more productive in areas outside of the project’s sphere of operations. Support to local organized fisher groups for the implementation of better fisheries law enforcement, advocacy against irresponsible fishing practices and the implementation of fish stock enhancement measures to protect fish growth, maturation and recruitment will be supported by the project in ways that can be viably integrated into its social development plan.

Mangrove planting
At present, there are no mangrove communities in or around the project site. Mangrove planting will be undertaken in the Busuanga River estuary in sites that are viable for mangrove growth employing suitable species. The growth of mangroves is anticipated to reduce sediment streams in the coastal area in front of the project site.

Prevention of oil and grease spills
Potential risks of small oil spills will be addressed through strict fuel and oil dispersal protocols backed-up by an oil/fuel spill contingency plan. Oil depots will be located a good distance from the coastline. No oil wastes will be disposed into waterways or canals. An oil and grease containment and waste containment plan will be formulated and enforced in all aspects of project operations. Prohibition of disposal of shipboard wastes will be absolute and a rigid monitoring system around the

port complex will be carried out constantly. A bilge and ballast water exchange system will be formulated in accordance with standard IMO protocols and treatment system fitted with oil separators.

2.2.3 AIR
2.2.3.1 Meteorology
2.2.3.1.1 Local Climate

Monthly Average Rainfall and Temperature of the Area; Climatological Normal/Extremes; Wind Rose Diagrams; Frequency of Tropical Cyclone

The meteorological data used to describe the climate of Rizal and San Jose is from the (Philippine Atmospheric, Geographical and Astronomical Services (PAG-ASA) San Jose Synoptic Station, in the Municipality of San Jose, Occidental Mindoro. It is located just 9.57 km SE from the project site. See figure below.

Figure 2.2.3-1. Nearest Synoptic Station to Project Site

The municipality falls under Type I climate according to the Modified Coronas Classification of PAGASA. Such areas exhibit two pronounced seasons, the dry season extending from November to April and the wet season from May to October. The latter is dominated by the southwest monsoon season with severe weather conditions associated with typhoons. (**Figure 2.2.3-2**)

Source: https://www.geoportal.gov.ph/, Data from PAGASA

Figure 2.2.3-2. Climate Map of Mindoro Island

The climatological normals and extremes are presented in **Tables 2.2.3-1 to 2.2.3-2** for the synoptic station in San Jose, Occidental Mindoro.

Climatological normals is defined as period averages computed for a uniform and relative long period comprising at least 3 consecutive10-year period.

Based on PAGASA's records from 1991-2020, the average rainfall in San Jose are as follows: from December to February is 33.2 mm (driest); from March to May is 69.93 mm; from June to August is 433.93 mm (wettest); and September to November is 259.17 mm. (*See Table 2.2.3-1*)

With regards to temperature, the observed baseline for the same period are as follows: DJF – 27.7°C; MAM – 29.3°C; JJA – 27.8°C; and SON – 27.7°C. March to May is the hottest season while the rest of the year have almost the same coolness.

The normals in terms of relative humidity are as follows: DJF - 76%; MAM – 72% (lowest); JJA – 83%; and SON – 88% (most humid).

The wind direction from November to May is easterly, June to September is westerly, and October is northeasterly.

Baseline rainfall and temperature data from 1991-2000 for the province of Occidental Mindoro are: DJF – 160 mm, 26.5 ℃; MAM – 266 mm, 28.3 ℃; JJA – 1,091 mm, 27.3 ℃; and SON – 763 mm, 27.1 ℃ (*Tables 2.2.3-4 to 2.2.3-5).*

The average monthly windrose diagrams are shown in **Figure 2.2.3-3**.

Table 2.2.3-1. *Climatological Normals, San Jose, Occidental Mindoro Station (1991-2020)*

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	13.0	3	32.5	21.9	27.2	27.4	23.5	22.0	26.4	73	1010.9	E	3	4	1	2
FEB	11.8	2	33.0	22.9	27.9	27.7	23.7	22.1	26.6	72	1011.3	E	3	4	1	2
MAR	11.8	2	34.0	23.8	28.9	28.7	24.4	22.8	27.7	71	1010.6	E	4	3	2	3
APR	31.6	3	34.9	24.3	29.6	29.6	25.4	23.9	29.7	72	1009.6	E	3	3	4	7
MAY	166.4	9	34.1	24.6	29.4	29.4	26.1	25.0	31.6	78	1008.7	E	3	4	13	18
JUN	325.5	15	32.5	24.4	28.4	28.3	26.0	25.2	32.1	84	1008.4	W	2	6	15	20
JUL	507.3	20	31.0	23.9	27.5	27.4	25.6	25.0	31.8	87	1008.1	W	3	6	14	16
AUG	469.0	20	31.0	23.9	27.5	27.4	25.8	25.2	32.1	88	1008.1	W	3	6	14	16
SEP	436.1	18	30.9	23.8	27.3	27.2	25.6	25.0	31.8	89	1008.5	W	2	6	13	15
OCT	244.0	13	31.7	23.6	27.7	27.5	25.5	24.8	31.4	86	1008.6	NE	2	5	13	17
NOV	97.4	7	32.8	23.7	28.2	28.1	25.1	24.1	29.9	79	1008.9	E	3	5	5	11
DEC	74.8	5	32.6	23.6	28.1	27.8	24.4	23.1	28.3	76	1009.7	E	3	5	2	5
ANNUA	2,388.7	117	32.6	23.7	28.1	28.0	25.1	24.0	30.0	80	1009.3	E	3	5	97	132

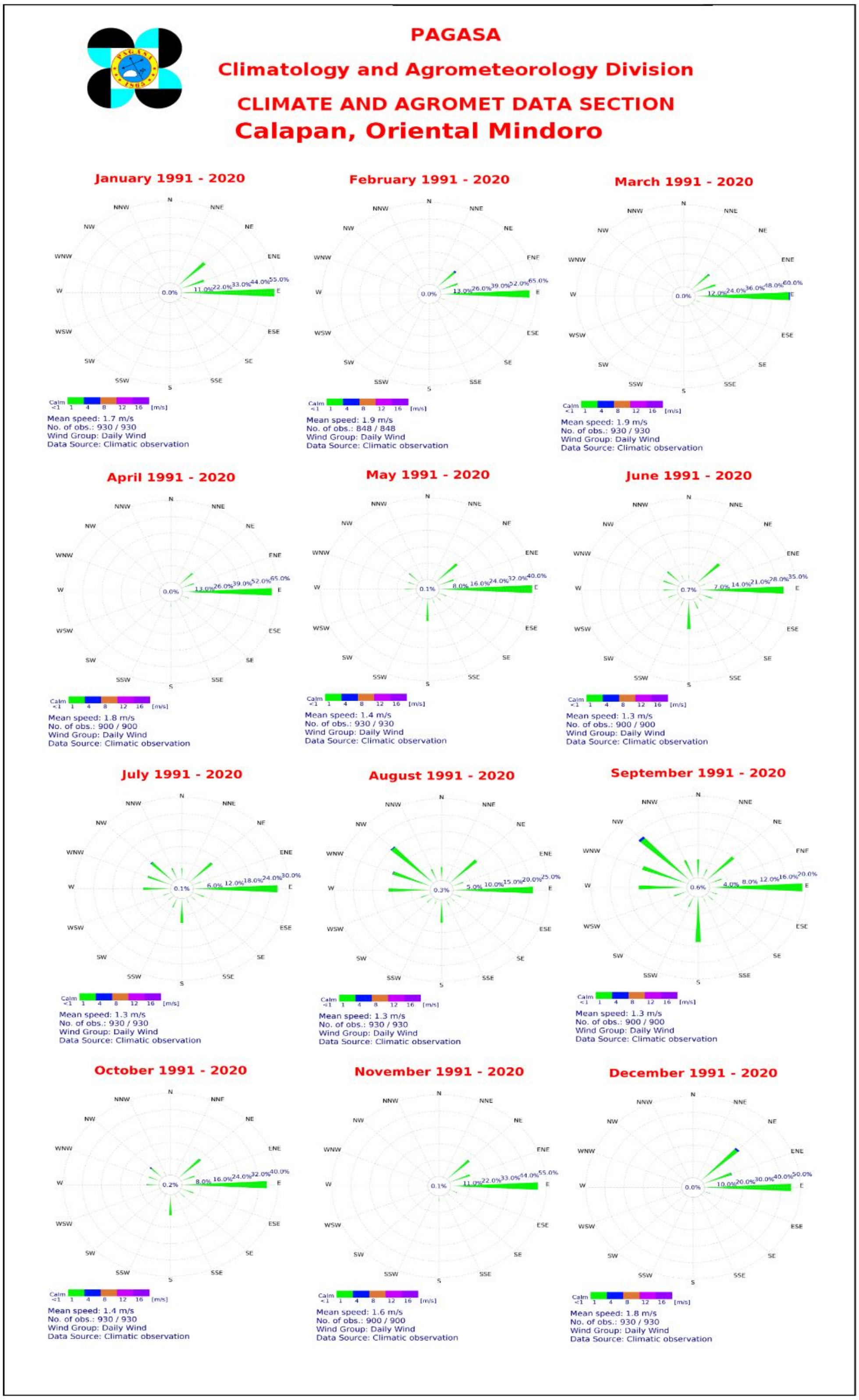
Source: PAGASA/CADS/CAD

Table 2.2.3-2. *Climatological Extremes, San Jose, Occidental Mindoro Station as of 2020*

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	35.5	01-11-1990	15.5	01-09-1985	28.1	01-21-2008	20	ENE	01-16-2001	1018.1	01-31-1998	1002.6	01-06-1999
FEB	36.5	02-09-2019	15.4	02-15-1982	50.4	02-22-1986	26	NE	02-18-2008	1018.7	02-15-2017	1002.7	02-08-1986
MAR	37.6	03-28-1992	18.5	03-01-2020	69.8	03-27-1982	22	E	03-26-1991	1017.1	03-03-1987	999.0	03-30-1995
APR	39.0	04-20-2020	18.8	04-09-2020	90.0	04-15-2014	20	E	04-04-2008	1016.1	04-04-1998	1000.6	04-28-1995
	39.0	04-25-2020	-	-	-	-	-	-	-	-	-	-	-
MAY	38.5	05-04-1993	20.5	05-27-1986	214.4	05-12-2006	35	WNW	05-12-2006	1013.8	05-20-1994	996.1	05-12-2006
	38.5	05-09-2016	-	-	-	-	-	-	-	-	-	-	-
	38.5	05-11-2020	-	-	-	-	-	-	-	-	-	-	-
JUN	39.2	06-03-2019	18.0	06-19-1981	273.4	06-27-1988	30	SSW	06-21-2008	1015.0	06-31-1995	996.6	06-06-1989
JUL	37.4	07-18-1998	20.0	07-30-1980	198.0	07-15-2014	28	W	07-24-2004	1014.2	07-27-2015	996.6	07-14-1983
AUG	35.0	08-02-1998	18.0	08-29-1980	187.2	08-25-2001	26	W	08-26-2002	1019.6	08-02-1980	996.5	08-12-1987

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
SEP	35.6	09-08-2020	19.0	09-17-1980	198.4	09-08-1982	35	E	09-02-1984	1019.9	09-20-1980	999.0	09-30-1995
OCT	36.0	10-30-1990	19.0	10-10-1983	286.7	10-21-1998	30	SW	10-25-2020	1015.4	10-05-1987	990.0	10-26-2020
	-	-	19.0	10-13-2019	-	-	-	-	-	-	-	-	-
NOV	38.0	11-14-1989	18.8	11-06-2019	178.0	11-07-1988	34	W	11-20-2004	1015.6	11-03-1994	989.0	11-07-1988
DEC	36.0	12-07-1991	17.5	12-29-1996	256.6	12-11-1998	42	S	12-25-2019	1017.3	12-27-2001	980.6	12-10-2006
ANNUAL	39.2	06-03-2019	15.4	02-15-1982	286.7	10-21-1998	42	S	12-25-2019	1019.9	09-20-1980	980.6	12-10-2006
Period of Record	1980 - 2020				1980 - 2020		1980 - 2020			1980 - 2020			

Source: PAGASA/CADS/CAD



Source: PAGASA

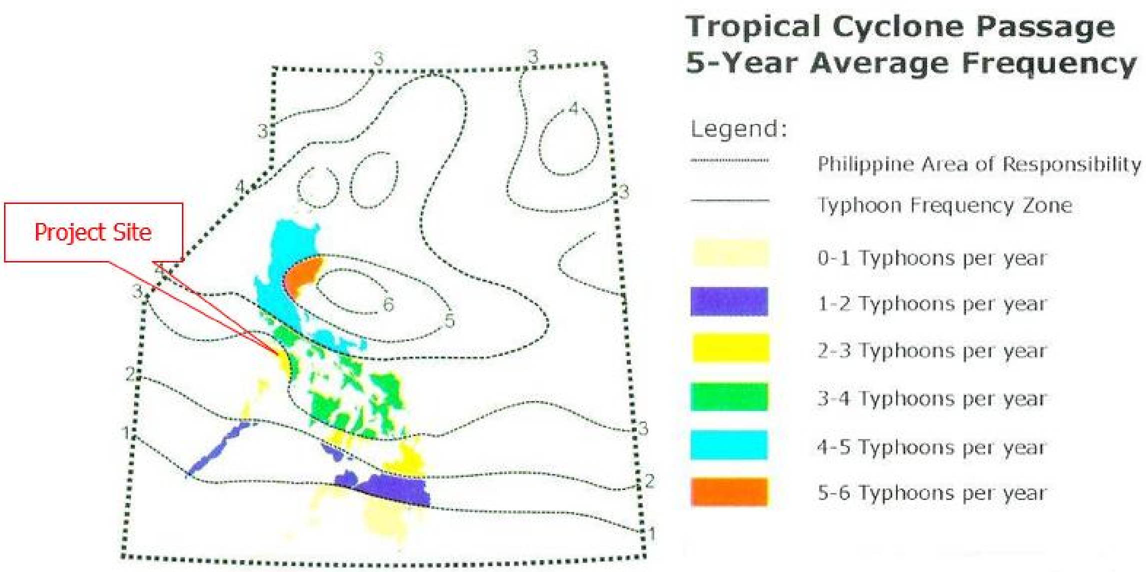
Figure 2.2.3-3. Average Monthly Wind Rose at PAGASA Calapan, Oriental Mindoro Station (1991-2020)

The project area is affected by tropical storms/typhoons with a statistical frequency of 2 to 3 cyclone per year as shown in the Tropical Cyclone Passage Map, which also confirms the observed flooding occurrences in the area. November and December are the months with the most tropical cyclones with 17 and 16 TCs, respectively. No TC occurred in the month of February. Typhoons are the predominant type (56.25%) that crossed the province. (**Figures 2.2.3-4** to **2.2.3-7** and **Table 2.2.3-3**)

Table 2.2.3-3. *List of Typhoons that Crossed Occidental Mindoro from 1948-2020*

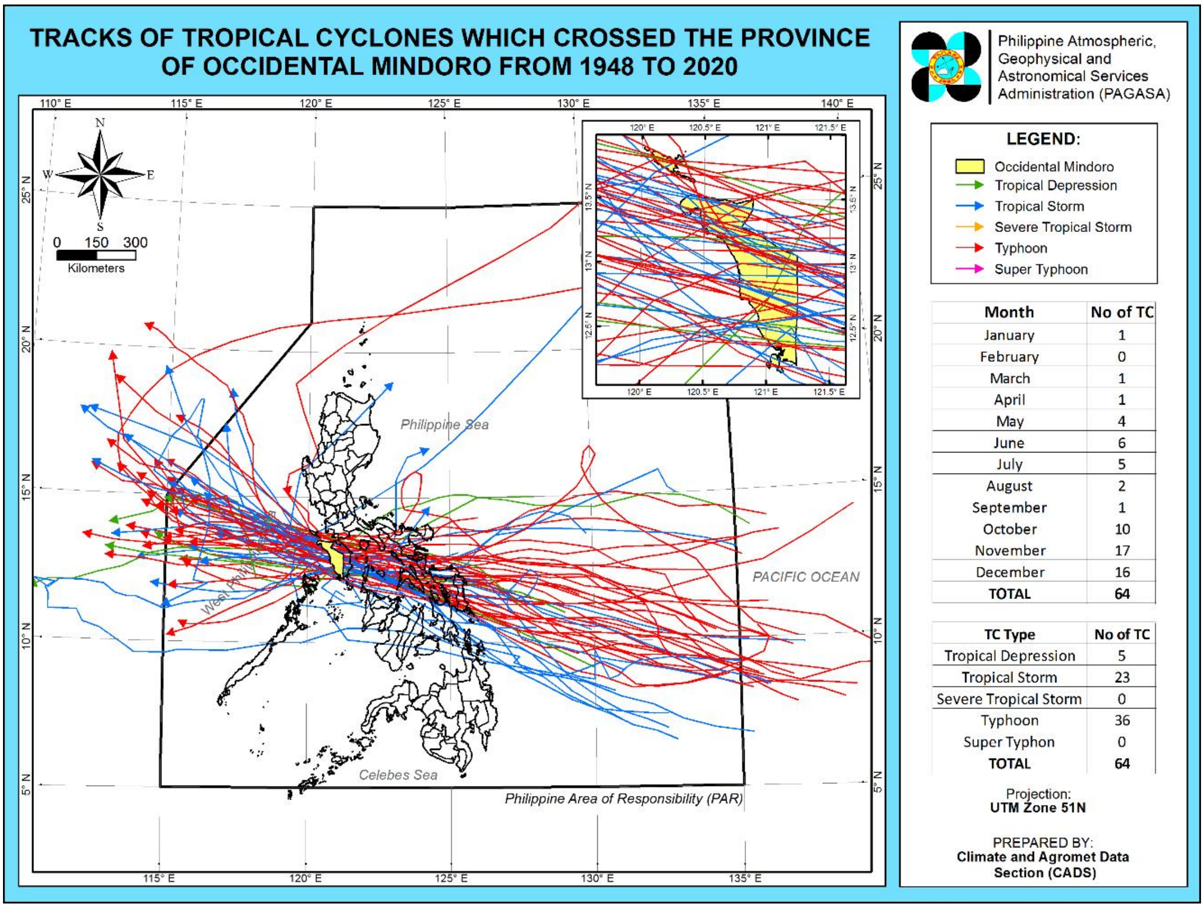
YEAR	MONTH	TYPE	TC NAME	PAR BEG	PAR END	MSW
1948	12	TY	TY4819	12/12/1948	16/12/1948	
1949	7	TS	ELAINE	04/07/1949	09/07/1949	
1951	11	TY	WANDA	18/11/1951	23/11/1951	
1952	10	TD	VAE	15/10/1952	18/10/1952	
1952	10	TY	TRIX	17/10/1952	23/10/1952	
1952	10	TY	WILMA	25/10/1952	28/10/1952	
1952	12	TS	FAYE	12/12/1952	16/12/1952	
1952	12	TY	GLORIA	19/12/1952	23/12/1952	
1953	11	TS	TS5315	27/11/1953	01/12/1953	
1956	7	TS	VERA	05/07/1956	06/07/1956	
1956	12	TY	POLLY	08/12/1956	10/12/1956	
1958	10	TY	KATHY	21/10/1958	23/10/1958	
1959	11	TD	TD5914	03/11/1959	14/11/1959	
1959	12	TY	GILDA	15/12/1959	20/12/1959	
1959	12	TY	HARRIET	28/12/1959	02/01/1960	
1960	10	TY	KIT	03/10/1960	09/10/1960	130
1962	8	TS	PATSY	06/08/1962	09/08/1962	83
1962	11	TY	JEAN	05/11/1962	08/11/1962	117
1964	11	TS	MONING	27/11/1964	29/11/1964	
1966	5	TY	KLARING	12/05/1966	21/05/1966	220
1966	12	TY	ANING	25/12/1966	30/12/1966	185
1971	6	TY	MAMENG	23/06/1971	26/06/1971	140
1971	7	TY	NENENG	01/07/1971	04/07/1971	185
1971	7	TY	PEPANG	12/07/1971	16/07/1971	150
1972	11	TY	TOYANG	04/11/1972	06/11/1972	185
1974	12	TD	KADING	14/12/1974	17/12/1974	55
1978	4	TY	ATANG	18/04/1978	26/04/1978	165
1978	6	TD	DELING	27/06/1978	29/06/1978	52
1979	5	TS	KARING	10/05/1979	16/05/1979	65
1979	12	TS	KRISING	21/12/1979	23/12/1979	130
1980	3	TS	BIRING	20/03/1980	27/03/1980	75
1981	6	TS	DALING	28/06/1981	02/07/1981	93
1981	11	TY	YEYENG	17/11/1981	21/11/1981	185
1981	12	TY	DINANG	23/12/1981	27/12/1981	167
1983	7	TY	AURING	09/07/1983	11/07/1983	122
1983	9	TD	MAMENG	29/09/1983	01/10/1983	55
1986	10	TY	PASING	10/10/1986	14/10/1986	130
1986	10	TS	RUPING	17/10/1986	20/10/1986	75
1986	11	TS	TERING	06/11/1986	09/11/1986	65
1986	11	TS	UDING	10/11/1986	14/11/1986	85
1987	8	TY	HERMING	08/08/1987	14/08/1987	260
1987	11	TS	ROSING	11/11/1987	16/11/1987	65
1987	11	TY	SISANG	23/11/1987	26/11/1987	220
1987	12	TY	TRINING	14/12/1987	19/12/1987	140
1988	1	TY	ASIANG	14/01/1988	17/01/1988	160
1988	6	TS	EDENG	26/06/1988	28/06/1988	65
1988	11	TY	YONING	05/11/1988	08/11/1988	175

YEAR	MONTH	TYPE	TC NAME	PAR BEG	PAR END	MSW
1989	6	TS	KURING	04/06/1989	08/06/1989	75
1993	12	TY	NANING	06/12/1993	12/12/1993	110
1994	5	TS	DELING	22/05/1994	25/05/1994	55
2000	11	TS	TOYANG	27/11/2000	02/12/2000	105
2004	11	TY	UNDING	14/11/2004	21/11/2004	120
2006	5	TY	CALOY	09/05/2006	15/05/2006	160
2006	6	TS	DOMENG	24/06/2006	26/06/2006	75
2006	12	TY	SENIANG	07/12/2006	12/12/2006	130
2007	11	TS	LANDO	19/11/2007	27/11/2007	130
2008	11	TS	QUINTA	06/11/2008	11/11/2008	85
2011	10	TS	RAMON	10/10/2011	13/10/2011	55
2012	10	TS	OFEL	22/10/2012	26/10/2012	85
2014	12	TY	RUBY	04/12/2014	10/12/2014	215
2015	12	TY	NONA	12/12/2015	16/12/2015	150
2019	11	TY	TISOY	30/11/2019	05/12/2019	175
2019	12	TY	URSULA	23/12/2019	28/12/2019	140
2020	10	TY	QUINTA	23/10/2020	27/10/2020	150
TC Type		No of TC	Month	No of TC	Month	No of TC
Tropical Depression		5	January	1	July	5
Tropical Storm		23	February	0	August	2
Severe Tropical Storm		0	March	1	September	1
Typhoon		36	April	1	October	10
Super Typhoon		0	May	4	November	17
TOTAL		**64**	June	6	December	16
					TOTAL	**64**



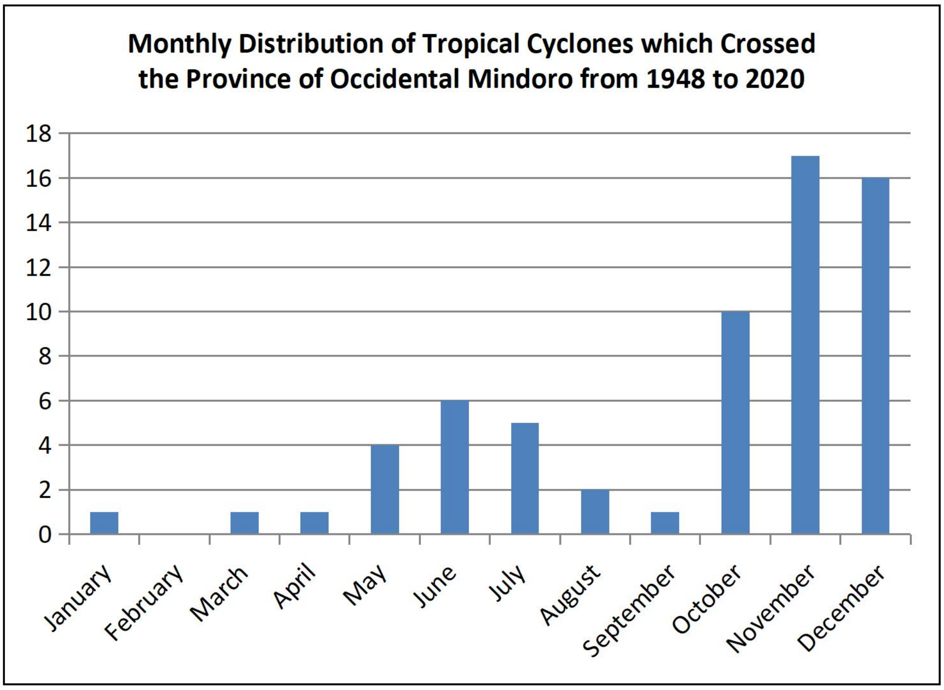
Source: PAGASA

Figure 2.2.3-4. Tropical Cyclone Passage



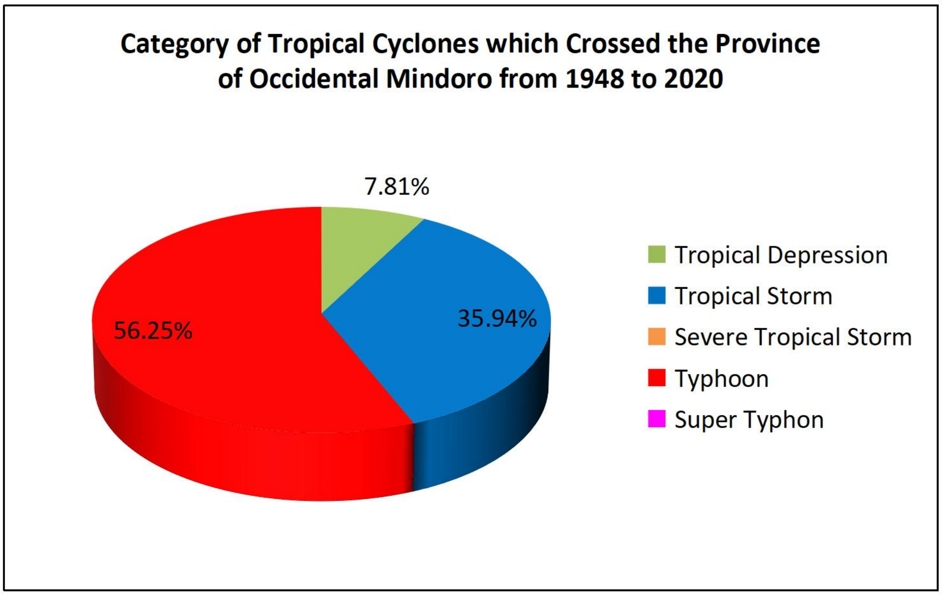
Source: PAGASA CADS

Figure 2.2.3-5. Tropical Cyclones Which Crossed the Province of Occidental Mindoro from 1948 to 2020



Source: PAGASA

Figure 2.2.3-6. Monthly Distribution of Tropical Cyclones which Crossed Occidental Mindoro from 1948 to 2020



Source: PAGASA

Figure 2.2.3-7. Category of Tropical Cyclones which Crossed Occidental Mindoro from 1948 to 2020

Data on Climate Change Using PAGASA Medium-Term Projections

Below are the tables for climatic projections of PAGASA for Occidental Mindoro.

Table 2.2.3-4. *Projected Changes in Seasonal Rainfall in the Mid-21st Century (2036-2065) for Occidental Mindoro Relative to 1971-2000*

Season	Scenario	Range*	Projected Change		Projected Seasonal Rainfall Amount (mm)
			Percent (%)	Rainfall amount (mm)	
December-January-February (DJF) Observed baseline = 160 mm	Moderate Emission (RCP4.5)	Lower Bound	-1.7	-2.7	156.8
		Median	13.2	21.1	180.6
		Upper Bound	52.3	83.4	242.9
	High Emission (RCP8.5)	Lower Bound	-1.4	-2.2	157.3
		Median	9.5	15.1	174.6
		Upper Bound	25.9	41.2	200.7
March-April-May (MAM) Observed baseline = 266 mm	Moderate Emission (RCP4.5)	Lower Bound	-5.0	-13.3	252.6
		Median	2.6	6.9	272.8
		Upper Bound	12.7	33.7	299.6
	High Emission (RCP8.5)	Lower Bound	-18.3	-48.7	217.2
		Median	-3.3	-8.7	257.2
		Upper Bound	23.3	62.0	327.9
June-July-August (JJA) Observed baseline = 1091 mm	Moderate Emission (RCP4.5)	Lower Bound	-25.1	-273.7	817.5
		Median	-20.6	-224.4	866.8
		Upper Bound	3.6	39.0	1130.2
	High Emission (RCP8.5)	Lower Bound	-28.1	-307.0	784.2
		Median	-13.0	-141.4	949.8
		Upper Bound	11.6	126.4	1217.6
September-October-November (SON) Observed baseline =	Moderate Emission (RCP4.5)	Lower Bound	-19.5	-148.8	613.8
		Median	-3.0	-22.6	740.0
		Upper Bound	4.2	31.7	794.3
	High Emission	Lower Bound	-18.1	-137.7	624.9

Season	Scenario	Range*	Projected Change		Projected Seasonal Rainfall Amount (mm)
			Percent (%)	Rainfall amount (mm)	
		Median	-3.6	-27.5	735.1
		Upper Bound	7.9	59.9	822.5

** upper: 90th percentile; median: 50th percentile; lower: 10th percentile*
Source: PAGASA Climap

Table 2.2.3-5. *Projected Changes in Seasonal Temperature in the Mid-21st Century (2036-2065) for Occidental Mindoro relative to 1971-2000*

Season	Scenario	Range*	Projected Change	
			Change in °C	Projected
December-January-February (DJF) Observed baseline = 26.5 °C	Moderate Emission (RCP4.5)	Lower Bound	1.0	27.5
		Median	1.3	27.8
		Upper Bound	1.7	28.2
	High Emission (RCP8.5)	Lower Bound	1.3	27.8
		Median	1.6	28.1
		Upper Bound	2.0	28.5
March-April-May (MAM) Observed baseline = 28.3 °C	Moderate Emission (RCP4.5)	Lower Bound	1.0	29.3
		Median	1.3	29.6
		Upper Bound	1.8	30.1
	High Emission (RCP8.5)	Lower Bound	1.4	29.7
		Median	1.7	30.0
		Upper Bound	2.3	30.6
June-July-August (JJA) Observed baseline = 27.3 °C	Moderate Emission (RCP4.5)	Lower Bound	0.9	28.2
		Median	1.2	28.5
		Upper Bound	1.7	29.0
	High Emission (RCP8.5)	Lower Bound	1.4	28.7
		Median	1.5	28.8
		Upper Bound	2.2	29.5
September-October-November (SON) Observed baseline = 27.1 °C	Moderate Emission (RCP4.5)	Lower Bound	1.0	28.1
		Median	1.1	28.2
		Upper Bound	1.8	28.9
	High Emission (RCP8.5)	Lower Bound	1.4	28.5
		Median	1.5	28.6
		Upper Bound	2.2	29.3

** upper: 90th percentile; median: 50th percentile; lower: 10th percentile*
Source: PAGASA Climap

2.2.3.2 Air Quality
2.2.3.2.1 Degradation of Ambient Air Quality

Air quality assessment was done with the use of air quality index (AQI) of Plume Labs[1] to describe the ambient air condition for a given time and day of the municipalities of Rizal and San Jose in Occidental Mindoro where the proposed project will be located. The plume AQI was calculated using Plume Labs[2] technology. The higher the value of AQI in the area, the greater its air pollution, which has a higher impact to human health. On the other hand, lower AQI in the area presents reduced air pollution, which translates to lesser impact to human health.

1 https://plumelabs.com/en/

2 Plume Labs uses World Health Organization (WHO) guidelines as well as international standards developed by the United States Environmental Protection Agency (EPA) and other scientific studies to define the Plume AQI and its seven associated categories.
The Plume AQI takes into account the concentrations of all different harmful pollutants your Flow is measuring and its overall value comes from the level of whichever pollutant is currently having the greatest impact on your health.

Table 2.2.3-6 shows the measured AQI in the area on October 9, 2023 while **Table 2.2.3-7** explains the plume index categories.

Measured AQIs were 30 and 37 for Rizal and San Jose, respectively. Both fall within the plume index range of 20-50 or moderate pollution level, which is still considered acceptable, with risk to certain people with health concerns for long-term exposure. San Jose, which has a slightly higher AQI has a higher population and with more existing economic activities.

Table 2.2.3-6. *Ambient Air Quality Data*

Location	Monitoring Date	Plume AQI
Rizal, Occidental Mindoro	October 9, 2023	30
San Jose, Occidental Mindoro	October 9, 2023	37

Table 2.2.3-7. *Seven Categories of Plume Index*

Range	Level of Air Pollution	Impact /Risk	Description
0-20	Fresh Air	No risk	The air is pure, ideal for outdoor activities !
20-50	Moderate pollution	Impact risk if chronic exposure	The air is moderately polluted. Greater than the maximum limit established for one year by WHO. A long-term exposure constitutes a health risk.
51-100	High pollution	Impact if chronic exposure	The air has reached a high level of pollution. Higher than the maximum limit for 24 hours established by WHO.
100-150	Very high pollution	Immediate impact on health	The air has reached a very high level of pollution. Effects can be immediately felt by individuals at risk. Everybody feels the effects of a prolonged exposure
150-200	Excessive pollution	Immediate effects for individuals at risk	The pollution level has reached a critical level. Individuals at risk feel immediate effects. Even healthy people may show symptoms for short exposures.
200-300	Extreme pollution	Immediate effects for everybody	The pollution has reached extreme levels. Immediate effects on health
>300	Airpocalypse	Major immediate effects	Airpocalyse! Immediate and heavy effects on everybody.

2.2.3.3 Noise

2.2.3.3.1 Increase in Ambient Noise Level

Noise level monitoring was conducted on October 9, 2023, all within the daytime period (9:00 am – 6:00 pm). A Digital Lutron® Model SL-4013 non-integrating type 2 sound level meter that meets the American National Standard Institute (ANSI) standard and IEC type 2 specifications was used in measuring noise level. Seven noise monitoring stations were established near the critical receptor areas to determine baseline noise levels.

On-site measurements for low and high parameters were taken. The sound level meter (SLM) was set to a weighting network and slow response during measurement. A pre-test calibration allows the response of the SLM to match the 94 decibel signal provided by the calibrator. Post-Test calibration was likewise done after each measurement and to verify that the SLM response has not drifted by more than 1 decibel from the 94 decibel output of the calibrator.

The median values of all instantaneous noise values per station are compared with the noise limit, applicable for Class A (residential areas) as shown in the following table.

Table 2.2.3-8. *Maximum Allowable Noise Levels in General Areas*

Category[1]	Maximum Allowable Noise (dBA) by Time Periods[2]		
	Daytime	Morning/Evening	Nighttime
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

Note: [1]**Class AA** - a section of contiguous area, which requires quietness, such as areas within 100 meters from school sites, nursery schools, hospitals and special houses for the aged; **Class A** - a section of contiguous area, which is primarily used for residential areas; **Class B** – a section or contiguous area, which is primarily a commercial area; **Class C** – a section primarily zoned or used as a light industrial area and **Class D** – a section, which is primarily reserved, zoned or used as a heavy industrial area. [2]**Morning** - 5:00 A.M. to 9:00 AM; **Daytime** - 9:00 A.M. to 6:00 P.M; **Evening** - 6:00 P.M. to 10:00 P.M.; **Nighttime** - 10:00 P.M. to 5:00 A.M.

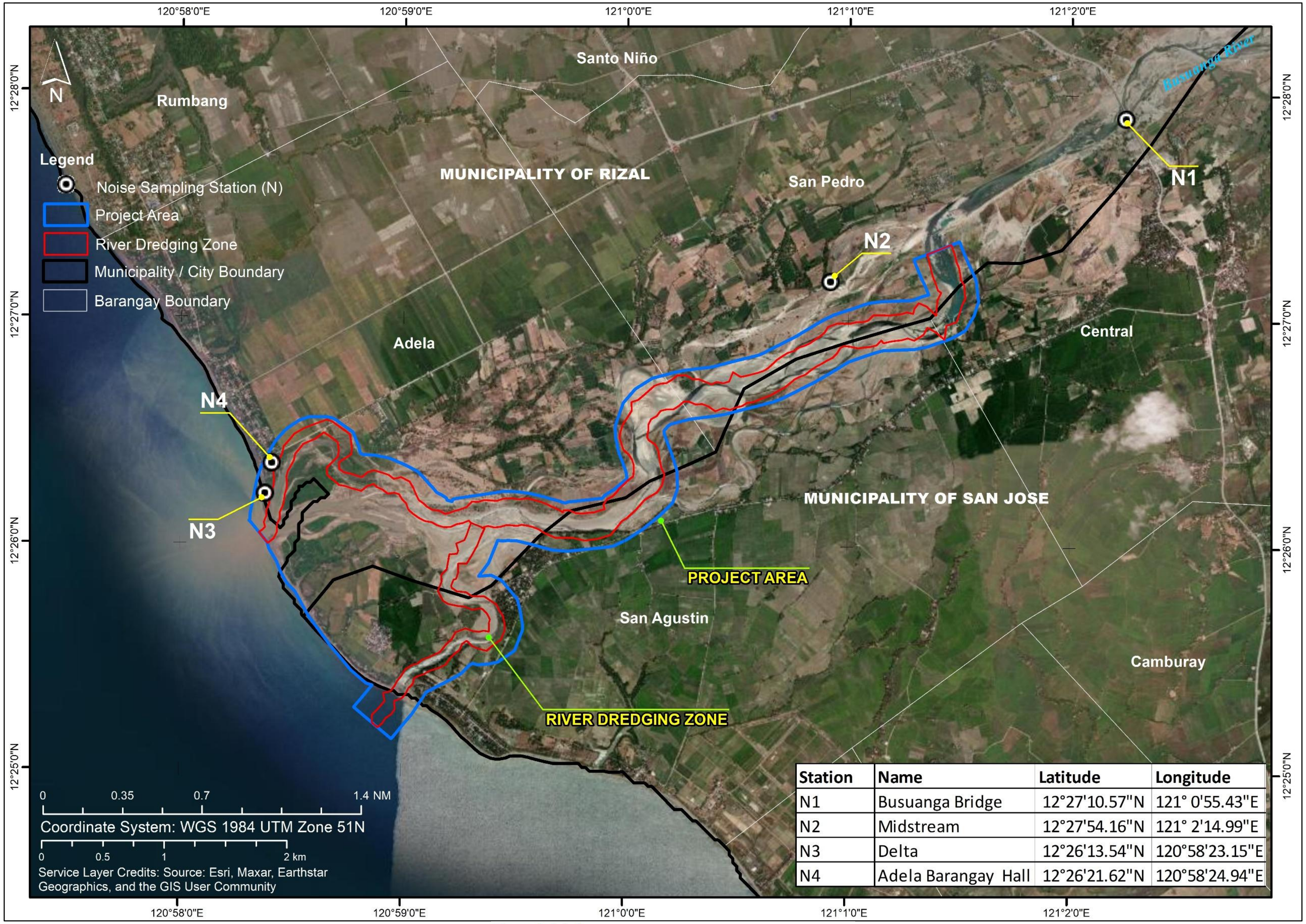
The noise level sampling locations and descriptions are listed in **Table 2.2.3-9** and illustrated in **Figure 2.2.3-7**.

Table 2.2.3-9. *Ambient Noise Level Measurement Results - Daytime Period (October 9, 2023)*

Station ID	Location	Latitude	Longitude	Time of Sampling	Noise (dB)		Remarks
N1	Busuanga Bridge (S end)	12°27'10.57"	121° 00'55.43"	morning	Min	61.1	Vehicles passing
					Max	70.7	
					Ave	**65.9**	
N2	Midstream at DPWH Dike (NE)	12°27'54.16"	121° 02'14.99"	morning	Min	37	Windy
					Max	70.7	
					Ave	**53.8**	
N3	Delta	12°26'13.54"	120°58'23.15"	morning	Min	39.2	Windy
					Max	68.4	
					Ave	**53.8**	
N4	Adela Barangay Hall	12°26'21.62"	120°58'24.94"	morning	Min	44.1	Motorcycle passing
					Max	67.3	
					Ave	**55.7**	
	DENR (NPCC) Standard (Class A)					**55**	

The station at the bridge (N1), and Barangay Hall of Adela (N4), recorded noise levels that exceed the DENR standard for Class A. As expected, the stations that are distant from dense human activities or the community registered acceptable noise levels (N3- river delta & N2-midstream)

In general, the highest peak noise readings in stations N1 and N4 were contributed by passing vehicles, gusts of wind and people chatting. N1 and N2 registered the highest level of noise at 70.7 dB while the lowest is at N1 (midstream) with 37 dB.



Station	Name	Latitude	Longitude
N1	Busuanga Bridge	12°27'10.57"N	121° 0'55.43"E
N2	Midstream	12°27'54.16"N	121° 2'14.99"E
N3	Delta	12°26'13.54"N	120°58'23.15"E
N4	Adela Barangay Hall	12°26'21.62"N	120°58'24.94"E

Figure 2.2.3-8. Noise Sampling Stations Location Map

Photo Documentation

N1. Busuanga Bridge

N2. Midstream

N3. Delta

N4. Adela Barangay Hall

Plate 2.2.3-1. Noise Sampling Stations N1 to N4

2.2.4. PEOPLE

2.2.4.1 In-migration. Proliferation of Informal Settlers

2.2.4.1.1 Demography

Background

The proposed project is the dredging works along the lower reaches of Busuanga River with a total length of 10,550.0 meters from the river mouth.

The Project area is located between the municipalities of Rizal (barangays Adela and San Pedro) and San Jose (barangays San Agustin and Central), Occidental Mindoro. The river basically acts as a boundary for both municipalities. The two municipalities are connected by the Busuanga Bridge.

Rizal is a 3rd class municipality in the province of Occidental Mindoro. It is 153 kilometers from Mamburao. Rizal is politically subdivided into 11 barangays each consisting of puroks and some have sitios. According to the 2020 census, it has a population of 40,429 people.

On the other hand, the Municipality of San Jose, Occidental Mindoro is a typical tropical community endowed with a generally gentle to rolling terrain which is rich in biodiversity resources that can be tapped and developed to enable the Municipality achieves what it plans for and regain its being one of the progressive municipalities of the province.

The Municipality of San Jose is strategically located about 130 kilometers southeast from the Provincial Capital of Occidental Mindoro belonging to Region IV-B (MIMAROPA). San Jose is approximately 230 nautical miles from the National Capital Region. It is geographically located at 121°15‘00” to 120°55‘00” east longitude and 120°10‘00” to 120°40‘00” north latitude. It shares a common boundary with Rizal on the north, Mansalay on the northeast, Magsaysay on the east and southeast; and at the Southern and Western Side, it is bounded by the Mindoro Strait.

Land Area

The Municipality of Rizal is a coastal municipality in the province of Occidental Mindoro. It has a total land area of 242.50 square kilometers which constitutes 4.14% of Occidental Mindoro’s total area.

The entire municipal territory of San Jose occupies a total land area of 67,068.61 hectares, which is 11.41% of the total land area of the province of Occidental Mindoro with a total land area of 587,985 hectares. Included in the mainland territory of San Jose are the three (3) islands namely the Buri Island, Cauicay Island and Manadi Island.

See Table 2.2.4-1 for the land area per barangay.

Table 2.2.4-1. Land Area by Barangay of San Jose

No.	Barangay	CLUP 2001-2010 (in hectares)	CLWUP 2017-2027 (in hectares)
Urban Barangays			
1	Bagong Sikat	375.00	559.08
2	Barangay 1	4.00	5.70
3	Barangay 2	4.00	8.87
4	Barangay 3	10.28	11.20
5	Barangay 4	6.86	8.66
6	Barangay 5	2.14	8.67
7	Barangay 6	6.48	6.71
8	Barangay 7	16.31	10.94
9	Barangay 8	3.97	6.31
10	Bubog	1760	1,351.27
11	Caminawit	77.09	170.58
12	Labangan Poblacion	850.00	718.33
13	Pag-asa	195.31	171.60
14	San Roque	241.00	298.75

No.	Barangay	CLUP 2001-2010 (in hectares)	CLWUP 2017-2027 (in hectares)
	Sub-Total	**3552.44**	**3,336.67**
Mainland Rural Barangays			
1**	Batasan	9,000.00	10,123.48
2	Bayotbot	5,000.00	2,396.02
3	Camburay	1,137.50	1,055.85
4	Central	2,540.00	3,624.87
5	La Curva	1,260.00	879.36
6	Mabini	427.00	513.40
7	Magbay	726.00	703.75
8	Mangarin	1,625.00	1,655.70
9*	Mapaya	4,890.00	4,288.68
10*	Monteclaro	9,662.00	20,208.21
11	Murtha	4,075.00	4,942.82
12	San Agustin	1,582.50	1,644.05
13	San Isidro	957.00	735.22
	Sub-Total	**42,882.00**	**52,771.42**
Rural-Island Barangays			
1	Ambulong	1037.5	1,033.41
2	Ansiray	1125	775.21
3	Bangkal	542.5	603.19
4	Buri	575	641.83
5	Catayungan	545	502.32
6	Ilin Proper	1025	1,398.05
7	Inasakan	470	483.02
8	Ipil	712	606.64
9	Labangan Ilin	820	689.10
10	Natandol	595	477.53
11	Pawican	1312	1,002.03
	Sub-Total	**8759.00**	**8212.34**
Small Islands			
1	Cauicay Island		1.06
2	Buri Island		5.23
3	Manadi Island		2.27
	Sub-Total	**0.00**	**8.56**
Barangay in conflict (not yet resolved)			
	Barangay ith other Barangay		
1	VS W/ BATASAN AND MONTECLARO		2,299.44
2	VS W/ CAMBURAY AND SAN ISIDRO		23.52
3	VS W/ CATAYUNGAN AND NATANDOL		97.81
4	VS W/ CENTRAL AND SAN ISIDRO		101.20
5	VS W/ LAPANGAN AND MABINI		27.87
6	VS W/ MANGGARIN AND MAPAYA		51.83
7	VS W/ PWICAN AND NATANDOL		68.35
8	VS W/ SAN ISIDRO AND LACURVA		69.58
	Sub-Total	**0.00**	**2,739.61**
	Grand Total	**55,192.94**	**67,068.61**

Source: Municipal Planning Development Office Data

The difference between the total area in the 2000 CLWUP compared with the 2017 CLWUP was that there was no actual determination of the total area of the Municipality. Neither the islands nor some of the service areas of the Municipality has undergone GIS and comprehensive mapping.

Population Size

The population of the Municipality of Rizal as determined by the 2020 Census was 40,429. This represented 7.70% of the total population of Occidental Mindoro, or 1.25% of the overall population of the MIMAROPA Region. Based on these figures, the population density is computed at 167 inhabitants per square kilometer.

The 2020 population of the Municipality of San Jose was 153,267 representingg 29.17% of the total population of Occidental Mindoro, or 4.75% of the overall population of the MIMAROPA Region. Based on these figures, the population density is computed at 343 inhabitants per square kilometer.

- Indigenous Tribe

As per CBMS of San Jose in 2013-2014, it was recorded that of the 64,233 male population of the municipality, 2,215 or 215% of it were members of the indigenous tribes, whereas, of the total 61,628 female population of the municipality, 2,078 or 3.37% were also members of an indigenous tribe. In the overall count of the population conducted thru the CBMS, 4,293 or 3.41% of the 125,861 male-female population are members of the indigenous tribe.

Of the 38 barangays in San Jose, only 17 barangays like Barangays Poblacion, 1 & 4, Batasan, Bubog, Camburay, Caminawit, Central, La Curva, Labangan Poblacion, Mabini, Magbay, Murtha, Monteclaro, San Agustin, San Isidro, San Roque) declared to have members of indigenous tribe in their community. The two barangays that registered quite a number of their population belong to an indigenous tribes are Monteclaro with 2,436 or 63.06% while Batasan has 1,367 or 27.64% members of its population.

Table 2.2.4-2. Population of Rizal and San Jose: 2020

Barangay	Population Percentage (2020)	Population (2020)	Population (2015)	Change (2015-2020)	Annual Population Growth Rate (2015-2020)
Municipality of Rizal					
1. Adela	10.39%	4,199	3,451	21.67%	4.22%
2. Aguas	6.25%	2,527	2,665	-5.18%	-1.11%
3. Magsikap	8.30%	3,357	3,240	3.61%	0.75%
4. Malawaan	14.43%	5,834	5,285	10.39%	2.10%
5. Manoot	14.69%	5,938	5,681	4.52%	0.94%
6. Pitogo	6.01%	2,429	2,513	-3.34%	-0.71%
7. Rizal	7.98%	3,226	3,327	-3.04%	-0.65%
8. Rumbang	9.74%	3,936	3,524	11.69%	2.35%
9. Slavacion	6.44%	2,605	2,357	10.52%	2.13%
10. San Pedro	6.13%	2,477	2,703	-8.36%	-1.82%
11. Santo Nino	9.65%	3,901	3,517	10.92%	2.21%
Total Rizal		**40,429**	**38,263**	**5.66%**	**1.17%**
Municipality of San Jose					
1. Ambulong	1.59%	2,435	2,224	9.49%	1.93%
2. Ansiray	0.60%	912	1,032	-11.63%	-2.57%
3. Bagong Sikat	5.04%	7,724	6,564	17.67%	3.48%
4. Bangkal	0.62%	944	933	1.18%	0.25%
5. Brgy 1 (Poblacion)	0.15%	227	283	-19.79%	-4.54%
6. Brgy 2 (Poblacion)	0.25%	381	415	-8.19%	-1.78%
7. Brgy 3 (Poblacion)	0.81%	1,249	1,323	-5.59%	-1.20%
8. Brgy 4 (Poblacion)	0.54%	829	500	65.80%	11.23%
9. Brgy 5 (Poblacion)	1.07%	1,640	1,569	4.53%	0.94%
10. Brgy 6 (Poblacion)	0.18%	274	398	-31.16%	-7.56%
11. Brgy 7 (Poblacion)	0.37%	567	436	30.05%	5.69%
12. Brgy 8 (Poblacion)	0.26%	394	348	13.22%	2.65%
13. Batasan	2.38%	3,643	6,260	-41.81%	-10.77%
14. Bayotbot	1.91%	2,935	2,492	17.78%	3.50%
15. Bubog	7.04%	10,792	9,356	15.35%	3.05%
16. Buri	0.42%	647	607	6.59%	1.35%
17. Camburay	1.24%	1,896	1,849	2.54%	0.53%
18. Caminawit	7.71%	11,810	12,223	-3.38%	-0.72%

Barangay	Population Percentage (2020)	Population (2020)	Population (2015)	Change (2015-2020)	Annual Population Growth Rate (2015-2020)
19. Catayungan	0.72%	1,110	1,021	8.72%	1.77%
20. Central	7.95%	12,178	10,901	11.71%	2.36%
21. Iling Proper	1.45%	2,217	2,124	4.38%	0.91%
22. Inasakan	0.46%	712	625	13.92%	2.78%
23. Ipil	0.54%	829	789	5.07%	1.05%
24. La Curva	2.08%	3,185	3,034	4.98%	1.03%
25. Labangan Iling	0.79%	1,209	1,070	12.99%	2.60%
26. Labangan Poblacion	6.26%	9,596	9,683	-0.90%	-0.19%
27. Mabini	2.30%	3,518	2,938	19.74%	3.87%
28. Magbay	2.99%	4,583	4,299	6.61%	1.36%
29. Mangarin	2.38%	3,647	3,410	6.95%	1.42%
30. Mapaya	5.65%	8,665	7,982	8.56%	1.74%
31. Monte Claro	2.99%	4,589	3,855	19.04%	3.74%
32. Murtha	4.17%	6,391	5,985	6.78%	1.39%
33. Naibuan	2.23%	3,420	NULL	NULL	NULL
34. Natandol	0.93%	1,426	1,521	-6.25%	-1.35%
35. Pag-asa	7.83%	12,001	11,232	6.85%	1.40%
36. Pawican	1.28%	1,956	2,295	-14.77%	-3.31%
37. San Agustin	3.27%	5,019	5,363	-6.41%	-1.39%
38. San Isidro	1.30%	1,996	1,785	11.82%	2.38%
39. San Roque	10.26%	15,721	14,706	6.90%	1.41%
Total San Jose	**153,267**	**143,430**	**6.86%**	**1.41%**	

Source: 2020 Census of Population. PSA

Historical Growth of Population

The population of Rizal grew from 12,108 in 1970 to 40,429 in 2020, an increase of 28,321 people over the course of 50 years. The latest census figures in 2020 denote a positive growth rate of 1.09%, or an increase of 2,166 people from the previous population of 38,263 in 2015.

San Jose is the most densely populated area in the province, with a 2.38% annual growth. Out of the total population of 143,430 people, about 42% reside in urban area while 58% are situated in rural barangays. The majority of the population consists of a mix of migrants of different ethnolinguistic groups from nearby provinces, namely: Tagalogs, Bicolanos, Visayans, Kapampangans, Pangasinans and Ilocanos. Some 2% of its population belong to the indigenous Mangyan peoples, primarily the Hanunuo and Buhid tribes.

Please see the table below.

Table 2.2.4-3. Historical Growth of Population

Census Date	Population	Growth Rate
Municipality of Rizal		
1970	12,108	-
1975	14,938	+4.30%
1980	18,609	+4.49%
1990	23,379	+2.31%
1995	27,112	+2.81%
2000	29,785	+2.04%
2007	32,065	+1.02%
2010	34,458	+2.65%
2015	38,263	+2.01%
2020	40,429	+1.09%
Municipality of San Jose		
1903	1,764	-

Census Date	Population	Growth Rate
1918	7,703	+10.33%
1939	11,788	+2.05%
1948	12,443	+0.60%
1960	36,211	+9.31%
1970	44,761	+2.14%
1975	53,100	+3.49%
1980	66,262	+4.53%
1990	87,520	+2.82%
1995	101,411	+2.80%
2000	111,009	+1.96%
2007	118,807	+0.94%
2010	131,188	+3.67%
2015	143,430	+1.71%
2020	153,267	+1.31%

Source: 2020 Census of Population., PSA

Male-Female Population/ Gender Profile

- **Municipality of Rizal**

According to the 2015 Census, the age group with the highest population in Rizal is *5 to 9*, with 4,909 individuals. Conversely, the age group with the lowest population is *75 to 79*, with 250 individuals. (Table 2.2.4-5)

Combining age groups together, those aged *14 and below*, consisting of the young dependent population which include infants/babies, children and young adolescents/teenagers, make up an aggregate of 38.64% (14,783). Those aged *15 up to 64*, roughly, the economically active population and actual or potential members of the workforce, constitute a total of 57.17% (21,875). Finally, old dependent population consisting of the senior citizens, those aged *65 and over*, total 4.19% (1,605) in all.

The computed Age Dependency Ratios mean that among the population of Rizal, there are 68 youth dependents to every 100 of the working age population; there are 7 aged/senior citizens to every 100 of the working population; and overall, there are 75 dependents (young and old-age) to every 100 of the working population.

The median age of 21 indicates that half of the entire population of Rizal are aged less than 21 and the other half are over the age of 21.

- **Municipality of San Jose**

According to the 2015 Census, the age group with the highest population in San Jose is *5 to 9*, with 17,247 individuals. Conversely, the age group with the lowest population is *80 and over*, with 822 individuals. (Table 2.2.4-5)

Combining age groups together, those aged *14 and below*, consisting of the young dependent population which include infants/babies, children and young adolescents/teenagers, make up an aggregate of 36.00% (51,639). Those aged *15 up to 64*, roughly, the economically active population and actual or potential members of the work force, constitute a total of 59.90% (85,918). Finally, old dependent population consisting of the senior citizens, those aged *65 and over*, total 4.09% (5,873) in all.

The computed Age Dependency Ratios mean that among the population of San Jose, there are 60 youth dependents to every 100 of the working age population; there are 7 aged/senior citizens to every 100 of the working population; and overall, there are 67 dependents (young and old-age) to every 100 of the working population. The median age of 22 indicates that half of the entire population of San Jose are aged less than 22 and the other half are over the age of 22.

Table 2.2.4-4. Age Dependency Ratio; 2015

Age group	Population (2015)	Age group percentage	Population (2015)	Age group percentage
	Municipality of Rizal		**Municipality of San Jose**	
Under 1	986	2.58%	3,365	2.35%
1 to 4	4,024	10.52%	13,815	9.63%
5 to 9	4,909	12.83%	17,247	12.02%
10 to 14	4,864	12.71%	17,212	12.00%
15 to 19	4,009	10.48%	15,354	10.70%
20 to 24	3,066	8.01%	12,230	8.53%
25 to 29	2,618	6.84%	10,381	7.24%
30 to 34	2,426	6.34%	9,834	6.86%
35 to 39	2,259	5.90%	8,949	6.24%
40 to 44	2,163	5.65%	7,983	5.57%
45 to 49	1,791	4.68%	7,259	5.06%
50 to 54	1,480	3.87%	5,793	4.04%
55 to 59	1,129	2.95%	4,769	3.32%
60 to 64	934	2.44%	3,366	2.35%
65 to 69	656	1.71%	2,514	1.75%
70 to 74	439	1.15%	1,463	1.02%
75 to 79	250	0.65%	1,074	0.75%
80 and over	260	0.68%	822	0.57%
Total	**38,263**	**100.00%**	143,430	**100.00%**
Youth Dependency Ratio	**67.58**		**60.1**	
Old Age Dependency Ratio	**7.34**		**6.84**	
Total Dependency Ratio	**74.92**		**66.94**	
Median Age	**20.55**		**21.93**	

The following figures demonstrate the population profile discussed above.

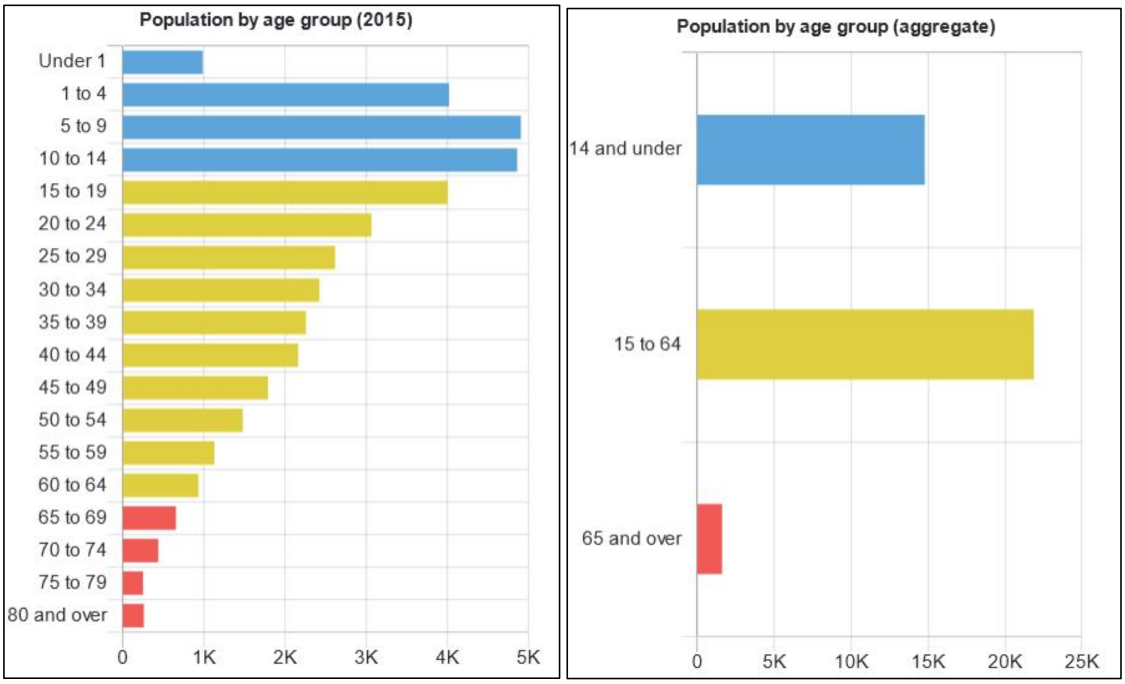


Figure 2.2.4-1. Individual age groups and Aggregate age groups of Municipality of Rizal

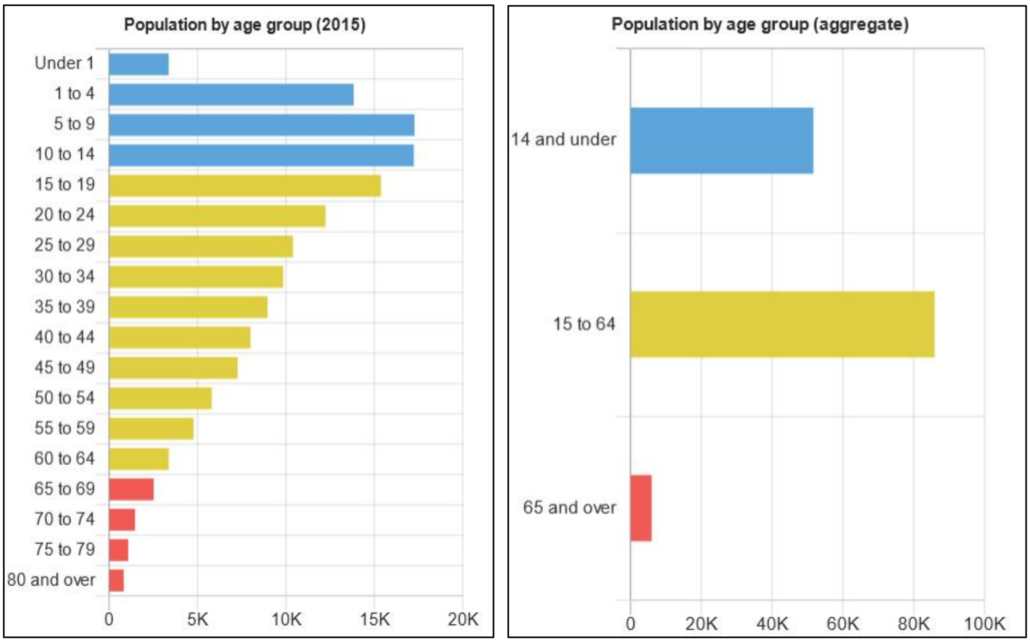


Figure 2.2.4-2. Individual age groups and Aggregate age groups of Municipality of San Jose

SOCIAL

Municipality of San Jose

Education

The Department of Education, in four districts in San Jose, faces many great challenges during the past years. Various priority programs and projects of the Department of Education seemingly demand instant results but as days gradually unfold, it successfully addresses its concerns one after the other towards better performance through Education for All (EFA) 2015.

Thus, the Local Government Units and the general leadership of San Jose put a premium on education in molding responsible citizenry, hopefully achieving the very foundation of a strong community. So far, it seems, that the Department of Education and the LGU join forces in the Comprehensive Land and Water Use Plan (CLWUP) Of The Municipality Of San Jose, Occidental Mindoro 128 fundamental aims that education should be accessible to all at all levels. The municipality continues to pour out their support and assistance to every Department of Education program and project which leads to the establishment of additional classrooms for the preschools, elementary and secondary schools, creation of both nationally and locally funded items of teachers, donations of educational materials for learning and enrichment of pupils and students. The LGU's intensification of the Alternative Learning System (ALS) which focuses on functional literacy and skills training aims to support and maintain participation rate and to provide livelihood and entrepreneurial skills to its target beneficiaries.

Educational Facilities

Seventy five (75) public and private elementary schools are in the locality with complete elementary education including minority and primary schools. In the case of the secondary level, there are five (5) private and seven (7) public high schools. These 12 secondary schools of San Jose have enough teaching staff to meet the needs of their secondary students.

On the other hand, there are 5 tertiary schools in the municipality which further enhance the education of the community people. With respect to the tertiary level, the Divine World College (DWC) offers degree courses while the Occidental Mindoro National College (OMNC) offers both the degree and vocational courses. The Abellada Technical School, Info net, and the Mindoro School of Electronics are purely vocational schools. Generally, the schools in San Jose are all dispersed in the locality to make them accessible to the students.

Literacy Rate

Children at various age levels attending schools

1. **Children 6-11 years old attending and/or not attending elementary education**

Based on the CBMS 2013-2014 data. Records show that there were more males (9,185) than females (8,630) during the period among the 38 barangays of the municipality. Of the total number of males between 6 to 11 years old, 940 or 10.23% did not attend elementary education, whereas, among the females group, 819 or 9.49% were not able to attend the elementary level. Overall, though, the literacy rate among the 6-11 years old was about 89.77% for males and 90.51% among females. It shows a general literacy rate of 90.13%.

2. **Children aged 12-15 years old who are not attending and attending the high school education**

There are 10,928 ages 12-15 years old, males are dominant with 5,605 or 51.29% as compared to females which recorded 5,323 or 48.71% only. Of the total number of males, 3,339 or 59.57% did not attend high school level while among the females group, 2,731 or 51.31% were not able to attend high school education.

The general literacy rate of females is at 48.69% which is relatively higher than the males group at 40.43% with a general literacy rate of 44.445%.

3. **Children 6-15 years old attending or not attending secondary education**

It is worth noting in this bracket that those in the urban barangays had a higher literacy rate at 93.72% compared to the Rural (Mainland) Classified Barangays which is 90.46% and the Rural Island Barangays general literacy rate 92.74. Higher literacy in urban barangays could be attributed to the accessibility and presence of schools (public & private) in the area. In all instances in this bracket, the female students had a higher literacy rate of 93.40% compared to the male students with 91.01%.

4. Literacy rate of persons ages 10 years old and above

The CBMS Census of 2013-2014 shows a total of 86,126 persons ages 10 years old and above, of which 43,835 or 50.90% were males and 42,291 or 49.10% were females.

From the data obtained, it was found out that of the 2,101 were found to be illiterate, 1,104 or 52.55% were males and 997 or 47.45% were females. Among the barangays with higher illiteracy, Murtha registered an illiteracy rate of 14.37%, followed by Monteclaro at 13.99%.

Of the total literates of 84,025, 42,731 or 50.86% were males and 41,294 or 49.15% were females. The barangays with high literacy rate among its 10 years old above per gender during the period under consideration were Poblacion 6 and Poblacion 8 at 100% literacy level.

2.2.4.1.1.1 Impact Assessment on In-migration/ Proliferation of Informal Settlers

The Project will contribute to the in-migration, though minimal, due to employment opportunities that will be brought about by the project. With this, the existing demographic data will be affected, specifically with respect to the following:

- Increased population of host barangays
- increased economic activity in the area

However, the influx of migrants may be expected to be confined to locals from different barangays because preference will be given to the host community. Only if there are expertise lacking in the manpower that are provided by the locality will the Proponent look for other workers from other areas

The Proponent will encourage migrant workers to participate in social activities and social development programs to interact responsibly with the host community. Proper orientation shall be conducted in respect to establishing good relationships with the locals, respect for cultural differences, and the like.

Please refer to the figure below for the location of house clusters in the vicinity.

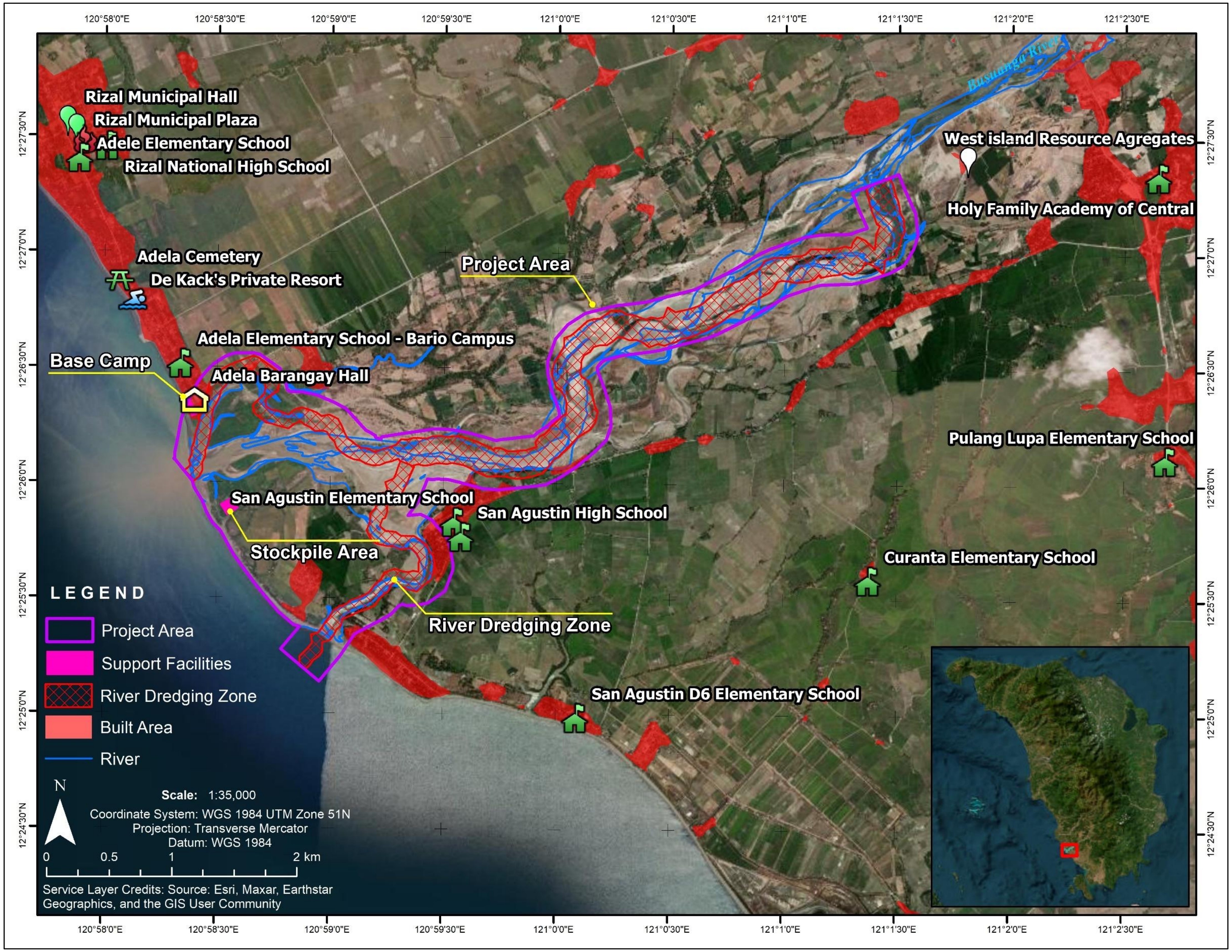


Figure 2.2.4-3. Houses Within and Around the Project Area

2.2.4.2 Threat to Delivery of Basic Services/ Resource Competition

Since the impact area comprises four barangays and 2 municipalities, hiring of skilled labor will give focus to them. However, in case of inadequacy of human resources, the company will be hiring labor from other barangays or probably from outside the municipality or province. This may have some impacts on food supply and other basic commodities. The low volume of local produce will serve as a challenge to the community to produce more, conserve what is available and develop to meet future demand.

Below is the current status of the basic services in the area.

1. **Municipality of San Jose**

Availability of Public Services in Terms of: Water Supply
San Jose is served by both Level II and III water supply. However, out of 13,111 households only 4,200 or 32.03 percent have access to the pipeline distribution system. This reveals that the majority of the households of the municipality depend on Level I systems such as shallow wells, pitcher pumps of jet-matic hand pumps and springs.

1. **Level I**

Level I water system is the primary source of water supply to 26 barangays where Level II and III water systems are inaccessible. There are around 17,771 households that depend on Level I water systems. Currently, there are 8,087 Level I water sources, of which 99.31% or 8,031 are shallow wells. Only 69% or 75% are improved in spring. However, there are few households specifically within urban areas which have open access.

2. **Level II**

Around 588 households are served by communal water faucets in Barangays Bubog, Ilin Proper, Labangan Ilin, Ipil, and Monteclaro. The same is also available in Barangay Batasan, however, household service is still unaccounted for. Three pumps and engine with a capacity range of 2-6 liters per second generating a total of 1,296,000 liters per day are being utilized to meet water demand in said barangays.

3. **Level III**

San Jose Water District provides Level III water supply in 18 barangays with 2,699 residential connections, Service area includes Barangays 1-8 (Poblacion), San Roque, Bagong Sikat, Pag-asa, Labangan Poblacion, Caminwait, Magbay, Bubog, ILin Proper and Batasan. The local water district is utilizing 13 pumpsets to facilitate water distribution. Water capacity generation per day was computed at 68 liters per second.Some of the Island Barangays also have access to a water pipeline installed in the island operated by two Barangay Water System Association (BAWASA). It also provides potable water supply in Barangays Bubog, Batasan and Monteclaro.

Availability of Public Services in Terms of: Power Supply
National Power Corporation (NAPOCOR) and Power Barge are the two sources of electric power supply distributed by the Occidental Mindoro Electric Cooperative (OMECO) servicing the 29 barangays. Power Barge is subcontracted by the NPC in order to sustain its power generators while the Municipal Government has initiated the provision of generators to the island barangays electrification project Power service is the major problem in the municipality despite the presence of NAPOCOR in the area which is distributed through Occidental Mindoro Electric Cooperative (OMECO). Provision of power is still needed in newly built houses. Fast action on power failure problems is needed to ensure uninterrupted power supply in the area.

Availability of Public Services in Terms of: Communication
The Communication systems operating in the Municipality of San Jose are carried out by a number of sources, to wit:

Print Media
Newspapers, tabloids and magazines in Manila also circulate in the locality regularly, Latest issues of the magazines/print media are available upon the arrival of an airplane from Manila. Local events/current issues can be disseminated through local tabloids, such as, Ang Bagong San Jose,

Tamaraw Bulletin (regional circulation), Mindoro Times (Oriental and Occidental circulation), and Mindoro Guardian. For the Ang Bagong San Jose, the distribution is done monthly with around 1,000 copies while Tamaraw Bulletin has new issues weekly with around 1,200 copies, respectively.

Telecast
Television programming from Metro Manila Channels and other international entertainment channels can be clearly watched through cable network subscription either L&S CATV or Ultimate CATV. Both are using satellite disc for reception and cable for transmission. Broadband internet services are likewise available through the numerous internet cafes located in the poblacion area.

Telephone
There are five telephone companies in the town, namely: Wireless PLDT, Smart, Globe, Sun Cellular, and Western Union. Those who failed to subscribe from PLDT may have an option to use cellular phones provided by SMART or utilize public calling stations by other companies or payphones using card systems by PLDT. Operator assisted public calling offices are available from 6:00 A.M. to 9 P.M. while the PLDT card system offers 24 hours service.

Broadcast Media
Aside from the local radio stations, two AM (DZYM and DZVT), and four FM (Bambi FM, Heart FM, Spirit FM and Radyo Natin FM), and DZRH can be clearly heard over radio transistor while other Manila/Panay based AM and FM radio stations can be received using antenna.

Postal Services
Postal Services are provided by the Philippine Postal Office (PPO) together with other private companies such as RCPI, JRS, FedEX/Air 21, 2Go, and LBC. However, PPO has a much lower charge rate compared to private companies. Currently, only registered mail is served in all government offices in San Jose, the PPO mail distribution center.

Other telecommunications services
It has been observed that the majority of the people in the municipality are using cellular phones and/or mobile phones. Owning one means a faster and convenient mode of communication among them, their friends and others.

Payphones and two-way radios provide alternative means of communication in the municipality. Barangay Chairman are provided with a unit of a handheld or two- way radio for faster information dissemination especially during cases of emergency.

Furthermore, communication is also served through e-mail or social networking (e.g. internet, facebook, etc.).

2.2.4.2.1 Impact Assessment

Water Supply
The entry of the proposed project will not cause significant competition in the access of these resources and services. On the other hand, the proposed project may also provide opportunities for the development and enhancement of these services.

For the proposed project, the water needed during the day-to-day operation will be sourced out from the available water supply within the area.

The construction stage will be limited only to horizontal development of the stockpile area since the Proponent shall be renting existing houses in the area for use as camp, accommodation, office and other facilities. Water usage at this stage is nil. At the construction stage of the project, the engineering work activities are dry in nature.

With regards to irrigation systems as verified with the National Irrigation Administration MIMAROPA Office, the irrigation inlet from Busuanga River is located far upstream from the project site, and therefore will not be affected. Nevertheless, the Proponent will strictly observe the approved dredging plan and coordinate with NIA before and during the operations phase to avoid possible impacts on water quality and stream flow of the river.

Power Supply
The Proposed Project will not create competition on power supply. The power requirements during the dredging works will be sourced from onboard power generators for the obvious reason that the vessels will not be able to connect to the power lines onshore. Hence, there will be no competition with the communities.

However, for its power supply requirements for the site office and the bunkhouse for the crew, the project is expected to draw the project's power requirement from OMECO. To ensure continuous supply of power and lessen resource competition, the proponent will have a readily available power generator set as backed up during operation. In any case, the consumption will not be significant as to create adverse competition.

Telecommunications
The proposed project will not pose a threat to the above. During the dredging activities, communications will largely be via radio on-board the vessels. Hence, no competition with the communities will arise.

There will be adequate communication systems from the various service providers such as Smart Communications, Globe, Sun, etc. Mobile systems will be adequately available in the project area.

Crime Rate
With regards to crime rate, in-migration of workers has the potential to result in an increase in crime rate as new faces will be introduced to the community. However, the hiring policy of Royal Crown is to prioritize the locals whenever possible, i.e., the skills required are available among the population.

Moreover, the Proponent shall rigidly implement a strict Code of Conduct among its employees/workers to ensure their safety and that of the host community.

2.2.4.3 Threat to Public Health and Safety

Municipality of San Jose

Medical and Health Facilities
The health services in the municipality are being provided by 3 private hospitals, 5 medical clinics, and 6 dental clinics. There are 7 private drugstores and pharmacies in the area. Usually, the private health facilities are situated in urban barangays. However services in private types of health facilities are always available at much higher rates. Consultations fee in private clinics vary from Php 200.00–300.00 per clinic visit as compared to government health services. The Public health facilities include San Jose District Hospital, 1 Public Health and Diagnostic Center (LGU operated), 38 Barangay Health Center and 29 Barangay Health Stations (BHS).

Table 2.2.4-5. Number and types of health facility of San Jose, 2010

Health Facility	Number	Status
Hospital	4	3 Private, 1 Government
MHO/Diagnostic Center	1	LGU Operated
Barangay Health Center	38	Government
Barangay Health Sttaions	28	Government
Medical Clinic	5	Private
Dental Clinic	6	Private
Drugstore / Pharmacy	7	Private
Total	**89**	

Source: Busuanga Watershed Characterization and Vulnerability Assessment Report, 2010

The government-run Rural Health Unit, manned by a doctor and support medical staff, provides health services for each municipality. It is capable of providing health services such as minor surgeries, and diagnosis and treatment of common diseases.

The threat associated with the activities during the construction and operational phases have taken into account the existing environmental conditions. It is assumed that the proposed project meets the requirements of the project.

During the construction and operations phase the workers temporary housing for the workers will be provided, with provision for adequate water and toilet facilities. Proper implementation of appropriate and adequate solid waste management schemes will be strictly monitored.. Workers will be oriented to strictly observe proper hygiene and sanitation practices in the area.

For the safety of workers and the community near the work areas, appropriate safety gears shall be required of workers. Enclosures and proper signages shall be placed on work areas (especially during working hours).

During the operations phase, there will be minimal health and safety impact on public health because all management and mitigating measures will be implemented.

Environmental Health and Sanitation Profile

- Household Without Sanitary Toilet

Of the 29,173 total households, 5,070 or 17.38% are households without access to sanitary toilets. Most of these households are noted in Inasakan, Natandol, Buri, Pawican, Ambulong, Ipil and Catayungan.

- Dwelling units with toilets

While so many have no access to sanitary toilets, others do have access to or own water- sealed flush toilets to sewer safe septic tanks (15,169 or 52% of total households). Others have access to sanitary toilets on sharing with relatives while others use the closed pit type or the open pit type of toilets. Others disposed of it anywhere.

- Protocol on How to Control the Spread of the Covid-19.

In line with the government protocol for Covid-19,Proponents will also implement additional safety measures for all of their employees by requiring use of a face mask and face shield while inside the premises and mandatory temperature check for all guests and employees. Employees showing symptoms of COVID-19 are also required to undergo swab/antigen test and mandatory quarantine. The company also provided and has donated rapid tests/swab test kits to LGUs as part of its commitment to safety and health of its employees and host communities.

2.2.4.3.1 Impact Assessment

The Project will generate positive impacts on public health and safety by reducing threats to life and property brought by floods. However, during the operations phase, there might be potential noise and water pollutants that will be generated during project implementation and may have insignificant impacts on the health and safety of the workers. There shall be no effects on residents/communities because they are distant from the project. Workers may be exposed to ergonomic stress and increased levels of noise and heat, as well as physical hazards associated with moving heavy equipment and vessels. Proper mitigation will be observed to provide a healthy and stress free environment for workers.

In accordance with Labor laws, the Royal Crown recognizes that a worker may cease, or refuse to carry out work if they have a reasonable concern that the work would expose the worker to a serious risk to their health or safety. The workers who cease work shall notify the relevant manager that they have ceased unsafe work as soon as practicable after doing so. Workers are also required to remain available to carry out ‘suitable alternative work’. This would not however require workers to remain at any place that poses a serious risk to their health or safety.

2.2.4.4 Generation of Local Benefits From the Project

Socioeconomic Data

Municipality of San Jose

Main sources of income and livelihood
The agricultural land occupies 17,543.86 hectares or 30.56% of the total municipal land area. It is devoted to the production of rice and other cash crops such as garlic.

It is the intent of the leadership of the municipality vis-à-vis those concerned in agricultural development that the agricultural land use is preserved, especially the irrigated agricultural lands. On the other hand, the remaining grassland shall be utilized for agricultural pursuit especially for livestock, poultry-raising and for tree crops. Lands devoted for livestock production are not restricted for reclassification from agriculture to other uses.

The agricultural lands of San Jose are located in Barangays Camburay, Murtha, Mangarin, San Agustin, Central, San Isidro, Mapaya, La Curva, Magbay and portions of Mabini. Major crops grown in the municipality can be further classified into permanent and annual/seasonal crops. Permanent crops include fruit trees, plantation crops, and agro- forestry. On the other hand, seasonal crops are dominated by rice, corn, vegetables, and root crops. Other crops grown in the municipality are tobacco. Furthermore, several piggery farms and few poultry farms also exist in some areas. However, the total land areas occupied for this purpose are still accounted for.

Livestock and poultry production
The best way to guarantee a sustainability of food supply in every household is by increasing agricultural productivity through livestock and poultry-raising.

Various types of livestock and poultry are raised in some barangays of the municipality such as swine, cattle, carabaos, goats, horses, goat, cow, native chicken, broiler (45 days), game fowl, pugo, ducks, and turkeys. Raising of the above-named animals plays an important role in augmenting family income and/or some of the food needs of the families.

Based on the data of CLUP of San Jose, ten (10) entrepreneurs in San Jose are engaged in livestock and poultry farms. Of the 41,840 heads raised in the locality, 200,000 are broilers, the other 20,000 are layers while livestock farms have an aggregate number of 1,840 hogs. On the other hand, a number of entrepreneurs are engaged in various types of livestock and poultry farms. Around 44,661 aggregate numbers of various kinds of livestock and poultry are raised by the animal and poultry entrepreneurs. Dominantly raised are native chickens with 13,507 heads while ducks have accounted for 8,475b heads. In livestock-raising, swine dominantly rule with 4,406 followed by goat with 3,215 and carabao 2,651 heads.

Fisheries
Fishing is another significant economic activity in the locality, especially dwellers living along the coast. Most of these communities depend on fishing as their source of income. Out of the 38 barangays in San Jose, there are 21 barangays engaged in fishing particularly in coastal barangays and other barangays in San Jose like Caminawit, Mangarin, Mapaya, Bubog, San Agustin, Ilin and Ambulong Island, fishing is considered one of the major sources of income of 1,854 fishermen. This is a significant economic activity in the locality considering that the Municipal fishing ground zone is 95,275.72 hectares.

With its fertile fishing grounds, the fishing sector is undoubtedly seen as an economic booster if given developmental priority. Among the important marine resources of San Jose are species of finfish, species of coral. A thousand species of other invertebrates; species of algae; a diverse collection of sea grass and species of mangroves. Records also show that aside from fishing, there are other activities related to fishing such as seaweeds farming and fish pens/cages.

Trade, Commerce and Industry
Commercial establishments in the municipality according to DTI are totaled to 1,030. Most are wholesale and retail (95.05 percent). Others include Banking and Finance and Insurance

establishments. Known commercial banks are: Allied Bank, Metro Bank, PNB, DBP, Land Bank, CARD Bank, Veterans Bank and other Rural Banks. Existing commercial establishments covered a total land area of 5.1655 hectares or an average land area of 50m2 per establishment. Registered Commercial establishment is around 1,030 and the public market, the center of commercial activities, is the largest in the province.

San Jose Wet and Dry Public Market covers a total land area of 4,202 hectares which serves as the center of commercial and trading activities. It is the largest public market in the province offering the most diverse goods and services. About 760 stalls are operating regularly from 5:00 A.M to 7:00 P.M every day. Local traders and middlemen from neighboring towns, Panay, Island and Coron, Palawan, facilitate commodity flow and exchange.

About 20 registered manufacturing and processing industries are operating at different scales. These could be classified into: manufacturing of hollow blocks/bricks/concrete pipes, food processing, processing of bath/detergent soap, and furniture making. A total of 117 workers are employed by industries occupying a total land area of 1.6556 hectares or an average space of 0.08278 hectares per industry. Industries include hollow blocks making, handicrafts and furniture, and other small scale processing and manufacturing plants. There are around eight (8) cottage industries in the locality. One of which is engaged in the production of peanut brittle while the rest are engaged in the production of bread. Volume of production is good for local consumption only. See **Table 2.2.4-6.**

Table 2.2.4-6. Types of commercial establishment, number and occupied land area in San Jose

Types of Commercial Establishment	Number	%	AREA (ha.)	%
Banking and Finance	32	3.11	0.1755	3.40
Wholesale Trade	4	0.39	0.032	0.62
Retailer / Wholesaler	979	95.05	4.895	94.76
Insurance	15	1.46	0.063	1.22
TOTAL	**1,030**	**100.00**	**5.1655**	**100.00**

Source: Tourism Office, 2014

Banking and Financial Institutions
Banking and Finance and other general services commonly concentrate within the periphery of the public market. Known commercial banks are Allied Bank, Metrobank, PNB, DBP, Land Band, CARD Banks and other Rural Banks.

While there were a number of possible sources of capital which may be tapped for their crops and livestock/poultry production and in fishing activities, the main sources came from income obtained from previous cropping season or from earnings from livestock and poultry raised. However, those lacking earnings/capital borrowed/obtained their capital needs from private crop and fish traders/buyers, the landowners, their parents or the 5-6 system of borrowing.

Furthermore, local farmers which are financially incapacitated in cultivating their lands can avail or seek assistance from banking and lending institutions with legal interest rate or through a middleman with high interest rate. If local farmers choose to agree with middlemen, mode of payment can be in cash or in kind depending upon the conditions and terms of payment that both parties agreed. On the other hand, banking institutions prefer to provide loan assistance to an organized farmer‘s cooperative rather than individual farmers.

Labor and Employment

1. **Employed and unemployed members of the labor force**

The total labor force of San Jose is 37,650 of which 26,843 or 71.30% are males and 10,807 or 28.70% are females. Of the total labor force, 3,290 or 8.73% are unemployed and 34,363 or 91.27% are employed members of the labor force. Of those employed members of the labor, 24,995 or 72.74% are males and the remaining 9,368 or 27.26% are females.

2. Nature of employment

Of those employed in the labor force, 20,488 or 58.64% are on permanent status of which 14,363 or 70.11% are males and 6,125 or 29.70% are females. On the other hand, 11,386 or 32.59% are in the short term – seasonal or causal category. The rest worked on different odd jobs either on a day to day or week to week basis. The common reasons for unemployment are due to schooling, due to housekeeping and due to being too young or too old to work, retired or permanently disabled.

It is necessary to include the main sources of income and livelihood as baseline. This will indicate how the locals interact with the resources and institutions provided by the Municipality resources and job opportunities. Hence, this will show the possible key concerns of the stakeholders to the proposed project and will therefore enable the proponent and its proponent to create an approach that would consider the enhancement of employment, livelihood opportunities and increased revenue of the LGUs.

The construction phase will not significantly bring about local benefits that will be generated in terms of:

- Opportunities for employment and livelihood
- Business Opportunities and associated activities
- Increased revenue taxes paid to each Municipalities and its multiplier effects in terms of resulting benefits

During this phase, only few workers will be hired since there will be very limited construction activities. More opportunities shall be available during the operation phase, to which the locals may be employed.

2.2.4.4.1 Enhancement of Employment and Livelihood Opportunities

The Proponent is committed to finding the right balance between investing in the affected communities and meeting the needs of the company. They strive to maximize local employment and training opportunities to ensure local communities continuously benefit from the project operations.

The Proponent will give priority for employment to qualified residents under mutually acceptable employment terms and conditions and subject to compliance with the rules of the Department of Labor and Employment (DOLE).

2.2.4.4.2 Increased Business Opportunities and Associated Economic Activities

Aside from the employees to be hired, secondary business opportunities will draw more people to the project area.

Whenever there is economic benefit that can be derived from an activity, people follow the source of the activity. Allied business opportunities shall be created whenever there is movement of people from one place to another.

The Project's procurement of supplies and materials from local establishments, together with expenditures by project workers typically result in increased business activity and employment in the local trade and service sectors.

2.2.4.4.3 Increased Revenue of LGUs

Taxes will be paid to the LGUs, the amount of which will be determined when all the parameters for the operation of the project shall have been established.

2.2.4.4.4 Impact Assessment

As discussed in the preceding subsections, a multitude of local socioeconomic benefits shall be brought about by the Project including but not limited to the following: enhancement of employment and livelihood opportunities; increased business opportunities and associated economic activities; and increased revenue of LGUs.

Majority of the workers for the project shall be from the host community, provided they have the required skills or qualifications. Their income from salaries and wages shall mean increased disposable income, which they will spend in the local market and in turn will help local businesses flourish. Consequently, quality of life for a lot of locals will improve giving them the chance to support their children's higher education. In the end, a brighter future for the young population can be actualized.

The LGUs direct benefits include not just the excise and business taxes to be paid by the Royal Crown. It can also save money that it would otherwise spend for flooding hazard-related expenditures such as repairs of damaged structures, relief operations for affected families, and lost revenues from damaged crops, among others. In addition, the increase in business enterprises will also lead to increase in local revenues. With such opportunity, the LGU can embark on other developmental projects that could propel Rizal and San Jose to economic growth and more urbanization. It may also opt to enhance the basic services they provide to their constituents.

Lastly, additional influx of investments and financial assistance will be accorded to the people of Brgys. Adela and San Pedro, Municipality of Rizal and Brgys. San Agustin and Central Municipality of San Jose through the various projects under the Project's Social Development Program (SDP).

2.2.4.5 Traffic Congestion

- **Municipality of San Jose**

Road Network

An intricate road network connects all the 27 mainland barangays of San Jose making them easily accessible. A total of 498.219 kilometers road networks surround the Municipality of San Jose providing internal and external accessibility (**Table 2.2.4.7**) but 60% of which remains unpaved while 14.30 kilometers are municipal roads. National highway within San Jose measures 73.03 kilometers in length while the provincial road is 34.64 kilometers. Majority of said roads are classified as barangay roads comprising about 76.34% share or 380.32 kilometers. Only about 38% of the total barangay roads are paved while the rest are unpaved mostly concentrated in the rural barangays. About 60 percent of the total road network remains unpaved isolating areas during a heavy rainfall. Illustrated in **Figure 2.2.4.3** is the Road Inventory Map (by classification).

Table 2.2.4-7. Inventory of roads and type of construction materials in San Jose

Administrative Classification	Length (m)	Width (RW & CW)	Road Surface (km)									
			Paved				Unpaved					
			Concrete	%	Asphalt	%	Gravel	%	Earth-filled	%	Unknown	%
National	73.03	6.57	23.04	31.55	16.22	22.21	33.16	45.41			0.06	0.08
Province	34.64	5.71	6.27	18.10			8.37	24.16			20	57.74
Municipal Roads	14.3	6	13.72	95.94			0.06	0.42			0.5	3.50
Barangay	143.3	5.33	53.89	37.61	89.4	62.39						
Other Barangay (Rural)	232.95	4.5							232.95	100.00		
Total	**498.22**	**-**	**96.92**	**19.45**		**84.60**	**41.59**	**8.35**	**232.95**	**46.76**	**20.56**	**4.13**

Source: PWH; Provincial Engineering Office; MPDO RW Right of Way CW Carriage Way

The total road network system of the municipality covers 748.92 meters divided into three classified barangays as follows: Urban Barangays (607.65m), Rural (Mainland) Barangays (28.49m) and the Island - Rural Barangays (28.49m).

Among the urban barangays, only 2 roads in Barangay Bubog are asphalted, 12 roads in 4 Barangays (Bagong Sikat, Bubog, Labangan Poblacion and San Roque) are of gravel surface; in Bubog, 3 of its roads are of earth surface; 10 Barangays (Bagong Sikat, Poblacion I, Poblacion 3, Poblacion 4, Poblacion 5, Poblacion 6, Poblacion 7, Poblacion 8, Labangan Poblacion, and San Roque) have concrete roads; and only in Barangay Pag-asa with 5 roads which are macadamized.

In the case of the rural (mainland) barangays, majority of the length of the roads of the barangays are asphalted and none is surfaced with gravel; eight roads in 5 barangays (Central, Mapaya, Monteclaro, San Agustin and San Isidro) are of 8 surface roads; 18 roads in 10 barangays (Bayotbot, Central, La Curva, Mabini, Magbay, Mangarin, Mapaya, Murtha, San Agustin, and San Isidro) are concrete; and no barangays with macadamized surface roads.

With regards to the island (rural) barangays, majority of the roads are asphalted; none with gravel surface while a quite a number of roads, too, are earth-filled surface; however, part of the roads of Ansiray, Ilin Proper, Inasakan, and Labangan Ilin are of concrete surface; and only one road in Barangay Pawican is macadamized.

Bridges
A total of 16 bridges located in 11 barangays (Mangarin, Mabini, San Roque, Bagong Sikat, Central, Bubog, Batasan, Monteclaro, La Curva, Magbay and Mapaya) are generally in good condition. All bridges were made of good construction materials (concrete and steel). However, the Talabaan Bridge at Barangay Mapaya needs repair. Among the bridges in San Jose, the longest ones are the Busuanga III Bridge located at Barangay Central, which is 170 meters long, 6 meters wide and with load capacity of 15 tons and the Pandurucan Bridge at Brgy. San Roque, which is 150 meters long. The other types of bridges located in the other barangays could be discerned in the table below.

Table 2.2.4-8. Inventory of bridges and type of construction materials in San Jose

Bridge Name	Location	Type of Construction						General Condition
		Concrete			Steel			
		L	W	LC	L	W	LC	
Palanghiran	Mangarin	25	6	15				
Tinabunan	Mangarin				12.2	4	5	
Pinamanaa	Mabini	50	6	15				
Mabini	Mabini				18.3	4	5	
Pandurucan	San Roque	150	6.7	15				
Bagong Sikat	Bagong Sikat	15	6	15				
Busuanga I	Central				109.8	4	10	
Busuanga II	Central	20	6	15				
Busuanga III	Central	170	6	15				
Bubog I	Bubog	26	4	15				
Bubog II	Bubog				15.2	4	5	
Manus I	Batasan				6.1	4	5	
Manus II	Monte Claro	36	3	15				
La Curva	Brgy. La Curva	12m	5m	10T				Good
Bayotbot	Brgy. Magbay	10m	5m	5T				Good
Talabaan	Brgy. Mapaya	6m	3m	5T				Needs Repair

Source: Department of Public Works and Highways – 1999
Provincial Engineers Office, Occidental Mindoro – 1999
Legend: L – Length W-Width LC-Load Capacity (in Metric tons)

Airport
The domestic airport is located at Brgy. San Roque in the Municipality of San Jose, about 2 km from the town center. It enhances air transport from the Municipality to Manila and Manila to San Jose vice-versa. Cebu Pacific has available daily flights from San Jose to Manila and vice-versa viz-a-viz with sitting capacity of more or less 100 passengers.

Feeder Port / Wharves / Pier
The seaport is 4 kilometers away from the town proper operated by the Philippines Ports Authority (PPA). Caminawit pier is classified as a national port that serves as another entrance and exit in transporting commodities from Visayan region and other neighboring islands. Motorized boats ply from Caminawit pier to Antique and Palawan, thus, only small size marine vessels/pumpboats operate in the area due to its closure for public pumpboats.

San Jose has one (1) major fish landing center and fish port located in Brgy. Caminawit whereas, minor fish landing centers were located at Purok I, Barangay Pag-asa; Poblacion IV; Poblacion V; San Roque; So. Quezon, Barangay Bubog and San Agustin (Sitios D6, Main Barrio and Lamis).

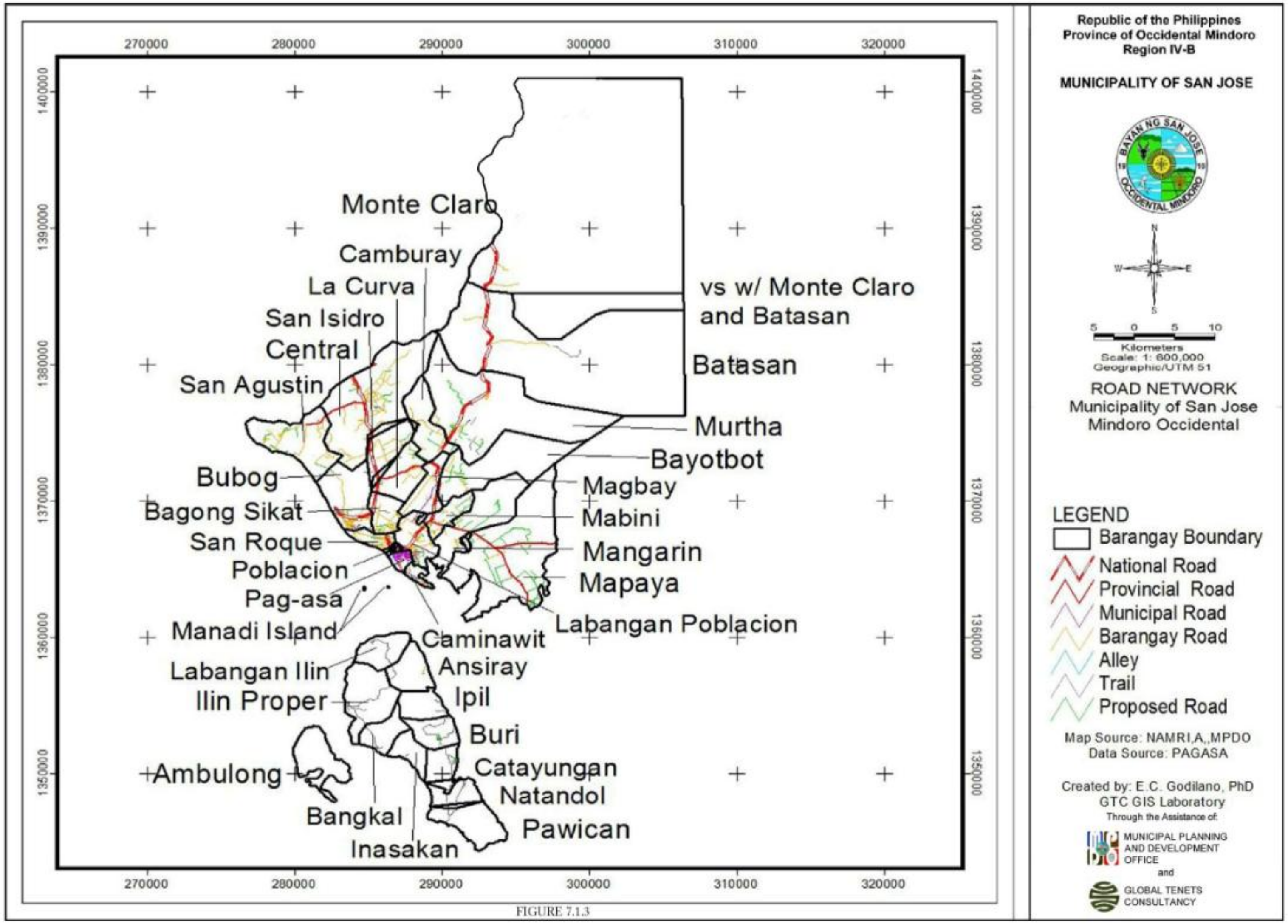


Figure 2.2.4-4. Road Network Map of Municipality of San Jose

Road Network/ Systems
Both municipalities of Rizal and San Jose are linked to all towns of Occidental Mindoro via a mostly-dusty provincial highway that runs from north to south. Roads in and around Rizal and San Jose are well-paved on mostly flat terrain. Local buses and jeepney operators ply the route from the northernmost town of Abra de Ilog all the way south to San Jose. There are also vans run from the bus terminal all the way to Calapan along the eastern coast of Mindoro. Most roads in the Poblacion area and nearby barangays are either paved with concrete or asphalt.

Existing Transportation/Traffic Situation
During construction, there is no anticipated congestion of vehicular traffic particularly near and along tertiary access roads going to the dredging site at the start of positioning and hauling of in-land equipment. Cumulative traffic impact during operation phase, in conjunction with project operation, may not aggravate the traffic situation along access roads. If there is any, the proponent will implement in coordination with the concerned LGUs to minimize disturbance of vehicular traffic and pedestrians during construction.

Advisories shall be posted at conspicuous places to caution travelers and passengers regarding the planned construction/development. Other mitigation measures include designation of traffic officer responsible for smooth traffic flow; formulation of traffic management system; provision of appropriate warning signs, lighting and barricades, whenever practicable; and observance of traffic rules such as vehicle speed.

2.2.4.5.1 Impact Assessment

The traffic system will not affect the overall traffic volume of the highway, since the dredging vessel and heavy equipment movement is restricted within the project area. Transportation of dredged materials will also be done via sea travel.

During the construction phase, no congestion of vehicular traffic is anticipated near and along access roads going to the dredging site at the start of positioning and hauling of inland equipment. Cumulative traffic impact during operation phase, in conjunction with project operation, will not aggravate the traffic situation along access roads.

While construction is ongoing, advisories shall be posted at conspicuous places to caution travelers and passengers regarding the ongoing development activities. Other mitigation measures include designation of traffic officer responsible for smooth traffic flow; provision of appropriate warning signs, lighting and barricades, whenever practicable; and observance of traffic rules such as vehicle speed limits.

The Philippine Coast Guard (PCG) and Maritime Industry Authority (MARINA) will issue an approved Navigational Traffic Scheme for the project before its operation

2.2.4.6 Perception Survey

The discussions below are based on the household perception survey conducted on October 18 in Barangays Adela and San Pedro Municipality of Rizal and November 9-10, 2023 in Barangays San Agustin and Central Municipality of San Jose. A total of 79 respondents covering the 4 barangays were interviewed. 16 of which are from Barangay Adela, 25 from Barangay San Pedro, 15 are from Barangay San Agustin and 24 are from Barangay Central. The purpose of this survey is to assess the socio-cultural-economic situation of the communities that are to be affected by the proposed Busuanga River Dredging Project, particularly the four barangays and 2 municipalities..

Results of the Survey

- ***Sex Distribution –*** The respondents were composed of 54.43% males and 45.57% females.

Table 2.2.4-9. Impact Barangay: Sex Distribution

Barangay	GENDER						Total No. of HH surveyed
	Male		Female		No Answer		
	Count	%	Count	%	Count	%	
Barangay Adela	6	37.5	10	62.5	0	0	16
Barangay San Pedro	17	68	8	32	0	0	25
Barangay San Agustin	6	40	9	60	0	0	15
Barangay Central	14	58.34	10	41.66	0	0	24
							79

Data Source: EIA Perception Survey 2023

- ***Civil Status*** – With the 4 impact barangays residents surveyed, mostly of the respondents are married.

Table 2.2.4-10. Impact Barangay: Civil Status

Barangay	CIVIL STATUS										Total No. of HH surveyed
	Single		Married		Widower		Separated		Atbp. (Live-in)		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	1	6.25	13	81.5	2	12.5	0	0	0	0	16
San Pedro	6	24	19	76	0	0	0	0	0	0	25
San Agustin	1	6.67	11	73.33	2	13.33	1	6.67	0	0	15
Central	0	0	21	87.5	2	8.33	1	4.17	0	0	24
											79

Data Source: EIA Perception Survey 2023

- ***Religious Affiliations*** – Results of the conducted survey indicated that almost 95% of the respondents in 4 impact barangays are Roman Catholic. Only about 5 percent belong to other religions.

Table 2.2.4-11. Impact Barangay: Religious Affiliation

Barangay	RELIGIOUS AFFILIATION										Total No. of HH surveyed
	Catholic		Protestant		Aglipayan		INC		Others		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	15	93.75	0	0	0	0	0	0	1	6.5	16
San Pedro	24	96	0	0	0	0	1	4	0	0	25
San Agustin	13	86.67	0	0	0	0	0	0	2	13.33	15
Central	23	95.83	0	0	0	0	1	4.67	0	0	24
											79

Data Source: EIA Perception Survey 2023

- ***Ethnicity*** – Majority of the respondents indicated that their ethnicity is Filipino/Tagalog and the Municipalities common local dialect used is 100% Filipino / Tagalog

Table 2.2.4-12. Impact Barangay: Ethnicity

Barangay	ETHNICITY										Total No. of HH surveyed
	Tagalog		Visayan		Ilocano		Waray		Others		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	14	87.5	2	12.5	0	0	0	0	0	0	16
San Pedro	24	96	1	4	0	0	0	0	0	0	25
San Agustin	9	60	5	33.33	1	6.67	0	0	0	0	15
Central	24	100	0	0	0	0	0	0	0	0	24
											79

Data Source: EIA Perception Survey 2023

- ***Income, Livelihood, and Employment*** - The main source of income of the respondents are mostly farming and almost 80% of the respondents stated that the husband is the primary earner in the household.

In terms of monthly income, **Table 2.2.2-13** shows that most of the respondents in every barangay stated different kinds of monthly income. In Barangay Adela, the highest income per household ranges from P 1001-P 5,000, in Barangay San Pedro the highest income ranges from P 1,000 below. While the 2 barangays of San Jose show that in Barangay San Agustin household monthly incomes range from P 1001-P5,000 and Barangay Central ranges below P 1,000.

Table 2.2.4-13. Impact Barangay: Main Source of Livelihood of Respondents

Barangay	OCCUPATION										Total No. of HH surveyed
	Farming		Regular Private/Govt Employee		Contractual Job/Sub-Contractor		Vendor/Family Business		No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	5	31.15	5	31.25	3	18.75	0	0	3	18.75	16
San Pedro	24	96	1	4	0	0	0	0	0	0	25
San Agustin	12	80	0	0	1	6.67	0	0	2	13.33	15
Central	16	66.67	0	0	3	12.5	2	8.33	3	12.5	24
											79

Data Source: EIA Perception Survey 2023

Table 2.2.4-14. Impact Barangay: Primary Earner in the Household

Barangay	PRIMARY EARNER												Total No. of HH surveyed
	Husband		Wife		Son		Daughter		Others		No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	10	62.5	1	6.25	3	18.75	0	0	2	12.5%	0	0	16
San Pedro	14	56	3	12	0	0	2	8	1	4%	5	20	25
San Agustin	14	93.33	1	6.67	0	0	0	0	0	0	0	0	15
Central	22	91.67	0	0	1	4.17%	1	4.17	0	0	0	0	24
													79

Data Source: EIA Perception Survey 2023

Table 2.2.4-15. Impact Barangay: Monthly Income of the Respondents

Barangay	MONTHLY INCOME												Total No. of HH surveyed
	P1,000 below		P1,001-P5,000		P5,001-10,000		P10,001-20,000		P20,001 Above		Others/No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	6	37.5	7	43.75	1	6.25	0	0	2	15.5	0	0	16
San Pedro	13	52	5	20	6	24	0	0	1	4	0	0	25
San Agustin	5	33.33	8	53.33	1	6.67	1	6.67	0	0	0	0	15
Central	6	25	4	16	4	16	10	36	0	0	0	0	24
													79

Data Source: EIA Perception Survey 2023

- ***Educational Attainment*** – the table below shows that the largest percentage or almost 58%% of the respondents reached high school level followed by those who graduated at the elementary level at 40%% and 2% are college graduates.

Table 2.2.4-16. Impact Barangay: Educational Attainment

Barangay	EDUCATIONAL ATTAINMENT										Total No. of HH surveyed
	Elementary		High School		Vocational		College		Others		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	3	18.75	11	68.75	0	0	2	15.5	0	0	16
San Pedro	10	40	12	48	0	0	2	8	1	4	25
San Agustin	2	13.33	9	10	0	0	4	26.67	0	0	15
Central	4	16.67	10	41.67	4	16.67	6	25	0	0	24
											79

Data Source: EIA Perception Survey 2023

Health

Sickness in the Family – Based on the survey conducted, almost 90% of the household respondents stated that they have at least 2 family members who experienced sickness for the past five years. (**Table 2.2.4-18**) Common sicknesses in the barangay as indicated by the household respondents are fever and colds. (**Table 2.2.4-19**)

Where do they Consult? – Most of the respondents stated that they seek consultation at the Barangay Health Center and Government Hospitals. The remaining others say that they prefer to stay at home while sick and others consulted at the private clinics as well. See **Table 2.2.4-20** for the survey data.

Table 2.2.4-17. Impact Barangay: Number of Family Member Who Got Sick for the Past 3 Years

Barangay	NUMBER OF FAMILY MEMBER WHO GOT SICK FOR THE PAST 3 YEARS												Total No. of HH surveyed
	1		2		3		4		5		NO ANSWER		
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	5	31.25	4	25	3	18.75	3	18.75	1	6.25	0	0	**16**
San Pedro	4	16	9	36	1	4	3	12%	1	4	0	0	**25**
San Agustin	4	26.67	7	46.67	0	0	0	0	0	0	7	28	**15**
Central	6	25	15	62.5	3	12.5	0	0	0	0	4	26.67	**24**
													79

Data Source: EIA Perception Survey 2023

Table 2.2.4-18. Impact Barangay: Common Illnesses in the Community

Barangay	Common Illness in the Community										Total No. of HH surveyed
	Covid 19		Cold		Fever		Others		No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	0	0	7	43.75	6	37.5	1	6.25	0	0	16
San Pedro	0	0	7	28	14	56	4	16	0	0	25
San Agustin	0	0	3	20	0	60	3	20	0	0	15
Central	0	0	12	50	12	50	0	0	0	0	24
											79

Data Source: EIA Perception Survey 2023

Table 2.2.4-19. Impact Barangay: Source of Treatment for Illness of Respondents

Barangay	Place of treatment for Illness of Respondents														Total No. of HH surveyed
	House		Barangay Health Center		Government Hospital		Private Clinic		Herbalist		Others		No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	6	37.5	7	43.75	3	18.75	0	0	0	0	0	0	0	0	**16**
San Pedro	7	28	0	0	5	20	0	0	4	16	0	0	9	36	**25**
San Agustin	5	33.33	6	40	1	6.67	0	0	0	0	0	0	3	20	**15**
Central	2	8.33	13	54.17	7	29.17	2	8.34	0	0	0	0	0	0	**24**
															79

Data Source: EIA Perception Survey 2023

Environmental Health and Sanitation - Based on the perception survey conducted, the majority of the total respondents have access to sanitation facilities. Almost all of the respondents stated that they are using a water sealed (pour flush) toilet.

Table 2.2.4-20. Type of Toilet Facility Used by Respondents

Barangay	Type of Toilet Facility Used by Respondents										Total No. of HH surveyed
	Water-sealed (pour flush)		Water-sealed (with flush tank)		Antipolo Type		Others		None		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Adela	16	100	0	0	0	0	0	0	0	0	16
San Pedro	20	80	3	12	0	0	0	0	2	8	25
San Agustin	12	80	0	0	0	0	0	0	3	20	15
Central	24	100	0	0	0	0	0	0	0	0	24
											79

Data Source: EIA Perception Survey 2023

2.2.4.6.1 Perception of the Community

- **Knowledge About the Proposed Project**

Table 2.2.4-22 shows the frequency of the respondents who answered that they are aware and they have prior knowledge or idea about the Busuanga River Dredging Project. Out of the 79 respondents, 78% of them answered Yes, while 22% answered No, which means they are not aware of the said project.

Table 2.2.4-21. Impact Barangay: Household Knowledge about the Proposed Busuanga River Dredging Project

Barangay	KNOWLEDGE ABOUT THE PROPOSED PROJECT						Total No. of HH surveyed
	Yes		No		No Answer		
	Count	%	Count	%	Count	%	
Adela	10	62.5	5	34.25	1	6.25	16
San Pedro	19	76	6	24	0	0	25
San Agustin	13	86.67	2	13.33	0	0	15
Central	20	83.33	4	16.67	0	0	24
							79

Data Source: EIA Perception Survey 2023

Respondents with knowledge about the project answered that their sources of information about the Proposed Busuanga River Dredging Project were learned mostly from the barangays, neighborhood and media. See **Table 2.2.4-23.**

Table 2.2.4-22. Impact Barangay: Household Source of Information about the Proposed Project

Barangay	SOURCE OF INFORMATION										Total No. of HH surveyed
	Neighbor		Barangay		IEC by Proponent		Media		No Answer		
	Count	%	Count	%	Count	%	Count	%	Count	%	
Barangay Adela	0	0	14	87.5	1	6.25	0	0	1	6.25	16
Barangay San Pedro	10	40	12	48	0	0	0	0	3	12	25
Barangay San Agustin	4	26.67	11	73.33	0	0	0	0	0	0	15
Barangay Central	0	0	19	79.17	0	0	4	16.67	1	4.17	24
											79

Data Source: EIA Perception Survey 2023

- **Perceived Impacts**

The respondents were also asked about their views on the possible beneficial and adverse impacts of the Proposed Busuanga River Dredging Project. As far as the perceived benefits are concerned, the top answers are flood mitigation, improvement of rivers and riverbank protection/enhancement,livelihood opportunities and livelihood protection especially on farming and taxes as mandated by law. On the other hand, perceived adverse impacts are effects on fish and existing livelihood.

Table 2.2.4-23. Possible Beneficial impacts of the Proposed Busuanga River Dredging Project

Answers	1. Flood Mitigation
	2. Improvement of Rivers and Riverbank Protection/enhancement
	3. Livelihood opportunities
	4.Livelihood Protection especially on Farming
	5. Taxes

Data Source: EIA Perception Survey 2023

2.2.4.6.2 Summary of Public Participation

Public Scoping – Full discussion is in the Executive Summary (ES) and Public Scoping Report in **Annex ES-3.**

Perception Surveys – Discussed in **Section 2.2.4.6 and attached in Annexes ES-3.**

Public Scoping

As discussed in the ES, the Public Scoping was conducted on 16-19 May 2023 through a Focus Group Discussion (FGD, Information Education and Communication (IEC) and Key Informant Interview (KII) format and was attended by participants from different sectors. The concerned stakeholders, as well as those located in the Impact Areas were invited to participate. The objective of the conducted Public Participation is to ensure that the Environmental Impact Assessment (EIA) will address the relevant issues and concerns of the stakeholders and that it will be consistent with the Philippine Environmental Impact Statement System (PEISS). A matrix summary of issues/suggestions raised during the public scoping is shown in **Table 2.2.4-25** below.

Public Consultation

The Public Consultation was held on 06 September 2023 at Barangay Hall Gymnasium of Barangay Adela, Municipality of Rizal, Occidental Mindoro. It was attended by a total of 114 individuals from different sectors. The same concerned stakeholders that were invited for the Public Scoping were once again invited for this event. Please see **Annex 3** for the list of invitees as well as participants.

The summary of issues and concerns raised and the corresponding responses is presented in **Table 2.2.4-26**.

Focus Group Discussion

Additional Focus Group Discussion (FGD) was conducted last 09 October 2023 covering the four impact barangays namely Barangays Adela and San Pedro, Municipality of Rizal and Barangays Central and San Agustin, Municipality of San Jose. See **Annex ES-3** for the Focus Group Discussion (FGD) documentation.

The summary of issues and concerns raised and the corresponding responses is presented in **Table 2.2.4-27**.

Table 2.2.4-24. Summary of Issues and Concerns Raised in the FGD, IEC and KII

Key Stakeholder/s	Comments	How it was addressed in the EIS
LGU BARANGAY ADELA, RIZAL OCCIDENTAL MINDORO	1. They agree on the dredging Project provided the following measures are considered prior and during the dredging: • Construction of breakwater/flood control/dikes; it was noted that Barangays San Antonio, San Pedro, Pitogo - the upper barangays have these flood control measures. • The Proponent should consider the design of the depth of dredging activity so that the "salt" water from Mindoro Strait will not flow over the freshwater of the Busuanga River.	*In the simulated flood scenario implementing the proposed flood control measure (dredging), the possible improvement in the flooding situation in the project area is very visible wherein the inundation after dredging will be mostly contained within the pilot dredging channel, thus, resulting in a significant reduction in flooded areas.* *Section 2.2.2 Water Page 2.2.2-30*
	2. Historical accounts: • In 2018 - the barangay was flooded with approximately more than 5 feet or up to neck level for two days; • A tsunami warning is posted in the barangay near the barangay hall; • A tsunami was experienced in the barangay in 1972.	*Simulated flood scenario implementing the proposed flood control measure (dredging) is presented to denote the possible improvement in the flooding situation in the project area. In this analysis, a 10m-deep cut was introduced along the main channel. The resulting 100-yr flow hydrograph was used as the upstream boundary while the downstream boundary condition was still set to a stage hydrograph with a value of 2m.* *Section 2.2.2 Water Page 2.2.2-28*
Analisa Guillarde MUNICIPAL DISASTER RISK REDUCTION AND MANAGEMENT OFFICE, RIZAL	• She agrees to the conduct of river dredging as she sees that it is a big solution to the perennial flooding in the municipality. • However, she suggests the construction of gabions along the waterway, particularly in Barangay Adela be considered. She provided the municipality's Risk Profile and the hazard maps' shapefiles.	
Honorable Mayor of Rizal and MPDC Randy Ramos.	The Mayor approves the conduct of dredging in the Busuanga River, but he emphasized that MGB and EMB should strictly qualify the proponent, that is, it should undergo the proper evaluation. He mentioned about the existing dredgers - West Island and Bluemax; that there is information of some irregularities in the Project implementation. The Mayor said that the regulating agency should provide them a monitoring and evaluation checklist which they can use, especially in the renewal of business license/permit.	*Based on the records of EMB-4B, six ECCs were issued to West Island Aggregates Inc ("West Island") covering various projects in the same project area being applied for by RC-GPC. However, 3 among the 6 ECCs issued are now under issue because they were previously subject of a Memorandum of Agreement (MOA) with the Provincial Government of Occidental Mindoro. The MOA has already been revoked. Copies of the 3 ECCs - ECC-R4B-1003-0044, ECC-R4B-11060082, ECC-R4B-1003-0042 - Letter of Revocation, and Letter from EMB Central Office are attached under **Annex 2B**.*

Key Stakeholder/s	Comments	How it was addressed in the EIS
		Section 2.2.1.3 Possible Tenurial / Land Issues Page 2.2.1-18
Mr. Randy Ramos MUNICIPAL PLANNING AND DEVELOPMENT OFFICE, RIZAL OCCIDENTAL MINDORO	Mr. Ramos reiterated that his Office agrees to the conduct of dredging along the Busuanga River. However, he advised first constructing flood control measures along the low-lying barangays. Mr. Ramos provided a link to access CLUP, CDP, LCCAP, and DRRM Plan; he also provided a hard copy of the CLUP.	*Simulated flood scenario implementing the proposed flood control measure (dredging) is presented to denote the possible improvement in the flooding situation in the project area. In this analysis, a 10m-deep cut was introduced along the main channel. The resulting 100-yr flow hydrograph was used as the upstream boundary while the downstream boundary condition was still set to a stage hydrograph with a value of 2m.* *Section 2.2.2 Water Page 2.2.2-28*
Mr. Edwin V. Arevalo, Section Chief NATIONAL IRRIGATION SYSTEM INSTITUTIONAL DEVELOPMENT UNIT	Mr. Arevalo agrees to the dredging as it is already heavily silted and if this needs to be acted upon may have a direct impact on the water intake to the several irrigation systems along the river. NIA operates irrigation systems and several CIS along the river. Number of hectares Mr. Arevalo showed through illustrated the water intakes of the irrigation system along the Busuanga River. He discussed the area wherein dredging should be undertaken in order to avoid future inadequacy of irrigation water resources. However, Mr. Arevalo, suggested the construction of training walls before the water intakes in order to control the flow or divert water flow during wet season, thus, preventing flooding in the low-lying areas. He mentioned that there is an ongoing feasibility study to construct a reservoir in the upland area. The reservoir will be a big help in sustaining water irrigation resources during dry season and at the same time in preventing flash floods/floods during wet seasons. They are looking at other options to build the reservoir since the proposed area is an ancestral domain.	*<u>Irrigation Water</u>* *The Busuanga River is one of the streams that supply water and irrigation for agricultural purposes to the Rizal and San Jose. There are existing irrigation canals around the project site while more are being built. According to the barangay officials and residents of Adela, the construction of the irrigation system is not yet complete. Water flows through the canals only when there is precipitation. According to Mr. Arevalo of NIA Occidental Mindoro (KII), NIA operates several Communal Irrigation Systems (CISs) along the river. He mentioned that dredging should be undertaken in order to avoid future inadequacy of irrigation water resources.* *The water inlet is located far upstream of the project area, and therefore, the Project shall not impact on the water quality of this irrigation system though there may be minimal effects in terms of supply volume as the surface water level is eventually lowered.* *Section 3.1.2 Water Page 3-2*
LGU BARANGAY SAN AGUSTIN, SAN JOSE OCCIDENTAL MINDORO	• The Barangay is dependent on a deep well because of lack of safe drinking water due to the saltwater intrusion. • There are two Irrigators Associations in the Barangay. One of the associations is headed by Barangay Kagawad Leopoldo F. Azuela. The farmers depend on Busuanga River for irrigation water.	*<u>Irrigation Water</u>* *The Busuanga River is one of the streams that supply water and irrigation for agricultural purposes to the Rizal and San Jose. There are existing irrigation canals around the project site while more are being built. According to the barangay*

Key Stakeholder/s	Comments	How it was addressed in the EIS
	• They prefer the dredging using backhoe, not the siphoning type because the latter may reach the seabed, depth; maghahalo • A portion of the barangay is an island and if the dredging is too deep, there is tendency that said island will submerge or will be washed out • They experience perennial flooding in their barangay affecting their livelihood; the majority of which is rice plantation • Requests: health centers for 7,000 plus inhabitants and priority in hiring construction workers from their community	*officials and residents of Adela, the construction of the irrigation system is not yet complete. Water flows through the canals only when there is precipitation. According to Mr. Arevalo of NIA Occidental Mindoro (KII), NIA operates several Communal Irrigation Systems (CISs) along the river. He mentioned that dredging should be undertaken in order to avoid future inadequacy of irrigation water resources.* *The water inlet is located far upstream of the project area, and therefore, the Project shall not impact on the water quality of this irrigation system though there may be minimal effects in terms of supply volume as the surface water level is eventually lowered.* *Section 3.1.2 Water Page 3-2* *Prioritize locals in hiring of workers if skills are available locally;* *Partner with the LGU for the implementation of the Social Development Program; Provide employees' wages and benefits as prescribed by law; Generation of livelihood opportunities by allowing local entrepreneurs to provide support services to the project and its workers.* *Section ES Page ES-15*
PROVINCIAL PLANNING AND DEVELOPMENT OFFICE OF OCCIDENTAL MINDORO	• There is ongoing construction of infrastructure such as gabions and conduct of small-scale quarrying along Busuanga River. • The coastal barangays of both Rizal and San Jose have a tsunami warning sign because the area is prone to it, although there is no record of tsunami or tidal wave that happened in the area since 1972. • There should be a contract between the proponent and the LGU and they must include the terms and conditions of the Project. • If dredging is likely to happen or approved the white island (coral reefs; white island) will be greatly affected. • There is really deforestation or illegal logging going on in our mountains. Still, the soil texture of our mountains is rocky, so even if it is just a little rain, the water will flow immediately.	*6.2 Multi-Sectoral Monitoring Framework* *According to Section 5.B of DAO 2022-02, the Inter-Agency Committee (IAC) shall have an option to establish a Multi-Partite Monitoring Team (MMT). The IAC shall identify the MMT members and also the monitoring activities to be undertaken during the life of the dredging project. The MMT will validate the Proponent's conduct of self-monitoring.* *Section 6 Page 6-5*

Key Stakeholder/s	Comments	How it was addressed in the EIS
PROVINCIAL GOVERNMENT ENVIRONMENT AND NATURAL RESOURCES OFFICE (PG-ENRO) OF OCCIDENTAL MINDORO	• Agrees on the conduct of river dredging • The municipality, through an ordinance, was able to establish the river dredging zones in the entire stretch of the Busuanga River; able to establish a 7 km radius; only 5 km is allotted for dredging • As per evaluation, the aggregates from Busuanga River are of first-class quality • Mentioned West Island that it was issued a 5-year permit to dredge. However, he alleged that there was a sort of "midnight" deal with the governor- which extended the 5 years to 25 years, the 5 km area was extended to the entire stretch of Busuanga River • There should be a mitigating measure to be implemented such as: o bamboo and coconut plantation; "maglagay muna ng dikes tapos bamboo plantation", the Officer suggested. • Construction of scour checks at the upper portion, this was introduced to the IPs; to hold back silt carried by the water flow and provide a series of stretches with gentle gradients interrupted by small "waterfalls" • Regarding the plan of NIA to construct the reservoir, he explained that since the area is an ancestral domain (Note: ancestral domain is located far upstream of the dredging project site), he suggested instead that the reservoir should be constructed at "tunnel" portion. • While he agrees on the dredging Project not only because there is already a joint memorandum, but he suggested including the small quarry permittees, locals should enjoy the aggregates from the Busuanga – "sila ang unang makikinabang dapat", the Officer added. • He agrees on the tax sharing for the dredging activity If the Project will be implemented • There are risks: one possible risk is depletion of water intake at Sta Fe. • Cutter suction is the best dredging method but this is not applicable in low-lying areas such as San Agustin where a backhoe is preferred instead.	*Based on the records of EMB-4B, six ECCs were issued to West Island Aggregates Inc ("West Island") covering various projects in the same project area being applied for by RC-GPC. However, 3 among the 6 ECCs issued are now under issue because they were previously subject of a Memorandum of Agreement (MOA) with the Provincial Government of Occidental Mindoro. The MOA has already been revoked. Copies of the 3 ECCs - ECC-R4B-1003-0044, ECC-R4B-11060082, ECC-R4B-1003-0042 - Letter of Revocation, and Letter from EMB Central Office are attached under **Annex 2B**.* *Section 2.2.1.3 Possible Tenurial / Land Issues Page 2.2.1-18*
MENRO OF SAN JOSE OCCIDENTAL MINDORO	• The MENRO gave copies of FLUP and ESWM Plan to be used for the River Dredging Project The Agency agrees to the dredging activity, but there should be a program on improvement of a watershed	
BFAR-PROVINCIAL FISHERY OFFICE	• Agrees to the river dredging Project • Willing to help in the Project; they will send the 2020-2021 production report and list of fisherfolks to identify/determine the target beneficiaries for the SDP and IEC Campaign plans.	*Partner with the LGU for the implementation of the Social Development Program; Provide employees' wages and benefits as prescribed by law; Generation of livelihood opportunities by allowing local entrepreneurs to provide support services to the project and its workers.* *Section ES Page ES-15*

Table 2.2.4-25. Summary of Issues and Concerns Raised in the Public Consultation

Module	Key Stakeholder/s	Comments	Response	How it was addressed in the EIS
LAND	**Mr. Restituto Awit** Resident of Adela and Municipal Councilor of Rizal	They have prior experience engaging in activities for similar applications and have already submitted interpositions for No Objection, yet no change in the status of flooding. Who is responsible? Is the certificate/permit of West Island already forfeited which is why the Royal Crown is applying? New application? New Resolution.	Mr. Nilo Salvador, Development Management Officer of DENR PENRO MIMAROPA clarified that the termination of West Island started in May 2020. Mr. Coden also shared that the ECCs issued to West Island are for quarrying activities. However, they also noted that West Island is conducting quarry activities with a dredging project which LGU- Adela applied for the ECC. Mr. Coden also confirmed the termination of the contract of West Island.	*Based on the records of EMB-4B, six ECCs were issued to West Island Aggregates Inc ("West Island") covering various projects in the same project area being applied for by RC-GPC. However, 3 among the 6 ECCs issued are now under issue because they were previously subject of a Memorandum of Agreement (MOA) with the Provincial Government of Occidental Mindoro. The MOA has already been revoked. Copies of the 3 ECCs - ECC-R4B-1003-0044, ECC-R4B-11060082, ECC-R4B-1003-0042 - Letter of Revocation, and Letter from EMB Central Office are attached under* ***Annex 2B****.* *Section 2.2.1.3 Possible Tenurial / Land Issues Page 2.2.1-18*
	Mr. Ferdinand Arca, Sr. Resident of Adela, Rizal	There has been a conflict with San Agustin, San Jose with the past dredging operations because of the 30% municipal, 30% Provincial and 40% barangay (Hematite) because of the boundary? There also should be a Geohazard Initial Report.	Mr. Salvador clarified that as per the latest cadastral survey which is the prevailing reference, the political boundary of San Jose and Rizal is in the middle of the Busuanga River.	*Section 1.1.1.1 Location* *The Busuanga River Dredging Project is located in the island of Occidental Mindoro. The project area is located between the municipalities of Rizal (Barangays Adela and San Pedro) and San Jose (Barangays San Agustin and Central), Occidental Mindoro. The river basically acts as a boundary for both municipalities. The two municipalities are connected by the Busuanga Bridge. No sensitive ecosystems may be affected or likely to be affected by the dredging operations because the areas considered to be critical are distant from the Project site.* *Section 1 Page 1-2*
	Mr. Romeo Aguirre Resident of Adela, Rizal	Numerous applications, West Island included, have been submitted before. A petition will be	The Proponent will ensure that the commitments will be initiated and will also engage the community all throughout the	*Based on the records of EMB-4B, six ECCs were issued to West Island Aggregates Inc ("West Island") covering various projects in the same*

Module	Key Stakeholder/s	Comments	Response	How it was addressed in the EIS
		initiated should the Proponent fail to fulfill their commitments.	project duration through the MMT. In case that there will be damages, there will be a cash bond.	*project area being applied for by RC-GPC. However, 3 among the 6 ECCs issued are now under issue because they were previously subject of a Memorandum of Agreement (MOA) with the Provincial Government of Occidental Mindoro. The MOA has already been revoked. Copies of the 3 ECCs - ECC-R4B-1003-0044, ECC-R4B-11060082, ECC-R4B-1003-0042 - Letter of Revocation, and Letter from EMB Central Office are attached under **Annex 2B**.* *Section 2.2.1.3 Possible Tenurial / Land Issues Page 2.2.1-18* *6.2 Multi-Sectoral Monitoring Framework* *According to Section 5.B of DAO 2022-02, the Inter-Agency Committee (IAC) shall have an option to establish a Multi-Partite Monitoring Team (MMT). The IAC shall identify the MMT members and also the monitoring activities to be undertaken during the life of the dredging project. The MMT will validate the Proponent's conduct of self-monitoring.* *Section 6 Page 6-5* *6.3 Environmental Guarantee and Monitoring Fund Commitments* *Royal Crown-Groundport and Partners consortium herein commits to provide an Environmental Monitoring Fund (EMF) on a yearly basis. The amount will be based on the Annual Workshop and Financial Plan (AWFP) of the MMT and shall be deposited in a government bank at the start of the calendar year. The disbursement shall be jointly handled by the MMT and the Proponent.*

Module	Key Stakeholder/s	Comments	Response	How it was addressed in the EIS
				The EMF shall be used to cover all MMT-related costs. *Section 6 Page 6-5*
WATER	**Mr. Restituto Awit** Resident of Adela and Municipal Councilor of Rizal	How long, deep and wide will the dredged area be? Are there contingency plans in place to address potential livelihood losses?	The Proponent will implement livelihood programs aimed at mitigating the impact of fisherfolk livelihood loss.	*See attached Approved Master Dredging Plan in Annex 1-B* *Royal Crown shall target 100% compliance to livelihood and Fish Aggregating Device (FAD) and the full implementation of its SDP.* *Page ES-10*
	Mr. Nico Clemente, Resident of Adela, Rizal	Despite the presence of dredging companies operating in the area, there has been no noticeable improvement in the flood situation. The main concern also leads to flooding and soil erosion. He anticipates that the Proponent stands apart from others and will genuinely execute their proposed plans and initiatives for the individuals and the area in question.		*The possibility of sediment streams spilling into coastal waters from river dredging can be prevented first and foremost by controlling erosion and spillage of sand at source and diverting and retrieving all loose or fugitive soil and sediments into sediment filters. During dredging, silt curtains are to be installed whenever possible to filter the sediments in the seaward side of the estuary. Loose materials shall be stockpiled in a landward area where control measures can easily be applied to prevent unnecessary dispersion. Replanting of beach vegetation, as well as enhancing vegetation cover in open areas will help significantly to minimize soil erosion and freshwater runoff. The planting of mangrove trees along the estuary of the river can be a worthy project of the firm.* *Section 2.2.2 Water Page 2.2.2-120*
PEOPLE	**Ms. Tessie Dolor** Resident of Purok 1, Barangay Adela, Rizal	What assistance or livelihood program will the Proponent offer to the affected people, particularly the fisherfolk, in the event of soil erosion occurring within the next	The Company will ensure a thorough examination of the project area and will consult the top management for appropriate mitigation strategies.	*Royal Crown shall target 100% compliance to livelihood and Fish Aggregating Device (FAD) and the full implementation of its SDP.* *Page ES-10*

Module	Key Stakeholder/s	Comments	Response	How it was addressed in the EIS
		two years? Will their fishing livelihood be halted?	Further, the Company will properly coordinate with the barangay chairman for the hiring of local residents during project execution, and communicate the project timeline to the affected barangays, specifying when the project will impact the area.	*Partner with the LGU for the implementation of the Social Development Program; Provide employees' wages and benefits as prescribed by law; Generation of livelihood opportunities by allowing local entrepreneurs to provide support services to the project and its workers.* *Section ES Page ES-15*
	Mr. Jonnie Garona Resident of Adela, Rizal	What assurances will the Proponent offer to ensure the security of the residents of Adela, Rizal?	Representatives from EMB4B and the Proponent reiterated again that the Environmental Guarantee Fund will be a part of the commitment of the Proponent.	*6.3 Environmental Guarantee and Monitoring Fund Commitments* *Royal Crown-Groundport and Partners consortium herein commits to provide an Environmental Monitoring Fund (EMF) on a yearly basis. The amount will be based on the Annual Workshop and Financial Plan (AWFP) of the MMT and shall be deposited in a government bank at the start of the calendar year. The disbursement shall be jointly handled by the MMT and the Proponent. The EMF shall be used to cover all MMT-related costs.* *Section 6 Page 6-5*
	Mr. Raffy Saulong, Resident of Adela, Rizal	The operation should just be in the middle, one way and have a protection deck on the side. Suggestion: 1 ship or vessel only.	The Proponent will ensure comprehensive oversight of all project-related elements, diligently monitoring potential impacts. They will also enforce the IEC (Information, Education, and Communication) measures and adhere to established security protocols. The project will only advance once the stakeholders and residents grant their No Objection consent. The Proponent will use suction dredger.	*For technology and design, RC-GPC shall use a Cutter Suction Dredger for the deeper portions of the river delta. On the inner sections of the river, a conventional mechanical dredging using backhoes/excavators in tandem with dump trucks will be used.* *Section 1.3 Alternatives Page 1-23*
	Mr Reynaldo Aguirre	There should be a MOA between	The Proponent will ensure that the	*6.2 Multi-Sectoral Monitoring Framework*

Module	Key Stakeholder/s	Comments	Response	How it was addressed in the EIS
	Barangay Chairman of Adela, Rizal	the Proponent and stakeholders and suggesting a protection deck before the dredging phase.	commitments will be initiated and will also engage the community all throughout the project duration through the MMT. In case that there will be damages, there will be a cash bond.	*According to Section 5.B of DAO 2022-02, the Inter-Agency Committee (IAC) shall have an option to establish a Multi-Partite Monitoring Team (MMT). The IAC shall identify the MMT members and also the monitoring activities to be undertaken during the life of the dredging project. The MMT will validate the Proponent's conduct of self-monitoring.* *Section 6 Page 6-5*
OTHERS	**Mr. Alex Coden,** Chief, PEMU-Occidental Mindoro	Mr. Coden provided insights into the entire project, which was initially described as a River Restoration Project (DAO 2020-12). He elaborated on the legal framework and outlined the necessary steps and procedures for project implementation, starting from obtaining the Master Dredging Clearance, Environmental Compliance Certificate (ECC), Notice to Award, Notice to Proceed, and other required permits and clearances, including the ore transport permit from the Mines and Geosciences Bureau (MGB). Additionally, he discussed the Environmental Impact Assessment (EIA) process, including details about the Environmental Guarantee Fund and the participation of stakeholders in the Multi-partite Monitoring Team (MMT).		

Table 2.2.4-1. *Summary of Issues and Concerns Raised in the Focus Group Discussion*

Name/Affiliation	Concerns raised	Response	How it was addressed in the EIS
Barangay Chairman	Hindi pa ba kayo magsisimula, parang ang tagal	Inaayos lang po namin ang mga kailangan na studies at dokumento para po matapos na ang mga clearance at makapag simula na.	*Royal Crown is on the process on securing all the necessary permits including the Environmental Compliance Certificate (ECC)*
Barangay San Pedro	Kami naman dito ay nag aantay lamang na makapag simula kayo lalo't meron kami mga kabarangay na malapit doon sa ilog na naapektuhan kapag bumabaha	Salamat po Kapitan.	
Barangay Central	No concerns		
Barangay San Agustin - Konsehal	Sa amin naman ay walang problema basta kami lamang ay sinasabihan o ipinapaalam sa amin ito. Kung para naman ito sa ikabubuti ng lahat para hindi na din kami mabaha ay wala naman issue.	Salamat po at makakaasa kayo na sa mga susunod pa na activity ay kasama po kayo.	

SECTION 3. CARRYING CAPACITY ASSESSMENT
(SPECIFICALLY ON SILT/SEDIMENTS)

3.1 ENVIRONMENTAL MANAGEMENT GOALS AND INDICATOR LIMITS

The proposed project is primarily aimed to restore and enhance the conveyance capacity of Busuanga River in order to minimize the perennially damaging floods of the adjacent areas at no cost to the government. Inspite it being an environmental enhancement project, potential adverse impacts in the process of performing the project activities are still present. As such, the general environmental management goal for this project is mitigate the potential impacts on land, water and people in such a way that residual adverse effects are significantly decreased if not entirely eliminated. A more detailed discussion of the environmental goals for each sector are separately discussed in the following subsections.

3.1.1 LAND

Disposal of Unacceptable Materials or Spoils and Management of Fugitive Silt
The proposed project will not generate unwanted dredged materials because all dredged materials shall be transported to targeted buyers. Hence, unwanted dredged materials to be disposed of are not expected. If ever, the disposal of such unwanted spoils shall be by reusing it, i.e., use them in areas where it is needed as preliminary dump piles or supplemental filling or be donated to government and non-government organizations needing it.

All the processes for extraction/dredging will be strictly mechanical and no chemicals will be used. Resuspended or fugitive silt may be produced during dredging due to the disturbance of the riverbed. This may be prevented with the installation of bio-friendly (geo-textile) silt curtains around the dredging area to trap any dispersed silt. Silt curtains shall be placed parallel to the direction of flow of water. The two layered containment boom and silt curtain will utilize fine mesh-sized material to filter fine and very fine sands. At the unloading site, a Type II silt and turbidity curtain and containment boom will be installed while the Type III curtains will be used at the dredging site. The curtain shall extend to the bottom of the water. Silt curtains shall likewise be installed around all civil works in or adjacent to waterways. This is done to control the movement of the suspended silt into the waterway.

In cases wherein silt curtains and other containment enclosures are not practicable, the proponent shall schedule the dredging operations during periods of calm winds or low tides as the rate of spread of silts and suspended solids will be much lower due to the limited mixing.

Moreover, the dredging crews will keep the edge of the suction pipe as close as possible to the riverbed to lessen the agitation of the sand to prevent siltation and/or increased turbidity.

3.1.2 WATER

Marine Ecology
The sediment streams, disturbance and resuspension of silt in the water column, to be carried downstream into the estuary is a likely consequence of dredging and substrate removal in the Busuanga River. Excessive sediment streams can intensify water turbidity that could lead to the demise of coral settlers (if any), disrupt feeding behavior and reproductive performance of the few fish and crustacean population in the coastal shelf. Extreme water turbidity can impair the photosynthetic capacity and lead to the demise of micro-algae and this can have far reaching impacts on both the primary productivity in the marine food chain as populations of larval stages of fish and crustaceans can be negatively affected by extremely turbid conditions in the water column. The further alteration of benthic habitats due to sediment loading would most likely result to the movement of fish and fish recruits away from the coastal area that is affected by the Project.

The proposed project aims to improve, and thereafter maintain the integrity and resilience of the coastal ecosystem through prevention of sediment streams and the rehabilitation of dredged areas though greening and waste management. The long term aim of improving the coastal environment is to enhance growth, reproduction and recruitment of fish and crustaceans and restore aesthetic quality.

The strategy includes: keeping the dredging suction pipe as close to the bottom of the river as possible; prevention of extensive streams of silt and sediments; curtailment of domestic wastewater pollution from dredging/hauling vessels; curtailment of oil spills; and re-seeding and transplantation of shellfish removed from highly-disturbed areas.

Freshwater Ecology
It is the management goal to ensure that dredging activities will not permanently impair the already highly-stressed freshwater ecology and that the existing fauna can be safely trans-located in undisturbed portions of the river to ensure that a new starter population is embedded. While it is true that the river fauna within the dredging area will be disturbed during the operation, the proponent shall endeavor to enhance its proliferation in the undisturbed portions of the river.

It is important that the protection of the integrity, enhancement of aquatic species and promotion of improvement and maintenance of water quality in the Busuanga River be pursued. To minimize or prevent sediment spills and degradation of the river, the following measures will be adopted: sediment and silt sequestration; re-stocking of aquatic fauna; sand and gravel stockpiles shall be rigidly bundled away from areas where spillage onto the river systems can occur; management of slurry from equipment and stockpiles; no abstraction of river water; prevention of blocking and congestion of stream flow; control and treatment of liquid wastewater; and prevention of oil and grease spills.

Irrigation Water
The Busuanga River is one of the streams that supply water and irrigation for agricultural purposes to the Rizal and San Jose. There are existing irrigation canals around the project site while more are being built. According to the barangay officials and residents of Adela, the construction of the irrigation system is not yet complete. Water flows through the canals only when there is precipitation. According to Mr. Arevalo of NIA Occidental Mindoro (KII), NIA operates several Communal Irrigation Systems (CISs) along the river. He mentioned that dredging should be undertaken in order to avoid future inadequacy of irrigation water resources.

The water inlet is located far upstream of the project area, and therefore, the Project shall not impact on the water quality of this irrigation system though there may be minimal effects in terms of supply volume as the surface water level is eventually lowered.

3.1.3 PEOPLE

The dredging operations may possibly impact on land tenure issue/s as well as accessibility of locals into the river and their adjacent farmlands and/or homes. Nevertheless, there will be no displacement of settlers as there are no existing dwelling units within the river.

Royal Crown-Groundport and Partners Corp will consult with land tenants around the project area and offer just compensation them in terms of crop damages or for the temporary use of the land, whichever is appropriate. It is to ensure that complaints are avoided as well as properly and promptly settled. No grievance should remain unaddressed for long periods of time.

Since the dredging activities involve heavy equipment and vessels, and that silt curtains will be installed along the perimeter of active dredging area, no one shall be allowed access to that particular small area for that period. In any case, people can still freely access the rest of the project site.

Displacement of sustenance fishers in the river and estuary, albeit few in number, is expected. To compensate, RCPC shall target 100% compliance to livelihood and Fish Aggregating Device (FAD) and the full implementation of its SDP. Strategies shall include: translocation/ re-stocking of suitable bivalve populations in the inter-tidal area; formulation of a Fisheries Improvement Plan; provision of supplemental livelihood training to the affected locals; replacement of dislocated fishing gears; and pursuance of crab and fish replenishment in nearshore sandy shoals.

A multitude of local socioeconomic benefits shall be brought about by the Project including but not limited to the following: enhancement of employment and livelihood opportunities; increased business opportunities and associated economic activities; and increased revenue of LGUs. Majority of the workers for the project shall be from the host community, provided they have the required skills or qualifications. Their income from salaries and wages shall mean increased disposable income, which they will spend in the local market and in turn will help local businesses flourish. Consequently, quality of life for a lot of locals will improve giving them the chance to support their children's higher education. In the end, a brighter future for the young population can be actualized. Moreover, additional influx of investments and financial assistance will be accorded to the people of the host barangays as well as the municipality through the various projects under the SDP.

3.2 CARRYING CAPACITY ANALYSIS

The project site is located at the lower reaches from 500 meters offshore to the river mouth for the navigation zone; and from the Sta 11+050 (mouth) to Sta 9+000 upstream for the main channel section and from Sta 0+950 (mouth) to Sta 3+550 for the river branch. The end point upstream is 1.95 km below the Busuanga Bridge.

The onshore project area covers **538.29 hectares** while the navigation zone (offshore) covers **70.82 hectares**. Within the onshore area is the fluvial dredging zone, which has an area of **175.59 hectares** along 10.55 line kilometers. See **Figure 1-2** and **1-3**.

Figures 1-17 to **1-25** are the segments of the Dredging Plan and Profile of the Project overlain on longitudinal section showing therein the elevation profile of the Design Flood Level without dredging, Design Flood Level, Existing Riverbed, and Design Riverbed Elevation. These were wholly taken from the approved DMP attached as **Annex 2-A**. The said design report is in accordance with the DPWH Design Guidelines, Criteria and Standards and other accepted engineering practices. It presents the details of the approach and methodology employed in the hydrologic and hydraulic assessment of the river. It includes discussion on the fundamental hydrology considerations and peak runoff estimation and hydraulics of open channel flow.

The profile along this line shows that the 100-year Design Flood Level (DFL-100YR) ranges from 0.80m to 16.85m (average 7.33m) before dredging and will be lowered to -1.77m to 14.15m (average 5.29m) after dredging.

The proposed dredging cross sections to be dredged have a 100 meters and 200 meters bottom width, 1V:2H side slope and 3-meter depth.

The volume of materials needed to be dredged to a level that will enable the carrying capacity of the river to handle 100-Year storms without overbanking / flooding was estimated at 4,538,686.02 m^3. At the navigation zone, the total volume to be initially extracted to create a navigable lane is estimated at 2,536,078.67 cubic meters.

The extraction rate based on the approved dredging plan for the river is **4,538,686.02 m^3/annum**. For the navigation zone, the whole extractable volume given above shall be dredged within the first six months of the operation.

3.2.1 HYDROLOGY

Methodology
Hydrologic analysis is conducted to determine the peak discharges which will be used in the hydraulic impact assessment of the project. In this study, there are two methods employed to determine the peak discharges corresponding to the 100-yr return periods. First, a deterministic approach using the HEC-HMS was carried out to numerically simulate the hydrologic response of the river basin.

Discharge analysis was conducted using the Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS). Supplemental analysis tools are provided for model optimization, forecasting streamflow, depth area reduction, assessing model uncertainty, erosion and sediment transport and water quality.

The discussions herein are likewise discussed under **Section 2.2.2.1 Hydrology/Hydrogeology.**

3.2.1.1 CATCHMENT AND CHANNEL DETAILS

Watershed Delineation
Busuanga River is located in the southwestern part of Occidental Mindoro with a total delineated watershed area of around 530.07 km^2. A dredging project is proposed in Busuanga River at Rizal, Occidental Mindoro which aims to increase the flood-carrying capacity of the said river. The project involves dredging of Busuanga River with a total length of 10,550.0 meters from the river mouth. The proposed dredging cross section to be dredged has 100 meters and 200 meters bottom width, 1V:2H side slope and 3-meter depth.

A watershed, also called catchment or drainage basin, refers to the topographic area that collects rainfall and discharges surface stream flow through the outlet of the watershed *(Mays, 2005)*. Watershed delineation is the process in which the boundaries of a watershed are identified by passing an imaginary line that traces the ridges and divides. The delineated area represents a 'bowl' and rainfall falling into this area drains into the portion with lowest elevation called the outfall or outlet. This outlet is designated as a point of interest located along the river of a watershed. The topographic, geometric, as well as the soil and land cover characteristics of the watershed are major factors in the transformation of rainfall into the volume that flows through the desired outlet along the river.

To delineate the watershed of Busuanga River, the digital elevation model of Mindoro Island obtained from the National Mapping and Resource Information Authority (NAMRIA) which has a resolution of 5m was used in the study. The delineated watershed of Busuanga River has an area of 530.07 km^2. Please refer to the following figure.

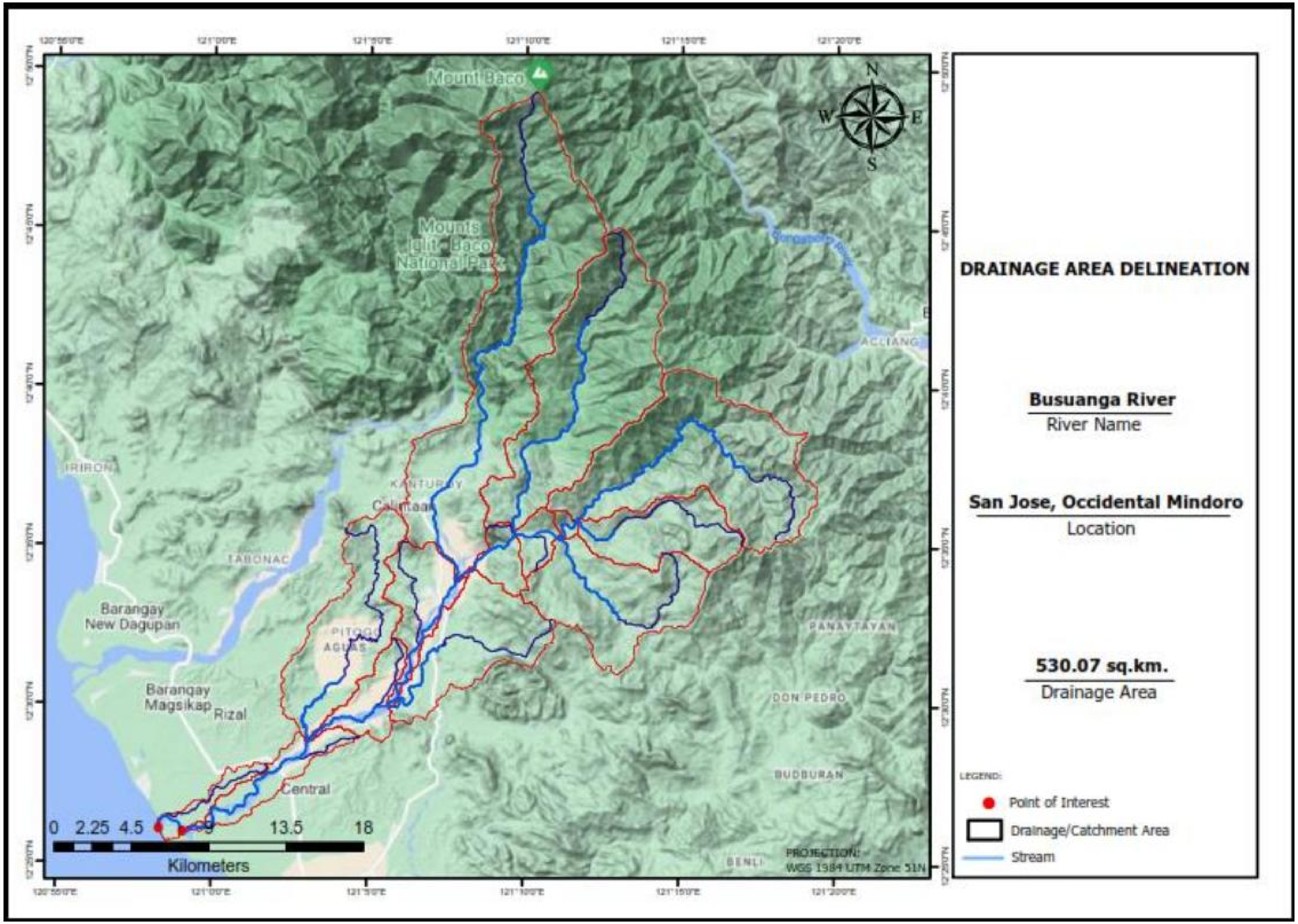


Figure 3-1. Delineated Watershed of Busuanga River

HEC-HMS Hydrologic Model

HEC-HMS developed by USACE was implemented in this study to simulate the hydrologic processes of Busuanga River. The sub-basins and reaches were generated in the basin model. The location of the outlet or sink of the basin is defined as the upstream boundary condition of the hydraulic model.

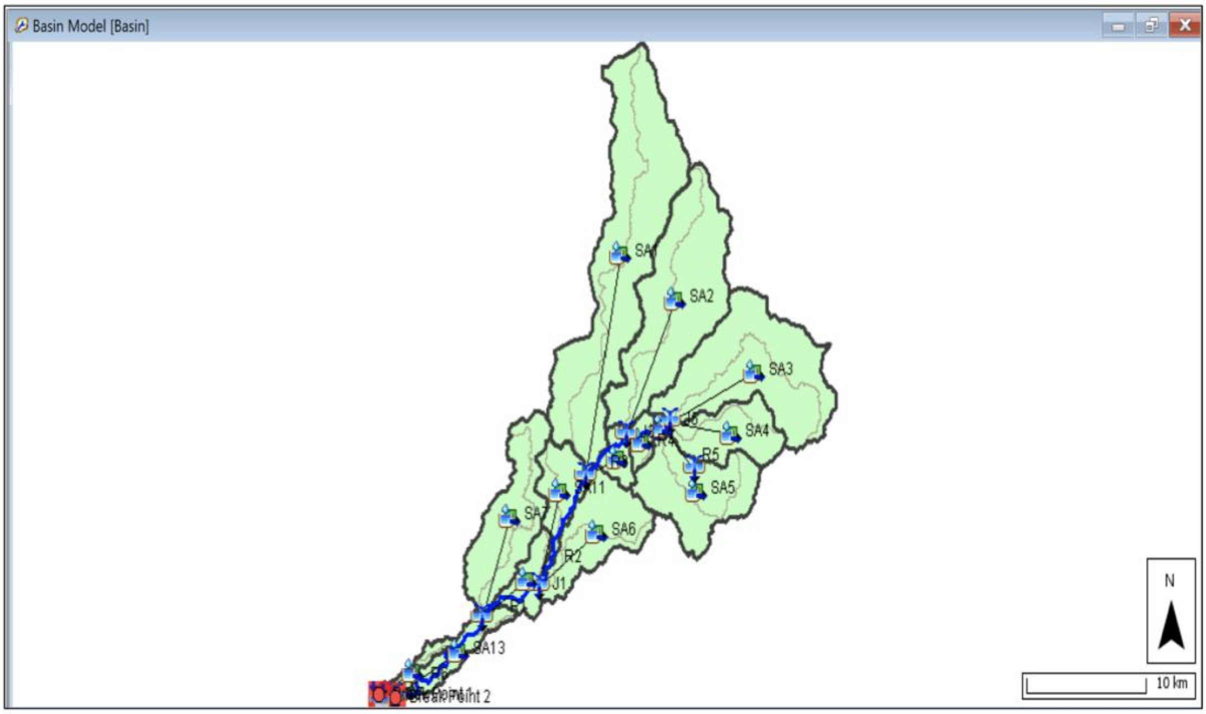


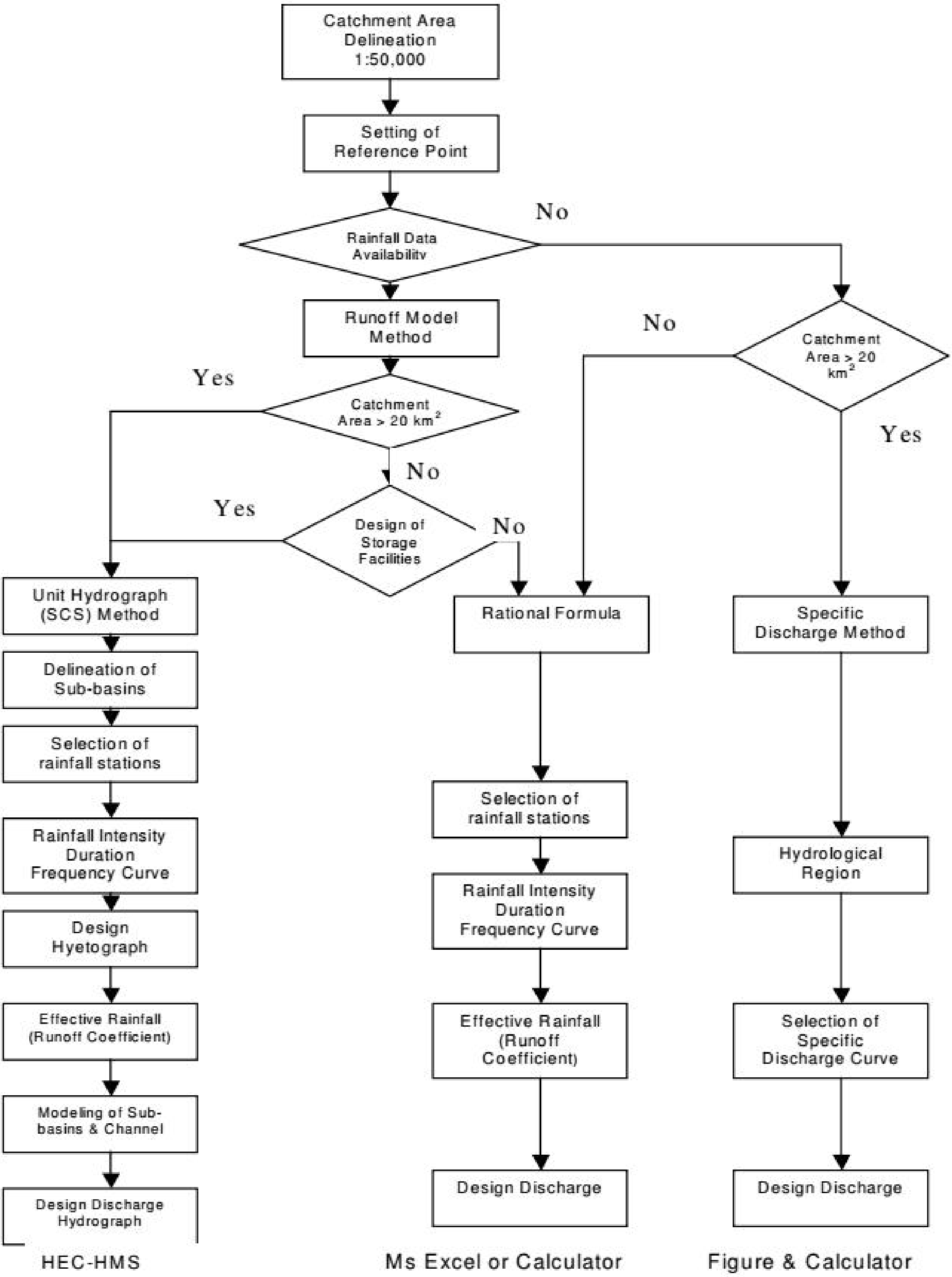
Figure 3-2. HEC-HMS Basin Model Used in the Study

Table 3-1. Physical Characteristics of Subbasins and Watersheds of Busuanga River

Subbasin ID	Catchment Area (km^2)	Length (km)	Lca (km)	ELEVATIONS		
				Highest Elev. (m)	Lowest Elev. (m)	Diff. (m)
0	116.81	35.63	19.9	1980	65	1915
1	85.28	23.57	12.32	1720	120	1600
2	103.99	23.69	9.68	1304	140	1164
3	10.31	4.53	3.55	120	65	55
4	6.91	2.92	1.44	140	120	20
5	26.07	8.78	4.02	260	64.5	195.5
6	52.3	17.77	5.61	1304	140	1164
7	8.2	4.51	3.9	65	64.5	0.5
8	8.8	6.89	3.56	64.5	39	25.5
9	37.39	10.62	6.63	120	37	83
10	32.3	14.34	8.62	760	39	721
11	6.5	5.08	3.48	39	37	2
12	5.24	3.84	3.36	37	36	1
13	9.59	7.24	4.25	100	36	64
14	6.78	4.66	2.83	36	10	26
15	6.55	4.51	1.57	10	5	5
16	8.96	3.19	1.35	10	5	5

Hydrological analysis is mainly conducted to determine the **design discharge necessary to approximate the expected inundation** within the project area. In order to determine the design discharge, extreme rainfall frequency analysis of observed rainfall data is commonly used. Annual maximum point rainfall data measured at specific durations is used in the frequency analysis to determine the point rainfall data at a given return period. These point rainfall data are used to generate rainfall intensity-duration- frequency (RIDF) curves necessary to generate rainfall hyetographs. The generated rainfall hyetographs are then used as input to the rainfall-runoff model which will be used to calculate for the design discharge.

In this project, both the 2015 Design Guidelines, Criteria & Standards (DGCS) Volume 3, and the 2010 Manual on Flood Control Planning by DPWH were used as references in conducting the rainfall and runoff analysis. Figure below shows the flow diagram for the design discharge determination. Please refer to flow chart below.



Source: DPWH Manual on Flood Control Planning

Figure 3-3. Flow Diagram for Determining the Design Discharge

3.2.1.2 RAINFALL INTENSITY DURATION FREQUENCY (RIDF)

Shown in Figure below are the available PAGASA Synoptic Stations and the respective Thiessen polygons. While no synoptic station was found within the catchment area, the Romblon Synoptic Station was located near the delineated basin. Hence, for this study, only the RIDF from Romblon Synoptic Station was used.

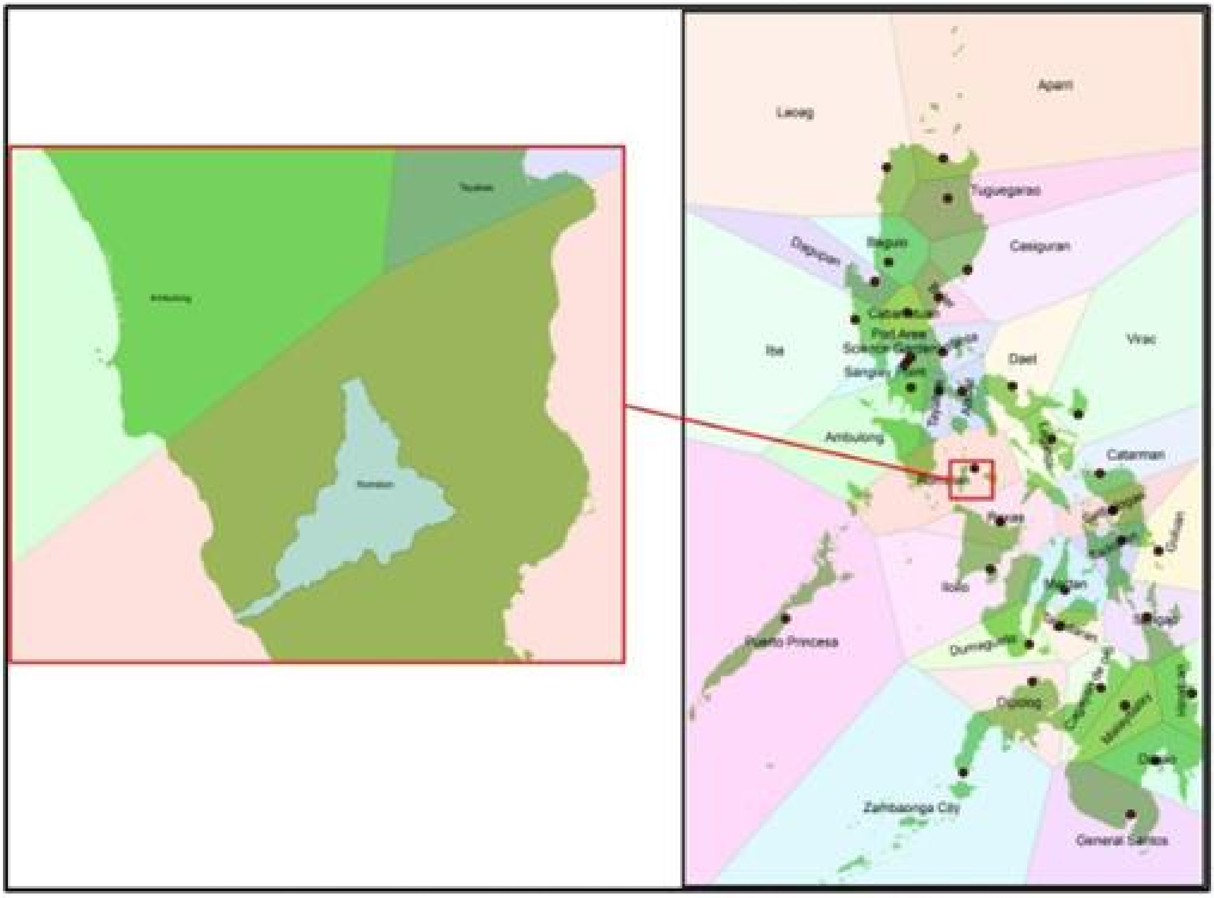


Figure 3-4. Thiessen Polygons of PAGASA Synoptic Stations

Rainfall that falls to the watershed will be intercepted by flora, stored in surface depression, and then infiltrated to the soil. Using the available station in San Jose, Occidental Mindoro, the rainfall intensity was computed using the MS Excel (Runoff Analysis Input Data Processing Form) provided by the DPWH FCSEC Manual on Runoff Computation with HEC-HMS in developing hourly rainfall hyetograph by alternating method. The method selected as per Runoff Analysis Input Data Processing Form is method 3, Iso-specific Coefficient and Isohyet of Probable 1-day Rainfall. Representative point can be the centroid of the river basin.

Among the list of PAGASA Synoptic Stations having FCSEC's RIDF Curve, the San Jose Station is used herein (see table below).

Table 3-2. Runoff Analysis Input Data Processing Form

* : Select one station ID from the table on sheet "01StList"

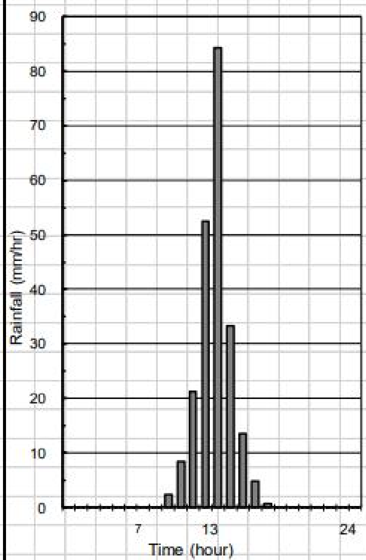
PAGASA Synoptic Station		**Station ID***		**531**	**Name**	**San Jose**				
Coefficients for RIDF Curves (from Reference 1)										
Return Period (Year)	Short Duration (10min - 1hr)**				Long Duration (1hr - 24 hr)				Formula	
	Type	A	C	b	Type	A	C	b		T (min)
2	2	322.65	6.14	0.40	2	681.48	-21.63	0.66	Type 1 :	
5	1	34026.06	179.84	1.38	2	20420.05	126.69	1.07	$R = \frac{A}{(C + T^b)}$	
10	1	47392.72	202.90	1.42	2	89237.71	191.89	1.24		
25	1	123208.14	444.49	1.62	2	1653388.46	357.37	1.60	Type 2 :	
50	1	181375.17	582.10	1.70	2	237807330.19	670.80	2.20	$R = \frac{A}{(C + T)^b}$	
100	1	94586.07	266.80	1.48	2	8442184.35	421.12	1.78		

Name of River	Busuanga River	Return Period (Year)	100	Rainfall Duration (hour)	24
C. A. (km^2) *	532.0	* :The total catchment area of all sub-basins.			
Area Reduction Factor fa	0.5939				
Area Reduction Factor fa Applied	0.5939	for Method 1: Value computed in the above cell for Method 2: 1.0 or value in the above cell (case-by-case) for Method 3: 1.0			

Manual Input

Time (hour)	Total Rain (adjusted by fa) (mm/hr)	Loss (mm/hr)	Excess Rain (mm/hr)	Excess Rain (%) to total
1	-2.93	0.00	-2.93	-1.61%
2	-3.06	0.00	-3.06	-1.68%
3	-3.05	0.00	-3.05	-1.68%
4	-3.11	0.00	-3.11	-1.71%
5	-3.05	0.00	-3.05	-1.68%
6	-2.75	0.00	-2.75	-1.51%
7	-2.00	0.00	-2.00	-1.10%
8	-0.53	0.00	-0.53	-0.29%
9	2.39	0.00	2.39	1.31%
10	8.37	0.00	8.37	4.60%
11	21.36	0.00	21.36	11.73%
12	52.47	0.00	52.47	28.82%
13	84.29	0.00	84.29	46.30%
14	33.37	0.00	33.37	18.33%
15	13.60	0.00	13.60	7.47%
16	4.85	0.00	4.85	2.66%
17	0.65	0.00	0.65	0.36%
18	-1.37	0.00	-1.37	-0.75%
19	-2.42	0.00	-2.42	-1.33%
20	-2.83	0.00	-2.83	-1.55%
21	-3.05	0.00	-3.05	-1.68%
22	-3.21	0.00	-3.21	-1.76%
23	-3.02	0.00	-3.02	-1.66%
24	-2.93	0.00	-2.93	-1.61%
Total	182.04	0.00	182.04	100.0%
Max.	84.29	0.00	84.29	46.30%

Design Hyetograph
(Excess Rain, Basin Rainfall)



HEC-HMS Input Data

For a 24-hr period, the total rain is 182.04 mm with peak at 84.29 mm (13th hour). Without any loss, the excess rain that will be converted to runoff is equivalent to the rainfall amount.

The transformation of the excess rainfall to runoff was modeled using the SCS method. The SCS method requires specifying the lag time and peaking coefficient. The lag time is the time interval between the mass of the rainfall to the peak runoff. The lag time parameters were initially calculated based on the length of the mainstream and geometric center of the basin while the peaking coefficient is dependent upon basin characteristics. To represent the watershed baseflow or the delayed subsurface flow after the storm, the exponential recession model was used.

As water moves through the river or channel, there is a change in the hydrograph shape because of the storage in the channel. Channel or river routing is the method to predict the change in the hydrograph as water moves down the channel. In this study, the Muskingum Cunge method is used for the channel routing.

In summary, the hydrologic models that were used in HEC-HMS are presented below. These models were selected in consideration of the availability of data for the determination of parameters and the best fit of the simulated data to the observed data. Parameters that were used in the model are discussed in the next section.

Table 3-3. Hydrologic Models Used in HEC-HMS

Hydrologic Process	Model
Transform	SCS
Baseflow	Recession
Routing	Muskingum Cunge

3.2.1.3 BASEFLOW/ DESIGN DISCHARGES

Baseflow is a sustained runoff of prior rainfall that was stored temporarily in the river basin. The baseflow can be assumed to be constant during flood. When a streamflow gauging station is located near the target river basin, the mean daily discharge of one day before the flood is used as the baseflow.

Due to lack of data on the average daily discharge along or near the target river basin, 0.05m^3 /s/km^2 is assumed as the baseflow as per recommended in the DGCS Volume 3. An area of 530.068 sq. km yielded a baseflow of 26.503 m^3/s/ constant value for the baseflow is assumed throughout the flood analyses.

Catchment Area	-	**530.07 km^2**
Baseflow	-	**26,503 m^3/sec**

3.2.1.4 DETAILED HYDROLOGIC ANALYSIS

Table 3-1 above shows the physical characteristics of the subbasins and watershed.

Lag Time

The modified Snyder's Lag Equation is used to determine the lag time and is commonly used for that purpose.

$$Lg = 0.6865 \times Ct \times \left[\frac{L \times Lca}{\sqrt{S}} \right]^{0.38}$$

Where:	Lg:	Lag time in hrs		
	Ct:	Lag time coefficient		
		Mountainous areas	:	1.2

Hilly areas : 0.70
Valley areas : 0.35

L: Length of watercourse from the downstream end of the subbasin to the upstream subbasin boundary (km)

Lca: length of water course from the downstream end of the subbasin to a intersection on the stream perpendicular from the centroid of the subbasin (km)

S: average basin slope (overall slope along longest water course from the downstream to upstream ends of the subbasin)

Table 3-4. Calculated Lag Time

Subbasin Name	Lag Time (hr)	Lag Time (min)
W500	13.52	810
W530	6.34	380
W560	3.08	180
W570	1.54	90
W580	5.92	360
W590	2.85	170
W600	7.13	430
W610	3.33	200
W620	1.06	60
W650	2.08	120
W660	6.44	390
W670	1.81	110
W710	5.93	360
W720	2.34	140
W730	2.20	130
W740	4.59	280
W760	1.14	70
W770	4.73	280
W780	13.81	830
W790	0.82	50
W800	7.55	450
W810	2.01	120
W830	1.29	80
W840	4.01	240
W860	2.14	130
W870	4.90	290
W880	1.50	90
W910	2.17	130
W920	1.36	80
W930	1.91	110
W940	4.01	240

In the determination of the computation time interval, the smallest lag time is multiplied by 0.29 and is rounded down to the nearest divisor of the hypetograph data. In this study, 10 minutes shall be applied. (0.29 x 50 min. = 14.5 = 10 minutes).

Summary Result, 100-Yr:

The results of the hydrologic analysis employing both hydrologic modelling and extreme value analysis in the determination of the design discharges for the 100-yr return periods for each of the dredging sections are presented below. The simulated peak discharges from the hydrologic modelling are used in the hydraulic modelling study.

Table 3-5. Computed Peak Discharges (100-Yr)

Peak Discharge	100-yr
Main Downstream	1,205.9 m^3/s
Section 1 Junction	1,972.33 m^3/s
Section 2 Branch	936.10 m^3/s

3.2.1.5 HYDRAULIC ANALYSIS

To determine the hydraulic impacts of the dredging Project, HEC-RAS program developed by USACE was implemented in this study. The results of the hydrologic analysis were used in the simulation of 100-yr peak discharges in the one-dimensional steady flow calculation of the water levels and surface profiles along the Busuanga River. The HEC-RAS program was also used in the sediment transport analysis for the 100-yr floods.

The basic computational procedure of HEC-RAS is based on the solution of the one-dimensional Energy Equation. In the computation of water surface profiles, the program uses the standard step method of Energy Equation, head loss and Manning's Equation for open channels.

HEC-RAS Geometry for Busuanga River
A bathymetric survey of the Busuanga River was conducted along the 10,550.0 meters length measured from the river mouth. This bathymetric survey was used to generate the cross-sections for the one-dimensional flow calculations using the HEC-RAS program. Two sets of HEC-RAS geometric model were developed - (1) baseline scenario "without" the dredging project and (2) scenario "with" the dredging project. The proposed river sections for dredging are located along the 10,550.0 meters length starting from the mouth of the Busuanga River. The cross-sections are generally spaced at 50-m intervals and the manning's roughness was set to 0.035, which is the recommended roughness for gravel beds. The downstream boundary condition was set to the mean sea level.

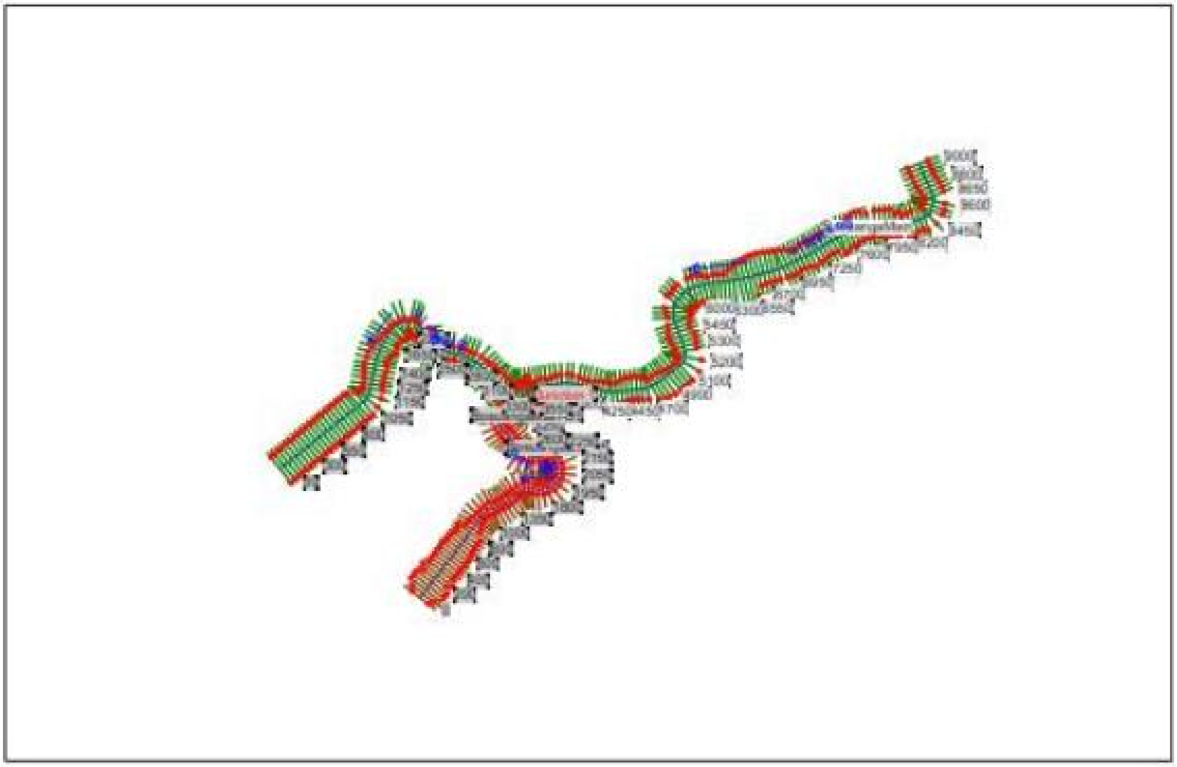


Figure 3-5. HEC-RAS Geometric Model of Busuanga River at the study area

Simulated Water Surfaces Profile Profiles for 100-yr Floods

The peak discharges of 1205.90 m^3/s (main downstream), 1,972.33 (section 1) and 936.1 m^3/s (section 2) m^3/s, all corresponding to 100-yr flood were simulated using the steady state 1-dimensional flow of the HEC-RAS program. In this section, the water surface profiles for the (1) baseline scenario "without" the dredging project and (2) scenario "with" the dredging project are presented for the 100-yr floods. The results for all the cross-sections can be found in pages 80 to 101 of Annex 2A.

The figure below shows the simulated water surface profiles for the "without" and "with" dredging project for 100-yr flood. In the figure, the water surface profile is along the 10,550.0 km length of Busuanga River, starting from the river mouth. Comparison of the water surface profiles for the "without" and "with" dredging project show that there is a decrease in riverbed and water levels along the length of the dredged channel.

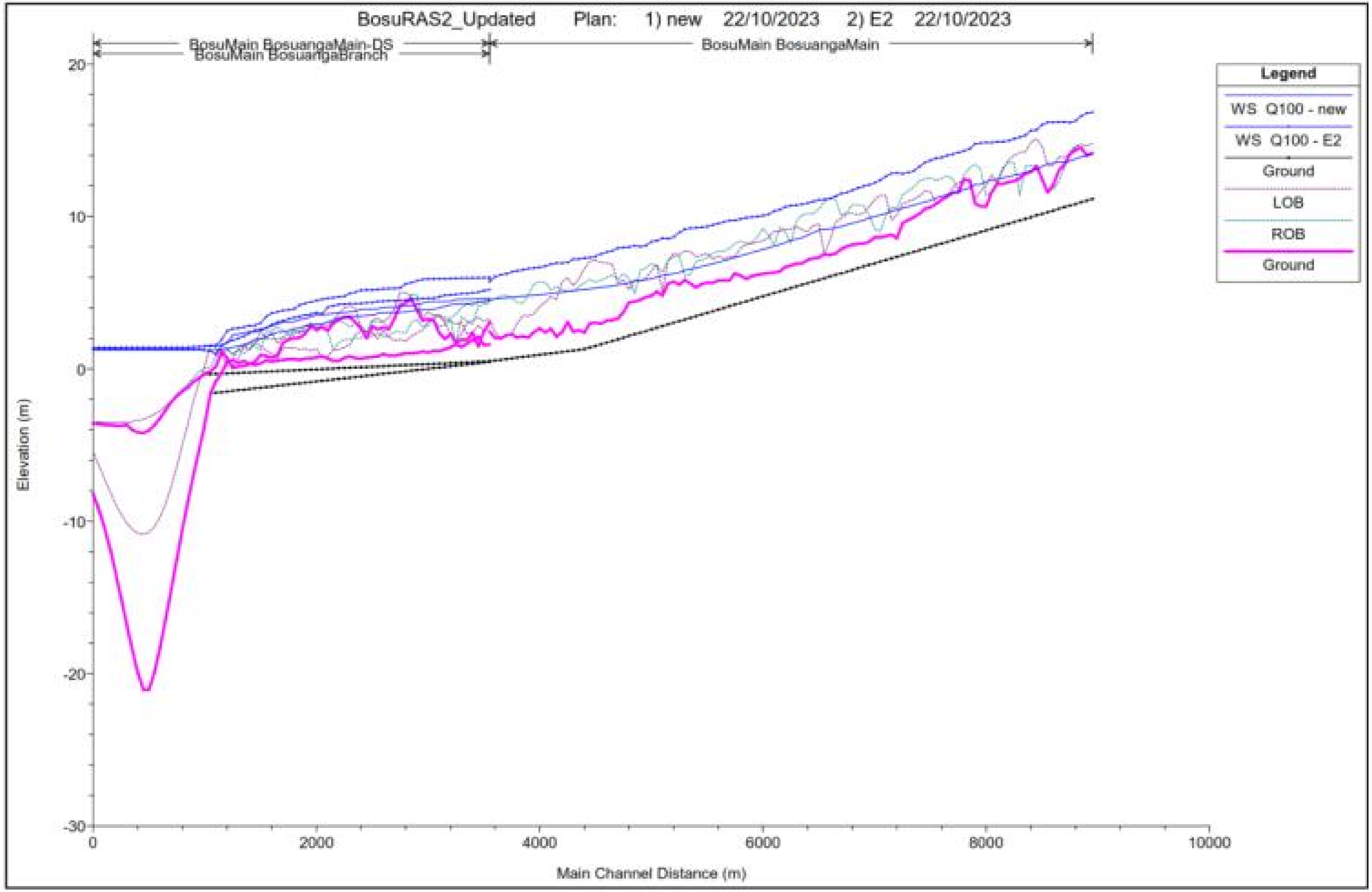


Figure 3-6. Water Surface Profiles for the Baseline Scenario "With and Without" the Dredging Project at 100-yr Flood

3.2.1.6 PROBABLE FLOOD

To determine the probable inundation in the target river stretch before and after the proposed dredging project, 2D – unsteady flow inundation models were used with the aid of the HEC-RAS Version 5.0.7 software. The Hydrologic Engineering Center River Analysis System (HEC-RAS) is a hydraulic analysis tool developed by the US Army Corps of Engineers, which aids in river flow analysis and floodplain evaluation.

In this unsteady flow model, flow hydrograph data was used as the upstream boundary condition while stage hydrograph data was used as the downstream boundary condition. Shown in **Figure 3-7** is the geometric model of the river including its flood plains used in the 2D unsteady flow analysis.

Figure 3-7. Geometric Model for 2D Unsteady Flow Analysis

The table below lists down the hydraulic parameters used.

Table 3-6. Hydraulic Parameters

Peak Discharge	100-yr
Model	2D unsteady flow
Geometry	25.037 cells, 20m x 20m cell size
Downstream boundary condition	Stage Hydrograph; assumed constant 2m obtained from combined storm surge and high tide water elevation above mean sea level
Upstream boundary condition	100-Yr Return Period Flow Hydrograph
Manning's Roughness Coefficient	0.025 for each cell

Design Cross Section
The results of the analyses (cross sections) are reflected in the Approved DMP (pages 14-28 of **Annex 1B** and **Figures 2.2.2-9 to 2.2.2-23**). As seen in the plan views (**Figures 1-17 to 1-25**), the Busuuanga River branches out into 2 rivers along Sta 3+600 with both channels leading towards the sea.

The design channel width ranges from 100m to 300m. Deepening of the existing channel is required to increase the flow capacity of the river and thereby lessen the effects of flooding. The figure below shows the typical cross section design.

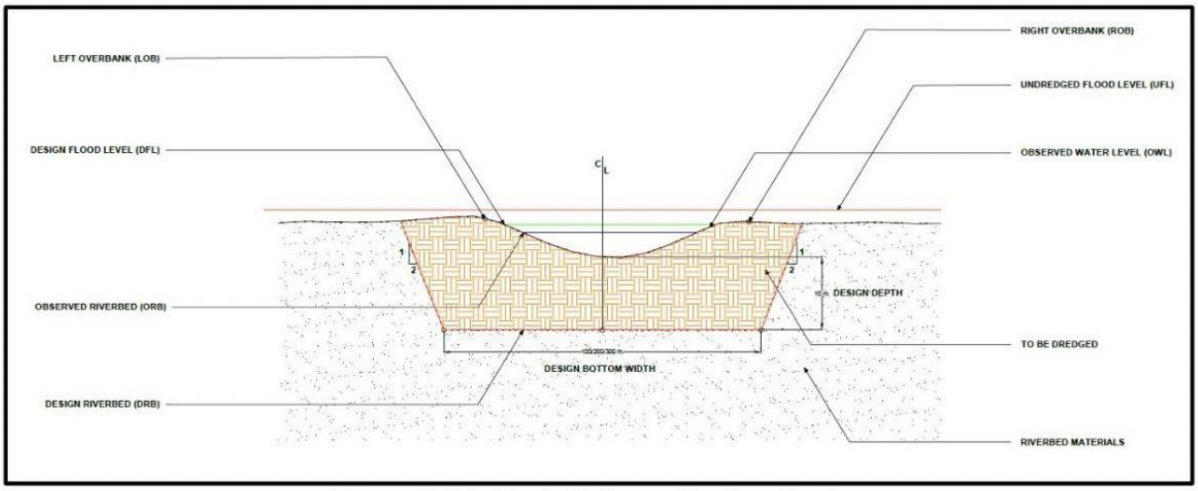


Figure 3-8. Typical Cross-Section Design

Design Riverbed Profile
The average slope of the channel is 0.18% and the design channel is set to follow this natural slope. The elevation of the design riverbed from the offshore towards the upstream ranges from -11.53m to 4.83 masl. In addition, the elevation of the design riverbed starting from the mouth of the branch up to the junction ranges from -11.19m to -4.98m.

Present Condition
A 2D unsteady flow was conducted to determine the capacity of the river and floodplains for a 100-YRP storm. The result, as shown in the inundation map in **Figure 3-9**, the lack of definite river channel of the Busuanga River results into the river discharge splitting across the floodplains. Although most of the floodplain experiences flooding with a depth equal or less than 1m, a significantly wide area is still expected to be affected.

Post-Dredging Condition
Simulated flood scenario implementing the proposed flood control measure (dredging) is presented to denote the possible improvement in the flooding situation in the project area. In this analysis, a 10m-deep cut was introduced along the main channel. The resulting 100-yr flow hydrograph was used as the upstream boundary while the downstream boundary condition was still set to a stage hydrograph with a value of 2m. Shown in **Figure 3-10** is the projected inundation map after dredging operations.

It can be seen that after the proposed dredging project, the flooding within the Busuanga River Basin will be mostly contained within the pilot dredging channel, thus, resulting in a significant reduction in flooded areas.

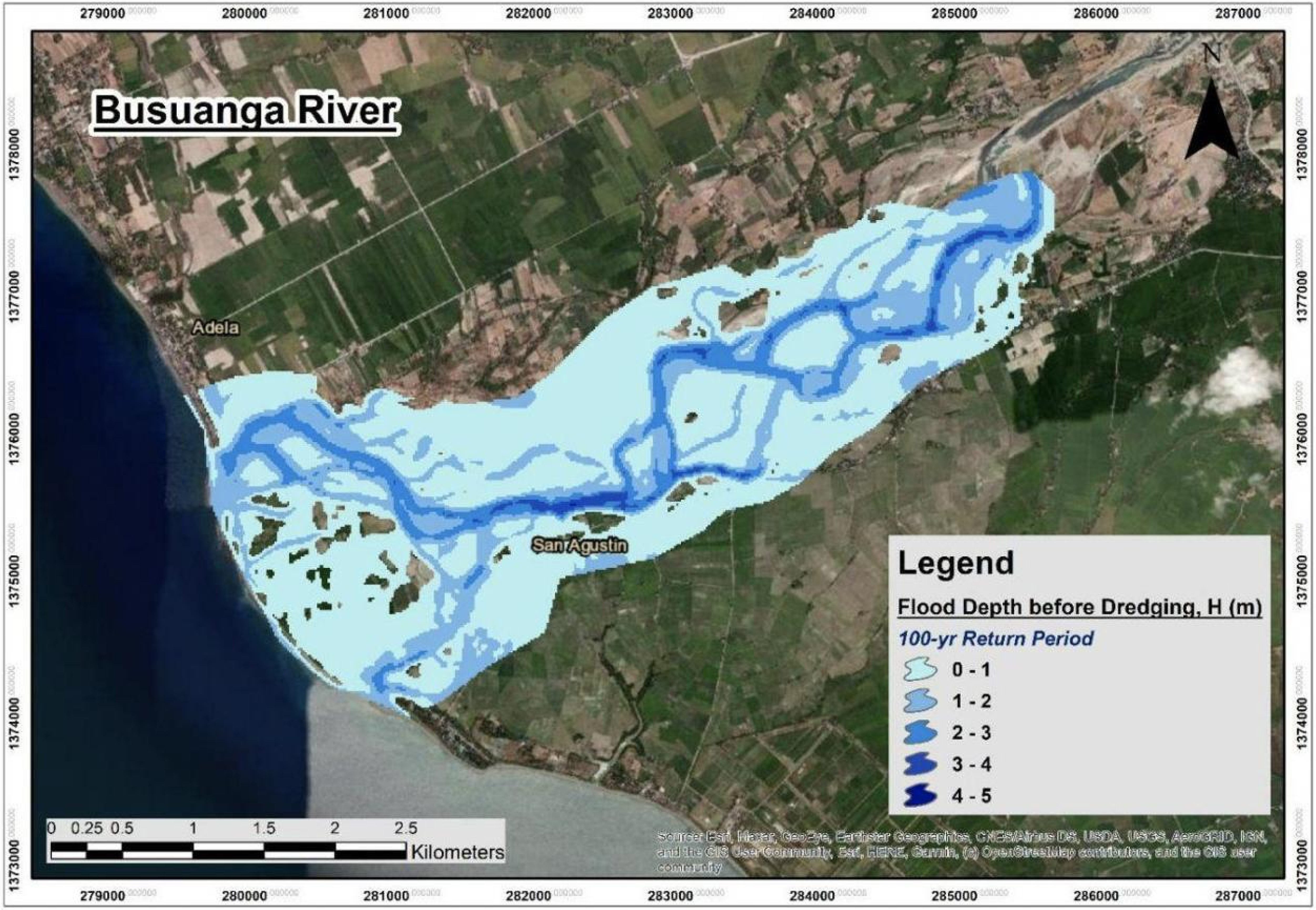


Figure 3-9. Inundation Map Without Dredging – 100 Year Flood

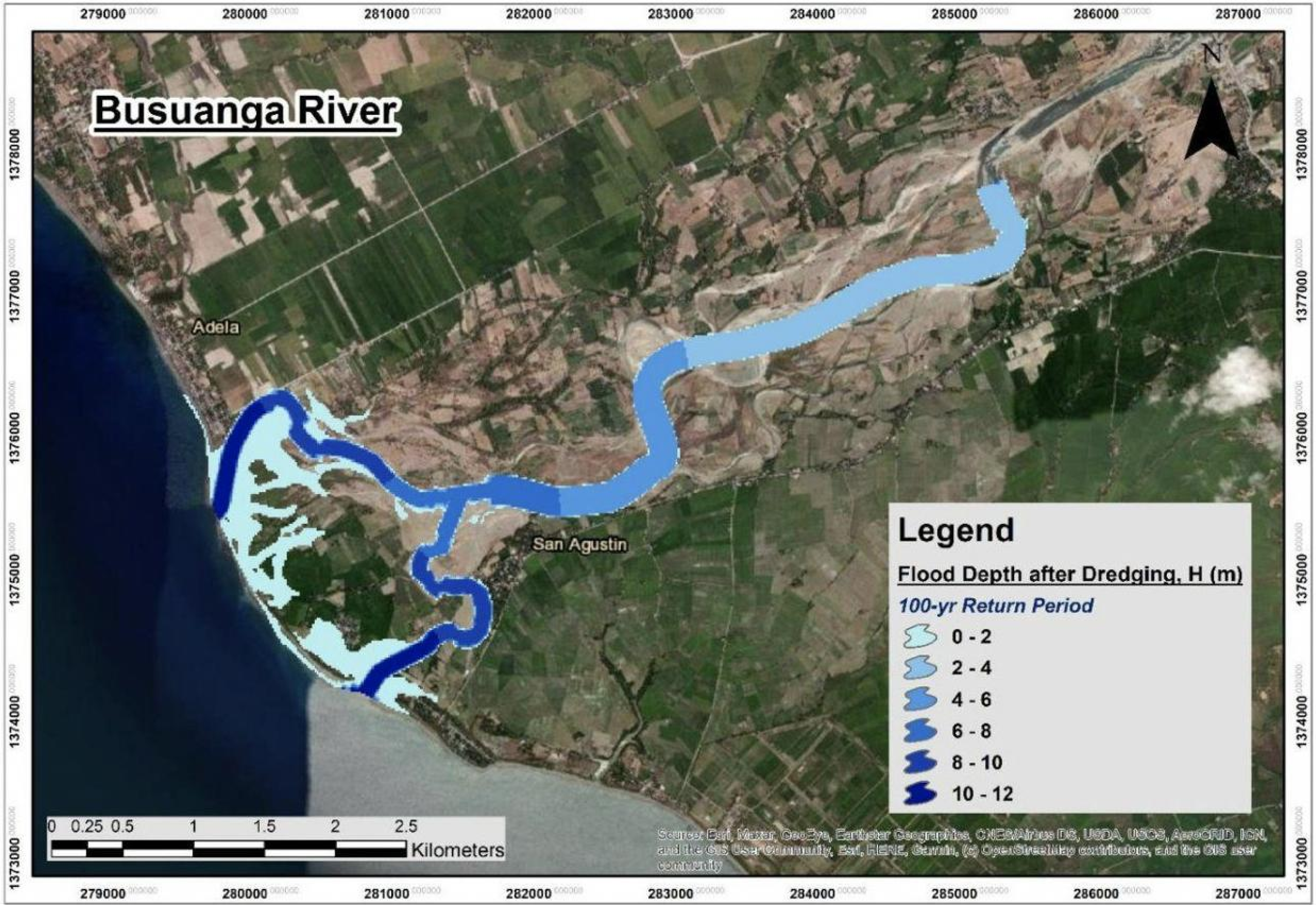


Figure 3-10. Inundation Map With Dredging – 100 Year Flood

3.2.2 SEDIMENT TRANSPORT ANALYSIS

In addition to determining the impact of the proposed dredging project to the water levels, this study also aims to determine the effect of the project to river scouring. The one- dimensional sediment transport calculation of the HEC-RAS program is used to estimate the scour and deposition for the 100-yr floods. The sediment transport potential is computed by grain size fraction, thereby allowing the simulation of hydraulic sorting and armoring. Figure shows the selected representative sediment particle size from Borehole data (BH-2, BH-15, BH-20 and BH-25) taken in August 2021 which was used in the sediment transport analysis.

The transport of sediments by river flow is the over-all solid transport of particles that passes through a cross section of the watercourse. The total transport of sediments is composed of different modes of transport which correspond to different physical mechanisms shown below.

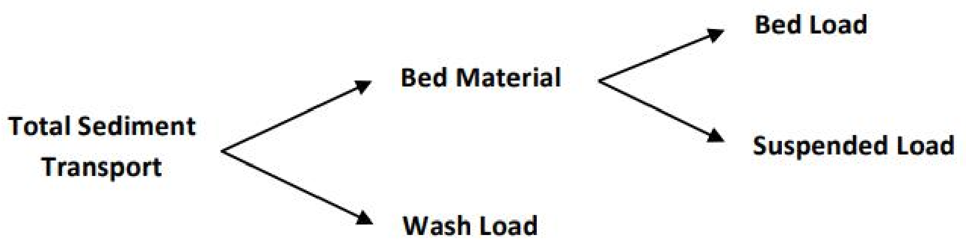


Figure 3-11. Total Sediment Transport Composition

The solid phase of sediments in a watercourse are transported as:

Bed load – are particles that stay in close contact with the bed. These particles (relatively large) displace themselves by gliding, rolling or shortly jumping.

Suspended load – are particles that occasionally stay in contact with the bed. These particles (relatively small) displace themselves by making more or less large jumps and remain often surrounded by water.

Wash load – are particles that are almost never in contact with the bed. These particles (relatively fine) are washed through the cross section by the flow.

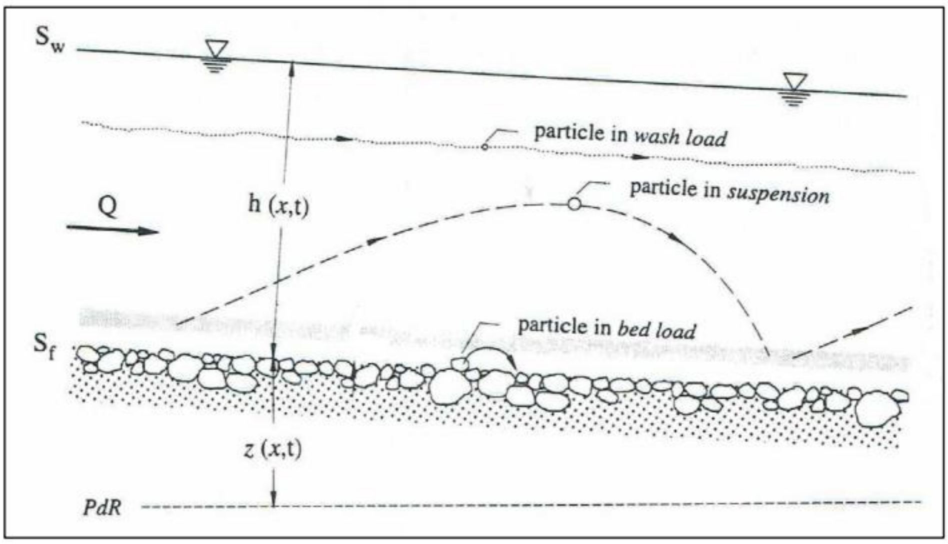


Figure 3-12. Scheme of the Modes of Transport

Many formulae are introduced to calculate the solid discharge that allow determining the capacity of the transport of sediments for a given flow. Under such condition, the transport of sediments is said to be in equilibrium. However, for the case of Busuanga River, the supply of solid discharge is not equal to the capacity of transport causing aggradation, thus, not in equilibrium.

HEC-RAS uses the Saint-Venant-Exner Equation, as shown below, in simulating unsteady and non-uniform flow in a prismatic open channel with a small bed slope. For simplification of the hydraulic process in sediment transport analysis, it is assumed that since variation in liquid discharge and bed elevation are generally short-term and long-term phenomena, respectively, a quasi-steady flow is maintained (Graf, 1998) for flows with small Froude numbers (Fr < 0.6), which will be used for this study.

Transport functions compute transport potential without consideration of movable sediment volume (Hydrologic Engineering Center, 2019), meaning the equation computes the transportable sediment volume based on the given cross sections regardless of the amount of deposition in the river. The bed sorting method used by HEC-RAS will monitor the bed gradation to calculate the grain-class specific capacities and simulate armoring processes that regulate supply. For this study, the Copeland (Ex7) sorting method velocity method, which are designed for sand bed rivers, will be used.

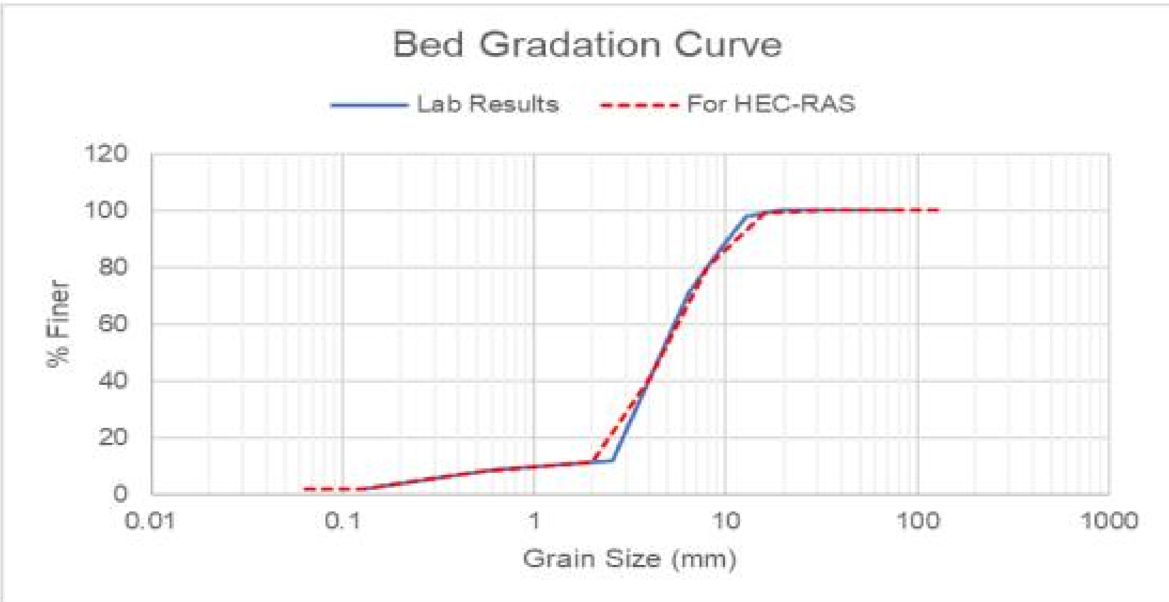


Figure 3-13. BH-2 Sediment Transport Analysis Bed Gradation Input

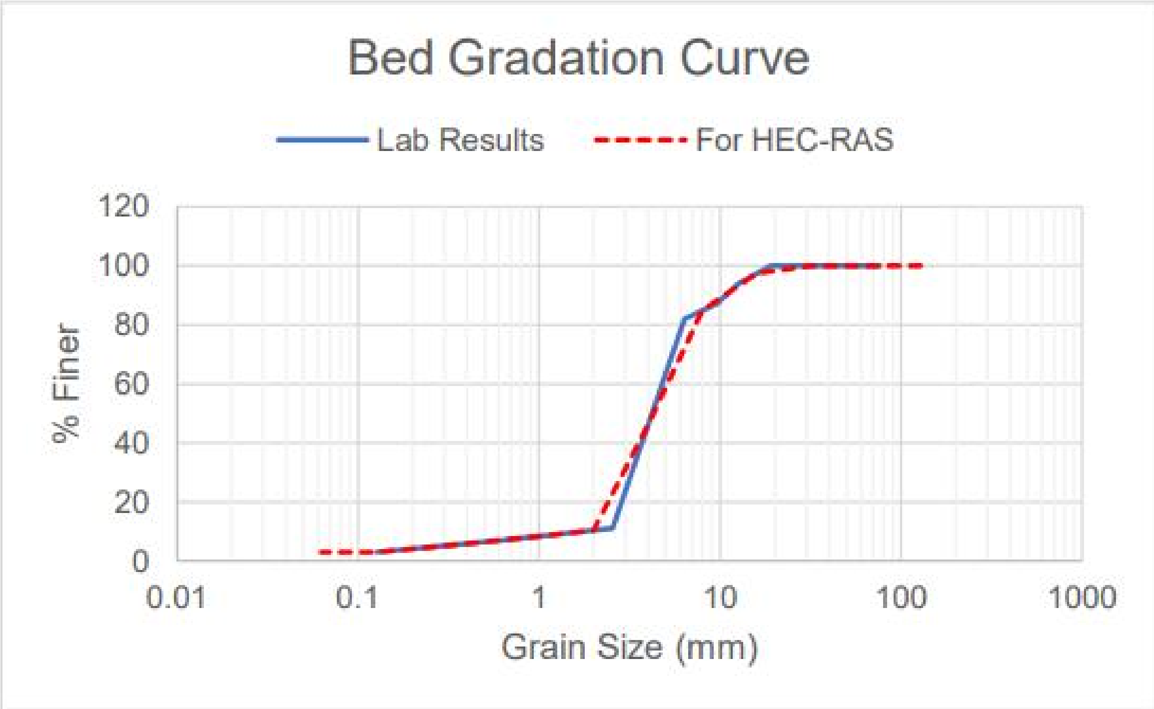


Figure 3-14. BH-15 Sediment Transport Analysis Bed Gradation Input

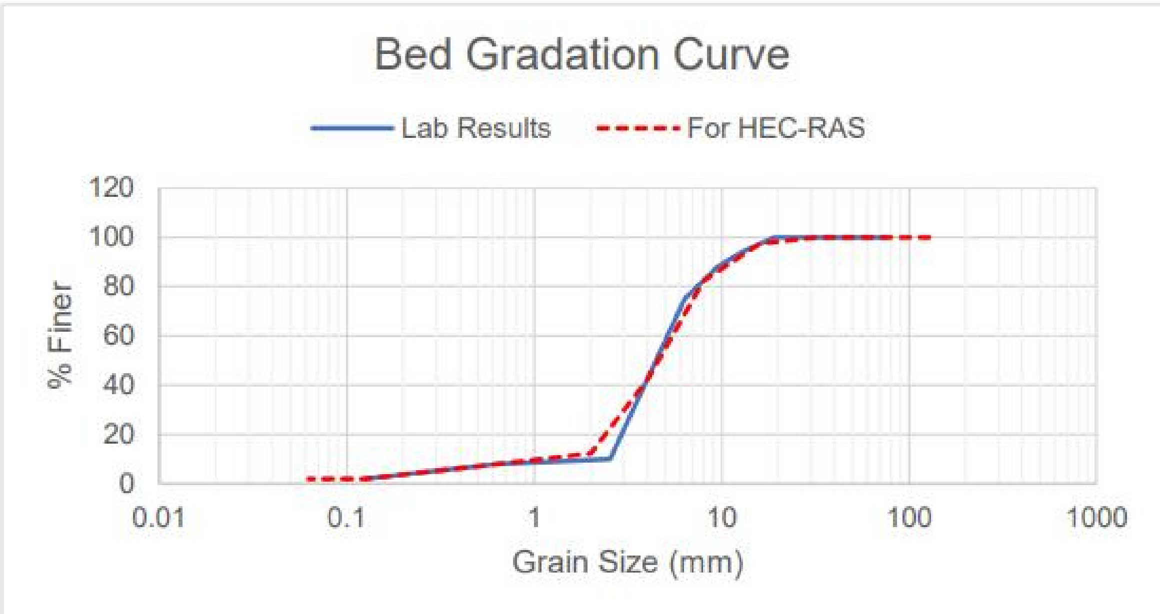


Figure 3-15. BH-20 Sediment Transport Analysis Bed Gradation Input

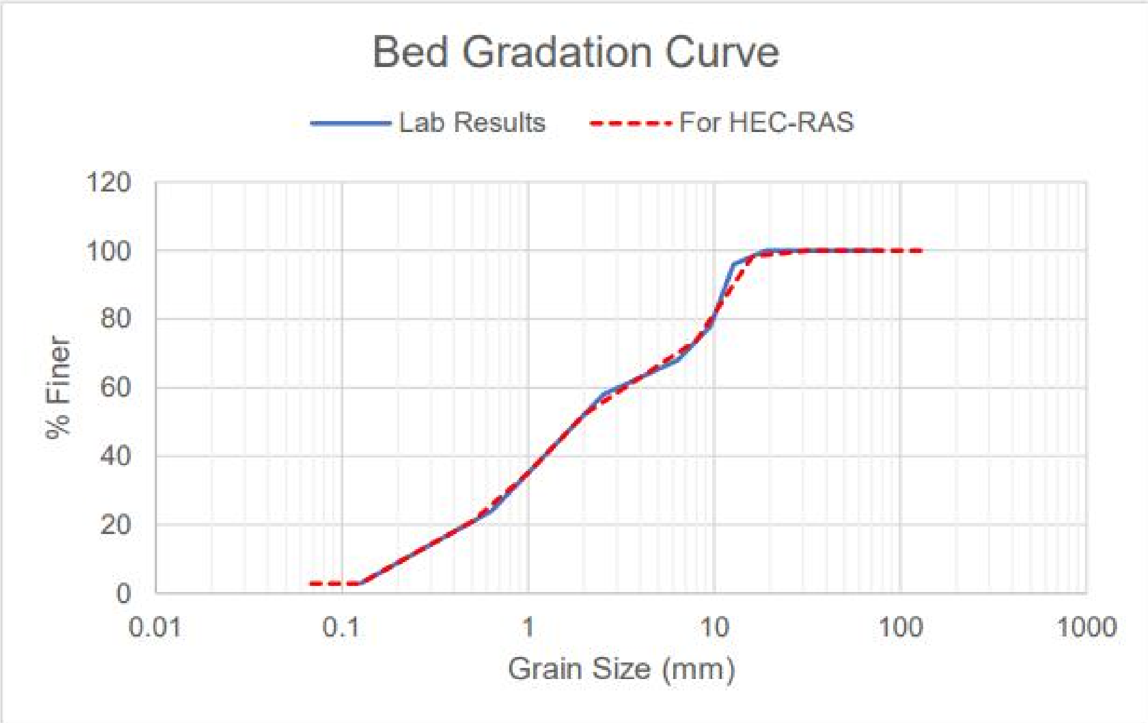


Figure 3-16. BH-25 Sediment Transport Analysis Bed Gradation Input

Minimal deposition can be expected along the upper portion of the Busuanga River. Deposition starts midway and continues to persist toward the mouth of the channel. The sudden drop along Station 3+600 is the result of the flow being redirected towards the formed tributary channel, which then leads down to the mouth at Station 9+050.

When plotted with the invert change along the channel, it can be seen that the sediments were indeed deposited in the portions where velocity dropped, thus, validating the relation of flow velocity to the riverbed fluctuation. Moreover, velocity drop should also be expected downstream where the river channel merges to the sea.

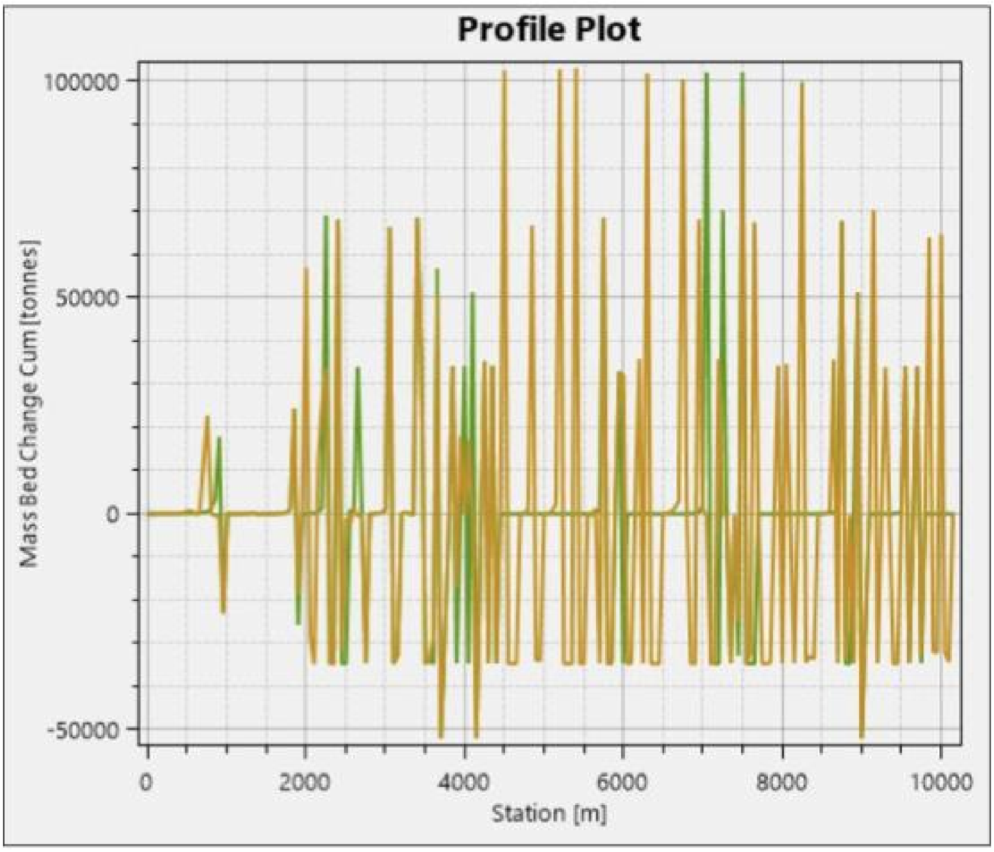


Figure 3-17. Mass Bed Change - With Project Scenario

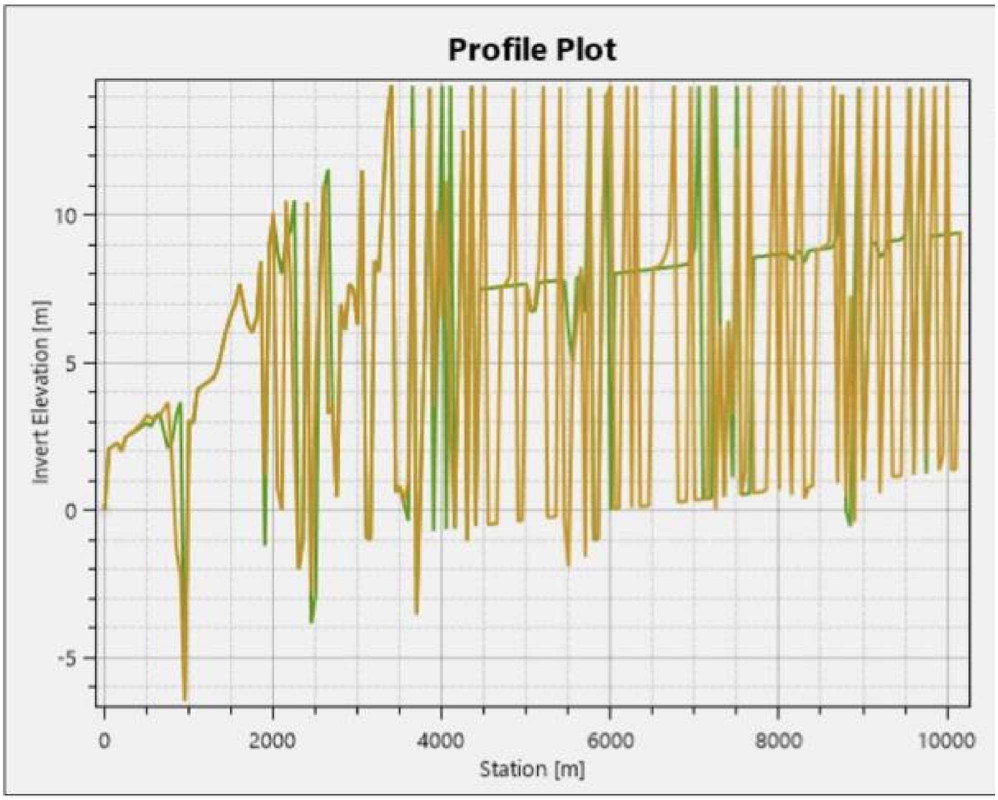


Figure 3-18. Invert Elevation - With Project Scenario

Figure 3-19. Volume - With Project Scenario

The channel elevation changes continuously due to erosion and aggradation along the riverbed. One factor that contributes to this fluctuation is the sudden change in the width and elevation of the target cross sections. This affects the flow velocity along the channel, which in turn determines whether the sediment particles will be deposited or eroded. As the flow velocity decreases, particles tend to deposit. Inversely, this means that the sediments tend to be eroded as the flow velocity increases. Shown in **Figures 3-20** and **3-21**, respectively, are the simulated channel velocity along the Busuanga River and its tributary river when considering the peak discharge during the 18th hour of the simulation.

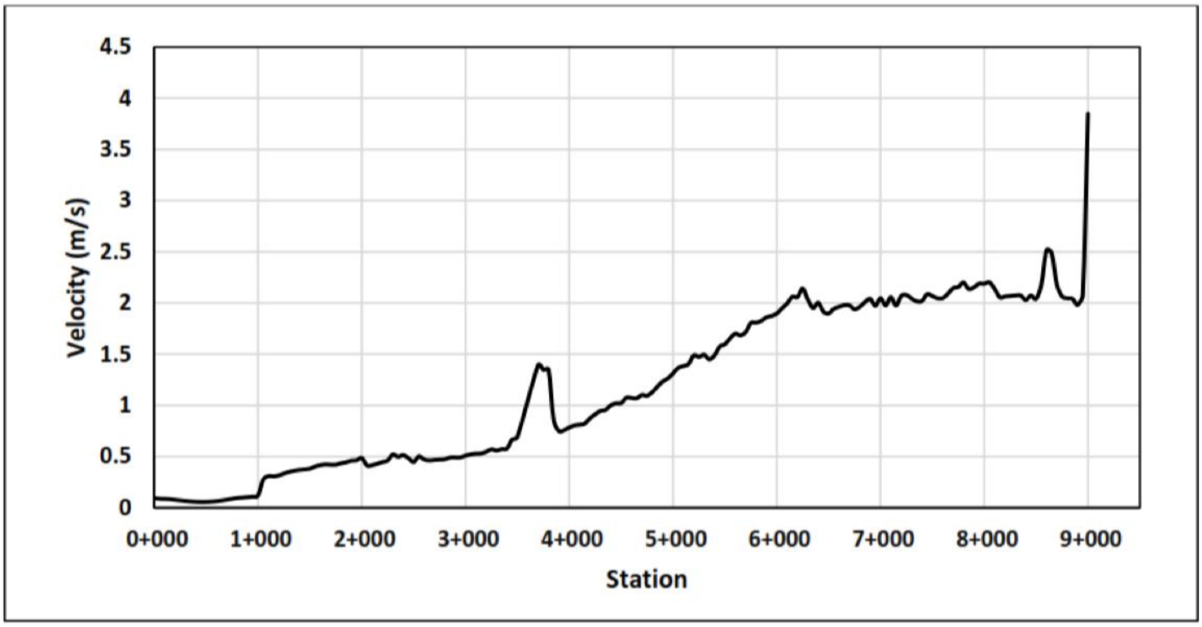


Figure 3-20. Channel Velocity at Peak Discharge (Main Channel)

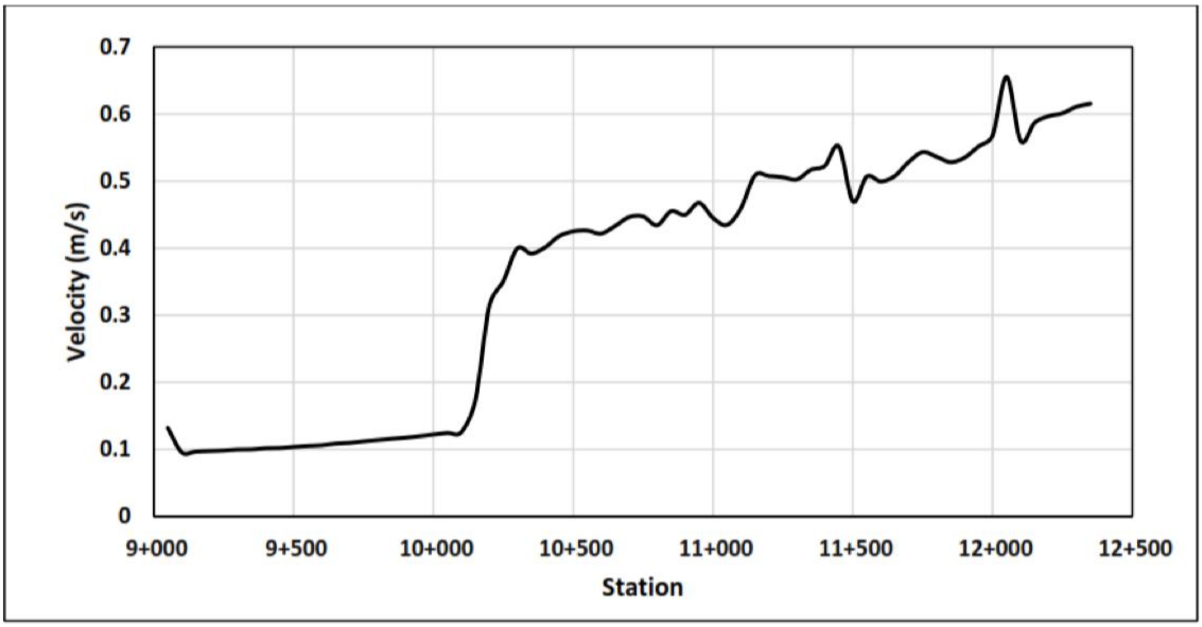


Figure 3-21. Channel Velocity at Peak Discharge (Branch)

It must be noted that a tributary river diverges from the Busuanga River at Station 3+600. As reflected in the dredging design plans, the mouth of the resulting tributary river was designated as Station 9+050, continuing all the way up to the junction.

At peak discharge, the sediment concentration along the river averages 1,760.02 mg/L. The estimated sediment transport capacity during the peak discharge is found to be about 104,432.4 tonnes/day for the main channel of Busuanga River, and about 1,746.93 tonnes/day for its tributary.

3.2.2.1 Scour Analysis

Estimation by Blench formula

Summary of Data/ Design Parameters

Sta 8+800 (Main)			
Q	Design discharge	m^3/sec	1,972.33
H	Depth of water at design discharge	m	2.92
dm	Median grain size	mm	1.05
Vm	Mean velocity	m/sec	3.28
Sta 2+050 (Main DS)			
Q	Design discharge	m^3/sec	1,205.903
H	Depth of water at design discharge	m	3.68
dm	Median grain size	mm	1.25
Vm	Mean velocity	m/sec	2.85
Sta 1+200 (Branch)			
Q	Design discharge	m^3/sec	936.1027
H	Depth of water at design discharge	m	1.99
dm	Median grain size	mm	1.23
Vm	Mean velocity	m/sec	3.57

1. Flood discharge intensity, qf:

qf = Vb(H)

where:
Vb = velocity along the bank = to 2/3 (Vm)

2. Regime depth, yfo:

yfo = (qf^2/Fbo) ^ (1/3)

where:
Fbo = an empirical parameter dependent on the bed grain size. See figure below

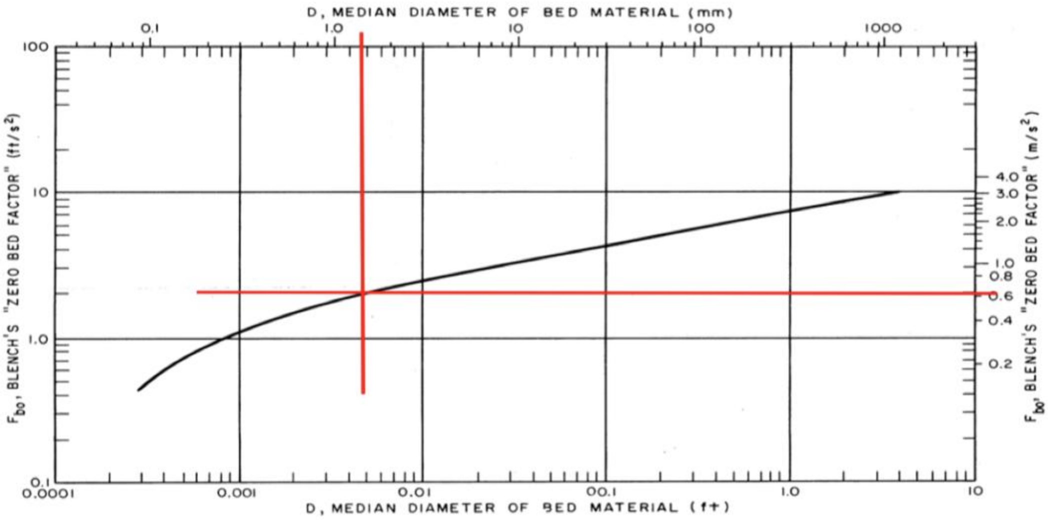


Figure 3-22. Relationship of Blench's "zero factor" to the size of bed material

Fbo = 0.6 m/sec^2

3. Maximum scoured depth, ys:

ys = yfo(z)

where:
z = multiplying factor

z = 1.75 for flow parallel to bank

4. Depth of scour, ds:

ds = ys - H

Table 3-7. Estimation Results for Blench Formula

	qf (m^3/sec/m)	yfo (m)	ys (m)	ds (m)
Sta 8+800 (Main)	6.385	4.081	7.141	4.221
Sta 2+050 (Main DS)	6.992	3.955	6.922	3.242
Sta 1+200 (Branch)	4.736	3.064	5.362	3.372

Estimation by Fruchert Formula (Improved Izard et Bradley)

Summary of Data

Sta 8+500 (Main)			
Q	Design discharge	m^3/sec	1,972.33
	Angle of Attack	degree	weak
D_{50}	Median grain size	mm	1.05
D_{50}	Median grain size	m	0.00105
K	K value		0.2
Sta 5+150 (Main)			
Q	Design discharge	m^3/sec	1,972.33
	Angle of Attack	degree	30
D_{50}	Median grain size	mm	1.25
D_{50}	Median grain size	m	0.00125
K	K value		0.26
Sta 2+150 (Main DS)			
Q	Design discharge	m^3/sec	1,205.903
	Angle of Attack	degree	45
D_{50}	Median grain size	mm	1.25
D_{50}	Median grain size	m	0.00125
K	K value		0.3

Formula:

$$Y = KQ^{1/3}/D_{50}$$

where:
Y = depth of scour, m
Q = design discharge m^3/sec
D_{50} = median grain size, m
K = Fruchart coefficient based on Angle of Attack

K values	Angle of Attack
0.35 - 4	90
0.3	45
0.26	30
0.2	weak
0.15	minimum

Table 3-8. Depth of Scour Estimations

	Q (m^3/sec)	Angle of Attack (deg)	D_{50}	K Value	Y (m)
Sta 8+500 (Main)	1,972.33	weak	1.05	0.2	**4.600817**
Sta 5+150 (Main)	1,972.33	30	1.25	0.26	**5.80976**
Sta 2+150 (Main DS)	1,205.903	45	1.25	0.3	**5.689626**
Sta 3+050 (Branch)	936.1027	45	1.25	0.3	**5.229025**
Sta 2+250 (Branch)	936.1027	45	1.23	0.3	**5.243101**

SECTION 4. ENVIRONMENTAL MANAGEMENT PROGRAM (EMP)

4.1 ENVIRONMENTAL PLAN FRAMEWORK AND STRATEGIC COMPONENTS INCLUDING ESTABLISHMENT OF AN ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

4.1.1 Impact Management in the Design of Dredging Activity

4.1.1.1 Description of Environmental Impact Management

The proposed Busuanga River Dredging Project is an environmental project in itself. Nevertheless, the RC-GPC consortium is committed to abide by all the conditions of the ECC and rules and regulations imposed by the concerned government agencies and the LGUs. It commits to minimize and/or eliminate significant adverse impacts, which could arise from the construction and operation of the Project. This Environmental Management Program (EMP) is made to serve as guide in managing the Project’s impacts, adopt the best available proven mitigating technologies and procedures, undergo a continuing process of review and positive action in the light of available monitoring results and continuing consultation with the local communities. This EMP will aim to achieve an impeccable environmental performance in the construction and operation of the proposed project.

The following will be implemented for the environmental protection and enhancement of the project area and all its components and impact areas:

- Application of Mitigation / Management Measures;
- Environmental Monitoring Program;
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication Plan;
- Reforestation Program for Buffer Zone;
- Institutional Plan; and
- Establishment of an efficient and effective HSEC Team.

The EMP is the plan on what to do with the identified potential impacts in this Environmental Impact Assessment. It is aimed to enhance the beneficial impacts and to lessen the adverse impacts of the proposed project in all stages of project implementation.

It shall be the sole responsibility of RC-GPC to implement this EMP as it will be the Dredging Operator itself in regard to compliance with all environmental, safety, and community matters. The monitoring and evaluation with respect to compliance shall be the responsibility of both the proponent and the Multipartite Monitoring Team (MMT).

The table below outlines the EMP.

Table 4-1. Environmental Management Program (EMP)

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
CONSTRUCTION / DEVELOPMENT PHASE					
NONE	No major construction works will be done since the support facilities (base camp) will be rented. Hence, no impacts are foreseen				
OPERATIONS PHASE					
Installation of slope protection; Opening of navigation zone and river mouth; Dredging Stockpiling or Hauling Ship Loading Vessel/s Operation Refueling Operation of other facilities	**LAND**				
	Possible conflict with existing land use; encroachment in environmentally critical areas; and impact in existing land tenure issue/s	Consultation with land tenants that will be affected by dredging activities. Give just compensation; Good housekeeping.	RC-GPC.	1,000,000	Work Program
	Generation of domestic solid wastes	Respective waste management facilities for all operating units; Improvement of segregation methods and recycling facility; River clean-up drives; and IEC on ecological solid waste management	RC-GPC	50,000	Work Program
	Generation of toxic and hazardous waste materials	Sorting, labeling and monitoring of hazardous wastes with bund wall and oil-water separator at the storage facility; Provision of oil spill kit and fire extinguisher; Collection, transportation and treatment of generated hazardous waste materials by a DENR accredited transporter and TSD facility	RC-GPC	50,000	Work Program
	WATER & LAND: Geohazards				
	Potential inducement of riverbank erosion	Maintaining slope stability of riverbanks by proper engineering measures; Adequate drainage control; Easement of at least 20 meters between bank and dredging operations; Maintain 1:4 height to base ratio for bank slope; The channel cutting will be strictly limited in the depth and other specifications as stipulated in the detailed engineering plan.	RC-GPC	500,000	Part of pilot channel development cost & regular Work Program

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
	Improvement in flood drainage containment capacity of lower Busuanga River leading to improvement in farm yield	IEC to inform locals about the perceived & planned enhancement of the river Installation and proper maintenance of drainage system.	RC-GPC	No additional cost	
	WATER				
	Change in drainage morphology	Maintain a central pilot channel to guide stream flow; Silt curtains to be installed will be strategically installed (when possible) to lessen the transport of silt-laden water.	RC-GPC	100,000	Work Program
	Riverbed deepened and water surface lowered - lessens flooding susceptibility	Maintain a central pilot channel; Strictly follow/stick to the approved Dredging Plan.	RC-GPC	No additional cost	
	Disruption in water circulation pattern, littoral current, and coastal erosion/deposition	Stick to DPWH-approved Dredging Plan; Employ geo-engineering technologies.	RC-GPC	200,000	Work Program
	Increase in background water quality levels due to resuspension of sediments. Overflowing of heavily-silted water into crop lands that can damage soil fertility.	Installation of silt curtains; If silt curtains and other containment enclosures are not possible, limit the dredging during periods of calm winds or low tides; Follow engineering and environmental plans stringently; Maintain a central pilot channel; Stick to approved Dredging Plan; Periodic water quality monitoring; Cover stockpiles of dredged materials if hauling is not yet available.	RC-GPC	800,000	Work Program
	Inadvertent spill of ship bilge, ballast water, fuel, oily residues, domestic wastewaters from vessel operations	Onboard bilge management; Ballast water management; Proper maintenance and regular inspection of vehicles and equipment; Provision of facilities for recovery of leaks and storage in drums; Proper training of vehicle operators especially on spill prevention and containment; Designation of a motor pool for refueling and maintenance works; Refueling by latch-lock between dispenser & receiving fuel tank; Prepare belt oil skimmer for oil spill emergency;	RC-GPC	100,000	Work Program

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
		Implement Oil (& grease) Spill Contingency Plan; No bilge water disposal at sea; Use of portable septic tanks in all facilities; Waste minimization, recycling and re-use including motor pool spoils; Proper handling and storage of petroleum products utilized by equipment, machineries and continuous checking / visual observation of leaks;			
	Potential increase in BOD & coliform level of water bodies from domestic wastewater and equipment.	Temporary facilities ("portalets") for workers onboard the vessels; Strictly impose proper waste disposal and sanitation/good housekeeping practices; Prevention of disposal of untreated wastewater to river/sea; Regular Water Quality Monitoring	RC-GPC	50,000	Work Program
	Siltation loading in coastal waters – leading to potential disturbance and alteration of the seabed and benthic substrate hosting fish, macro-invertebrates and crustaceans	Contain erosion at source and entrap fugitive sediments thru provision of silt curtains and sediment filters around estuary and around coral reef; Mangrove planting in foreshore areas; Compensate any substantiated loss of income from fishing due to project; Loss of gear efficiency of stationary gears due to sediment streams will be replaced.	RC-GPC	500,000	Work Program
	Potential loss of sandy demersal fish habitat; Migration of fish; Physical damage to macro-invertebrate habitats	Translocate/ re-stock suitable bivalve populations in the inter-tidal area; Formulation of a Fisheries Improvement Plan	RC-GPC	200,000	Work Program
	AIR AND NOISE				
	Air pollution due to GHG emissions from burning of fossil fuel for the dredger, vehicles, generator and other equipment	Regular Preventive Maintenance System (PMS) for al vessels; Vessels fully compliant with international standards; Use of low Sulphur content fuel; Use of turbo charging engines for efficient combustion to minimize the generation of criteria pollutants; Install mufflers and scrubbers at the exhaust pipe to capture	RC-GPC	100,000	Work Program

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
		pollutants (particulates and gasses); and Install filter in the exhaust pipe.			
	Increase in ambient noise level	Regular preventive maintenance of vessels/vehicles/equipment; Choose less noisy equipment or cover noisy equipment with noise reducing sheets; Enclosure of equipment emitting high level noise; Use alternative power source for cooling system such as solar power; If possible, plant trees at the banks to act as buffer; Proper scheduling of dredging and hauling; Imposition of speed limits for land vehicles along access roads (30 kph maximum); Periodic monitoring of noise level during operating hours.	RC-GPC	100,000	Work Program
	PEOPLE				
	Improved safety due to lesser flooding problems as a result of dredging	IEC to inform locals about the perceived & planned enhancement of the river	RC-GPC	100,000	SDP
	Public health and safety issues related to project implementation	Provide health clinic manned by a doctor, nurse and health workers; Provision and maintenance of signages demarcating buffer zone; Facilitate training for Project-related Disaster Risk Reduction Management in the Barangays.	RC-GPC	200,000	H&S budget
	Physical injuries arising from accidents	Wearing of PPEs for all workers while at the project premises; Conduct regular safety trainings and drills; Conduct basic medical check-up for newly-hired workers; Provide warning and safety signs where needed; Daily toolbox meeting; and Implement Emergency Response Plan and Health and Safety Management Plan.	RC-GPC	100,000	H&S budget

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
	Equipment and personnel safety during rainy season	Use amphibious dredger; Define quick shelter route in event of strong rain; Conduct emergency drills; Set up barometer and anemometer at site; Assign somebody to monitor weather and provide all-weather communication equipment with all operators; and Provide training for adaptation of working procedures and protocol under all weather conditions.	RC-GPC	50,000	H&S budget
	Uncontrolled developments around the project site	Coordinate with Barangay LGU regarding developments to discourage building of permanent structures due to flood hazard.	RC-GPC	50,000	SDP
	Spread of epidemic (i.e., virus)	Rigidly implement all protocols implemented by the government at all times; Provide insurance/compensation benefits to workers when there is a known epidemic.	RC-GPC	100,000	H&S budget
	LIVELIHOOD: Displacement of sustenance fishers in the river and estuary.	Translocate/ re-stock suitable bivalve populations in the intertidal area; Formulation of a Fisheries and other Livelihood Improvement Plan (part of SDP); Provide the affected local people with supplemental livelihood training; Replace dislocated fishing gears; and Pursue crab and fish replenishment in nearshore sandy shoals and private fish hatcheries.	RC-GPC	100,000	SDP
	Threat to stability of foundation of the gabions and other FCs of DPWH	Provide scour protection for FCs if very proximal; Maintain a minimum of 50m distance from FCs for dredging operations or upgrade engineering protection for the FCs if Dredging Master Plan dictates shorter distance.	RC-GPC	500,000	Work Program
Hiring of workers	Employment and livelihood opportunities for local people and entrepreneurs	Prioritize locals in hiring of workers if skills are available locally; Partner with the LGU for the implementation of the Social Development Program; Provide employees' wages and benefits as prescribed by law; Generation of livelihood opportunities by allowing local	RC-GPC	No additional cost	SDP and Work Program

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
		entrepreneurs to provide support services to the project and its workers.			
Dredging activities, Hiring of workers	In-migration might cause health and safety issues, social conflicts, peace and order, and introduction of other social evils.	Prioritize locals in hiring; Establish and maintain strict hiring policy for migrant workers and orient them properly upon or before arrival; Coordination with the Barangay LGU to ensure only authorized establishments are able to operate in the area.	RC-GPC	No additional cost	
	Discrimination of women in the workplace and security issues to women and children	Promote equal protection or treatment to women and children as part of the gender and development initiatives; Implement flexible and gender-sensitive employment and equal opportunities for the elderly, men, women, and youth that are not employed; Assist the women in capability-building and/or skills training; Uphold fundamental human rights by never discriminating against others based on their legally-protected traits.	RC-GPC	No additional cost	
SDP implementation & payment of taxes and other fees.	Delivery of supplemental basic social services to local people	Partner with the LGU for the implementation of the SDP; pay all taxes and fees diligently.	RC-GPC	No additional cost	SDP budget
DECOMMISIONING AND ABANDONMENT PHASE					
Dismantling and removal of equipment and structures	Generation of solid waste from dismantling of structures.	Implement ecological solid waste management system	RC-GPC	50,000	Decommissioning Work Program
	Generation of hazardous waste from dismantling of structures.	Commission a DENR-accredited 3rd Party Contractor to haul out all hazardous waste materials and dispose only to approved Treatment, Storage and Disposal (TSD) facility.	RC-GPC	50,000	Decommissioning Work Program
	Collapse of riverbanks or damage to bridge &/or gabions	Provision of engineering mitigation measures to portions of riverbanks when necessary (in coordination with DPWH); Project site to be inspected by concerned government agencies & LGUs before the Proponent turns over the site to the LGU. Reforestation of riparian zones (along riverbanks) whenever applicable, with indigenous species.	RC-GPC	500,000	Decommissioning Work Program
	Increase in turbidity due to sediment resuspension	Maintain sediment barrier until TSS values are below the limit for Class C/ Class SC	RC-GPC	No additional cost	

Project Activity	Potential Impact	Options for Prevention, Mitigation or Enhancement	Responsible Entity	Estimated Annual Cost	Guarantee / Financial Arrangements
	Potential spill of oil, lubricants or wastewater	Commission an accredited 3rd Party Contractor to haul out and/or treat all liquid wastes (especially used oils/lubricants and its containers).	RC-GPC	50,000	Decommissioning Work Program
	Re-establishing riparian vegetative cover in the project area	The planting of trees/vegetative cover at riverbanks for the duration of the project shall have grown and improved the area by the time of decommissioning.	RC-GPC	100,000	Decommissioning Work Program
	Return and/or increase in population of fish and other water species due to restoration of habitat	An enhancement	RC-GPC	No additional cost	
	GHG and particulate emissions from equipment	Provide catalytic converters and particulate filters for petroleum-fueled equipment; Construct at site a concrete platform with lip, surfaces lightly dipping to an oil collection sump with oil and grease separator unit. Collected used oil and fuel storage should be on concrete flooring with containment lip in case of spillage; and Used oil should be hauled out only by DENR accredited waste handler and treater.	RC-GPC	100,000	Decommissioning Work Program
	Cessation of employment and loss of business opportunities for locals.	Ensure capability training as part of employment benefits to help them become employable after life of project; Provide assistance in job seeking; Prepare the communities through capability building and assistance in the development of alternative sustainable livelihood; and Implement satisfactory retrenchment package.	RC-GPC	100,000 excluding retrenchment package (1-time)	Decommissioning Work Program
	Accidents due to collapse of riverbanks or damage to bridge &/or gabions	Provision of engineering mitigation measures to portions of riverbanks when necessary (in coordination with DPWH); Project site will be inspected by concerned government agencies & LGUs before the Proponent turns over the site to the LGU.	RC-GPC	500,000	Decommissioning Work Program

4.2 WATER QUALITY MANAGEMENT PROGRAM

4.2.1 Water Quality Monitoring Plan

Monitoring of the environment in the project area and vicinity in all phases of the project shall be undertaken to establish the construction and plant operational water quality conditions, survey the degree of changes, and assess the effects of pollutants. Regular water quality monitoring of river and marine waters shall be implemented to ensure the effectiveness of the pollution control measures.

Water quality monitoring will include monitoring of sediment traps/curtains and oil separators to ensure their continued effectiveness. This will be conducted immediately downstream of all points of discharge. The parameters to be monitored are: pH, BOD5, oil and grease, TSS, and fecal/total coliform. The primary objective of the water quality monitoring program will be to check the effectiveness of suspended sediment and oil pollution control.

The earth-moving activities during the construction and the dredging operations could result in silted runoff, which could lead to increased turbidity and TSS) and may also carry other pollutants like heavy metals and solid wastes. Spillage and washings of oil and grease resulting from maintenance of equipment and vehicles, if not properly managed, may find their way into the water bodies. This could produce oil film on the water surface, reducing the rate of re-oxygenation of affected surface waters, harming the aquatic biota.

The generated domestic wastes and sewage can also cause pollution of surface waters by increasing BOD levels and thereby decreasing the DO levels.

To prevent siltation of the estuarine and the bay areas, provision of drainage canals with silt traps or curtains will be done to intercept washed out soil particles. Where natural depression is available, surface runoff will be directed into it by a ditch to allow settlement of suspended solids. The area will be protected from surface runoff by installing a properly designed drainage system.

Ecological solid and liquid waste management shall be employed at the project site. Sanitation systems in the facilities such as toilets and lavatories will be constructed with standard septic tanks.

Spoil Dump Runoff
Baseline studies indicate that there will be no spoils or unwanted dredged materials since all the materials in the river are deemed suitable for use. If and when there will be a small volume of spoils, the scheme being considered is the re-use of the spoils in other areas in the municipality where backfill materials are needed.

Sewage from Surface Facilities
Sewage will be collected and remediated in septic tanks, which shall be appropriately designed for the anticipated volumes.

Waste Management System.
The movement of workers mainly generates domestic solid wastes. Hazardous wastes will be generated from the operation of major and support equipment, mainly the waste oil and lubricants. Solid waste management plan, and hazardous waste management plan will be developed for proper handling, transport and disposal of these wastes. This shall include but not limited to the following:

- All operating vessel/s to have respective waste management facilities;
- Provision of segregated trash bins at all facilities and offices. 3 receptacles trash bins classified into biodegradable, non-biodegradable and recyclable;
- Orientation for every new employee; conduct of community-wide IEC on solid waste management;
- Regular waste collection and disposal. Wastes shall be collected and segregated according to classification. Recyclables will be such as plastic bottles shall be collected and stored at the MRF;
- Sorting and labeling of hazardous wastes according to their characteristics and classification;

- Daily visual monitoring and inspection for condition and monthly for inventory of generated hazardous wastes;
- Provision of bund wall and oil-water separator at the hazardous waste storage facility;
- Provision of oil spill kit and fire extinguisher in case of sudden spill and fire emergency;
- Collection, transportation and treatment of generated hazardous waste materials by a DENR accredited transporter and TSD facility;
- River clean-up drives; and
- IEC on ecological solid waste management for workers and the community.

Stormwater Management and Drainage Plan.
RC-GPC shall install a storm drainage system especially along the access/maintenance roads. It will ensure that the operation will be confined in the project area only with proper monitoring of suspended solids (TSS), oil and grease, discharges, and potential leaks in their equipment. Containment structures and silt curtains will be incorporated in the storm drainage system to prevent the spread of silt and other suspended particles. Regular TSS concentration monitoring should be undertaken in the area where dredging activities occur, and the removal of silt curtains or containment enclosures should be made only if the TSS concentrations become consistently less than the DENR allowable limit for Class C and SC waters.

If the use of silt curtains and other containment enclosures are not possible, limit the dredging activities during the periods of calm winds or low tides as the rate of spread of silts and suspended solids will be much lower due to the limited mixing.

4.2.2 Coastal Resource Management Plan

RC-GPC shall be drawing up a Coastal Resource Management Plan (CRMP) in collaboration with the municipal and barangay LGUs, Fisherfolk People’s Organization, BFAR and other stakeholders. Meanwhile, below shall be the working plan to serve as the starting point in the planning.

The baseline analysis of the existing coastal environment, as well as the freshwater ecology in the area was conducted as the starting point of the Coastal Resource Management Plan. The physical properties of the land, water and people and the existing environmental resources in the vicinity were also gathered. Together with the perceived/studied impacts of the proposed project, the results of the baselining will be the basis of the CRMP.

In coastal resource management, the most proven strategy to rehabilitate fish populations over the long term is the establishment of Marine Protected Areas. Supporting the effective management of the local MPA, especially the Sudlon MPA in Bgy Rumbang, Rizal lies 2.5 km Northwest of the Busuanga River estuary provides the impetus for greater efforts for restoration of ecosystem functions and structures and promotes a high degree of corporate social responsibility.

RC-GPC shall consult or work with the as well as the municipal and barangay LGUs to plan and implement rehabilitation programs for the coastal resources.

Conservation zones in the marine environment are areas where fragile and ecologically significant habitats and its associated biodiversity are conserved, consistent with best practices in adaptive protected area management. The establishment of core conservation zones is a widely recognized strategy that is based on the premise that certain components of the natural environment should be conserved in perpetuity for their own sake and not for any utilitarian purpose. The following are the objectives of this activity:

- protection and maintenance of marine biological diversity and its associated natural resources;
- enhancement of the potential for fish stock replenishment in the surrounding coastal waters through the allocation of enough habitats for protection of maturing species of fish;
- protection of the remaining coral habitats and associated ecological structures;
- provide a refuge for intensively fished species of fish;
- protection of important local species;

- enhancement of recreational assets in the marine environment;
- increase law enforcement activity by increasing the members of deputized Bantay Dagat, if any, and extending monetary compensation; and
- assist in the information dissemination on the importance of the conservation of marine biodiversity and the importance of MPA networking.

Furthermore, the Project will support fisheries management and stock enhancement measures through collaboration with the local government, drawing strategic support from Integrated Coastal Resource Management strategies. The objective is to make fisheries more productive in areas both inside and outside of the impact area. Support to local organized fisher groups for the implementation of better fisheries law enforcement, advocacy against irresponsible fishing practices and the implementation of fish stock enhancement measures to protect fish growth, maturation and recruitment will be supported by the project in ways that can be viably integrated into its social development plan.

More importantly, the Project will police its own ranks to ensure that the dredging operations are done in an environmentally sustainable manner by implementing mitigating and enhancement measures.

With regards to freshwater and marine ecology, it is important that the protection of the integrity, enhancement of aquatic species and promotion of improvement and maintenance of water quality in the Busuanga River be pursued. To minimize or prevent sediment spills and degradation of the river, the following measures will be adopted:

1. *Sediment and silt sequestration*
   The primary mitigation strategy to prevent fugitive sediments and disturbed riverbed materials from being carried into other river sections while the substrate is being dredged and extracted is the establishment of a series of sediment mitigation structures, including catchment and sand/silt - filtering curtains, in strategic points to ensure that loose sand, silt and sediments will not wantonly flow into undisturbed river sections and in the estuary but are immediately collected and disposed into stock piles. Sediment filters will also be positioned in front of the estuary to sift sediment-laden waters from reaching two small reef formations. Where necessary if river streams are flowing rapidly during the rainy season, the measures will include installation of catchment basins where sand-laden waters are diverted and contained for sediment extraction. Loose soil runoff and sediments from water run-off from riverside facilities will be sieved through filters and geotextile materials before water is discharged into project diversion waterways. Such loose soils will be piled up and can be re-used in reforestation areas in riverbanks. This will be supported by state-of-the-art erosion control measures that will include trench diaphragms, revegetation activities in slopes and open areas along the riverbanks. The stabilization of river water where dredging has occurred will be enhanced through improvement of river flow velocity through riverbed compacting and slope stabilization. Construction of sediment controls such as silt fencing or revetments that will prevent riverside scouring and to collect soil particles in loose river bends and in sluggishly flowing portions will be instituted where required.

2. *Restocking of aquatic fauna*
   Through the involvement of fishers using traps, fish and crustacean species in the dredging site should be collected (live) before project operation and re-stocked in undisturbed portions. Re-stocking of tilapia and the freshwater giant prawn can be adopted to enhance fish biota replenishment. Thiarid snails can likewise be collected and placed in undisturbed river sections to ensure that a new starter population is embedded. Regular in-situ monitoring of river water quality and the state of habitats and diversity of aquatic fauna will be conducted.

3. *Stockpile management*
   Sand and gravel stockpiles will be located away from the riverbanks and from areas where spillage onto the river systems can occur, and stabilized to prevent spillage. Construction stockpiles shall be covered and rigidly bundled.

4. *Management of slurry from construction equipment and stockpiles.*

Heavy equipment areas will be located away from waterways where erosion control measures can be easily applied. As a precautionary approach, slurry walls will be built around areas where such slurries can emanate extensively.

5. *No abstraction of river water; prevention of blocking and congestion of stream flow*
   There will be no abstraction of river water and no materials will emanate from the project that can cause river blocking. In upstream river sections past the quarry site, no freshwater fishes, habitats and migration pathways of fish and crustaceans will be affected.

6. *Control and treatment of liquid wastewater*
   Modern wastewater treatment facilities and a solid waste management plan will be implemented and strictly enforced as mitigation to potential waste disturbances. This will include the setting up of a wastewater treatment facility in premises where project offices, personnel quarters and mess halls are to be located. State-of-the art modern sanitation facilities with 3-chambered septic tanks will be installed in all project latrines.

7. *Prevention of oil and grease spills*
   An oil and grease containment and oily waste containment and recovery plan will be formulated and enforced in all aspects of project operations. Remediation will include recovery and treatment of sludge. Carpools will be located farthest from river systems and all vehicle oil discards will be recovered and discarded in inland waste management systems.

4.2.3 Irrigation Water

The existing irrigation system of the NIA, which supplies water for the crop lands in the area, has its intake point farther upstream of the project area. Therefore, the Project shall not impact on the water quality of this irrigation system though there may be minimal effects in terms of supply volume as the surface water level is eventually lowered. More importantly though, the restoration of the river in the future shall mean improved stream flow, and hence could lead to improved water quality for the irrigation waters.

Sediment that enters freshwater is usually the result of wind and water erosion from agricultural areas or stream bank erosion. On the other hand, the dredging activities have the potential of further increasing the TSS levels of the river water, which may overflow into the adjacent rice fields in times of flooding and affect farm yield.

A high level of turbidity can affect the performance of the irrigation facility, and can lower the hydraulic conductivity of the soil and in turn pollute the soil surface through surface flow. Many countries apply the suspended solids standards for indirectly consumed crops, (15 mg/L standard, which is a standard for using lake water as agricultural irrigation). In the case of paddy rice, where water is supplied through surface irrigation, adverse effects to irrigation facilities do not exist or nil. In any case, TSS levels below 80mg/L of the areas outside the active dredging zone (which will be contained through silt curtains) should be maintained to ensure that there will be no adverse effects in the productivity of the rice fields.

4.3 Social Impact Management and Development Program

4.3.1 Resolution of Conflicting Issuances

The proposed dredging project is located along Busuanga River. If in case there is land ownership within the dredging zone, RC-GPC shall coordinate with the landowner and seek clearance or permission. Just compensation shall be among the points of discussion.

With regard to mining tenements, MGB 4B stated that a portion of the main channel estuary is in conflict with the Exploration Permit Application of TCSC Corporation denominated as EPA-IVB 355. The proponent shall meet with TCSC in coordination with the Provincial Governor's Office and MGB-4B.

This Project will coexist with any and all valid prior rights in the river that overlap with the Proposed Project site and the Proponent is willing to sit down with other operators/tenement holders to reach an amicable settlement. Nevertheless, it is explicitly stated in DAO 2020-12 that no other quarrying permits shall be operational within the project site once the dredging project is in operation, and that no quarrying permits will be issued within the area. This dredging project will prevail as mandated by DPWH, DENR and the Local Government shall be an exclusive River Dredging Zone (RDZ) wherein dredging activities are allowed but quarrying is strictly prohibited.

4.3.2 Compensation Plan for Affected Stakeholders

- **Disturbance Compensation.** For land severely affected the lessees are entitled to disturbance compensation. Intensive consultation with the affected people during this period will be undertaken to avoid misunderstanding and opposition against the project. Formulation of an equitable compensation and acquisition scheme will be designed to ensure that affected people will have a just compensation for the land, crops and other properties that will be affected by the project.
- **Income Loss.** For loss of business/income, including small fisherfolks who will be directly affected, the proponent will negotiate the rightful compensation based on applicable laws and government procedures.

4.3.3 Social Development Plan

An Indicative Social Development Plan (ISDP) was developed through consultation with the various stakeholders such as: concerned LGU, barangay and the Government agencies such as the Municipal Social Welfare Development (MSWD), the Municipal Heath Officer (MHO), Department of Education (DepEd), Non-Government Organizations (NGOs), People's Organizations (PO) and the residents. The indicative sustainable social development plan is based on the government requirement under RA 7279/ DAO 2003-30 and RC-GPC's corporate responsibility.

This is discussed in more detail in **Section 5** of this EIS Report.

4.3.4 Information, Education and Communication Program (IEC)

Information Education Campaign (IEC) conducted for the project in compliance with DAO 2017-15. IEC is one of the strategies of the SDMP of RC-GPC. This component mainly responds to the need to inform, educate and communicate to various stakeholders what the Company intends to accomplish vis-à-vis environmental, safety and socio-economic development concerns and how these are to be accomplished. This will consist of an information dissemination campaign through posters, streamers and frequent meetings with the community.

To soften project social entry, the Proponent will undertake Information, Education and Communication (IEC) activities as a means of promoting and strengthening peace in its working environment. The Project Information, Education and Communication Framework Plan is shown in **Table 5-2.**

This is discussed in more detail in **Section 5** of this EIS Report.

4.4 Environmental Risk Management Plan for the river system

4.4.1 Safety Management System

Health and Safety Plan.
The Health and Safety Plan for the community especially the directly affected/impact area involves the following: a) Medical and Dental Program with the provision of a health clinic manned by a Doctor, Nurse and Health workers; b) Provision and maintenance of signages demarcating buffer zone;
Practice good housekeeping; c) Facilitating training for Project-related Disaster Risk Reduction Management in the barangays; and d) Emergency Disaster Health Program. An Occupational Health and Safety Management Plan for workers will also be created and rigidly implemented.

Emergency and Contingency Plan.
Emergency response/procedures will be developed for accidents due to equipment/machinery failure or malfunction; and calamity from flood and typhoon occurrences, and a major earthquake event. Muster points shall be designated and drawn on maps to be posted at different areas of the Project site. Evacuation drills shall be conducted to assess the applicability of the plan.

Fire Protection System.
A comprehensive fire detection, alarm system and fire protection system are designed for the facility to provide a high degree of protection for plant buildings and other auxiliary facilities. The Fire Protection System shall consist of fire suppression systems, independent fire detection systems, standpipe, fire hose stations, fire loop system, and portable fire extinguishers to protect the asset, buildings and facilities. Fire drill shall be undertaken regularly to ensure preparedness of the personnel in the event of fire or fire risks.

Reforestation Program for Buffer Zones/Riverbanks.
The need for a buffer zone is recognized in view of neutralizing the noise level at the property line, creating a habitat for displaced vegetation, wildlife and biodiversity ecosystems, and improving the aesthetics of the project site. Local riparian species shall be grown along the riverbanks for reforestation.

4.4.2 Emergency Response Plan in Case of Oil Spill

Foremost in the dredging operations is the implementation of controls for oil spill prevention. Nevertheless, a response plan in the unlikely event of an accidental oil spill still needs to be drawn. The plan will include a review of oil spill risks, identify the sensitive receiving environments, a description of some relevant safe work practices, as well as describing the institutional framework (organization), communication, response equipment, procedures and actions that will be implemented in an oil spill incident. This plan shall be in compliance with the International Convention for the Prevention of Pollution from Ships / MARPOL 73/78, other such regulations.

Before the start of the project, an oil spill response training shall be organized for the possible members of the ERT. The course shall provide practical tools for an effective response to oil spills. In terms of logistics, oil spill kits and fire extinguishers shall be provided in case of sudden spill and fire emergency.

If operational spills are caused by a failure of equipment in machinery spaces any further operations of this equipment should be stopped immediately or measures are to be taken to avoid a spill.

In the event of a casualty, the ship Captain's first priority is to ensure the safety of the vessel's personnel and to initiate actions which may prevent escalation of the incident and the pollution of marine waters.

The affected vessel should be grounded/stranded ASAP. Immediate assessment must be done thoroughly, in order to determine remedial action to be taken for ensuring the safety of the vessel, the crew, and the environment.

If the ship is aground and cannot maneuver, eliminate all possible sources of ignition and take action to prevent flammable vapors from entering the machinery spaces or the accommodation.

Moreover, assess the possibility of damage to the environment and whatever action can be taken to reduce further damage from any release, such as:

- Emergency dump of dredged materials to reduce the vessel’s draft;
- Transfer of bunkers internally, provided shipboard piping system is in an operational condition and in careful view of the compatibility of the substance and the tanks/pipes used for transfer while considering the impact on the ship’s overall stress and stability;

- Isolate damaged/penetrated tank(s) to secure the stability of the vessel's hydrostatic pressure in the tanks during tidal changes;
- Consider transferring bunkers to barges or other ships and request for assistance; and
- Consider the additional release of oil under the supervision of the PCG.

If the risk of further damage to the ship is greater as the crew attempts to refloat the vessel by own means, than it shall remain aground until professional assistance has been obtained. Should an explosion and a fire occur onboard, sound the alarm immediately and send distress messages. Further actions should be initiated in accordance with the ship's Muster List.

Remember the order of priorities: 1. saving lives; 2. preventing escalation of the incident; 3. preventing environmental pollution; and 4. limiting the damage to the vessel/equipment.

Once the incident is contained, mitigating measures should be put up including: - care for further protection of the personnel, use of protection gear, assessment of further risk for health and safety; containment of the spilled material by absorption and safe disposal within leak-proof containers of all used material onboard until proper unloading onshore; decontamination and medical checkup of personnel after finishing the cleanup; assessment of damages to the environment and immediate implementation of appropriate cleanup and payout of compensation where necessary.

4.4.3 Carbon Sink Program

Air pollution-generating equipment will not be used regularly in the dredging operations, and thus, emissions are temporary and minimal. The use of fuel in operating the vessels and equipment is the main source of carbon dioxide emission. Although emissions may be nil, the Proponent shall strive to reduce the project's contribution to greenhouse gas. The Carbon Sink Program shall involve: proper and regular maintenance of vessels, vehicles and equipment; Ecological Solid Waste Management especially waste minimization; and reforestation program for the buffer zone, riparian zone and nearby mangrove areas. Tree planting in the buffer zone to neutralize the noise levels, serve as natural slope protection of riverbanks, and also for further flood mitigation. Only endemic species shall be planted in the reforestation areas in the vicinity of the project site.

4.4.4 Compensation Fund

The Environmental Guarantee Fund, which shall be set up at the start of the project and continue to be built up as the operation goes on, shall be the primary source for the indemnification of damages and immediate rehabilitation of the affected ecosystems. This shall be paid out to the government or parties/communities whose properties were affected.

The assessment of the value of the damages will be done by the Proponent in coordination with the Coast Guard, the LGUs, and other affected stakeholders.

SECTION 5. SOCIAL DEVELOPMENT PROGRAM

5.1 SOCIAL DEVELOPMENT PLAN (SDP)

A Social Development Program (SDP) is designed towards a sustained improvement of the living conditions of the host communities of the Project. This can be done by formulating strategic actions that will create livelihood options to make the local communities self- reliant using local resources. A self-reliant community is capable of developing, implementing, managing, and developing local resources to create economic activities that will increase disposable income for themselves.

Significant positive variables such as creation of more alternative livelihoods and other economic activities and improvement of environmental services were found to be the major factors contributing to the local communities' high acceptability for the Project.

The SDP Framework that Royal Crown will implement will address the issues and concerns and impacts identified during the consultations and discussions with the affected barangays. It will incorporate the proposed interventions based on needs of various stakeholders of the Project.

It will also strive to develop strategies that will alleviate poverty and improve the standard of living of communities through socio-economic programs and Projects that will harness the productivity of the affected host barangays to the fullest, strengthen their self-reliance values and enhance their dignity as members of civil society.

As part of its social responsibility, the proponent will aim to provide basic social services and empower the stakeholders, especially the affected residents as partners for sustainable development.

The Project will create employment at operational phases of the Project. There would be expected to hire additional staff to manage the maintenance and operations of dredging vessels. This would create additional jobs in engineering, operations and administration. Increased operations would also require additional support personnel in security and accounts. This will address the unemployment problem in the short-term and will generate more economic activity since demand for goods and services will increase.

Below is the preliminary SDP for the proposed project. The indicative cost for this program is Five Million Pesos **(PhP 5,000,000.00)**.

Table 5-1. Preliminary Social Development Plan/Framework for the Proposed Project

CONCERNS	Responsible Community Member/ Beneficiary	Government Agency/ Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
LIVELIHOOD					
▪ Provision for Gender-responsive Employment Opportunities / Training Programs for the elderly, men, women, and youth that are not employed.	▪ Barangay Chairmen and Councils ▪ Chairperson of all affected sectors (fisherfolks, farmers)	• Barangays Adela and San Pedro, Municipality of Rizal and Barangays San Agustin and Central, Municipality of San Jose, Occidental Mindoro • Municipality of Rizal and San Jose Municipal Planning and Development Office • TESDA	Community Relations Officer (CRO)	Construction Operation	RC-GPC
HEALTH AND SAFETY					
▪ Medical Mission and Emergency Relief programs ▪ Health Information Campaign	▪ Barangay Chairman ▪ Barangay Kagawads for Health ▪ Barangay Health Workers (BHWs) ▪ Residents of the 4 affected barangays	• Municipal Health Office • Barangay Health Units	MHO/CRO	Construction Operation	RC-GPC
EDUCATION					
▪ Assistance to school rehabilitation program ▪ Scholarship programs for qualified students of Municipality of Rizal and San Jose ▪ Annual assistance to the Education-related program of the LGU	▪ Barangay Councilors for Education ▪ Teacher and/or Principal ▪ Qualified and indigent students from the impact barangays	• DepEd • Barangays/LGU	Community Relations Officer (CRO)	Dredging Operation	RC-GPC
ENVIRONMENT AND SANITATION					
▪ Brgys. Solid Waste Management Plan	▪ Barangays Council Committee Chairs on Environment	• Municipal ENRO	Community Relations Officer (CRO)	Dredging Operation	RC-GPC

CONCERNS	Responsible Community Member/ Beneficiary	Government Agency/ Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
	▪ Affected Communities				
▪ Peace and Order	Barangay Council Committees for Peace and Order	• LGU/PNP • Capacitate Barangay Tanods to keep peace and order	Chief Safety Officer	Dredging Operation	RC-GPC
▪ Adopt a Mangrove Program	▪ Barangay Council Committee Chairs on Environment ▪ Affected fishermen or their wives	• Municipal ENRO	Community Relations Officer (CRO)	Dredging Operation	RC-GPC
SPIRITUAL					
Support on fund-raising activities relevant to religious programs and value formation programs	Head of church	• Leaders of Religious Sector	Community Relations Officer (CRO)	Dredging Operation	RC-GPC
DISASTER RISK REDUCTION / CLIMATE CHANGE ADAPTATION (in sync w IEC)					
▪ IEC on Disaster Risk Management ▪ Seminars/training on Disaster Risk Preparedness and Mitigation ▪ Provision of equipment and aid in response and recovery of affected communities	• Barangay Council Committee heads for Environment • Barangays and communities around the project area • Workers	• PDRRMC; MDRRMC; Barangay Councils for Environment	LGU	Dredging Operations	RC-GPC

5.2 INFORMATION AND EDUCATION CAMPAIGN (IEC)

The objective of conducting IEC activities is to inform the concerned stakeholders through the process of education using communication mediums. The communication processes shall provide feedback to the Proponent about the stakeholders' understanding of the Project, the issues and concerns about the Project, as well as their suggestions and other inputs.

The IEC materials will be prepared in a manner and language that can be easily understood by everybody and will contain balanced and complete information. The information material for IEC, as much as practical, will be in the local language or dialect. It will also contain sufficient information including a description of the Project, the proponent, and the developments of the Project. It will also include such appropriate studies as the evaluation of public health, environment, population, gender, socio economic, and cultural impacts of the Project or undertaking and the appropriate mitigation and enhancement measures.

The Information, Educational Communication (IEC) Plan Framework is an important tool in establishing harmonious relationships between the Proponent and Project stakeholders. It opens the line of an open interaction that will critically identify issues and concerns on the part of Project stakeholders and a responsive mitigation measure to be developed by both the Project proponent and Project stakeholders.

The IEC plan goes beyond the objective of providing information or conducting dissemination activities. It focuses on providing ongoing interaction between Project proponents and stakeholders during the construction, operation, and decommissioning phases. It provides information on the milestones and progress of development and issues during the implementation stages.

More meaningfully, the IEC program will inculcate value formation by making the community and residents aware of their roles as Project stakeholders. When the IEC program is conducted effectively, it is a significant confidence and trust-building tool for both the Project stakeholders and the Project proponent.

The Project Information, Education and Communication Framework Plan shows in **Table 5-2**.

Table 5-2. Information and Education Campaign

Target Sector	Major Topic/s of concern in Relation to Project	IEC Scheme/ Strategy/ Method	Information Medium	Indicative Time/ Frequency	Indicative Annual Cost (PhP)
Different sectors, organizations and resource users In the project affected barangays (i.e. education and health sectors, women's group, youth, elderly and fishermen organization	Project impact and mitigating measures	Focus Group discussions	Invitation letters Reports/ consultation meetings Focus group discussions	Pre-construction to operations phase	50,000.00
LGU and all affected Barangays	• ECC Compliance Report • Environmental Monitoring status and SDP Compliance • Disaster preparedness and emergency response such as flooding, tsunami, earthquake, and other identified hazards and risk in the area	Focus Group Discussions	Invitation letters Reports/consultation meetings	Pre-construction to Operations Phase	50,000.00

Target Sector	Major Topic/s of concern in Relation to Project	IEC Scheme/ Strategy/ Method	Information Medium	Indicative Time/ Frequency	Indicative Annual Cost (PhP)
Fisherfolks	Actual impact and safety measures during operations phase	FGDs	Meeting with Fisherfolks organizations Multi-sectoral meeting Sending of individual letters	Operations phase / regular as needed	50,000.00

SECTION 6. ENVIRONMENTAL COMPLIANCE MONITORING

This module presents the commitment of Royal Crown-Groundport and Partners to conduct self-monitoring as well as facilitate a multipartite monitoring wherein the effectivity of implemented mitigating measures is evaluated in order to ensure that the significant adverse impacts which will be caused by the proposed Busuanga River Dredging project are minimized and properly managed. If the measures are found inadequate, improvements can immediately be introduced. The DAO 2003-30 RPM provisions issued as MC 002 Series of 2007, which requires the establishment of the Environmental Monitoring Fund (EMF) and the Environmental Guarantee Fund (EGF) is taken into account.

6.1 SELF-MONITORING AND REPORTING PLAN

The Self-Monitoring Plan shows the monitoring that needs to be accomplished with regard to compliance to the environmental laws (PEISS, Air Quality, Water Quality and Solid Waste Management).

As part of the plan, RC-GPC will conduct a self-monitoring activity of its environmental operations. It involves all project phases to determine and find explanation on any changes in the baseline data. This includes volume of spoils, spaces opened up, influx of workers, water consumption, jetty operations, waste generation, disposal of hazardous wastes, operation and maintenance of equipment, fuel and oil storage.

The initial Environmental Monitoring Plan (EMoP) is presented in **Table 6-1**. The plan is largely indicative and will be refined during project implementation. The Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS) is presented in **Annex 6-A**.

The Company through its Environmental Officer shall be tasked to prepare daily, weekly and monthly reports and collate the same as part of the quarterly submission of the Self-Monitoring Report (SMR), which will be submitted to the Environmental Management Bureau.

In the same manner, the various conditions in the ECC including the SDP and IEC commitments shall be complied with. A modified Self-Monitoring Report (SMR) shall be submitted to EMB as part of the compliance monitoring system in accordance with DAO No. 2003-27, on a quarterly basis. The Proponent shall also submit a semi-annual Compliance Monitoring Report (CMR) to EMB. The Monitoring Report will include percentage exceedance to standard in terms of pollution and permit violations, if any.

This EMoP discusses the: mitigation measures; location; measurement method; frequency of monitoring; and responsibility (for both mitigation and monitoring). This contains the proposed framework for compliance monitoring of the project, which includes, among others, the environmental parameters necessary to monitor the identified key environmental impacts of the proposed project.

As required by DENR MC No. 2010-14 and RPM for DAO 2003-30, and as a proactive tool in minimizing/eliminating adverse project consequences to the environment, an “Environmental Quality Performance Level” (EQPL) was identified for each critical parameter associated with identified significant project impacts. The limit level shall be the regulated threshold of pollutant (standard that must not be exceeded) while the action level is set lower than the limit level wherein management measures must be implemented so as not to reach the regulated threshold.

Table 6-1. Environmental Monitoring Plan (EMoP) with Environmental Quality Performance Levels (EQPL)

Key Environmental aspects per Project Phase	Potential Impacts	Parameter	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
CONSTRUCTION PHASE - No major construction works will be done since the support facilities (base camp) will be rented. Hence, no impacts are foreseen													
OPERATION PHASE													
LAND													
Dredging Stockpiling Hauling Office operations	Pollution due to Solid Waste Generation	Volume of solid waste	Waste management audit	Weekly	All project facilities	RC-GPC	Part of Opex						
	Decreased slope stability of riverbanks	Occurrence of bank erosion or slides	Site observation	Quarterly	Project area	RC-GPC / MMT	Part of MMT Costs	30% of banks have eroded			Inspect & assess the installed control structures, install additional if needed; plant vegetative slope protection		
	Pollution due to accidental spill of hazardous wastes	Quantity, type of substance Occurrence of accidental spills Condition of equipment and machinery, oil and fuel storage	Ocular inspection Regular reporting and documentation	Daily visual Monthly	Dredging areas, staging areas	PCO, SHE	Part of Opex	Spill incidence	Spill-related complaints persist after 3 months	Spill-related complaints persist after 6 months	Implement Cleanup Report actual status on a periodic basis, document results	Implement Clean-up Prepare incident report highlighting the findings. Provide recommendations.	Execute remedial measures. Temporary limit operation as needed to prevent damage to environment
			Soil sampling and analyses for chemicals of components	As needed	Affected areas	PCO, SHE	Part of Opex	Compliance to RA 6969 for the treatment, storage and disposal of contaminated materials Develop remediation plan with appropriate clean-up goals if groundwater is affected			Compliance to RA 6969 for the treatment, storage and disposal of contaminated materials Initiate remediation clean-up to achieve identified goals for impacted groundwater		
WATER													
Dredging Stockpiling Hauling Office operations	Wastewater discharge (Effluent C)	pH	In-situ with portable meter	Monthly	Oil - Water Separator discharge outlet Motor pool/shop	PCO/ MMT	Part of Opex	pH 6.5-9.2	6.3-9.4	6.0-9.5	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project inform MMT regarding possible source for the group's investigation
		BOD_5	Azide Modification (Dilution Technique)					BOD_5 40	45	50			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS 80	90	100			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G 4	4.5	5			
	Wastewater discharge (Effluent SC)	pH	In-situ with portable meter	Monthly	Oil - Water Separator discharge outlet Motor pool/shop	PCO/MMT	Part of Opex	pH 6.5-8.7	6.3-8.8	6.0-9.0	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project inform MMT regarding possible source for the group's investigation
		BOD_5	Azide Modification (Dilution Technique)					BOD_5 80	90	100			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS 80	90	100			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G 8	9	10			
	Degradation of Freshwater Quality due to re-suspension of sediments causing turbid water, , discharge of wastes	pH	In-situ with portable meter	Monthly	To be established by MMT	PCO/MMT	Part of Opex	pH 6.7-8.8	6.6-8.9	6.5-9.0	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the construction/operation area, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation
		BOD_5	Azide Modification (Dilution Technique)					BOD_5 5.6	6.3	7			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS 64	72	80			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G 1.6	1.8	2			
		Fecal Coliform, MPN/100ml						Fecal Coli 140	160	200			
		Total Coliform, MPN/100ml						Total Coli 160	180	200			
	Degradation of Marine Water Quality due to re-suspension of sediments causing turbid water, discharge of wastes	pH	In-situ with portable meter	Monthly	Stations to be established by MMT	PCO MMT	Part of Opex	pH 6.7-8.2	6.6-8.3	6.5-8.5	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project, conduct adjustments/appropriate corrective action at identified pollutant source. Continuous improvement of ERP	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation Continuous improvement of ERP Stream stabilization
		BOD_5	Azide Modification (Dilution Technique)					BOD_5 n/a	n/a	n/a			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS 64	72	80			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G 2.4	2.7	3			
		Fecal Coliform, MPN/100ml						Fecal Coli 140	160	200			
		Total Coliform, MPN/100ml						Total Coli 160	180	200			
	Less lands inundated by flood & less frequency	Area size inundated compared to baseline. Frequency of flooding compared to baseline.	Site observation KIIs	After TC occurrence	Busuanga River/ impact barangays	RC-GPC / MMT	Part of MMT costs	Improvement in flood reduction noticed by Year 5			Continue/maintain improvement		
	Dredging depth and area compliant	Dredging basin depth Dredging basin width	Handheld depth echo sounding and record keeping	Monthly	Dredging sites	RC-GPC	Part of Opex	80% of approved plan	90% of approved plan	100% per approved plan	Maintain pace to attain plan	Maintain pace to attain plan	Maintain pace to maintain plan

Key Environmental aspects per Project Phase	Potential Impacts	Parameter	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	with approved Dredging Plan	Dredging basin location at center of river Dredging basin location 150m from shoreline											
	Decrease in abundance and change in composition of freshwater & marine biota	Species composition, density and relative abundance of phytoplankton, zooplankton, bottom benthos, fish, corals, seagrass, seaweeds	Standard scientific methods used in baseline assessment- Line Transect Fish Visual Census, plankton/benthos sampling, mangrove and seagrass assessment; KII	Every 2 years	Same stations during baseline study	RC-GPC	Part of Opex	30% decrease in baseline findings especially in live coral cover inside; discoloration of sea waters	50% decrease in baseline findings and discoloration of sea water; and increase in HABs	70% decrease in baseline findings and discoloration of sea water; and increase in HABs	Conduct marine biota monitoring; check if effluent released complies with DAO 2016-08	Increase the frequency of conduct of marine biota monitoring to semi-annual; Company to check if effluent released complies with DAO 2016-08	Increase the frequency of conduct of marine biota monitoring to Quarterly; Company to check if effluent released complies with DENR AO-35; Temporarily cease activities in point sources of pollution
AIR													
Dredging Hauling Use of emergency generators & other diesel-powered equipment	Generation of Noise	Sound levels/ noise (dBA)	Actual noise measurement using Handheld Noise Meter	Monthly	4 primary impact barangays	PCO/ MMT	Part of Opex	does not exceed 71.6dB	does not exceed 76.6 dB	does not exceed 81dB	Investigate and identify source of noise	Identification of the source of noise and check buffer zones and noise attenuation measures	Review performance of the attenuation measures, employ corrective measures and install additional measures if necessary
PEOPLE													
Dredging Hauling In-migration Movement of workers	▪ Traffic congestion ▪ Employment ▪ Livelihood ▪ Local tax	Traffic condition / Road Accessibility	Visual: Number of vehicles per report Representation with the LGU regarding road network and its infrastructure plans Traffic Impact Assessment	Daily	Access Road	PCO/ MMT	Part of Opex	20 minutes traffic	Half hour traffic	1 hour traffic	Strengthen implementation of traffic management plan	Increase deployment of traffic enforcers	Review traffic management plan and impact assessment and revise if necessary
	Accidents	Incident reports	Records from Clinics Safety Records Monitoring of use of PPEs	Monthly	Site of accident/incident	SHE	Part of SHE cost	5 NM or MTI	1 LTI	3 LTI	Review safety procedures, check equipment and facilities	Regular and more frequent IEC on Safety and Health Program/strategies	Revise Safety and Health Programs
	Socio-economic impacts	No. of employees/workers employed/hired	Survey / FGD	Quarterly	4 primary impact barangays	ComRel	Part of salaries & wages	70% of local workers	60% local workers	50% local workers	Review hiring procedures	Identify problem areas and check bottlenecks	Assess hiring procedures and implement improvements
		No. of Livelihood Programs Implemented	Survey / FGD	Quarterly	4 primary impact barangays	ComRel	Part of SDP	90% accomplishment	80% accomplishment	70% accomplishment	Review programs	Revise programs	
	• Reduced flooding incidence and expanse; • Reduced requirement for disaster rescue and relief operations; • Reduced damage to local infrastructures; • Reduced damage to properties; • Improved agricultural yield	Value of damages to infrastructures; Value of damage to properties; Cost of disaster rescue & relief operations; Value of agricultural yield;	Review of BDRRMC and MDRRMC records	Annual	4 primary impact and secondary impact barangays	RC-GPC & LGUs	Part of MMT costs	Improvement in flood reduction noticed by Year 5			Continue/maintain the enhancement/river restoration.		
	Generation of local revenues from taxes, permits and LGU share in dredging	Total taxes paid to the national government Development of small and medium enterprises like transport, construction and utility services, food services and laundry supplies	▪ Real Property Tax payments ▪ Payments of occupation tax ▪ SDP allotments ▪ Excise tax ▪ Business tax	Quarterly	4 primary impact barangays	ComRel	Part of opex & SDP	90% availment	70% availment	60% availment services	Review availment and identify issues	Coordinate with LGU to determine if there are revisions/ improvement needed	Enhance program implementation
DECOMMISSIONING AND ABANDONMENT PHASE													
LAND													
Dismantling of equipment and structures (e.g., office) Demobilization of	Waste piles at riverbanks	Volume of solid waste	Waste management audit	Until wastes are completely removed	Project site & adjoining areas	RC-GPC	Part of remaining EGF	Project wastes remaining in areas around the project site			Haul out remaining wastes until NONE remains		
	Riverbank stability		Site observation	Once, before turnover of	Banks alongside dredging basin	RC-GPC / DPWH	Part of remaining	10% of bank length in project area have moved	20% of bank length in project	30% of bank length in project area have	Plant vegetative cover	Plant more vegetative cover	Install control structures & plant vegetative cover

Key Environmental aspects per Project Phase	Potential Impacts	Parameter	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Range				Management Measure		
			Method	Frequency	Location				Alert	Action	Limit	Alert	Action	Limit
dredging vessels				area			EGF			area have moved	moved			
WATER														
Dismantling of equipment and structures (e.g., office) Demobilization of dredging vessel and equipment	Wastewater discharge (Effluent C)	pH	In-situ with portable meter	Monthly	Oil - Water Separator discharge outlet Motor pool	PCO/ MMT	Part of remaining EGF	pH	6.5-9.2	6.3-9.4	6.0-9.5	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the operation area, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation
		BOD_5	Grab sampling and laboratory analysis					BOD_5	40	45	50			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS	80	90	100			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G	4	4.5	5			
	Wastewater discharge (Effluent SC)	pH	In-situ with portable meter	Monthly	Oil - Water Separator discharge outlet Motor pool	PCO/MMT	Part of remaining EGF	pH	6.5-8.7	6.3-8.8	6.0-9.0	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project area, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation
		DO, mg/l	In-situ with portable meter					DO	4	4.5	5			
		BOD_5	Azide Modification (Dilution Technique)					BOD_5	80	90	100			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS	80	90	100			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G	8	9	10			
	Degradation of Freshwater / Surface Water Quality due to re-suspension of sediments causing excessively turbid water, discharge of wastes	pH	In-situ with portable meter	Monthly	Freshwater sampling stations: to be established by MMT	PCO/ MMT	Part of remaining EGF	pH	6.7-8.8	6.6-8.9	6.5-9.0	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project area, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation
		BOD_5	Azide Modification (Dilution Technique)					BOD_5	5.6	6.3	7			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS	64	72	80			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G	1.6	1.8	2			
		Fecal Coliform, MPN/100ml						Fecal Coli	140	160	200			
		Total Coliform, MPN/100ml						Tot Coli	160	180	200			
	Degradation of Marine Water Quality due to re-suspension of sediments causing turbid water, discharge of wastes	pH	In-situ with portable meter	Monthly	Marine sampling station: to be established by MMT	PCO/ MMT	Part of remaining EGF	pH	6.7-8.2	6.6-8.3	6.5-8.5	Investigate the source and identify possible pollutant sources Conduct corrective actions if needed	Investigate the source and identify possible pollutant sources If the problem is within the project area, conduct adjustments/appropriate corrective action at identified pollutant source.	Investigate the source and identify possible pollutant sources Provide additional mitigation measures or pollution control facilities If not from project, inform MMT regarding possible source for the group's investigation
		BOD_5	Azide Modification (Dilution Technique)					BOD_5	n/a	n/a	n/a			
		TSS, mg/l	Gravimetric (dried at 103-105°C)					TSS	64	72	80			
		Oil and grease, mg/l	Gravimetric (Petroleum Ether Extraction)					O&G	2.4	2.7	3			
		Fecal Coliform, MPN/100ml						Fecal Coli	140	160	200			
		Total Coliform, MPN/100ml	Multiple Tube Fermentation Technique					Total Coli	160	180	200			
PEOPLE														
Dismantling of unnecessary structures	Safety issue, eyesore to landscape	Physical and chemical safety of area	Site observation	Once	Project Site	MEPEO/MMT	Part of remaining EGF							
Disposal of solid wastes	Health Hazard	Based on the result of the Environmental Site Assessment (ESA) that will be conducted prior to abandonment	Based on the recommendation of the ESA that will be conducted prior to abandonment	Once	Project Site	MEPEO/MMT	Part of remaining EGF							
Disposal of hazardous materials	Health Hazard	Based on the result of the Environmental Site Assessment (ESA) that will be conducted prior to abandonment	Based on the recommendation of the ESA that will be conducted prior to abandonment	Once	Project Site	MEPEO/MMT	Part of remaining EGF							

6.2 MULTI-SECTORAL MONITORING FRAMEWORK

According to Section 5.B of DAO 2022-02, the Inter-Agency Committee (IAC) shall have an option to establish a Multi-Partite Monitoring Team (MMT). The IAC shall identify the MMT members and also the monitoring activities to be undertaken during the life of the dredging project. The MMT will validate the Proponent’s conduct of self-monitoring. The MMT shall prepare a monitoring report for the endorsement of IAC to EMB-R4B for recording purposes of the project compliance and for validation purposes. It is the Proponent’s responsibility to provide the funds for the monitoring activities of the MMT, the amount of which shall be based on the Annual Work and Financial Plan to be prepared by the MMT in consultation with EMB-R4B.

Please refer to **Annex 6-B** for the MMT Memorandum of Agreement.

6.3 ENVIRONMENTAL GUARANTEE AND MONITORING FUND COMMITMENTS

The Royal Crown-Groundport and Partners consortium herein commits to provide an Environmental Monitoring Fund (EMF) on a yearly basis. The amount will be based on the Annual Workshop and Financial Plan (AWFP) of the MMT and shall be deposited in a government bank at the start of the calendar year. The disbursement shall be jointly handled by the MMT and the Proponent. The EMF shall be used to cover all MMT-related costs.

To ensure the just and timely compensation for damages for any harmful event and adverse effect of dredging operation may cause, such as accidental oil spill, an Environmental Guarantee Fund shall be set up at the start of the project and will continue to be built up as the operation goes on. It shall be a sufficient environmental deposit to ensure the availability of funds at any time it will be needed. It is to be deposited in a government bank as well.

The EGF shall be a fund source for the compensation of damages that may be caused by the project and immediate rehabilitation and/or reforestation of the affected ecosystems, and used exclusively for the following purposes: immediate rehabilitation of damaged area; just compensation of parties and communities affected by the negative impacts of the project; conduct of research studies related to the proposed Busuanga River Dredging Project that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

At the end of the project life, a sufficient amount left from the EGF may be utilized to ensure that rehabilitation, restoration, decommissioning, or abandonment are adequately financed. The EGF Trust Fund and EGF Cash Fund shall be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund shall be renewed upon every expiration. An indicative amount of One Million Pesos (PhP 1 Million) shall be deposited for the EGF in increments. This shall later be finalized upon the issuance of the ECC.

SECTION 7. DEMOBILIZATION / DECOMMISIONING POLICY

The consortium of Royal Crown-Groundport and Partners Corporation is set on providing a restored river system coupled with fully cooperative and self-reliant community amidst the equitable profitability and optimum utilization of the dredged materials within a framework of sustainable development. This Project is categorized as an Environmental Mitigation; Disaster Risk Reduction; Climate Change Adaptation project. Nevertheless, its implementation may generate impacts to the environment. The main issues in the decommissioning and closure are public health and safety, and the environmentally-stable conditions compatible with the surrounding environment.

This Project is envisioned to continue in perpetuity so that after it has restored the normal river conditions, it will continue dredging to maintain such condition in view of the steady influx of sediment loading from upstream of Busuuanga River. In effect, it will be a cycle. However, in the event that the Project has to be abandoned by whatever reason, a detailed abandonment plan shall be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance with the IAC requirements. This shall be done in consultation with the IAC and the host communities.

The Consortium shall endeavor to meet the following for the safe relinquishment of the area and to be released from accountability for the Project site:

- The unobstructed and efficient surface flow in Busuanga River is observed, the riverbed elevation enables it to handle a storm with longer term return period such as a 100-year storm as approved by the DPWH;
- All project structures, equipment and the engineering protection structures/measures are removed;
- All social commitments made by the Proponent were fulfilled;
- All wastes including hazardous materials shall have been removed;
- No riverbank erosion, if any, remains uncontrolled;
- No damages to existing and planned Flood Control infrastructures, bridge and other government infrastructure;
- The retrenched employees/workers are sufficiently compensated, have acquired employable skills, and assisted in future job hunting; and
- No complaint on damage to property against the Proponent, if any, remains unresolved.

The IAC, MMT and/or the EMB shall be invited to the sampling for final water quality at the identified monitoring stations and inspect the area vis-à-vis its compliance to the submitted abandonment plan.

The major dredging equipment shall be demobilized. Other equipment or structures that will be deemed beneficial to the locals or barangay LGU shall be donated to the host community.

SECTION 8. INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The Joint Venture consortium of Royal Crown-Groundport and Partners Corporation (RC-GPC) shall be the dredging operator itself, and therefore, the primary and sole accountable entity in the implementation of the project and in complying with all technical, safety, environmental and safety commitments/conditionalities attached to it. Should there be legal claims or complaints against the Project, RC-GPCC shall be liable.

In the organizational chart for the proposed project (**Figure 8-1**), the project personnel and their inter-relation with the management and different departments are shown. The objective of this organization is to achieve the following:

- Efficient, effective and safe operations and maintenance of the project's components;
- Strict implementation of company policies;
- Environmental protection and enhancement, compliance to all ECC conditionalities, and sustainability; and
- Promotion and enhancement of the social acceptability of the project.

The institutional organization will involve the top level management, since this group is responsible for providing the corporate direction and policies of the Company. The policies shall then be disseminated to department heads and managers for implementation of the company personnel, including those who will be working on the operations of the project.

From the conception of the project, RC-GPC has established a collaborative relationship with concerned government agencies especially the members of the IAC such as the Provincial Government of Occidental Mindoro, DENR and DPWH. As the project progresses, the Company shall continue to build partnerships with other relevant government agencies, various stakeholders and host communities. These partnerships are essential in maintaining transparency, as well as to ensure that the environmental protection and enhancement measures are complied with. The stakeholders of the project will be identified as the following:

- Municipality of Rizal;
- Municipality of San Jose
- Barangays Adela and San Pedro, Municipality of Rizal;
- Barangays San Agustin and Central, Municipality of San Jose;
- Residents and community organizations that will be affected by the proposed project;
- Various industry organizations;
- Local peace-and-order councils (i.e., Philippine National Police, Coast Guard, Barangay Police) and;
- Other concerned non-government organizations.

RC-GPC commits to:

- Comply with the conditions that will be stipulated in the ECC and other related environmental laws;
- Foster mutually beneficial partnership and cooperation with host communities;
- Promote sustainable use and responsible development of resources by adopting appropriate technologies;
- Develop livelihood programs and upgrade skills of host communities to contribute and enhance the quality of life; and
- Develop training programs for its employees which will ensure that they will be continually prepared for the tasks assigned to them. The trainings will also cater to the preparation of employees' skills to ensure their employability after the life of the project.

In the organization, the Environmental Protection and Enhancement Officer is the chief person for the environmental concerns of the Company in the project area. He/she reports directly to the Project Manager who is the overall manager of the operations. He/she will work hand-in-hand with the other HSEC heads to ensure the smooth implementation of the project in an environmentally and socially acceptable manner. He/she prepares monthly environmental reports on the operation. He/she is the representative of the Company for the periodic MMT mailings and conferences. The environmental clerk keeps the record of the environmental reports prepared periodically. The environmental inspector supports the environmental supervisor in all environmental concerns of the Company in the Project location.

The Resident Manager, in turn, shall be the one to report to top management. The Support Team will be facilitating the financial, administrative, logistical, and general support to the HSEC Team to ensure smooth operations. They shall be guided with an Annual Work and Financial Plan, which shall be prepared jointly by all department heads, with consideration of the Company's commitments to the ECC conditions, the DENR, DPWH, and LGUs/DILG, DOTr, and other relevant government agencies.

The HSEC team, together with its Resident Manager shall be supervising the dredging activities in terms of compliance with environmental. social and safety policies of the Company as well as compliance with ECC conditions.

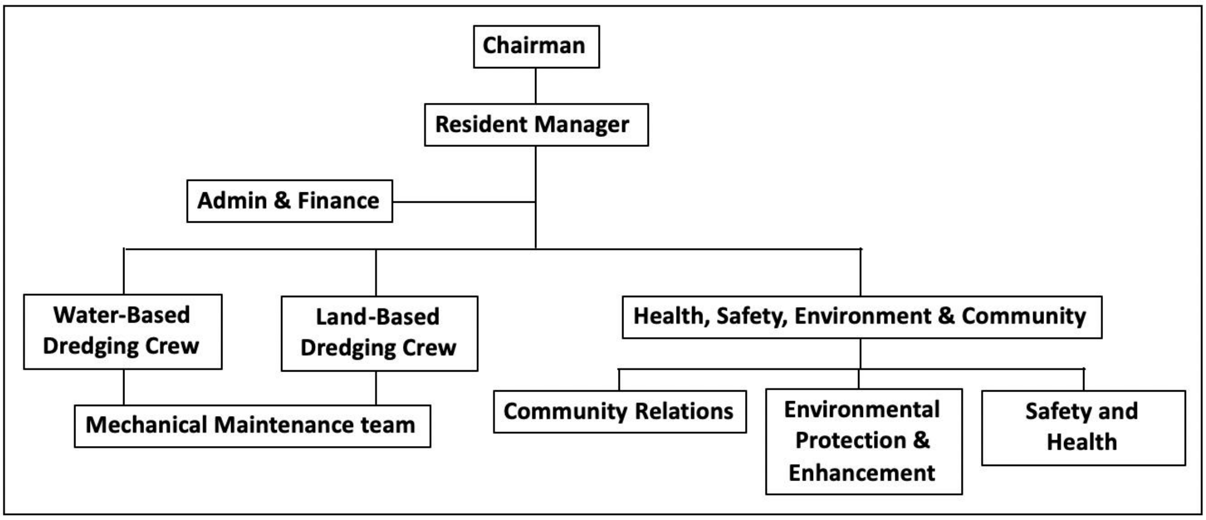


Figure 8-1. Organizational Structure for EMP Implementation

SECTION 9. ENVIRONMENTAL RISK ASSESSMENT

9.1 SCOPE & COVERAGE

9.1.1 Level of Coverage of the ERA

The requirement for the conduct of ERA shall be defined at three (3) levels:

a. 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.

b. 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.

c. 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.

9.1.2 Technical Guidelines for the Conduct of ERA

9.1.2.1 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: a) alkylation; b) amination by ammonolysis; c) carbonylation; d) condensation; e) dehydrogenation; f) esterification; g) halogenation and manufacture of halogens; h) hydrogenation; i) hydrolysis; j) oxidation; k) polymerization; l) sulfonation; M0 desulphurization, manufacture and transformation of sulphur-containing compounds; n) nitration and manufacture of nitrogen-containing compounds; o) manufacture of phosphorus-containing compounds; p) formulation of pesticides and of pharmaceutical products; q) distillation; r) extraction; and s) 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)

9.1.2.2 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 9-1. Inventory of Chemicals and Their Threshold Levels

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

CATEGORY	LEVEL 1 (tons)	LEVEL 2 (tons)
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 9-2. Definition of Different Categories 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 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).

The guideline for Societal Risk is reflected in **Figure 9-1.**

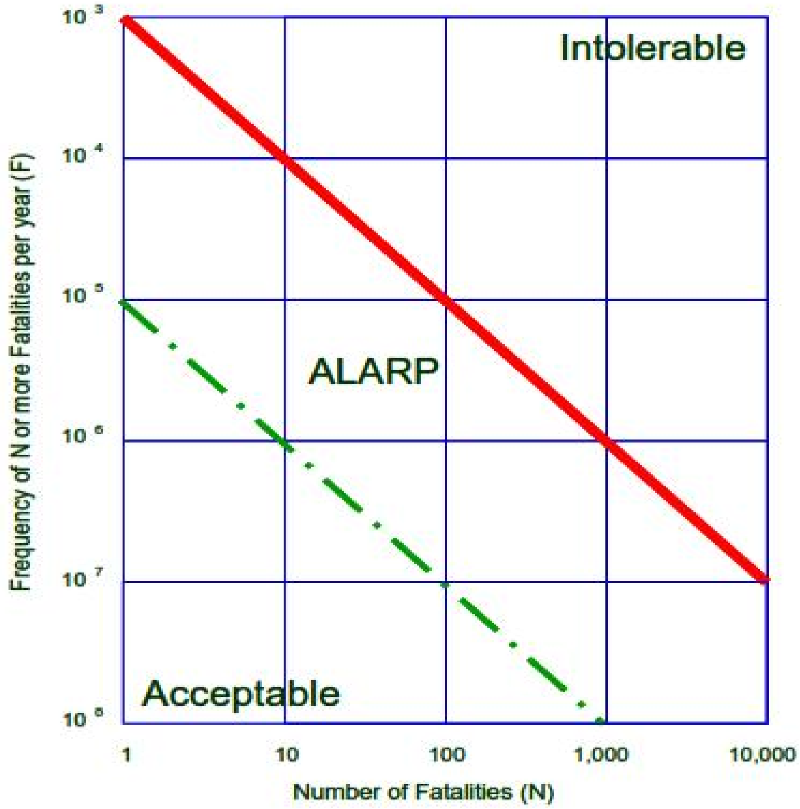


Figure 9-1. Societal Risk Criteria

Using the criteria set under the ERA guidelines enumerated above:

- The project does not fall in any of the " facilities" indicated for the production or processing of organic and inorganic chemicals and it shall not engage in any of the abovementioned activities.
- The proposed project shall not use chemicals or hazardous materials listed above except for fuel, oil and lubricants for the dredging vessel/s and equipment. Under the " threshold inventory" (Table 9-1), the quantity of fuel, oil and lubricants (flammable substances (Table 9-2)) to be stored during the dredging operations will not exceed the level 1 threshold.
- The project is also outside the "Societal Risk" Criteria (Figure 9.1) due to small number of affected personnel during the dredging operations and construction of facilities.

Nonetheless, a risk screening study was undertaken for the purpose of compliance with the technical scoping checklist.

9.2 METHODOLOGY

Environmental risk is the probability and consequence of an unwanted accident. Risk assessment is a a scientifically based methodology developed for estimating the likelihood and magnitude of the possible adverse effects that may be produced by a particular activity. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. The hazards cannot be 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. The process is illustrated in the figure below.

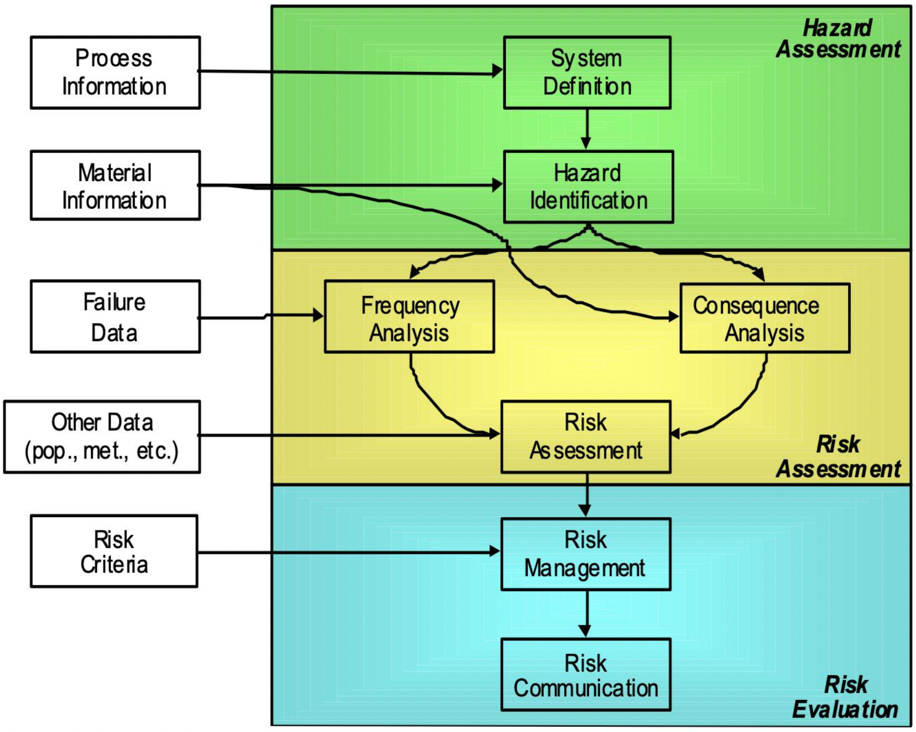


Figure 9-2. Risk Assessment Process

Hazard Identification

It is 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 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

It 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

This is the estimation of the likelihood of number of occurrences of the identified hazard and/or the time occurrences of such.

Risk Management

This 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.

In the context of Philippine EIS System (PD 1586), the ERA is concerned with human safety where risks are characterized by probabilities, consequences, accidental nature, and acute effects. Its primary purpose 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.

The environmental hazard identification for this proposed project is focused on hazards or incidents associated during the construction of facilities, actual dredging operations and marine activties. Specifically, this study gave more emphasis on the safety hazards and risks associated during construction phase that involves specific health and safety issues of the workers which are no longer present during operation phase.

9.3 SAFETY RISKS

9.3.1 Description of Conditions, Events and Circumstances Which Could Be Significant in Bringing About Identified Safety Risks

The identified safety risks and safety measures for the proposed dredging activities are shown in the table below.

Table 9-3. Safety Risks and Measures

Activities	Safety Risks	Outcomes	Frequency	Safety Measure
Construction of Facilities	• heat • vibration • noise	injury	negligible very low	• strict adherence to prescribed SOP • regular and adequate training for personnel • regular monitoring of processing activities and working conditions
Dredging Activities (river and navigation zone)	• heat • vibration • noise	injury	negligible very low	• strict adherence to prescribed SOP • regular and adequate staff training and orientation • strict implementation of the use of PPEs • regular monitoring of processing activities and working conditions
	• fires • explosion	fatality/ injury	negligible very low	
Marine Activities (navigation zone/offshore)	• fires • explosion	fatality/ injury	negligible very low	• strict adherence to planned route • provision for fire control devices • regular and adequate staff training and orientation • proper implementation of emergency plan • proper coordination with another agency

Potential hazards and safety risks such as occurrence of fire and explosion are present during the dredging operations and movement of marine vessels offshore. The above table lists the safety measure to minimize such hazards and risks.

No significant safety risks are identified during the onshore construction of facilities.

9.3.2 Description and Assessment of the Possible Accident Scenarios Posing Risk to the Environment

9.3.2.1 Accidental Oil Spill

Accidental oil spills has the potential to happen due to vessel oil-storage leaks, marine vessel collision, dredging vessel and equipment mishandling and extreme weather condition causing ship wrecks.

This will have a have a serious threat for human and aquatic environment. Chronic increase in oil toxicity could kill marine resources which will lead to depletion for human consumption.

Oil can block sunlight penetration and reduce dissolved oxygen in the water bodies which is also known as “Hypoxia” that will lead to fish kill and suffocation of marine organisms.

Even with smaller amount of oil contamination, physiological process of aquatic organisms can also be affected resulting to abnormal reproductive rate, growth and development. Plankton, providing a crucial role in aquatic ecology is also vulnerable to the effects of oil leaks. Coral reproduction growth and behavior which are sensitive to oil will also be in critical condition.

Strict implementation and adherence to Marine Vessel Management Procedures must be observed during project implementation.

9.3.2.2 Accident Involving Fishing Activities

During operations, dredging vessels will move through its planned route from offshore towards the river delta (navigational route for dredging vessels entering the river). The risks and accidents involving fishing boats and fishing activities is very remote. Proper coordination with Barangay and LGUs as well as coast guards will be conducted prior to project implementation.

Based on the actual surveys conducted during EIA activities, the location of fishing grounds in the area where already established and will serves as guide during project implementation.

The river delta/navigation zone dredging will only last for six months until the dredging vessel will have its suitable access towards the river mouth.

9.3.3 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

9.3.3.1 Chemical Hazards

No major quantity and source of chemicals, toxic and hazardous substances will be involved or needed during project implementation (both construction of facilities and dredging operations). Thus, potential release of toxic and hazardous substances for this dredging project is considered negligible.

9.3.3.2 Physical Hazards

Heat
Heat as occupation hazard can potentially happen during construction of facilities especially working in summer months and during maintenance of related hot equipment. Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress. Exposure to extreme heat can result in occupational illnesses and injuries. Heat stress can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. Heat can also increase the risk of injuries in workers as it may result in sweaty palms, fogged-up safety glasses, and dizziness. Burns may also occur as a result of accidental contact with hot surfaces or steam.

Recommended prevention and control measures to address heat exposure include:

- Limiting the amount or time of working in elevated temperature environments and ensuring access to drinking water;
- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.;
- Use of personal protective equipment (PPE) such as insulated gloves and shoes; and
- Implementing appropriate safety procedures.

Noise
Noise sources for the project are mainly related to the equipment and dredging vessel activities. Continuous exposure to intense noise may cause hearing loss, whether temporary (also called auditory fatigue) or permanent/irreversible.

In addition, certain vibration hazard may also be present. Localized vibration may lead to neurovascular alterations in the hands, including Raynaud's phenomenon (dead hand or white fingers); bone alterations, including formation of cyst on some of the bones of the hand; muscular weakness and muscle atrophy; degenerative alterations, primarily in the ulnar and median nerves; and, tenosynovitis.

Noise abatement technology includes the use of mufflers, sound insulation, and barriers, in addition to silencers on equipment in the steam processing facility. Vibration in equipment can controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Other management measures include: use of PPE, limiting hours of work-exposure and regular medical/health check-up.

9.3.3.3 Construction and Other Operation Hazards

Construction and other hazards are always present in the workplace. As such, safety policies and guidelines are implemented and expected to reduce to the minimum, if not eliminate such occupational hazards.

Possible hazards within the project site are worker's accidents, accidents caused by equipment failure, accidents caused by collisions between vehicles/equipment and many others.

Fires and/or explosion may also occur with the use of support equipment such as generators, heavy equipment and other electrical/mechanical/large-size units. Fire could occur due to external incidents or operational error. Operational/vehicular accidents could also lead to such incidence. Likewise, poor maintenance leading to corrosion and/or failure of containment is another probable scenario.

Explosion hazards are inherent with storage and handling of flammable substances. An explosion could also lead to fire and/or release of hazardous materials. Also, an explosion could result in physical damages that will be caused by overpressures.

Safety measures to reduce fire and explosion hazards will include safety monitoring and management, operational guidelines (e.g., operational limits), and provisions for emergency equipment. Close coordination with the appropriate government agencies (e.g., barangays, LGU, BFP, PNP) will also be undertaken. Regular safety training will form part of the program.

9.3.3.4 Natural Hazards

Seismic activity/Earthquake-related events
Mindoro is transected by the Central Mindoro Fault, Aglubang River Fault and Southern Mindoro Fault. To the north along Verde Island Passage is the Lubang Fault, while the Manila Trench lies offshore to the west of the island. Significant earthquake events have affected Mindoro. The estimated earthquake intensity in the area is degree VII. The potential earthquake effects (ground shaking) might affect and impede the construction of facilities and dredging activities in the project site.

Storm Surge Inundation
Storm surge is an important issue because our country is located at the typhoon prone area and surrounded by the Pacific Ocean and the West Philippine Sea. Coastal development, as well as people living near the coast need to pay attention to the damages of storm surge, especially the inundation during typhoon's duration.

Storm surge inundation will affect the river mouth/downstream portion of Busuanga River. Areass with thick tree cover are partially protected.

Tsunami
Tsunami is a series of large waves with impulsive undersea disturbance or activity near the coast or in the ocean. Manila Trench, an offshore earthquake and tsunami generator, is located to the west of Mindoro Island. Several tsunamis have affected Occidental Mindoro in the past and the project site is within the tsunami inundation zone.

9.3.4 Safety Policy and Emergency Preparedness Guidelines Consistent With the Regulatory Requirements

9.3.4.1 Prevention of the Occupational Hazards and Traffic Risks (Land and Water)

Marine Vessel Risk Management Procedures

To minimize risk and mitigate hazards inside the marine vessel where personnel will stay for a period of time, the following should be adapted:

1. All marine vessels 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.

Prior to commencement, all relevant notices (e.g. Notifications to Mariners; Port Marine Notices) shall be provided to the ship's Captain, who will verify them for implementation.

2. Strict adherence on the ships protocol, SOP, navigational and planned route.
3. Health and Safety Inductions – all personnel boarding the vessel must undergo basic health and safety trainings which include but not limited to:
   - Layout of the vessel
   - Housekeeping rules
   - Muster Stations
   - Emergency Preparedness Plan
   - Alarms
   - Safety Equipment
   - PPE
   - Emergency Escape Routes
   - Emergency Life Jackets, Life Rafts and Life Buoys
   - HSE Management
   - Environmental Awareness

4. Navigation - aside from the safety trainings and familiarization inside the vessel, the personnel should also be properly notified of the ship's route and the operation it will undergo. Navigational route and maps should be properly provided.
5. Engine and machinery room safety – onboard mechanics, engineers and wipers shall be made familiarize for some procedures for safe working practice in the engine and machinery rooms.
6. Weather and Forecast - the ship's Captain and/or the Superintendent shall continuously monitor the weather conditions and shall restrict or even interrupt certain works when safe work is not possible.
7. Safety Signages and Fire Fighting Equipment - safety signs (e.g. no smoking, emergency exits) and firefighting equipment shall be posted in accordance with the SOLAS regulations. Crew shall be familiar with the signs and adhere to them.

   The type of fire-fighting equipment and the location is shown on the safety plan and fire plan. The equipment is subject to regular maintenance and inspection.

   Fuel tanks must be marked with the warning that naked flames and heat are dangerous and there must be safety devices in place to prevent 'overfill'. Engine exhausts in the vicinity must be fitted with spark arrestors.

Dredging and Construction Risk Management Procedures

Safety measures to reduce the hazards include the following:

- Minimizing equipment failure by application of quality assurance systems to ensure that the design, fabrication and construction of equipment meet recognized International and Philippine codes and standards.
- Provision of safety gears and PPE's
- Careful selection of contractors with track record especially in the handling and transport of hazardous materials.
- Formulation and implementation of emergency response procedures and systems during construction.

9.3.4.2 Protocols in Case of Oil Spill

Inhalation:

- Immediately move to fresh air and seek medical assistance at once.
- Unconscious casualties must be placed in the recovery position. Monitor breathing and pulse rate and if breathing has failed, or is deemed inadequate, respiration must be assisted, preferably by mouth to mouth resuscitation. Administer external cardiac massage if necessary.
- Do not induce vomiting unless directed to do so by medical personnel and never give anything orally to an unconscious person.
- If unconscious, place in recovery position and get medical attention immediately.

Skin Contact:

- Immediately flush skin with plenty of water while removing contaminated clothing and shoes.
- For hot product, flood skin with cold water to dissipate heat, cover with clean cotton or gauze, obtain medical advice immediately.
- For cold product - wash contaminated skin with soap and water. Remove contaminated clothing and wash underlying skin as soon as reasonably practicable.
- Never use gasoline, kerosene or other solvents to remove product from skin or clothing.

Eye Contact

- For hot product - flood with water to dissipate heat. In the event of any product remaining, do not try to remove it other than by continued irrigation with water. Obtain medical attention immediately.
- For cold product - wash the eye thoroughly with abundant quantities of water, ensuring eyelids are held open. Obtain medical advice if any pain or redness develops or persists.

In Case of Fire:

- Use water fog, foam, dry chemical or carbon dioxide extinguisher or spray. Do not use water jet.
- Under no circumstances should water be allowed to contact hot product because of the danger of boil-over.
- Avoid spraying directly into storage containers because of the danger of boil-over. Boil-over is the rapid increase in volume caused by the presence of water in hot product and the subsequent overflow from a tank. Vapors can form explosive mixtures with air, and since these are heavier than air, it can spread along the ground or float on water surfaces to remote ignition sources.
- In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. These materials are harmful to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain. This liquid will float and may reignite on surface of water.
- No action shall be taken involving any personal risk or without suitable training.
- Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. First move people out of line-of-sight of the scene and away from windows.
- Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- The firefighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Spill

- Immediately contact emergency personnel.
- No action shall be taken involving any personal risk or without suitable training.
- Eliminate all ignition sources.

- Evacuate surrounding areas.
- Keep unnecessary and unprotected personnel from entering.
- Do not touch or walk through spilt material.
- Floors may be slippery; use care to avoid falling.
- No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation.
- This material can contain hydrogen sulphide (H_2S), a very toxic and extremely flammable gas.
- Entry into a confined space or poorly ventilated area contaminated with vapor, mist or fume is extremely hazardous without the correct respiratory PPE and a safe system of work. Wear self-contained positive pressure breathing apparatus (SCBA). Wear a suitable chemical protective suit with chemical resistant boots.
- Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.
- Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Oil is a water-polluting material and it may be harmful to the environment if released in large quantities. Collect the spillage.
- Depending upon its temperature, the product may be liquid, semi-solid or solid. Protect drains from spills and prevent entry of product, since this may result in blockage on cooling. Should blockage occur, notify the authority immediately.

Spillage in water or at sea:

- Fuel is less dense than water. In case of small spillages in closed waters, contain product with floating barriers or other equipment.
- Collect spilled product by absorbing with specific floating absorbents.
- If possible, before working in the combustion/exhaust spaces of engines/boilers or before handling ash/dust produced by the combustion of product, the work area should be thoroughly dampened with water. This will help to minimise the amount of airborne contamination produced by the work activity.
- However, because of the risk of explosion, do not allow water to come into contact with hot ash/dust.
- The oil-contaminated sediments or other solids, which is denser than water will sink to the bottom, and usually no intervention will be feasible.
- In special situations, excavations of trenches on the bottom to collect the product with sand may be a feasible option.
- If possible, large spillages in open waters should be contained with floating barriers or other mechanical means and store/dispose of according to relevant regulations.
- If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and approved by local authorities.
- Collect recovered product and other contaminated materials in suitable tanks or containers for recycle, recovery or safe 3rd Party disposal.

Containment and Clean Up

Small Spill

- Get rid of all ignition sources;
- Stop the leak if without risk;
- Use only spark-proof tools and explosion-proof equipment;
- Move containers/tanks from the spill area;
- Absorb the spilled oil with an inert material and place in an appropriate container;
- Make sure that the method and equipment used must be in conformance with appropriate regulations and industry practice on explosive atmospheres;
- Dispose of via a 3rd Party licensed contractor.

Large Spill

- Get rid of all ignition sources;
- Stop the leak if without risk;
- Approach the release from upwind;
- Prevent entry into sewers, water courses, basements or confined areas;
- Enclose the spill area (erect temporary dike) and do not allow product to reach sewage system and surface or groundwater;
- Contain and collect spillage with noncombustible, absorbent material and place in container for disposal in accordance with DENR regulations. Remember that the contaminated absorbent material may pose the same hazard as the spilt product.
- Use only spark-proof tools and explosion-proof equipment;
- Dispose of via a 3rd Party licensed contractor;
- Depending on its temperature, the product may be liquid, semi-solid or solid. Protect drains from spills and prevent entry of product, since this may result in blockage on cooling. Should blockage occur, notify the appropriate authority immediately;
- Scrape up bulk of solid material and remove liquid with sand or other suitable inert absorbent material. If necessary, clean the contaminated area using hot water and detergent: absorb the washings - do not wash into drains.