SILICA SAND QUARRY EXPANSION PROJECT

ENVIRONMENTAL PERFORMANCE REPORT AND MANAGEMENT PLAN

OCTOBER 2020

SEDC SOLID EARTH DEVELOPMENT CORPORATION

RHR Consult Services, Inc.

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EXECUTIVE SUMMARY

ES-1. PROJECT FACT SHEET

PROJECT NAME	**Silica Sand Quarry Expansion Project**
NATURE OF PROJECT	Quarrying - Extraction of Non-metallic minerals: Silica Sand deposits
PROJECT LOCATION/S	Barangays of Duangan, Lut-od, Punod, Sibago and Guimbawian, Municipality of Pinamungajan, Province of Cebu, Region VII, Philippines
PROJECT SCALE/LIMIT	Annual Production Capacity of 660,000 MT of Silica Sand
PROJECT COST	PhP 61,120,000.00
PROPONENT'S NAME	**Solid Earth Development Corporation (SEDC)**
OFFICE ADDRESS	9th Floor Insular Life Business Center, Cebu Business Park, Cebu City
AUTHORIZED SIGNATORY	**Atty. Dennis B. Tenefrancia** President
CONTACT DETAILS	Tel. No.: (032) 350 290/Fax. No. (032) 234 2795
EPRMP PREPARERS	RHR Consult Services, Inc.
OFFICE ADDRESS	Unit 606, 6th Floor, FSS Building II, Scout Tuazon corner Scout Castor, Barangay Laging Handa, Quezon City
AUTHORIZED SIGNATORY	**Jess M. Addawe** Project Director
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ES-2. PROJECT BACKGROUND

The SEDC Silica Sand Quarry Expansion Project proposes an amendment increasing the annual production capacity from 200,000 MT to 660,000 MT. This shall be sourced out from the existing production area of 229.50 hectares located within MPSA 314-2010-VII and MPSA 323-2010-VII. The existing production area and production capacity is covered by the existing ECC with Ref. No. CO-1512-0027 which was issued on 17 June 2016.

Since 2016, there was no quarrying activity or any major development conducted as SEDC is still applying for a DMPF. A small scale mining located in Barangay Duangan was done by a different proponent under a different ECC.

ES-3. PROJECT SIZE

Existing and Proposed Modification on the Annual Production Capacity of Silica Sand Quarry Expansion

	MPSA 314	MPSA 323
LOCATION	Municipality of Pinamungahan, Province of Cebu	
	1. Barangay Duangan 2. Barangay Binabag*	1. Barangay Lut-od 2. Barangay Punod 3. Barangay Sibago 4. Barangay Guimbawi-an
ECC AREA (in hectares)	Existing: 389.44 has	
	84 has	305.44 has
	For Amendment: 389.44 has (NO CHANGES)	
EXISTING PRODUCTION AREA (in hectares)	229.50 has	
PRODUCTION AREA (in hectares)	229.50 has (NO CHANGES)	
ANNUAL PRODUCTION	**Existing= 200,000MT**	
	Proposed Amendment = 660,000 MT	
MINERAL RESERVES	2,000,000	9,000,000
	Total = 11,000,000MT Silica Sand	

***Barangay Binabag is included in MPSA 314 but not in the production area.

ES-4. PROJECT COMPONENTS

ES-4.1. MAJOR PROJECT COMPONENTS

ES-4.1.1. QUARRY

The Silica Sand deposits will be extracted using an open cut mining method using backhoes, front-end loaders, and dump trucks for earthworks. The quarry operation shall use backhoes for the ripping and stockpiling; backhoes and payloaders for loading into trucks; and dump trucks for transporting the extracted materials to the crusher. The existing production area within MPSA 314-2010-VII and MPSA 323-2010-VII has a total area of 229.50 hectares and will have no change for the ECC amendment. Three quarry sites were identified within the project area: Lut-Od, Pun-Od, and Dungan.

ES-4.1.2. HAUL ROADS

The quarry area has existing access roads that connect to barangay and provincial roads that directly connect to the Natalio B. Bacalso South National Highway along which the TCPI cement processing plant is located, with total length of about 21 kilometers. The Provincial Road traversing the quarry site has average width of approximately 7 meters. For materials sourced from Pinamungajan and San Fernando quarries, this haul road is capable of handling the volume of haul trucks serving the quarry site. Minimal new access road openings are perceived to bring production to the main road, as the quarry is close to the main road.

ES-4.1.3. DRAINAGE

Drainage from the quarry sections will be through the contour canals along base of the slope face. Benches would be cut to allow the bench floor for positive drainage (5-degree fall away from the cut surface) approximately 1mx1m (contour canal cross-section) to reduce surface water flow over the cut face and bench, and limit soil erosion potential. Surface run-off from benches would be directed to rock-lined water channels; forming a drainage system on quarry floor as necessary and directed toward the settling ponds designed sufficiently to contain expected surface run-off from the opened quarry area. Background area surface run-off will be directed toward the natural waterways.

ES-4.1.4. TOPSOIL AND WASTE MATERIAL STOCKPILES

Topsoil stockpiles and waste materials stockpiles will be properly situated in locations with minimal additional disturbed area, areas with minimal tree and vegetation cover, will require no tree cutting and in relatively higher elevation that is easy to provide earth bunds or surrounding compacted embankment soil barriers. Three stockpile sites will be located within the quarry area for efficient operations for sectional rehabilitation, and within the buffer zone. While each stockpile area may hold the topsoil overburden and the waste materials, these two items will not be allowed to mix, physical the stockpile slope will be kept at low angle and safe height to minimize slumping. The proposed height of the stockpile will be finally determined by the angle-of-repose of the materials, observed to average approximately three meters. Angle of repose is the maximum angle of descent or dip of the stockpile slope relative to the horizontal plane. This is to ensure that the maximum volume materials will be stockpiled without sacrificing safety.

ES-4.1.5. NURSERY

Small “satellite” nurseries proximate to the planting area and near a surface water source will need to be established and will be stocked with fruit and forest trees through contract planting and maintenance with landowner-partners living in the local community. Recommended tree species under the NGP and native species originally found in the Project site will be propagated in the nurseries.

ES-4.1.6. QUARRY ADMINISTRATION BUILDING

SEDC will construct one small site management office with footprint area of approximately one hundred square meters, and a small maintenance shed made for emergency on-site materials requirement. The site office will be equipped with sanitary facilities for use of the project staff and occasional visitors. Construction of these structures will be in accordance with the National Building Code.

ES-4.2. POLLUTION CONTROL FACILITIES AND MANAGEMENT SYSTEMS

Siltation Control

For the proposed expansion, the project will utilize a combination of contour canals and 22 siltation ponds to meet Class C TSS value (DAO 35). The contour canal dimension shall be 0.5- meter wide and 0.5-meter deep, with settling sumps 1.0-meter-deep with stone pile “baffles” or water velocity decelerators at every 700 meters interval. The contour canals will hug the land side of the slope being quarried and will have horizontal slope alignment between 2% - 3% gradient only. The contour canals will be interconnected such that excess surface is directed toward the settling pond before the water exits the quarry zone. Twenty two (22) siltation ponds (10 x 30 x 3) with a capacity of 900 m3 will be constructed to recover considerable volume of sand and silt in order to

reduce the Total Suspended Solids (TSS) going to the Main Silt Pond (MSP). Periodic desilting of the MSP will be done to improve its efficiency. Figure 1 7 shows the location of the siltation ponds.

Waste Management

SEDC will implement its Waste Management Procedure to ensure proper handling, segregation, collection and disposal of all types of waste generated from the company's administrative and operational activities. One Materials Recovery Facility will be built in Duangan Quarry to cater the wastes during operation.

Air and Noise Pollution Control

Dust emissions during operations especially during the hot dry season (from March to May) is more likely to be rampant and harmful to worker's health. SEDC shall also ensure continuous implementation of road watering and spraying to control dust suspension in the air. Tree Planting shall be conducted to improve air quality and compensate for the emissions coming from trucks and heavy equipment. Regular Preventive Maintenance Strategies/Systems (PMS) for all equipment and hauling trucks are to be employed to minimize noise impact to the community as well as reduce their dust emissions.

ES-5. EIA Process Documentation

Solid Earth Development Corporation (SEDC) commissioned the RHR Consult Services, Inc. to conduct an Environmental Impact Assessment (EIA) and prepare an Environmental Performance Report and Management Plan (EPRMP) for the proposed Silica Sand Quarry Expansion Project to be located in the Barangays of Duangan, Lut-od, Punod, Sibago and Guimbawian, Municipality of Pinamungajan, Province of Cebu, Region VII, Philippines.

This EPRMP will guide SEDC in implementing environmental management strategies to address the adverse impacts of the project. These strategies will determine the extent of development that will be allowed in the project site. This EPRMP contains the following:

- Project Description
- Analysis of Key Environmental Impacts
- Impact Management Plan
- Social Development Plan and IEC Framework
- Environmental Compliance Monitoring
- Emergency Response Policy and Guidelines
- Abandonment/Decommissioning/Rehabilitation Plan
- Institutional Plan for EMP Implementation

A participative process was adopted through various means public consultations, perception surveys, key informant interviews, and IEC activities. The conduct of EIA is based on the issues, concerns, and suggestions by the stakeholders collected during the public scoping and the requirements of the EIA Review Committee in the Technical Scoping Checklist. Implicit in the approach was allowing the various project stakeholders to provide their inputs and ideas from which the Impact Management and Monitoring Plan.

ES-6. LIMITATIONS OF THE STUDY

The scoping process essentially determined the coverage of the study. Sensitive issues as well as other applicable parameters were included in the scoping activity. The study was limited to the primary and secondary data gathered on-site, other related literatures and fieldwork conducted. The provision of precise data determines the effectiveness of the report in supplying all the appropriate conclusion and recommendations. The study team put forth its thoroughness in completing the entire EIS. Details on the scoping checklist were carefully considered to generate a reliable and accurate report.

ES-7. EIA TEAM

Table ES-4: EIA Team Members

TEAM MEMBER	EXPERTISE/MODULE	IPCO NO.
JESS M. ADDAWE	Project Management, EIA Process, GIS Mapping	056
RONALD S. PAHUNANG	Air Quality and Noise; Meteorology; Oceanography	173
ARMANDO V. GILLADO, Jr.	Terrestrial Ecology- Flora	312
RUSSEL D. BANIQUED	Terrestrial Ecology- Fauna	157
HENRY JAMES P. BOTENGAN	Socio-Economic/ People Module	063
CATHERINE L. ADDAWE	Water Quality	055
GILBERT B. BELASON	Mining Engineering	504
JORI P. LENTIJAS	EIA Process	503

ES-8. EIA STUDY SCHEDULE AND AREA

The EIA Study was undertaken within the vicinity of the proposed project area and its identified impact areas, particularly in Barangays of Duangan, Lut-od, Punod, Sibago and Guimbawian, Municipality of Pinamungajan, Cebu. The coverage of the EIA study is based on the agreed scope of the EIA Review Committee (EIARC) during the technical scoping activity conducted on 29 April 2019.

ES-9. EIA METHODOLOGY

The approach and methodology adopted to complete this EPRMP is in accordance with the prescribed methods of DENR-EMB and the procedural manual for DAO 2003-30. The table below provides the methodology used for each module:

Table ES-5: EIA Methodology

MODULE	METHODOLOGY
• Land Use and Classification • Geology and Geomorphology • Pedology	-Review of secondary data -Site observation and validation -SEDC Feasibility Studies -SEDC Exploration Reports
• Geological Hazards	-Review of PHIVOLCS Hazards Maps -Generation of Hazard data and maps from Hazard Hunter PH (https://hazardhunter.georisk.gov.ph/)

MODULE	METHODOLOGY
• Terrestrial Ecology - FLora	-Gathering of data and validation of secondary data from previous SEDC EIS in 2016. -Site observation and species inventory -Random plot method -Transect walk method -Vegetation characterization, analysis
• Terrestrial Ecology- Fauna	-Gathering of data and validation of secondary data from previous SEDC EIS in 2016. -Site observation and species inventory -Random plot method -Transect Surveys
• Hydrology and Hydrogeology	-Site observation -Gathering of Secondary data
• Water Quality	-Site observation -Gathering and review of data from SMR and CMR Reports -Ambient Water Quality monitoring in July 2019
• Climate	-Gathering of Secondary data from PAGASA weather station in Mactan Island, Cebu.
• Air Quality	-Site observation -Gathering and review of data from SEDC monitoring data in 2017 and 2018 -Ambient Air monitoring by ACES in July 2019
• Ambient Noise	-Gathering and review of data from ambient noise data from SMR Reports -Measurement of Sound levels using Peak Sound Level Meter
• Socio-Economic Profile	-Review of Secondary information -Site visit/Ocular inspection -Household and perception survey -Focus Group Discussion (FGD) -Key Informant Interview (KII) -Public Scoping and consultations

ES-10. PUBLIC PARTICIPATION

Stakeholder participation was ensured to determine the current situation of the affected residents, including issues and concerns they are experiencing in their community.

Table ES-6: Public Participation Activities Conducted

ACTIVITY	DATE	VENUE	PARTICIPANTS
Perception Survey	22 November– 30 November 2018	Municipality of Pinamungajan 1. Barangay Duangan 2. Barangay Lut-od	100

ACTIVITY	DATE	VENUE	PARTICIPANTS
		3. Barangay Punod 4. Barangay Sibago 5. Barangay Guimbawian	(using Purposive Sampling)
Information, Education, and Communication (IEC) Activities	14 November – 03 December 2018.	Municipality of Pinamungajan 1. Brgy. Sibago 2. Brgy.Duangan 3. Pinamungajan Mun. Hall	39
Public Scoping	27 March 2019	Duangan Basketball Court, Barangay Duangan, Pinamungajan, Cebu	56

ES-11. EIA SUMMARY

The summary of project activities with the corresponding environmental impacts and mitigation measures is presented below:

Table ES-7: Impact Management Plan

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
DEVELOPMENT PHASE			
Site preparation, site clearing, excavation, and filling	Vegetation removal and loss of habitat Displacement of fauna species due to loss of habitat	• All statutory requirements relating to tree cutting permits shall be secured from the DENR prior to any clearing operations. • Establish at least a 10-meter buffer zone around and within the perimeter of the project site • Progressive and planned/necessary clearing of land will be undertaken to minimize total area of land that will be disturbed at any one time (maximum of 50 hectares)	100% Felled trees and cleared vegetation will be replaced with appropriate species
Development of access roads, quarry areas and support facilities	Degradation of surface water quality due to siltation brought about by earthmoving activities	• Installation of silt traps at strategic locations, and spoils to be properly contoured to prevent runoff. • Construction of proper and adequate drainage systems.	100% no siltation of receiving waterbody
	Degradation of water quality due to runoff from sanitary sewage, wastewater, solid wastes, and other construction materials	• Removal of debris along the waterways will be conducted, all construction wastes will be properly disposed, silt traps at strategic locations and spoils will be properly contoured to prevent erosion. • Portalets will be provided for use of the workers and its corresponding wastewater will be properly disposed. • Implementation of Solid waste management program and Hazardous waste management program. • Use of DENR accredited haulers/TSD companies.	100% compliance to proper solid waste management
	Air pollution from fugitive dust resulting from ground clearing operations, site preparation and vehicle movement.	• Implement dust suppression measures in active construction areas such as road surface watering to minimize dust.	100% Ambient air quality within DENR Air Quality Guideline Values

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
		• Provision of tarpaulin cover on trucks loaded with construction materials • Immediate hauling of spoils • Impose speed restrictions/limits and proper signages	
	Air pollution from SO_2 and NO_2 emissions from heavy equipment used in site preparation.	• Regular maintenance of heavy equipment, motor vehicles and all emission generating equipment	100% Ambient air quality within DENR Standards
OPERATIONAL PHASE			
Quarry operations (bulldozing and materials handling, grading, hauling)	Degradation of air quality Dust generation	• Planting of trees at the quarry/s periphery; Enhance buffer strip or tree buffer around and along the boundaries of the project site • Continue monitoring of wind speed and wind directions as part of the environmental management plan to lessen or minimize release of fugitive dusts • Regular watering of haul roads during dry condition; visual inspection of fugitive dust • Maintenance of quarry roads • Speed limits of vehicles (light and heavy) will be controlled to a maximum of 30 km/hr at the quarry site • Regular maintenance of trucks to reduce or maintain tailpipe emissions • Provide wheel washing facilities for vehicles leaving the quarry and project site. The wheel washing facility should be used to remove muds at the tires of trucks and heavy equipment • In case of very dry weather condition where wetting of dry surfaces would be effective for short duration, consider re-routing of vehicles away from area sensitive receptors (households or residences)	100% Ambient air quality within DENR Standards

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
	Generation of wastes Water pollution, land contamination, health hazards	• Daily monitoring of waste generated from the quarry operations • Arrange disposal and treatment of hazardous waste to DENR accredited transporter/treater • Arrange disposal of scrap materials with accredited buyer • Continuous segregation/collection of combustible materials for kiln feeding at the TCPI cement plant; Combustible waste recycling • Workers will be provided with adequate and environmentally sound domestic facilities.	100% compliance to proper solid waste management
	Increase in ambient noise level	• Install effective mufflers on all heavy equipment and other equipment using internal combustion engines • Impose speed limits at quarry and along access roads (30 kph) • Daytime quarry operation; Restrict use of equipment at nighttime especially equipment that emits high noise levels • Construct temporary noise barriers between households and quarry, when necessary • Progressive planting in mined-out areas and planting of trees at the buffer zone; Enhance buffer strips or tree buffers around and along project boundaries	100% compliance to noise standard

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
Quarry operations (bulldozing and materials handling, grading, hauling)	Siltation / degradation of surface water quality	• Construction of settling ponds and silt traps • Provision of storm drainage canals to prevent rain water from eroding the quarry area. • Desilting of settling ponds as needed. Sediments will be used for road surfacing within quarry areas or to Barangays in need. • Topsoil stockpile slope shall not exceed its angle of repose. • Mobile heavy equipment and vehicles shall have a designated holding area for removal of excess silt and mud from the tires and underbellies. The holding area shall have adequate drainage and traps to contain the washed sediments.	100% Ambient water quality within DENR Water Quality Guideline Values
Quarry development	Land clearing, alteration of topography / natural drainage	• Progressive rehabilitation of the mined-out areas, through reforestation • Establishment of SEDC nursery. • The company shall also practice community-based reforestation on areas outside the mined-out areas. • Weekly maintenance/inspection of the existing drainage system	100% Compliance to planned progressive mine plan and rehabilitation
Quarry development	Removal of vegetation cover and loss of habitat	• Limit the quarrying activities within direct impact area only to avoid vegetation removal of adjacent areas • Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations is recommended	100% Compliance to planned progressive mine plan and rehabilitation

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
	Threat to existence and/or loss of important local species	• Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations • Monitor replacement planting to ensure growth and survival	
	Threat to abundance, frequency and distribution of important species	• Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations are recommended • Monitor replacement planting to ensure growth and survival • Continuous allocation of annual budget for these activities is likewise recommended to allow sustainability of the mitigation activity	
	Proliferation of invasive species	• Immediate revegetation with preference to indigenous plant species within the cleared and opened areas should be conducted • Generate list of invasive species and avoid its reintroduction on site	
DECOMMISIONING / REHABILITATION PHASE			
Mine closure / abandonment	Loss of livelihood of local workforce Reduction/loss of company support for some services Decrease in economic activity in the area (i.e. reduced business profits due to project closure therefore reduced market consumers)	• Provide psycho-social services to project-affected families • Re-training and enhancement of alternative livelihood programs for workers in the affected areas	100% Compliance to approved FMRDP
Clearing / removal of support facilities	Removal of structures may result to accidental spillage of toxic and hazardous wastes	• Proper implementation of the approved Final Mine Rehabilitation and Decommissioning Plan (FMRDP)	100% Compliance to approved FMRDP

PROJECT ACTIVITY	POTENTIAL IMPACT	MITIGATING MEASURES	TARGET EFFICIENCY
		• Use of DENR-accredited haulers/TSD companies for hazardous wastes	

1 PROJECT DESCRIPTION

Solid Earth Development Company (SEDC) is a Philippine-based company engaged in quarrying and mining of cement raw materials such as clay, limestone, and silica sand. SEDC is the proponent of the Silica Sand Quarrying Expansion.

On 10 February 2010, SEDC entered into a Mineral Production Sharing Agreement (MPSA) with the Philippine Government docketed as MPSA 314-2010-VII covering 84.1453 hectares. Subsequently on 26 February 2010, SEDC entered another agreement docketed as MPSA 323-2010-VII with 1,257.1831 hectares.

On 17 June 2016, the Department of Environment and Natural Resources – Environmental Management Bureau issued the Environmental Compliance Certificate with Ref. No. CO-1512-0027 (ECC CO-1512-0027) covering a quarry operation with an annual rate of 200,000 MT of Silica Sand within the 229.50 hectares of production area located in MPSA 314-2010-VII and MPSA 323-2010-VII.

Since 2016, there was no quarrying activity or any major development conducted as SEDC is still applying for a DMPF. A small scale mining located in Barangay Duangan was done by a different proponent under a different ECC.

As a response to the growing infrastructure developments in the country stimulated by the "Build Build Build" Program, SEDC moves for an ECC amendment increasing the annual production rate to 660,000 MT of silica sand from the currently approved annual production of 200,000 MT. No increase in the production area is proposed.

1.1 PROJECT LOCATION AND AREA

1.1.1 PROJECT LOCATION

The Proposed Silica Sand Quarry Expansion is within MPSA 314-2010-VII and MPSA 323-2010-VII; specifically in Barangays of Duangan, Lut-od, Punod, Sibago and Guimbawian, Municipality of Pinamungajan, Cebu Province.

The quarry area is approximately 21 kilometers from the TCPI's Plant in Municipality of San Fernando, Cebu. The quarry sits at 60 meters to 270 meters above sea level (masl).

Figure 1-1 shows the general location of the quarry area while shows the current ECC and Production Areas. **Table 1-1** to **Table 1-3** contains the geographical coordinates of MPSA 314-2010-VII and MPSA 323-2010-VII.

Table 1-1. Geographical Coordinates of MPSA 314-2010-VII

POINT	LATITUDE	LONGTITUDE
1	10°15'30"	123°37'30"
2	10°16'00.00"	123°37'31"
3	10°16'00.00"	123°38'00"
4	10°15'30"	123°38'00"

Table 1-2. Geographical Coordinates of MPSA 323-2010-VII (Area 1)

POINT	LATITUDE	LONGTITUDE
1	10°16'00.00"	123°37'00"
2	10°17'00.00"	123°37'00"
3	10°17'00.00"	123°37'30"
4	10°16'30.00"	123°37'30"
4A	10°16'21.41"	123°37'36.35
4B	10°16'15.23"	123°37'37.07"
4C	10°16'12.49"	123°37'38.37"
4D	10°16'10.59"	123°37'43.79"
4E	10°16'11.36"	123°37'44.05"
4G	10°16'14.08"	123°37'45.15"
4H	10°16'16.22"	123°37'41.57"
4I	10°16'21.55"	123°37'38.70"
4J	10°16'21.41"	123°37'36.35"
4K	10°16'30.00"	123°37'36.43
5	10°16'30.00"	123°38'00"
6	10°17'00.00"	123°38'00"
7	10°17'00.00"	123°39'00"
8	10°16'00.00"	123°39'00"

Table 1-3. Geographical Coordinates of MPSA 323-2010-VII (Area 2)

POINT	LATITUDE	LONGTITUDE
1	10°14'00.00"	123°37'00"
2	10°15'30.00""	123°37'00"
3	10°15'30.00""	123°37'30"
4	10°15'00.00"	123°37'30"
5	10°15'00.00"	123°38'00.00"
6	10°14'30.00"	123°38'00.00"
7	10°14'30.00"	123°38'30.00"
8	10°15'00.00"	123°38'30.00"
9	10°15'00.00"	123°39'00.00"
10	10°14'00.00"	123°39'00.00"

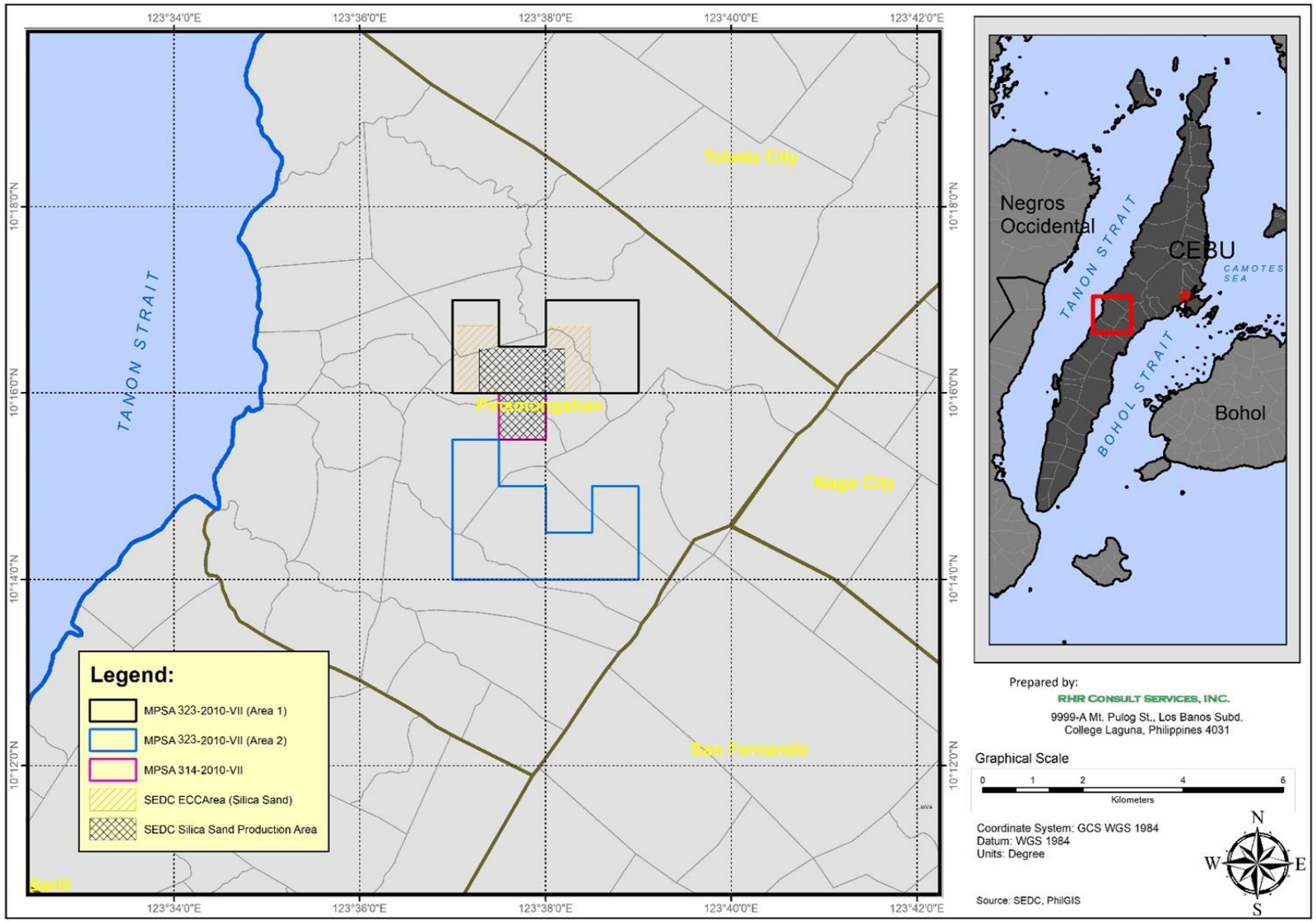


Figure 1-1. General Location Map of Silica Sand Quarry

1.1.2 PROJECT ACCESSIBILITY

The project area is located within Barangays of Duangan, Lut-od, Punod, Sibago and Guimbawian, Municipality of Pinamungajan, Cebu Province. The quarry area is approximately 11 kilometers from the cement manufacturing plant of TCPI in Municipality of San Fernando, Cebu. The host municipality, Pinamungajan, is approximately 70 kilometers from the province's capital- Cebu City.

The project can be reached via the Cebu South Road through the Naga-Toledo- Pinamungajan access road or the Manipis Road along the Mananga watershed. Travel time from Pinamungajan is about two hours going to Cebu City, depending on the traffic. It would take another 10 minutes to reach Barangay Lut-od, the nearest section claim. Buses and other public utility vehicles are plying the Cebu City-Pinamungajan route. To reach the mountainous areas, one can hire motorbike which is locally known as "habal-habal".

The project site does not have a private airport facility, but the province is accessible by a 1-hour flight from Manila through its nearest airport – Mactan-Cebu International Airport (MCIA). MCIA is approximately 42 kilometers away from the project site.

Furthermore, the project is more than 35 kilometers away from the Cebu International Port making it accessible by a 20-hour maritime travel to Manila.

1.2 PROJECT RATIONALE

Based on the geological explorations conducted, the land areas defined by MPSA 314-2010-VII and MPSA 323-2010-VII contain significant amount of Silica Sand deposits that are technically and economically viable for the manufacture of cement. Cement is important for construction and infrastructure development which catalyzes economic progress especially in the rural areas.

The Philippine Government, through the Department of Trade and Industry (DTI) and in cooperation with the Cement Manufacturer's Association of the Philippines (CEMAP), has recently charted the Philippine Cement Industry Roadmap with respect to the country's infrastructure development program. CEMAP's study regarding this matter concluded that:

1. The Philippines must import cement due to a severe shortfall of domestic supply against the Philippine development requirement;
2. The Philippines must be self-sufficient in quality cement supply in the long term;
3. The Philippines must benefit from the jobs from the massive infrastructure program; and
4. The Philippines must benefit from taxes generated by the construction and cement industry under the "Build- Build-Build Program".

Foreign exchange payments for the purchase of imported cement diminishes the country's foreign (currency) reserves which may impact the Philippine peso valuation particularly that the former Philippine gold production has declined and the Philippine dollar reserves and therefore importation is only a last recourse. The recent issues related to low quality imported cement highlights the need to assure good cement quality for Philippine infrastructure program which is taken-on with huge national indebtedness.

Cement Production in the Philippines

CeMAP reported that there are 16 local cement plants operating in the country as of 2013 with a total capacity of 21,047,000 metric tons per year. TCPI have recorded consistent kiln capacity of approximately 840,000 metric tons per year from 2009 to 2013 (**Table 1-4**). Still, cement imports increased from 1,000 metric tons in 2009 to 159,000 metric tons in 2013; In contrary to this, the cement exports decreased from 197,000 metric tons to nothing in 2009 and 2013, respectively (**Table 1-5**).

Table 1-4. Operating Local Cement Plants from 2009 to 2013

COMPANY NAME	KILN CAPACITY IN MILLION TONS				
	2009	2010	2011	2012	2013
1. Cemex Philippines					
a. Apo Cement Corporation	2.400	2.400	2.400	2.792	2.792
b. Solid Cement Corporation, Antipolo	1.860	1.860	1.860	2.102	2.102
c. Rizal Cement Company, Binangonan	0.375	0.375	0.375	0.388	0.388
2. Holcim					
a. La Union Plant	1.020	1.020	1.020	1.020	1.020
b. Bulacan Plant	2.694	2.694	2.694	2.694	2.694
c. Davao Plant	1.742	1.742	1.742	1.742	1.742
d. Lugait Plant	1.782	1.782	1.782	1.782	1.782
3. LaFarge Cement					
a. Fortune Cement Corporation, Batangas: i. Batangas Plant	1.260	1.260	1.100	1.100	1.100
b. FR Cement Corporation, Teresa, Rizal	1.530	1.530	1.100	1.100	1.100
c. Republic Cement Corporation, Bulacan	1.575	1.575	1.100	1.100	1.100
d. Iligan Cement Corporation	0.465	0.465	0.500	0.500	0.500
e. Mindanao Cement Corporation, Iligan	0.450	0.450	0.500	0.500	0.500
4. Taiheiyo Cement Philippines	0.840	0.840	0.840	0.840	0.840
5. Pacific Cement Company	0.180	0.255	0.250	0.270	0.270
6. Northern Cement Corporation	0.960	0.960	0.960	0.960	0.960
7. Goodfound Cement Corporation	0.350	0.350	0.350	0.350	0.350
Total Capacity, in million tons	**18.847**	**19.547**	**19.547**	**21.047**	**21.047**
No. of Operating Plants	**16**	**16**	**16**	**16**	

Table 1-5. Cement Importation and Exportation in metric tons from 2009 to 2013.

IMPORTS IN METRIC TONS					
YEAR	2009	2010	2011	2012	2013
TOTAL	1,000	1,000	30,000	39,000	159,000
EXPORTS IN METRIC TONS					
YEAR	2009	2010	2011	2012	2013
TOTAL	197,000	4,000	0	0	0

Since 2010, the demand for cement continued to escalate. To date, the annual volume of local sales and imports consistently remained higher than the total volume of sales and exports. In 2013, the domestic sales and export of the commodity was reported at 19,445MT while local sales and import was at 19,604 MT. Mean annual growth rate in local sales and exports from 2010 to 2013 was 7%, while the annual growth rate in local sales and imports was 8% for the same period. This was catalyzed

by the increase in construction works especially of the Private sector. CeMAP reported that the growth in the construction industry is at 14.4% during the same period.

Table 1-6. Cement Production, Sales and Consumption in metric tons from 2009 to 2013.

YEAR	PRODUCTION	SALES	CONSUMPTION	PRICE/BAG
2009	14,865,000	14,666,000	14,470,000	P165.00
2010	15,900,000	15,449,000	15,450,000	P170.00
2011	16,063,000	15,595,000	15,625,000	P176.00
2012	18,907,000	18,356,000	18,395,000	P188.00
2013	20,150,000	19,445,000	19,604,000	P193.00

The demand that cannot be supplied by domestic production is filled by importation. Hence, retarding the economic development associated to domestic production such as: job creation, import substitution, increase in internal revenues, and increase in sources of support for local social development and development or improvement of carbon sink. Furthermore, CeMAP has recorded in 2019 that the demand for cement reached 30.92 Million metric tons (**Table 1-8**); and this is projected to escalate more in the coming years to keep pace with the infrastructure development in the Philippines brought by President Duterte's "Build Build Build" program.

Based on actual local cement consumption from year 2015-2019, the estimated raw materials production is presented in **Table 1-7**.

Table 1-7. Estimated Raw Materials Production 2015-2019

Year	Cement Consumption (DMT)	Limestone Production		Siliceous Clay Production		Silica Production	
		DMT (70% of Cement)	WMT (12% Moisture)	DMT (20% of Cement)	WMT (22% Moisture)	DMT (10% of Cement)	WMT (15% Moisture)
2015	24,360,000	17,052,000	19,377,000	4,872,000	6,246,000	2,436,000	2,866,000
2016	25,960,000	18,172,000	20,650,000	5,192,000	6,656,000	2,596,000	3,054,000
2017	27,520,000	19,264,000	21,891,000	5,504,000	7,056,000	2,752,000	3,238,000
2018	29,170,000	20,419,000	23,203,000	5,834,000	7,479,000	2,917,000	3,432,000
2019	30,920,000	21,644,000	24,595,000	6,184,000	7,928,000	3,092,000	3,638,000
Average	27,586,000	19,310,000	21,943,000	5,517,000	7,073,000	2,758,000	3,245,000

Based on the actual cement consumption from 2015-2019, there is a substantial increase in demand per year of 1,312,000 metric tons. Below are the actual cement consumption from year 2015 to year 2019 showing the increase in demand per year.

Table 1-8. Increase in Cement Demand per Year

Year	Cement Consumption (DMT)	Difference (DMT)
2015	24,360,000	
2016	25,960,000	+1,600,000
2017	27,520,000	+1,560,000
2018	29,170,000	+1,650,000
2019	30,920,000	+1,750,000
Total increase in demand		+6,560,000
Increase in demand per year		+1,312,000

Consumption: Domestic Sales plus Imports

Source: Cement Manufacturers' Association of the Philippines (CeMAP)

Then, the projected cement production and the corresponding raw materials requirement are shown below based on 1,312,000 metric tons per year increase in demand of cement consumption.

Table 1-9. Projected Raw Materials Requirement for the next 10 years

Year	Cement Production (MT)	Limestone Requirement		Siliceous Clay Requirement		Silica Requirement	
		DMT (70% of Cement Production)	WMT (12% Moisture)	DMT (20% of Cement Production)	WMT (22% Moisture)	DMT (10% of Cement Production)	WMT (15% Moisture)
2020	32,232,000	22,562,400	25,639,000	6,446,400	8,264,600	3,223,200	3,792,000
2021	33,544,000	23,480,800	26,682,700	6,708,800	8,601,000	3,354,400	3,946,300
2022	34,856,000	24,399,200	27,726,300	6,971,200	8,937,400	3,485,600	4,100,700
2023	36,168,000	25,317,600	28,770,000	7,233,600	9,273,800	3,616,800	4,255,000
2024	37,480,000	26,236,000	29,813,600	7,496,000	9,610,200	3,748,000	4,409,400
2025	38,792,000	27,154,400	30,857,200	7,758,400	9,946,600	3,879,200	4,563,700
2026	40,104,000	28,072,800	31,900,900	8,020,800	10,283,000	4,010,400	4,718,100
2027	41,416,000	28,991,200	32,944,500	8,283,200	10,619,400	4,141,600	4,872,400
2028	42,728,000	29,909,600	33,988,100	8,545,600	10,955,800	4,272,800	5,026,800
2029	44,040,000	30,828,000	35,031,800	8,808,000	11,292,300	4,404,000	5,181,100

In April 10, 2019, the Philippine News Agency reported that new local construction projects were deferred because of the current cement shortage; clearly manifesting the importance of speeding the expansion on local productions. In response to this situation, Solid Earth Development Corporation aims to increase their production capacity of cement raw materials; hereby, applying for the Silica Sand Quarry Expansion Project. The project promotes rural development by boosting local employment and providing livelihood opportunities to the local communities while at the same time generating revenues for the local and national government. The project will likewise help in minimizing the importation which will strengthen the economic stand of the country in the infrastructure and cement industry.

1.3 PROJECT ALTERNATIVES

SEDC plans to increase the production rate of silica sand to meet the demand of its sister company, Taiheiyo Cement Philippines, Inc. (TCPI). Considering the demand for cement production, no project alternatives are foreseen other than to resume and expand the production of silica sand quarrying operations. Deviating from the nature of the production would not be cost-efficient as the existing project components and facilities are solely for extraction of non-metallic minerals, specifically silica sand.

Based on the results of geological exploration conducted, the project MPSAs satisfies the material quality criteria for the cement manufacture of its sister company, TCPI. The exploration activities were undertaken covering various promising locations within the MPSAs, and only the areas proposed herein are deemed most feasible at the moment for the quarry operations due to the material quality, quarriable volume, and contiguity of the proposed extraction area which contributes to operational efficiency and better profitability profile. Major project components are limited to quarry of silica sand and materials transport by land.

1.3.1 SITING

The geological explorations conducted ensured that the quarry sites within MPSA 314-2010-VII and MPSA 323-2010-VII will meet the material quality criteria and are economically viable for the operations of TCPI. The following are the criteria used for site and technology selection:

- Functionality of the site location which refers to accessibility and mobility of the ore body with respect to the transport system to the market and the resources available essential for the sustained operations of the quarry and the manufacturing counterpart.
- Complementarity, and compatibility between and with various uses of adjacent lands, and associated activities they serve.
- Consistency with the natural resources plans and policies, and environmental regulations that guide the cities, province, region, and the national government.
- Mining facility design and operational requirements as established by others, including the Mining and Geosciences Bureau, the industry, and requirements of the market, among others.
- Implied in the choice of area would be the relatively stable peace and order situation.
- Input and participation from local stakeholders, and appropriate regional and national oversight agencies.
- Cost effectiveness – the value returned to the proponent for the investments to be made, and the contributions to the national and local governments, and the other stakeholders, including contributions to social development and management, environmental protection and enhancement, safety and health, mine rehabilitation and decommissioning.
- Development design factored in provisions for health and human safety, including the provisions for mining operations as provided by the Mines and Geosciences Bureau for set back; and guidelines to protect humans, and their sources of livelihood, for example providing allowances to protect equipment used to minimize environmental impact due to operations.

1.3.2 TECHNOLOGY SELECTION/OPERATION PROCESSES AND DESIGN SELECTION

The nature, location of the ore, the host matrix earth form and characteristics, prevailing environmental requirements and economic conditions defined the project technology to be applied and its components. The quarry method most suitable for sandy materials particularly with thin overburden is surface extraction. The method of extracting the target materials by benching and terracing the affected surface area entails less environmental consequences than random excavation targeting only the desired silica grades, as observed to be utilized by applied by small scale quarries in the area.

This project involves simple extraction of surface earth materials for cement manufacturing, by excavators and pay loaders; loading of extracted materials to waiting dump trucks for hauling to the cement manufacturing plant approximately 21 kilometers away; and stabilization and rehabilitation of mined-out areas. The equipment and manpower skills needed are readily available on site as SEDC has been undertaking the activity since the past decade. This project does not include any processing of the extracted silica sand. No other facilities need to be established for this project as the manufacturing cement plant already exists. For this reason, this simple project technology is preferred by the Proponent.

1.3.2.1 Stages of Mining Operation

1.3.2.1.1 Development Stage

This involves the construction of sub-access and main access roads leading towards the targeted elevation of the minable area. Upon reaching the desired elevation, undesirable overburden is stripped off to expose the needed rock materials using backhoe or bulldozer if needed. Stripped waste materials loaded to dump trucks and stockpiled.

1.3.2.1.2 Production Stage

Prepared benches are then scheduled for cutting by backhoe hoe and will be loaded directly. Front end loader is also utilized to load the excavated rock materials to the dump trucks which are then delivered to the crusher.

1.3.2.2 Description of the Mining Method

A conventional method of Open Cut Mining shall be continued with the utilization of bulldozers, backhoe, dump trucks and payloader for earthworks. Working benches are designed as 5 meters in height. Final bench should be limited to 5 meters in height with 70º slope. Lowest working level would be maintained at +60 meters above sea level.

1.3.3 No Project Option

Not proceeding with the expansion project will result to lower production of local cement; hence, an additional importation and a decrease on exportation. Consequently, this shall cause delays on the construction and infrastructure programs of the Philippine government; therefore, delaying the economic development of the country.

The social development programs of the host communities which shall be supported by SEDC as the expansion project operates will either remain the same or will be hampered due to lack of additional support projected under the said expansion. Not proceeding with the project also means loss of additional employment and livelihood opportunities for the constituents of Pinamungajan especially of the host barangays.

1.4 Project Components

SEDC seeks for an ECC amendment increasing the annual production rate to 660,000 MT of silica sand from the currently approved annual production of 200,000 MT. No increase in the production area is proposed.

There was no major development in the two MPSAs covered by the ECC since 2016. Hence, majority of the components presented in this section are proposed as seen on **Figure 1-2**.

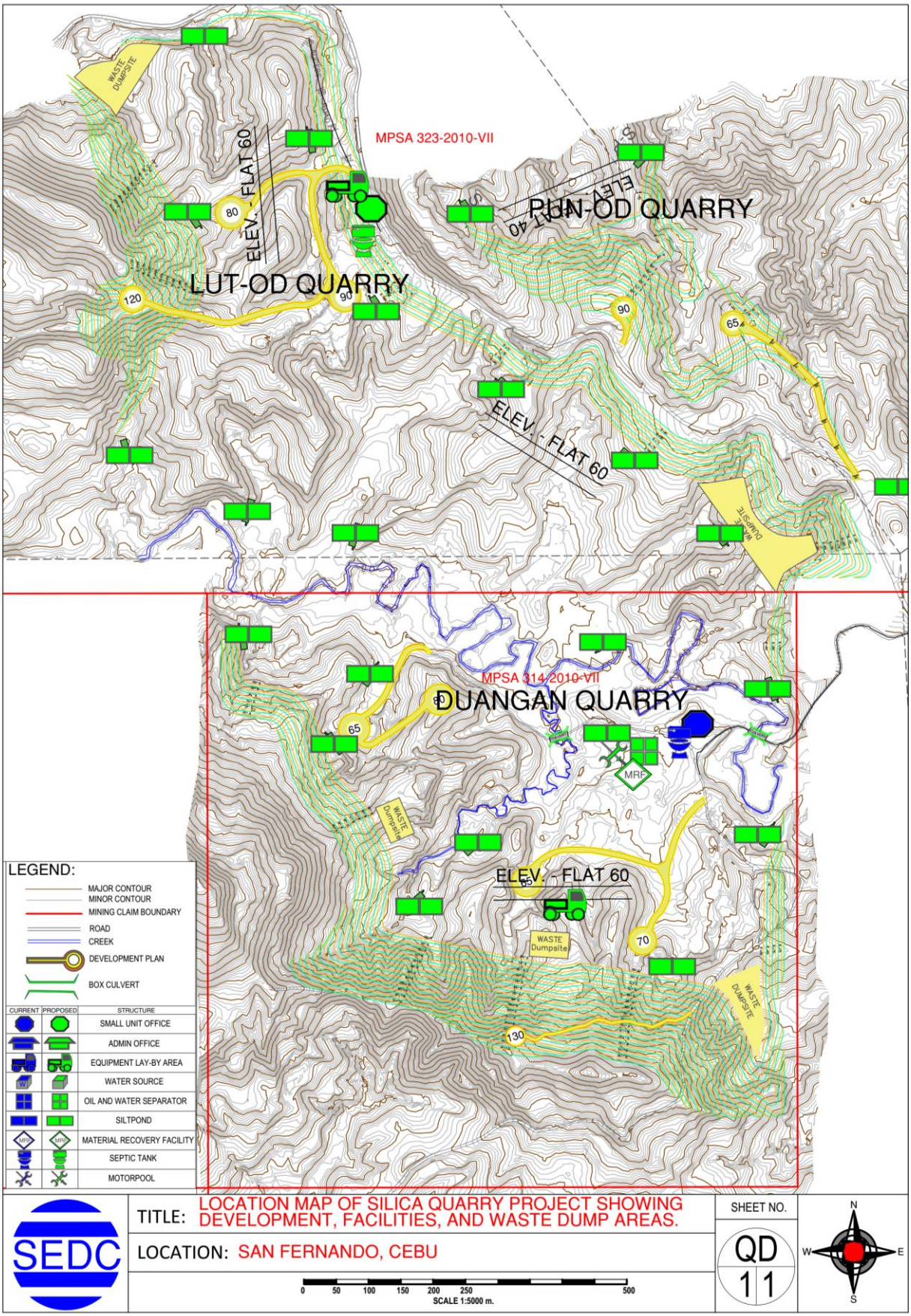


Figure 1-2. Site Development Map of Silica Sand Quarry

1.4.1 QUARRY

The existing production area within MPSA 314-2010-VII and MPSA 323-2010-VII has a total area of 229.50 hectares and will have no change for the ECC amendment. Three quarry sites were identified within the project area: Lut-Od, Pun-Od, and Dungan (**Figure 1-2**).

The Silica Sand deposits will be extracted using an open cut mining method using backhoes, front-end loaders, and dump trucks for earthworks. The quarry operation shall use backhoes for the ripping and stockpiling; backhoes and payloaders for loading into trucks; and 20-tonner dump trucks for transporting the extracted materials to the crusher. The quarry operations will produce silica sand suitable for cement manufacture, with a Silica (SiO_2) cut-off grade of 70%. The lowest working level will be maintained at +60 meters above sea level (masl). The benches shall be limited to 5 meters in height with 70-degrees slope. The final pit figure will be terraced to prevent sloughing of materials from higher elevations. Final pit bottom will not be lower than the existing national road elevation. Cut-off drainage channels with baffles or rock pile velocity decelerators/sediment settling sumps will be established to separate background surface run-off from quarry areas; then channel these to natural surface drainage systems to reduce the load and silt spill-over coming from the settling ponds. A canal will be constructed within the quarry zone adjacent to and parallel to the public road in order to prevent sediment overtopping on public roadway. The following are considerations for the pit design and stripping ratio:

Table 1-10. Pit Design and Stripping Ratio Considerations of Silica Sand Quarry Expansion Project

Parameters	Remarks
Bench Width	5 meters
Bench Height	5 meters
Bench slope	70 degrees
Pit slope	45 degrees

An initial quarry area of 40 hectares has been defined taking into account the presence of roads, minimizing direct impact on creeks, houses, schools, farms, etc. Its pit bottom will either be the nearest public road or creek level, whichever is shallower. The average overburden is one meter thick and waste material accounts for about 1%. Silica sand weighs about 1,220 kg per cubic meter, with about 20% moisture content.

The first phase of mining will be concentrated in Lut-od-Duangan Area where the small-scale quarry is located and the computed mineable reserve according to the subject exploration report is 11,000,000 MT. Below are other quarry design considerations:

1. Final pit bottom will not be lower than existing national road elevation
2. Cut-off drainage channels with baffles or rock pile velocity decelerators / sediment settling sumps will be created to separate background surface run-off from project quarry areas, channel these to natural surface drainage systems to reduce the load and silt spill over from project settling ponds
3. A canal or depression will be provided within the quarry zone adjacent to and parallel to the public roadway to prevent project sediment overtopping on public road
4. Surface drainage course within the quarry zone are to be maintained freely flowing
5. Settling Pond Surface Area are always to be equivalent to 10% of opened areas

6. Total Settling Pond Capacity per sub-catchment area is to be equivalent to 110% of highest normal monthly rainfall volume for the disturbed quarry area
7. Topsoil and Waste stockpiles will not be situated on areas with live trees

The table below shows the five-year production schedule for the project. In its first year, a total of 150,000 MT of sand while 1% (1,500 MT) of topsoil or waste materials will be produced. During second to fifth year, 660,000 MT of silica sand and 6,600 MT of waste will be produced annually. The section details of three silica quarries (**Figure 1-3**) located in Lut-od, Duangan, and Pun-od are presented in **Figure 1-4** to **Figure 1-6**.

Table 1-11. Five-Year Production Schedule

ACTIVITY	MT	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
A. MPSA 314 - Duangan Quarry						
Elevation B+145 to Bench+125	100,000					
Bench+120 to Bench+115	150,000					
Bench+110 to Bench+105	220,000					
Bench+100 to Bench+95	290,000					
SUBTOTAL		75,000	150,000	150,000	150,000	150,000
B. MPSA 323 - Lut-od Quarry						
Bench+120 to Bench+115	80,000					
Bench+110	70,000					
Bench+105	100,000					
Bench+100	140,000					
Bench+95	260,000					
Bench+90	470,000					
Bench+85	810,000					
SUBTOTAL		75,000	360,000	360,000	360,000	360,000
C. MPSA 323 Pun-od Quarry						
Bench+95 to Bench+85	150,000					
Bench+80 to Bench+75	300,000					
Bench+70	150,000					
SUBTOTAL			150,000	150,000	150,000	150,000
TOTAL SAND PRODUCTION , MT		150,000	660,000	660,000	660,000	660,000
TOPSOIL/WASTE PRODUCED, MT		1,500	6,600	6,600	6,600	6,600

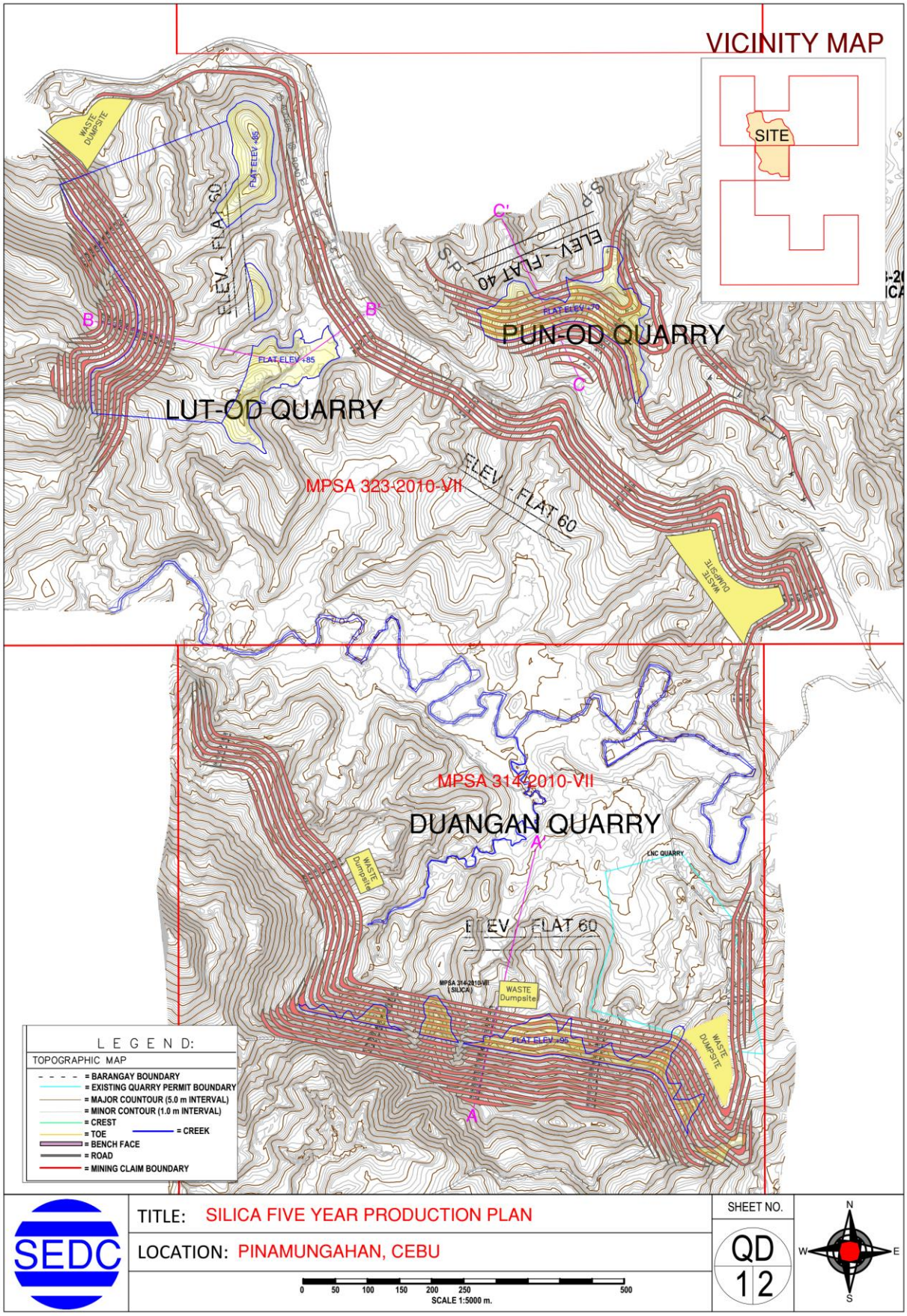


Figure 1-3. Silica Sand Quarry Expansion Five-Year Production Plan

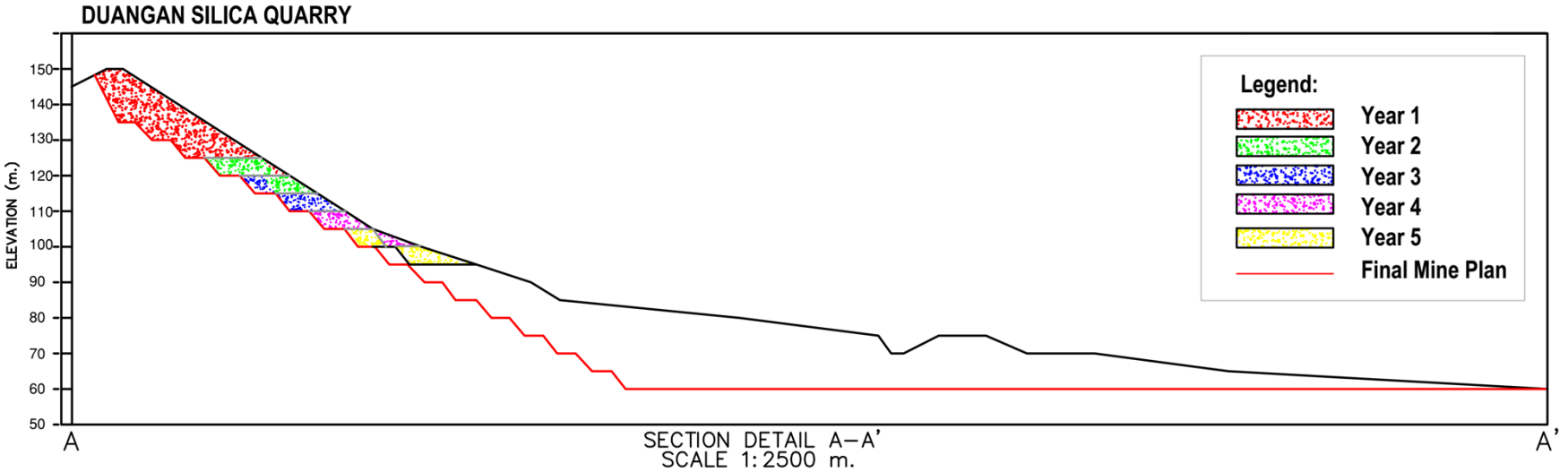


Figure 1-4. Duangan Area Section

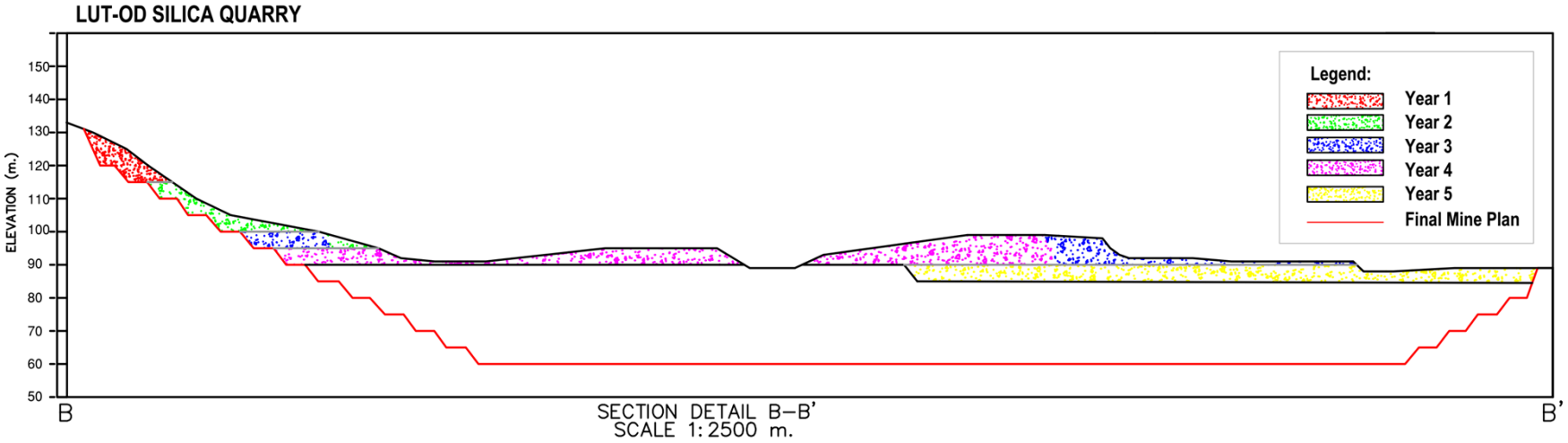


Figure 1-5. Lut-od Area Section

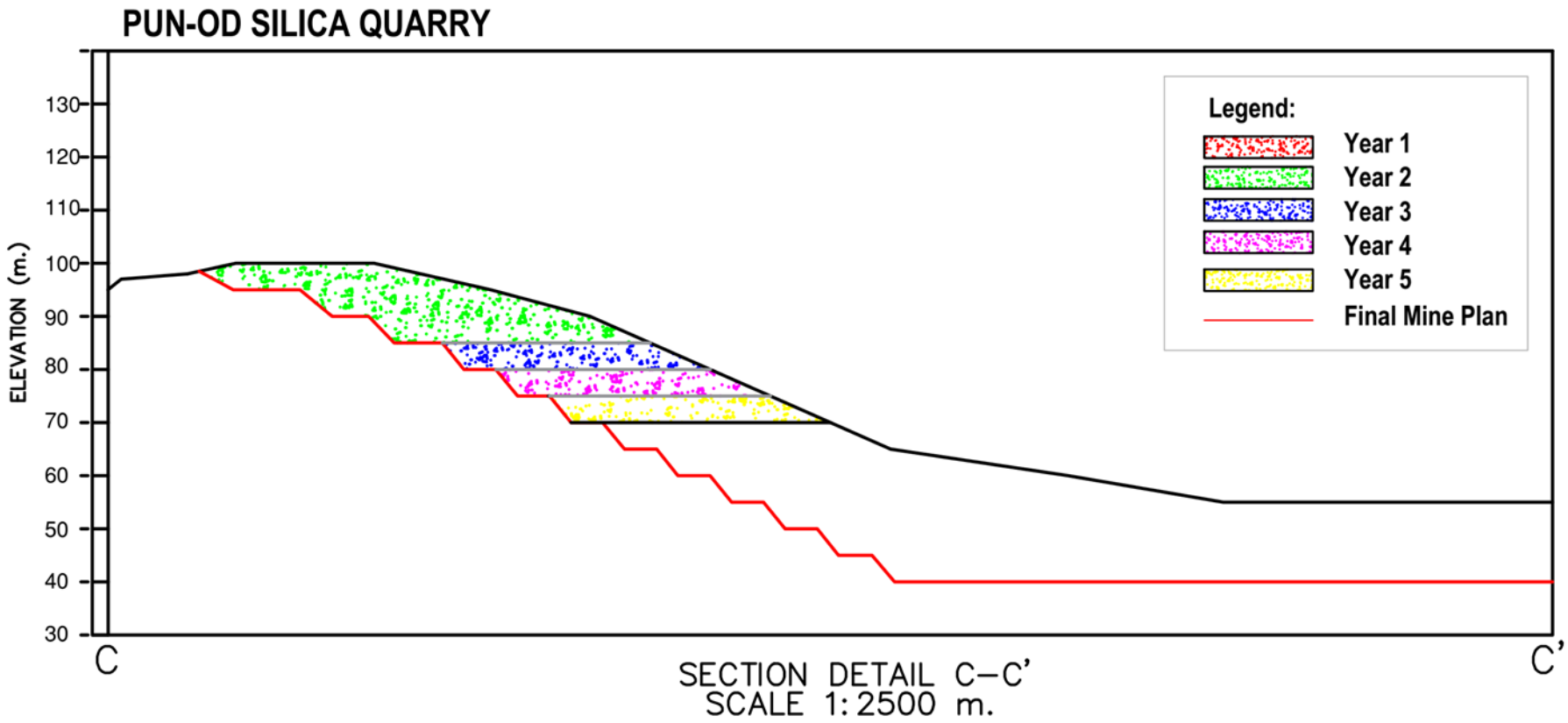


Figure 1-6. Pun-od Area Section

The table below details the major equipment necessary for the project:

Table 1-12. Existing and Proposed Major Equipment for Development and Production Stage of Silica Sand Quarry Expansion Project

Phase	Equipment Type	Existing		Proposed		Ownership	Use
		Capacity	No. of Units	Capacity	No. of Units		
Development	Backhoe	-	-	1.5 metric ton	1	Leased	For access road excavation, material loading and siltation pond construction
	Dump trucks	-	-	17 metric ton	2		For hauling
Production	Bulldozer	8 ton	2	5 metric ton	1	Contractor	For hauling
	Backhoe	1.5 metric ton	2	1.5 metric ton	2		For excavation & loading
	Payloader	4.5 metric ton	1	4.5 metric ton	1		For road maintenance
	Road Grader	4.5 metric ton	1	4.5 metric ton	1		For dozing, stockpiling and road repair
	Dump truck	18 metric ton	10	20-25 metric ton	26		For loading
	Water Truck	12,000 liter	1	12,000 liter	1		For wetting haul roads
	Lube Truck	-	-	4,000 liter	1		For onsite refill services
	Service Vehicle	4.5 metric ton	-	Isuzu Elf	1		For personnel transport
Note: Preventive Maintenance Servicing (PMS): For heavy equipment - frequency is every 500 engine running hours, & for dump truck - frequency is every 5,000 kms.							

The process flow of the Silica Sand Quarry Expansion is shown in the following figure:

EXTRACTION

Quarrying starts by extracting the raw materials using Backhoes and Hydraulic Excavators.

LOADING

The excavated materials are then loaded to hauling trucks using Payloader or Backhoe loader.

HAULING

The excavated materials loaded in the Hauling trucks/dump trucks are delivered to the Cement Manufacturing Plant for Crushing and Milling operations.

Figure 1-7. Silica Sand Quarry Process Flow

1.4.2 HAUL ROADS

The quarry area has existing access roads that connect to barangay and provincial roads that directly connect to the Natalio B. Bacalso South National Highway along which the TCPI cement processing plant is located, with total length of about 21 kilometers. The Provincial Road traversing the quarry site has average width of approximately 7 meters. For materials sourced from Pinamungajan and San Fernando quarries, this haul road is capable of handling the volume of haul trucks serving the quarry site. New access roads will be constructed to bring production to the main road, as the quarry is close to the main road. **Figure 1-8** shows the haul road map for the project.

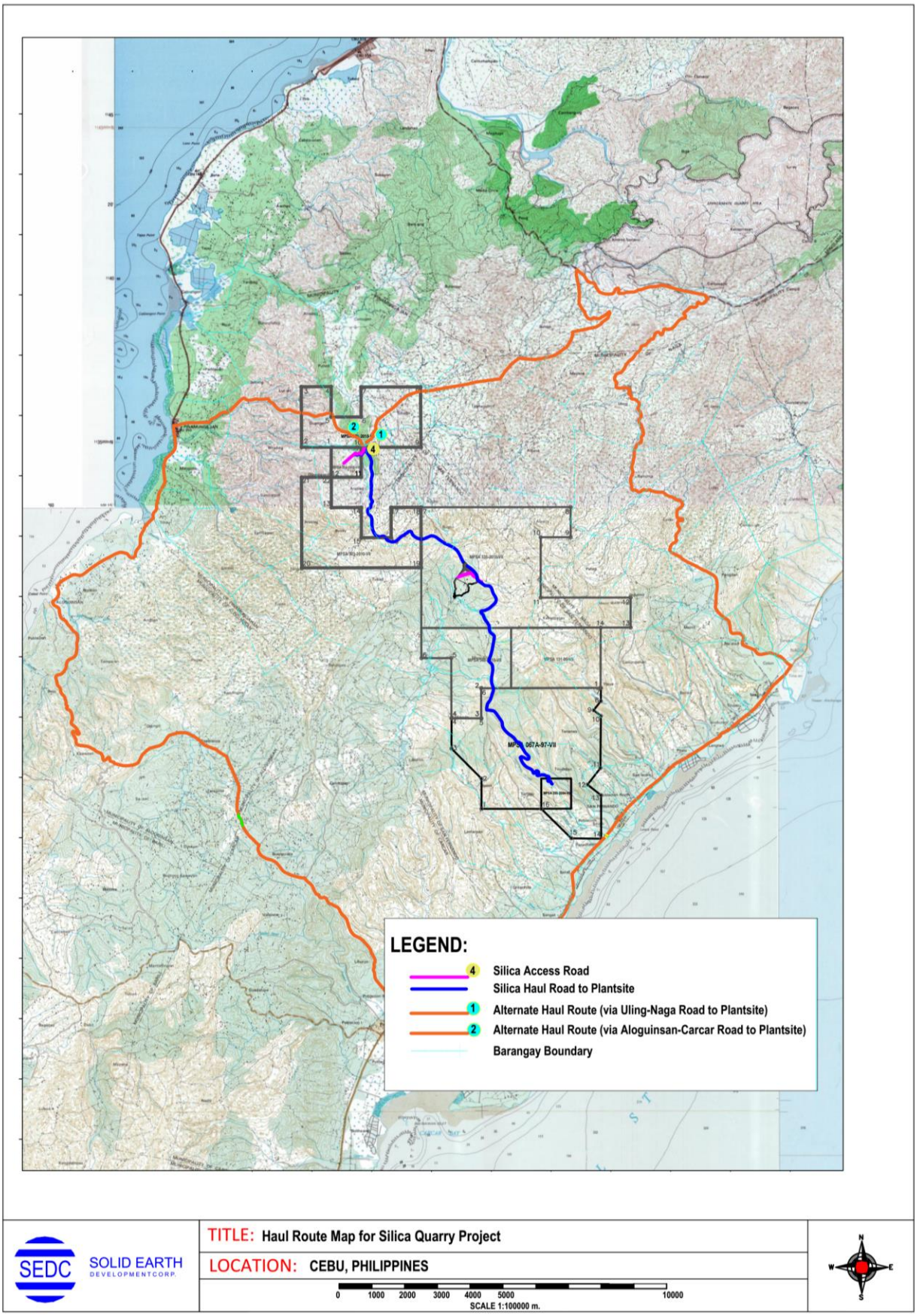


Figure 1-8. Haul Route Map

1.4.3 DRAINAGE

Drainage from the quarry sections will be through the contour canals along base of the slope face. Benches would be cut to allow the bench floor for positive drainage (5-degree fall away from the cut surface) approximately 1mx1m (contour canal cross-section) to reduce surface water flow over the cut face and bench, and limit soil erosion potential. Surface run-off from benches would be directed to rock-lined water channels; forming a drainage system on quarry floor as necessary and directed toward the settling ponds designed sufficiently to contain expected surface run-off from the opened quarry area. Background area surface run-off will be directed toward the natural waterways. Due to the nature of the deposits which occur consistently from elevation +60 masl and above, the quarry activities will be a continuous extraction process until a pre-deter quarry elevation and quarry boundary limit is attained, after which quarry rehabilitation activities commence at each elevation level.

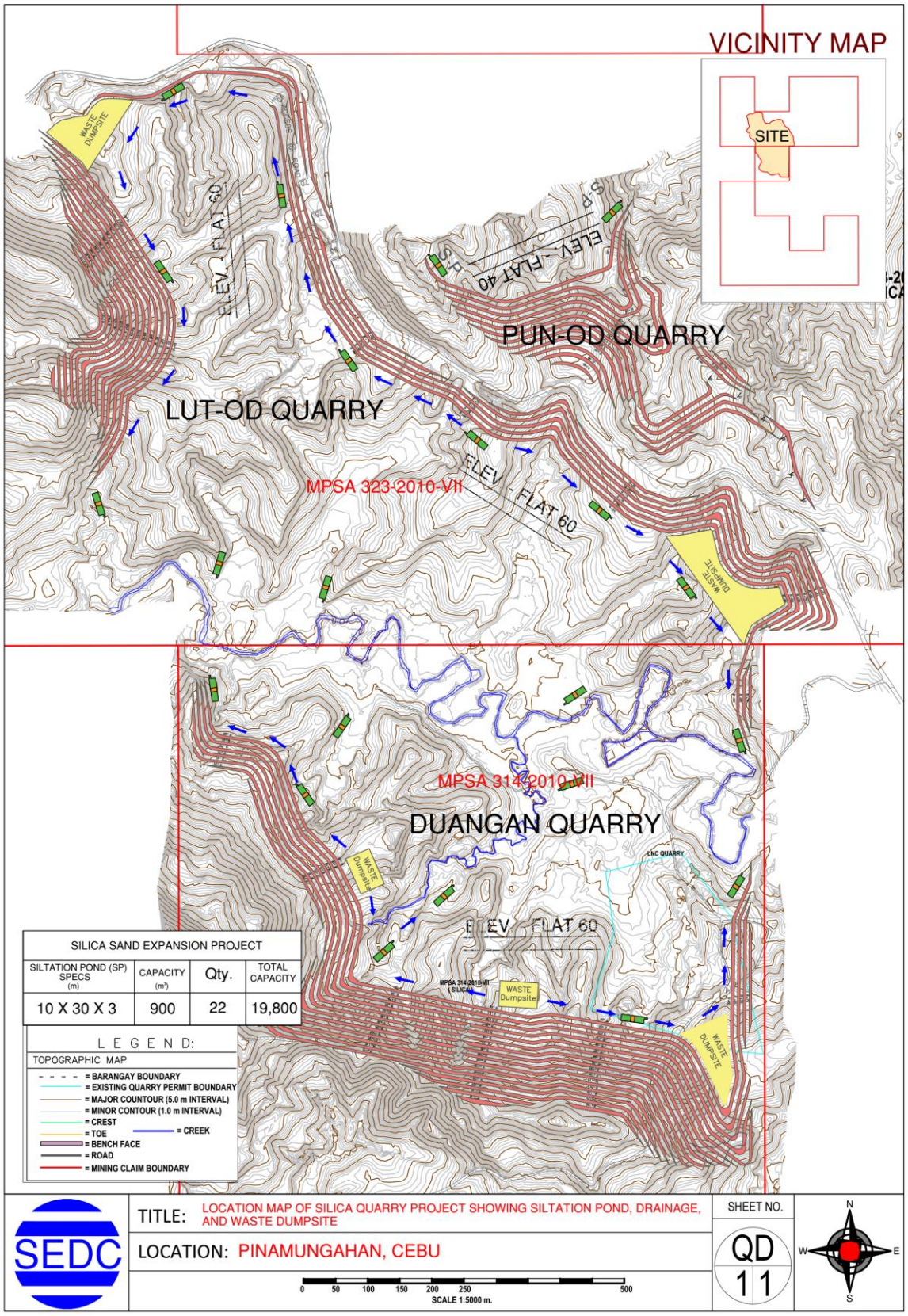


Figure 1-9. Drainage Map

1.4.3.1 STOCKPILE DRAINAGE

Stockpile drainage will serve as a water catchment basin to address possible problems related to damage of nearby farms and exceedance of the water quality standard; stockpile areas will be carefully selected to have proper natural drainage features (**Figure 1-10**).

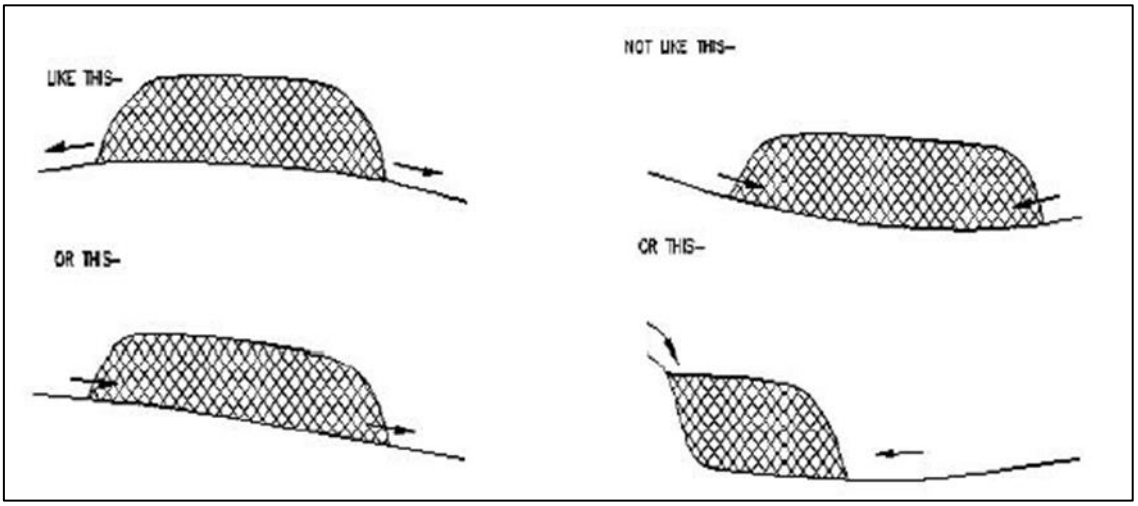


Figure 1-10. Ideal Natural Drainage Features of Stockpile Area

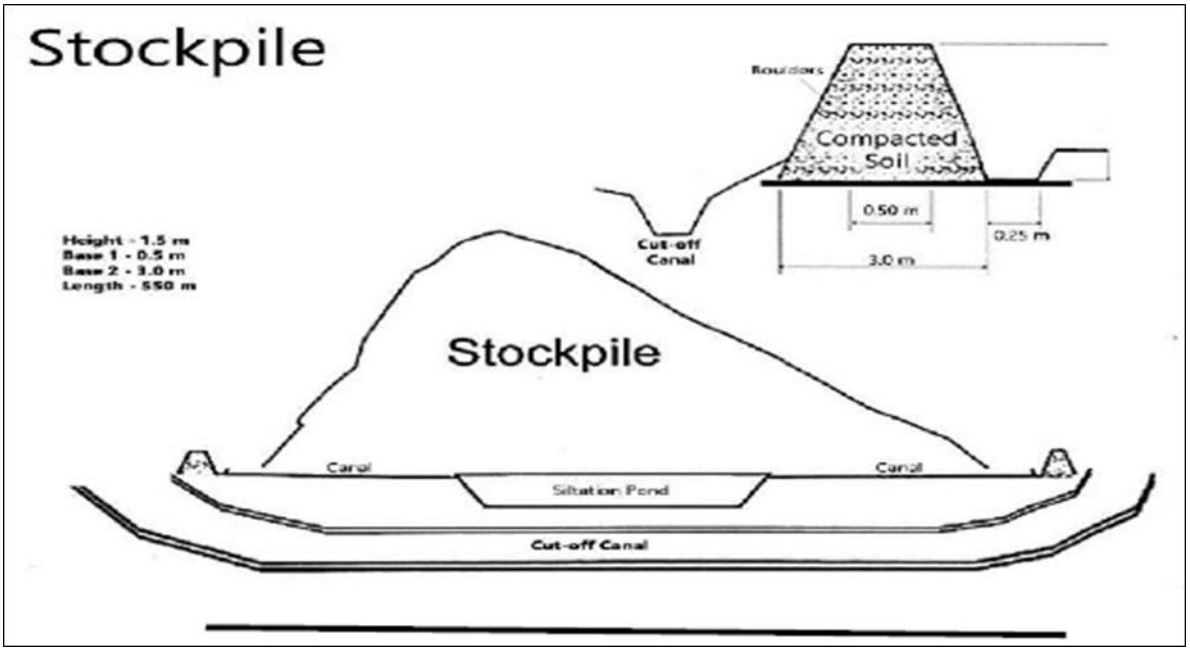


Figure 1-11. Drainage Provisional Plan for Stockpile

1.4.4 TOPSOIL AND WASTE MATERIAL STOCKPILES

The stockpiles that will be created will be of organically-rich topsoil for compensation planting and nursery operations, and for the waste materials which are set aside of road maintenance and for use by the public needing backfill materials for land development, with estimated volume of 34,000 cubic meters.

Topsoil stockpiles and waste materials stockpiles will be properly situated in locations with minimal additional disturbed area, areas with minimal tree and vegetation cover, will require no tree cutting and in relatively higher elevation that is easy to provide earth bunds or surrounding compacted embankment soil barriers. Three stockpile sites will be located within the quarry area for efficient operations for sectional rehabilitation, and within the buffer zone. While each stockpile area may hold the topsoil overburden and the waste materials, these two items will not be allowed to mix, physical the stockpile slope will be kept at low angle and safe height to minimize slumping. The proposed height of the stockpile will be finally determined by the angle-of-repose of the materials, observed to average approximately three meters. Angle of repose is the maximum angle of descent or dip of the stockpile slope relative to the horizontal plane. This is to ensure that the maximum volume materials will be stockpiled without sacrificing safety.

1.4.5 NURSERY

Small "satellite" nurseries proximate to the planting area and near a surface water source will need to be established and will be stocked with fruit and forest trees through contract planting and maintenance with landowner-partners living in the local community. Recommended tree species under the NGP and native species originally found in the Project site will be propagated in the nurseries.

1.4.6 QUARRY ADMINISTRATION BUILDING

SEDC will construct one small site management office with footprint area of approximately one hundred square meters, and a small maintenance shed made for emergency on-site materials requirement. The site office will be equipped with sanitary facilities for use of the project staff and occasional visitors. Construction of these structures will be in accordance with the National Building Code.

1.4.7 POLLUTION CONTROL FACILITIES AND MANAGEMENT SYSTEM

1.4.7.1 SILTATION CONTROL

For the proposed expansion, the project will utilize a combination of contour canals and 22 siltation ponds to meet Class C TSS value (DAO 35). The contour canal dimension shall be 0.5- meter wide and 0.5-meter deep, with settling sumps 1.0-meter-deep with stone pile "baffles" or water velocity decelerators at every 700 meters interval. The contour canals will hug the land side of the slope being quarried and will have horizontal slope alignment between 2% - 3% gradient only. The contour canals will be interconnected such that excess surface is directed toward the settling pond before the water exits the quarry zone. Twenty two (22) siltation ponds (10 x 30 x 3) with a capacity of 900 m^3 will be constructed to recover considerable volume of sand and silt in order to reduce the Total Suspended Solids (TSS) going to the Main Silt Pond (MSP). Periodic desilting of the MSP will be done to improve its efficiency. **Figure 1-9** shows the location of the siltation ponds.

Table 1-13. Siltation Pond Specifications for the proposed Silica Sand Expansion Project

Parameters	Existing (Under SSQ Permit by LGU)	Proposed (MPSA under DMPF)
No. of Siltation Pond	2	22
Dimension	3 x 4 x 3	10 x 30 x 3

Parameters	Existing (Under SSQ Permit by LGU)	Proposed (MPSA under DMPF)
Capacity, m^3	36	900
Total Capacity, m^3	72	19,800

1.4.7.2 WASTE MANAGEMENT

SEDC will implement its Waste Management Procedure to ensure proper handling, segregation, collection and disposal of all types of waste generated from the company's administrative and operational activities. Presented below is SEDC's Waste Management Procedure (**Figure 1-12**) and the recovery facility (**Figure 1-13**). Based on the Waste Management Procedure, all employees must properly identify their wastes generated as categorized in **Table 1-14** prior to the next step- Waste Segregation. The Pollution Control Officer must ensure that proper segregation and storage is strictly implemented. Segregated wastes will be collected and disposed as scheduled by the Administration Manager; while wastes that are not segregated shall be retained until proper segregation is done. Pollution Control Officer shall facilitate the coordination with LGUs to ensure timely collection and disposal, and with accredited traders for the separate collection of recyclable and hazardous wastes.

No.	Flow Chart	Responsibility	Procedure
	Start		
01	Waste Identification	All Employees	01. Identify wastes generated from your office. Refer to Definition of Terms as to its type.
	A		
02	Waste Segregation	All Employees	02. Segregate wastes accordingly. Place them in their respective receptacles provided.
		Pollution Control Officer	Ensure that storage and segregation of wastes in the MRF is practiced.
03.	Segregated? No / Yes A	Pollution Control Officer	03. Segregated wastes shall proceed to collection and disposal. Non-segregated wastes shall be retained for segregation.
04.	Waste Collection & Disposal	Administration Manager	04. For office wastes, coordinate with TCPI – Admin to ensure that wastes are collected as per schedule.
		Pollution Control Officer	All other wastes shall be coordinated with LGU to ensure timely collection and disposal. Recyclables and Hazardous waste are to be coordinated to accredited buyers/ treaters for a separate collection.
	End		

Figure 1-12. Flowchart of Waste Segregation and Responsible Personnel

Figure 1-13. Material Recovery Facility for Waste Management

Table 1-14. Waste Classification, Collection, and Disposal Matrix

Type	Source	Collection Frequency	Segregation System	Disposal Method	Disposal Point
Biodegradable- Wastes that can be decomposed in a reasonable amount of time (Paper related products)	Administrative office	Daily	Trash bin/MRF	Kiln Feeding	Per disposal determination point or delineation line
	Satellite Office	Daily	Trash bin/MRF	Kiln Feeding	
	Nursery	Semi-monthly	Trash bin/MRF	Kiln Feeding	
	Quarry Area	Weekly	Trash bin/MRF	Kiln Feeding	
Non-Biodegradable- Wastes that cannot be decomposed into organic and environmentally safe products (Plastic related products)	Administrative office	Daily	Trash bin/MRF	LGU Collection	Per disposal determination point or delineation line
	Satellite Office	Daily	Trash bin/MRF	LGU Collection	
	Nursery	Semi-monthly	Trash bin/MRF	LGU Collection	
	Quarry Area	Weekly	Trash bin/MRF	LGU Collection	
Recyclable- Materials that can be processed or used again (metal, steels, tires)	Administrative office, Satellite Office, Nursery, Quarry Area	As per request	MRF	Sold to scrap buyer	point or delineation line
Hazardous- Substances that have hazardous characteristics such as flammable, corrosive, reactive, toxic, radioactive, poisonous, carcinogenic, or infectious; materials with potential risk to humans and/or environment. (batteries, empty ink cartridges, used oil)	Administrative office, Satellite Office, Nursery, Quarry Area	As per request	MRF	Accredited treater	If desired quantities are attained
Electronic Waste- discarded electrical or electronic devices (discarded computers/printers)	Administrative office, Satellite Office, Nursery, Quarry Area	As per request	MRF	Accredited treater	If storage period reaches 1 year
Quarry Site Waste- waste generated from site clearing activities (displace trees, vegetation,	Quarry Area	As per request	Stockpile Area	Sold to interested buyers	-
	Nursery	As per request	Stockpile Area	-	End of every project

Type	Source	Collection Frequency	Segregation System	Disposal Method	Disposal Point
top soil, hard rocks, boulders, etc.)					
Special Wastes- wastes that require special handling, trained people, and/or special disposing methods. It may be special because of its quantity, concentration, or physical, chemical, or biological characteristics. (dead animals/toilet wastes)	Quarry Area	As per request	-	Septage collector	-

1.4.7.3 AIR AND NOISE POLLUTION CONTROL

Dust emissions during operations especially during the hot dry season (from March to May) is more likely to be rampant and harmful to worker's health. SEDC shall also ensure continuous implementation of road watering and spraying to control dust suspension in the air. Tree planting shall be conducted to improve air quality and compensate for the emissions coming from trucks and heavy equipment. Regular Preventive Maintenance Strategies/Systems (PMS) for all equipment and hauling trucks are to be employed to minimize noise impact to the community as well as reduce their dust emissions.

1.5 RESOURCE REQUIREMENT

1.5.1 POWER REQUIREMENT

No generator set will be necessary as the project is right beside the Provincial road and power supply from the Visayas Electric Company (VECO) is readily available. The project will also operate primarily using day light, with operations at most starting at 6am and ending in 6pm in maximum condition. Back-up illumination of one or two LED beacon lights are expected to be used for lighting dusk operations (at 6pm) only if these become necessary.

1.5.2 WATER REQUIREMENT

Water requirement on worst case is 288.8 m^3 per day. Likewise, the Project will pursue progressive compensation planting to fulfill the requirements of EO 26, and to offset project carbon emissions in support of the Philippine Government programs to address climate change as called-for by Republic Act 9729, and both activities will require water resources. The requirement for dust suppression in 1 was confirmed after the conduct of an inventory of particulate matter emissions and the GHG emissions from operation that will require carbon sequestration and thus the watering of additional tree plantations.

The Project personnel will also be utilizing water for day stay at the office (i.e., washing, domestic use), and sprinkling of active quarry sections. For these an estimated volume of about 13.2 m3/day will be needed. Drinking water will be brought-in from a local purified water supplier.

1.6 PROCESS / TECHNOLOGY

The nature, location of the ore, the host matrix earth form and characteristics, prevailing environmental requirements and economic conditions defined the project and its components. The quarry method most suitable for sandy materials particularly with thin overburden is surface extraction. The method of extracting the target materials by benching and terracing the affected surface area entails less environmental consequences than random excavation targeting only the desired silica grades, as observed to be utilized by applied by small scale quarries in the area.

1.6.1 QUARRYING

This project involves simple extraction of surface earth materials for cement manufacturing, by excavators and pay loaders; loading of extracted materials to waiting dump trucks for hauling to the TCPI cement manufacturing plant approximately twenty-one (21) kms away; stabilization and rehabilitation of mined-out areas. The equipment and manpower skills needed are readily available on site as the Proponent has been undertaking the activity since the past decade. This project does not include any processing of the extracted silica sand. No other facilities need to be established for this project as the manufacturing cement plant already exists. For this reason, this simple project technology is preferred by the Proponent. The general quarry process is shown in **Figure 1-14**.

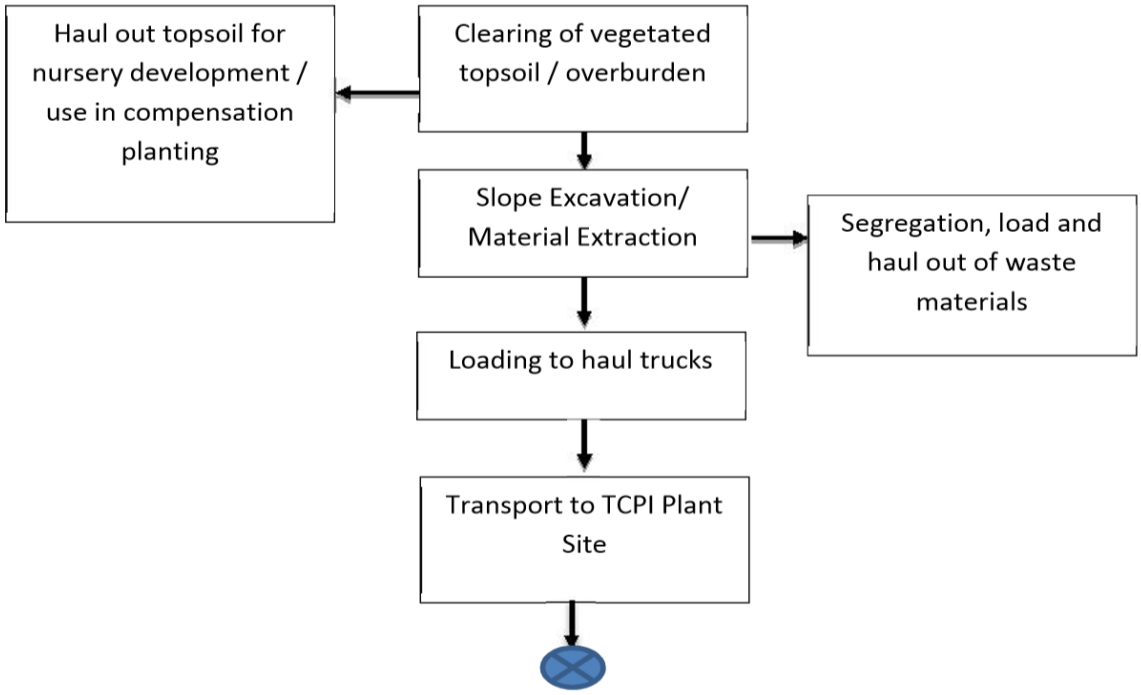


Figure 1-14. Quarry Operations Activity Flowchart

1.7 PROJECT SIZE

Based on the result of the exploration conducted by SEDC, the two (2) MPSAs has total combined mineable reserve of silica sand deposit of about 11,000,000 Metric Tons with an average grade of 75% SiO_2 and a cut-off grade of 70%. Increase in annual production of 660,000 MT from 200,000 MT shall

be sourced from the existing production area of 229.50 hectares. A summary is presented in the table below:

Table 1-15. Summary of Existing and Proposed Changes in the Silica Sand Quarry

	MPSA 314	MPSA 323
LOCATION	Barangay Duangan	3. Barangay Lut-od 4. Barangay Punod 5. Barangay Sibago 6. Barangay Guimbawi-an
ECC AREA (in hectares)	Existing=	389.44 has
	84 has	305.44 has
	For Amendment=	389.44 has (NO CHANGES)
EXISTING PRODUCTION AREA (in hectares)	229.50 has	
FOR AMENDMENT PRODUCTION AREA (in hectares)	229.50 has (NO CHANGES)	
ANNUAL PRODUCTION (in metric tons)	**Existing= 200,000MT**	
	For Amendment = 660,000 MT	
MINERAL RESERVES	2,000,000	9,000,000
	Total Silica = 11,000,000MT	

1.8 Development Plan, Description of Project Phases and Corresponding Timeframes

The project will be implemented in several phases namely, a) project preparation phase; b) project development phase; c) quarry operations phase; and d) abandonment phase. The details of these project phases are summarized in the sections below.

1.8.1 Project Preparation Phase

These are the pre-construction activities necessary to proceed to the project development phase.

- Procurement of Equipment
- Land Acquisition
- Permit Application and Acquisition
- Stakeholder consultations
- Geological explorations
- Feasibility study and Planning

1.8.2 Project Development Phase

The project development phase will include the following:

- Construction of additional access roads
- Construction of quarry administration facilities
- Construction/Installation of pollution control devices/facilities

1.8.2.1 Access Road Construction and Haul Roads Improvements

Access roads are used to ease and fasten the movement of quarry materials from its source towards the provincial road. These will be constructed connecting the quarry site/s to the provincial road. Existing access roads in initial quarry sections will be improved through widening activities. Short access road sections will be opened as the quarry operations progress inward the quarry site. The

access roads development will be simple direct cut, matting, leveling and compaction. To keep the run-off flow on the roadsides and reduce damage on the roadway center, contour canals will be part of the design. The design of the access roads and haul roads are designed sufficiently to carry the load of production and ensure efficiency during transport operations.

1.8.2.2 CONSTRUCTION OF QUARRY ADMINISTRATION FACILITIES

The construction of quarry administration facilities will be simple and straightforward like the common construction procedure for a simple single-story dwelling structure with concrete flooring and walls and galvanized iron sheet roofing. Facilities like these are meant to provide comfort and shelter for employees involved in administrative works and resting place during operational recess or breaks.

1.8.2.3 SETTLING PONDS

Settling ponds are the silt control measures to be installed in the project site. These will be constructed at the base of quarry benches where it can collect run-off water coming from the contour canals of the quarry blocks. Each settling pond location shall have a series of two or three cascading basins to adequately detain sediments before releasing the quarry drainage water, meeting the requirement of Class C water quality guidelines.

1.8.3 OPERATIONS PHASE

1.8.3.1 CLEARING OF VEGETATED TOPSOIL OR OVERBURDEN

Land clearing would entail clearing, balling, and transfer of trees less than 15cm diameter at breast height (DBH), timber recovery of trees above 15cm DBH, chipping/mulching of removed vegetation to be added to top soil heap, and the separation and haul out of humus (topsoil). Bulldozers, front-end loaders, and trucks would be deployed to undertake these clearing works. Stockpiling of the removed overburden at designated areas for future re-use would preserve the mulched vegetation and the topsoil. The overburden, topsoil, and other organic remnants are necessary requirement for the rehabilitation activities such as re-soiling and re-vegetation.

1.8.3.2 OVERBURDEN REMOVAL

With the use of appropriate heavy equipment (i.e. backhoe, bulldozers, etc.), the overburden layer would be removed from the ground, loaded on 10-ton haul trucks, and piled at waste stockpile areas or transported for benching and contouring of quarried out areas.

1.8.3.3 QUARRY /MATERIAL EXTRACTION

The overburden in the production area is declared by the Proponent to be very thin, averaging 10cm.The waste material is reported to be nil, estimated to be 2%. After the overburden is stripped, the silica sand will be excavated using an excavator in backhoe mode. In view of the moderately rolling terrain of the landform hosting the target materials; quarrying or material extraction will start from mid-elevation (bench elevation +80m) in Lutod, progressing downward to the last bench at elevation +30m. Extraction shall progress downwards. The quarry elevation equivalent to the top bench will be gradually totally extracted, and. Then a lower bench shall be begun, and the enter bench will again be extracted before the next level is begun. If the slope is too steep for safe digging, the slope will be dozed down in horizontal layers until a staging platform is achieved.

Once extracted, the materials will be loaded in waiting dump trucks. Material quality control will aim to ensure haulage of suitable materials to the plant and avoid sending silica sand to the waste dumps. Suitable materials will be immediately hauled to the TCPI cement plant. There will be no stock piling

at the quarry site. Waste materials will be hauled out to the stockpile location within the quarry, for later use in final slope rehabilitation. At each bench level where applicable, a plateau will be created, and mined-out upper slopes will be stabilized by contouring and benching. Temporary slopes in advancing the working face inland will have an over-all slope of about 80 degrees from toe to top of the quarry section. The batter slope angle shall be between 60 deg to 75 degrees Levels of terraces will result as the quarry elevation progresses downward. The resulting landform shall be like an engineered valley, designed to be stable and having efficient drainage design, so as not to exclude the possibility for the area to be suitable for housing development. The final pit elevation will not be lower than the nearest road and slightly higher than the surface water course (creek) that drains the area. The land surface will be sloped to drain toward the creek.

1.8.3.4 DRAINAGE SYSTEMS

Drainage from the quarry sections will be through the contour canals along base of the slope face. Benches would be cut to allow the bench floor for positive drainage (5-degree fall away from the cut surface) approximately 1mx1m (contour canal cross-section) to reduce surface water flow over the cut face and bench, and limit soil erosion potential. Surface run-off from benches would be directed to rock-lined water channels; forming a drainage system on quarry floor as necessary and directed toward the settling ponds designed sufficiently to contain expected surface run-off from the opened quarry area. Background area surface run-off will be directed toward the natural waterways. Due to the nature of the deposits which occur consistently from elevation +60 masl and above, the quarry activities will be a continuous extraction process until a pre-deter quarry elevation and quarry boundary limit is attained, after which quarry rehabilitation activities commence at each elevation level.

1.8.4 DECOMMISSIONING / ABANDONMENT / REHABILITATION

A final mine rehabilitation and decommissioning plan will be prepared to address concerns on planned and/or unplanned closure, and care and maintenance scenarios. The plan must be consistent with the company's closure policy, and with the provisions and relevant rules and regulations of the Republic Act no. 7942, known as the Philippine Mining Act of 1995.

Decommissioning activity will commence after the operating life of the project. This involves dismantling of company infrastructures and machineries. Simultaneously, rehabilitation will be carried out. Aside from the rehabilitation activities that were progressively done during the operation, a final rehabilitation shall be conducted succeeding the project's operation period. Stabilization of steep slopes, backfilling, grading and reforestation of mined-out areas, among others, will be performed as part of the Rehabilitation.

The Abandonment phase will follow as the mined-out sections are environmentally restored, ensuring its stability and sustainability, with respect to the mine relinquishment guidelines from Mines and Geoscience Bureau (DENR-MGB). The following are activities involved in abandonment phase:

1. Topsoil enrichment and preparation – This is done before restoring/re-soiling the mined-out areas. This is to support the nourishing and growing vegetative and tree cover in the future. Soil analysis (chemical and physical properties) including x-ray fluorescence are to be undertaken to determine soil suitability.

2. Final benching and contouring – This is conducted to achieve the slope stability all through the benches and terraces; following the slope gradient from toe to edge of benches to top-most point of about ±83.3% (40 degrees) or as approved by the Mines and Geosciences Bureau.
3. Restoring, and spreading of enriched topsoil – The enriched topsoil to be spread on the bench panels with 0.25m thickness with 50cm bench edge barrier for storm drainage control, with the 2% inward slope.
4. Re-vegetating of benches – This is implemented if the local government unit opted to classify the area as an agricultural land.
5. Bench and slope assessment – The slope condition and benches are assessed to ensure that the bench edges possess the enough run-off control barrier features.
6. Tree planting – This is undertaken especially on mined-out areas with highest elevation to increase the rainfall infiltration and ensure sufficient water catchment function. This shall be undertaken with the participation of local communities.
7. Turn-over of infrastructures – Depending on the agreement between the proponent and local communities, there shall be a turn-over of infrastructures like roads and buildings to the Local Government Unit/s or relevant government agencies. Structures that are not beneficial for the LGUs may be dismantled and hauled out.

To ensure the plan's proper implementation, the budget for decommissioning, abandonment, and rehabilitation shall be deposited in a government depository bank. The said funding is established in accordance with the provisions of the Philippine Mining Act of 1995.

The table below shows the Project Schedule of the Silica Sand Quarry Expansion Project.

Table 1-16. Project Schedule of the Proposed Silica Sand Quarry Expansion Project

SOLID EARTH DEVELOPMENT CORPORATION

MPSA 314-2010-VII, MPSA 323-2010-VII

SCHEDULE OF PROJECT (Silica Sand Quarry Project)

Year		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
A. DEVELOPMENT											
A.1 MPSA 314-2010-VII											
1. Access Road	1,000 m										
2. Silt Pond	4 units										
3. Waste Stripping	20,000 MT										
A.2 MPSA 323-2010-VII											
1. Access Road	1,500 m										
2. Silt Pond	4 units										
3. Waste Stripping	30,000 MT										
A.3 MPSA 330-2010-VII											
1. Access Road	1,500 m										
2. Silt Pond	4 units										
3. Waste Stripping	30,000 MT										
B. PRODUCTION (MT)											
1. MPSA 314-2010-VII											
Tonnage, MT	1,080,000		120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
2. MPSA 323-2010-VII											
Tonnage, MT	2,700,000		300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
3. MPSA 330-2010-VII											
Tonnage, MT	2,160,000		240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
C. TOTAL PROD. (MT)	5,940,000		660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000

1.9 MANPOWER

Once the project will be implemented, as may be observed from **Table 1-17**, employment opportunities supported by this project totals 69 positions. Out of 69 positions, 58 may be filled by males and 42 by females. The constraints for female employees in certain positions are also listed in the same table. Workforce to fill employee replacements or fill day-work (extra) job opportunities are sourced by SEDC from a pool of qualified workers recommended from the Local Government Units.

Table 1-17. Manpower needed by the Project

Description	Quarry/ Production			Services			Security			Hauling			Total Gender		
	No	M	F	No	M	F	No	M	F	No	M	F	No	M	F
Manager	1	x	x	0			0			0			1	1	1
Safety Officer	1	x	x	0			0			0			1	1	1
Supervisor	1	x	x	1	x	x	1	x	x	1	x	x	4	4	4
Foreman	0			1	x	x	0			0			1	1	1
Mechanic	4	x		0			0			1	x		3	3	0
Equipment Operators	3	x		0			0			0			3	3	0
Drivers	10	x		2	x	x	0			4	x		16	7	1
Welder	2	x		0			0			0			2	1	0

Description	Quarry/ Production			Services			Security			Hauling			Total Gender		
	No	M	F	No	M	F	No	M	F	No	M	F	No	M	F
Electrician	2	x		0			0			0			2	1	0
Equipment Spotters	2	x	x	0			0			0			2	2	2
Utility Aide	2	x	x	4	x	x	0			4	x		6	6	4
Survey Aide	0			8	x	x	0			0			8	8	8
Accounting Staff	2		x	0			0			0			2	2	2
Administrative Staff	2	x	x	0			0			0			2	2	2
Plant Nursery Staff	0			2	x	x	0			0			2	2	2
Security Guards	0			0			14	x	x	0			14	14	14
TOTAL	32	19	7	18	10	10	15	8	8	10	5	1	69	58	42

1.10 PROJECT INVESTMENT/COST

The estimated Volume of Investment for the Silica Sand Quarry Expansion Project is approximately PhP 61,120,000.00 covering the mining properties and equipment. The estimated Production Costs are pegged at the following first 10 commercial production years:

Year 1 : P 342.00 / MT
Year 2 : P 356.00 / MT
Year 3 : P 370.00 / MT
Year 4 : P 385.00 / MT
Year 5 : P 400.00 / MT
Year 6 : P 416.00 / MT
Year 7 : P 433.00 /MT
Year 8 : P 450.00 / MT
Year 9 : P 468.00 / MT
Year 10 : P 487.00 / MT

2 ASSESSMENT OF ENVIRONMENTAL IMPACTS

2.1 LAND

2.1.1 LAND USE AND CLASSIFICATION

The Silica Sand Quarry Expansion Project is located within the Municipality of Pinamungajan, Province of Cebu which is in the Southwestern coastline portion of Cebu. Pinamungajan is a 2nd class municipality sharing its boundaries with municipalities of Toledo, Naga, Aloguinsan, San Fernando, and Carcar. It has a total land area of 11,725.27 hectares occupied by 26 barangays. The project is in barangays of Duangan, Lut-od, Punod, Sibago, and Guimbawian.

Table 2-1 shows the existing land use distribution in the municipality. As observed, the largest percentage (33.59%) is used for agricultural purposes while the smallest percentage is used for tourism. 3.68% of the total land area is used for industrial purposes.

Table 2-1. Existing Land Use Distribution in Pinamungajan, Cebu

LAND USE	AREA (in has)	% TO TOTAL LAND AREA
Agricultural	3,939	33.59%
Timberland	3,242	27.66%
Protection Forest	3,200	27.29%
Built-up Area/Commercial	365	3.12%
Industrial	431	3.68%
Tourism	20	0.17%
Mangroves	150	1.28%
Fishponds	377.5	3.21%
TOTAL	**11,725.27**	**100.00%**

Source: Official Website of Pinamungajan, Cebu (www.pinamungajan.gov.ph)

2.1.1.1 LAND CLASSIFICATION

The project areas in Pinamungahan, Cebu are classified as Alienable and Disposable Lands and Forest Lands. The distribution of forest land and alienable and disposable land within the MPSA Areas is shown in
Figure 2-1.

Land classification refers to the establishment of boundaries between alienable and disposable lands and other land uses. Presidential Decree (P.D.) 705 defined Alienable and Disposable Lands as lands of the public domain which have been subjected to the present classification system and declared as not needed for forest purposes, and national parks. Claims or titles may be applied by private individuals over these lands for settlement, agricultural and other production purposes unlike forest lands which cannot be titled.

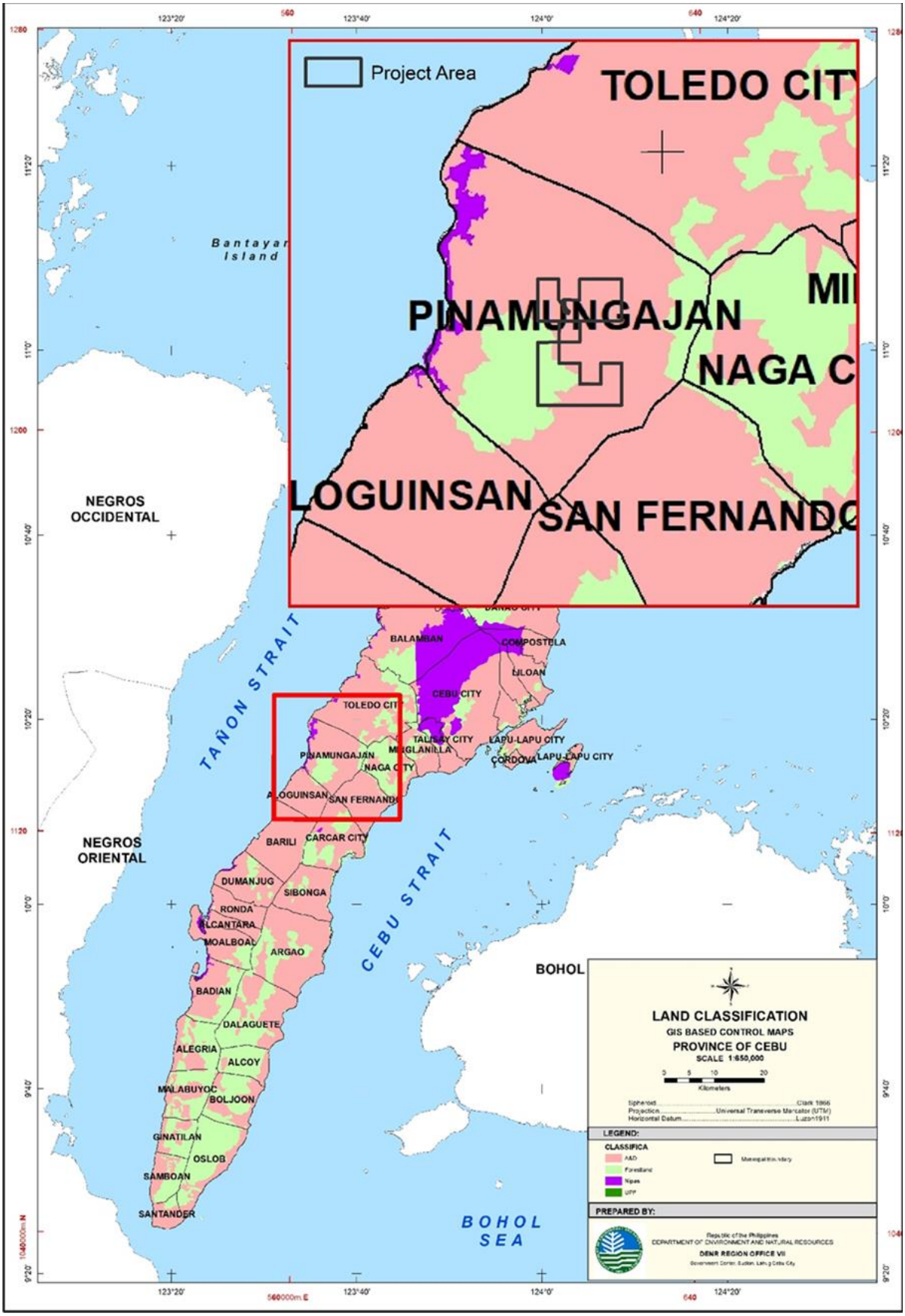


Figure 2-1. Land Classification of Project Area
(Source: DENR Region VII)

2.1.1.2 LAND TENURE

Figure 2-2 presents the existing tenurial instruments while **Figure 2-3** presents the existing Community-Based Forest Management Agreement (CBFMA) in Cebu. Special Land Use Permit exists in the municipality but not within the areas of the proposed Silica Sand expansion. Other instruments such as Sustainable Integrated Area and Development (SIAD), Certificate of Ancestral Domain Title (CADT), Forest Land Use Agreement (FLAG), Forest Land Management Agreement (FLMA), Memorandum of Agreement (MOA), Socialized Industrial Forest Management Agreement (SIFMA), and Tree Farm Lease Agreement (TFLA) are also not present within the boundaries Pinamungajan, Cebu. A Community-Based Forest Management Agreement (CBFMA) is identified in the boundary of Pinamungajan interconnected with the boundary of Toledo City. However, this CBFMA is not within and not covered by the project area.

Figure 2-4 shows the Protected Areas in Cebu namely, the Tañon Strait Protected Seascape covering 521,018 hectares; and the Central Cebu Protected Landscape which is approximately 38 kilometers away from Pinamungajan. The Tañon Strait Protected Seascape is more than 15 kilometers from the host barangays.

No tenurial issues are raised and recorded during the social consultations and surveys conducted.

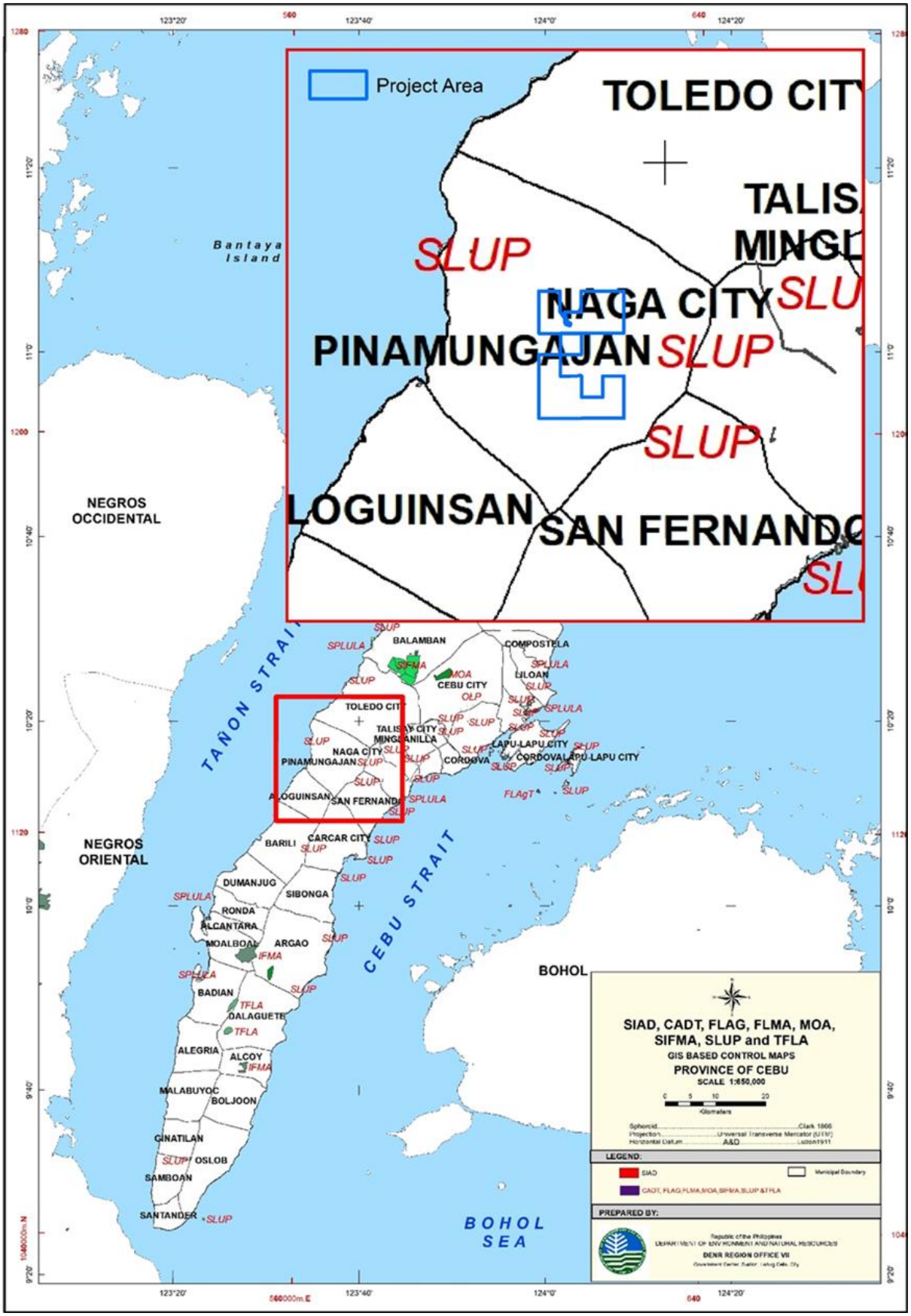


Figure 2-2. Tenurial Instruments in Cebu
(Source: DENR Region VII)

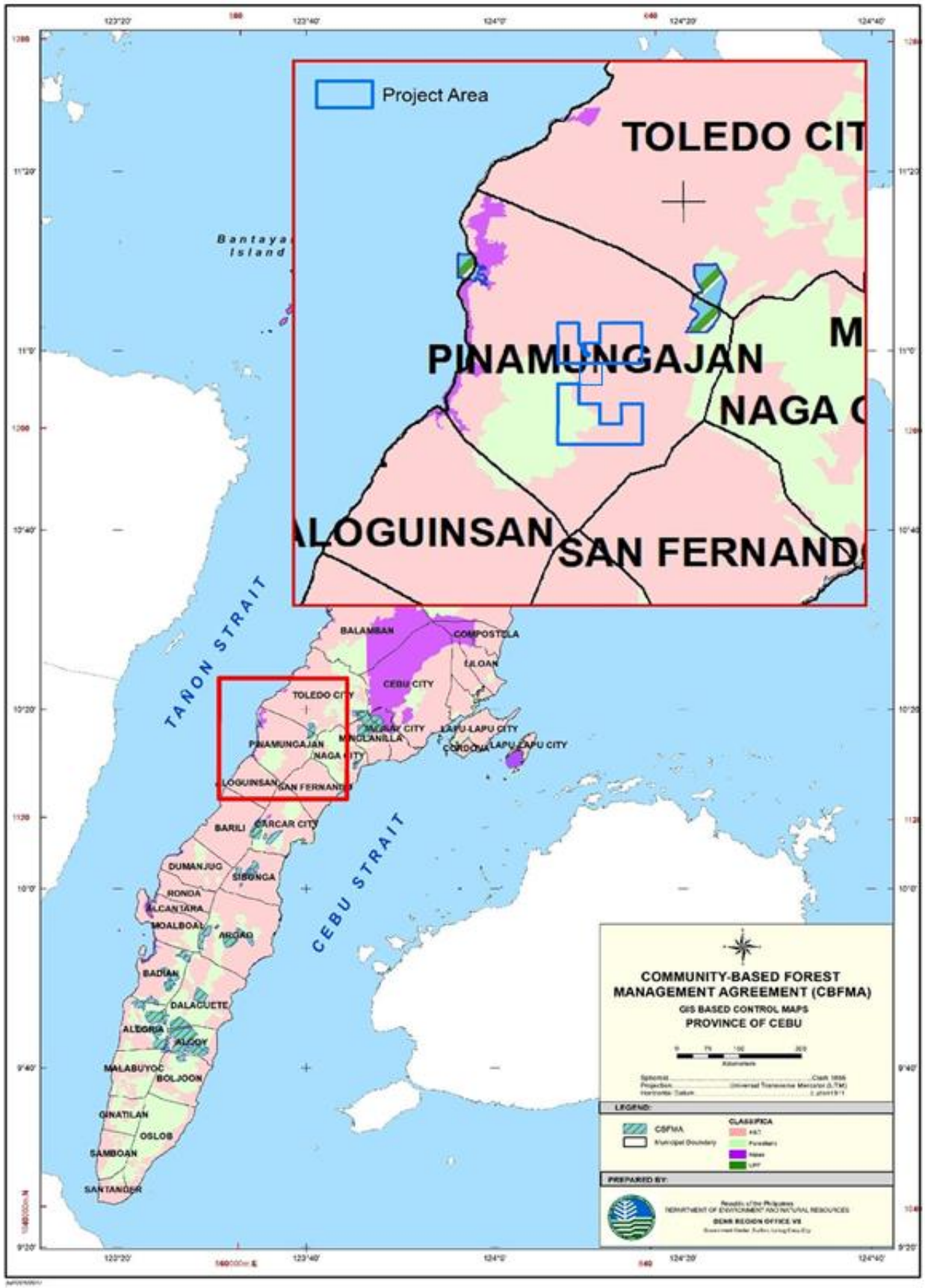


Figure 2-3. CBFMA in Cebu

(Source: DENR Region VII)

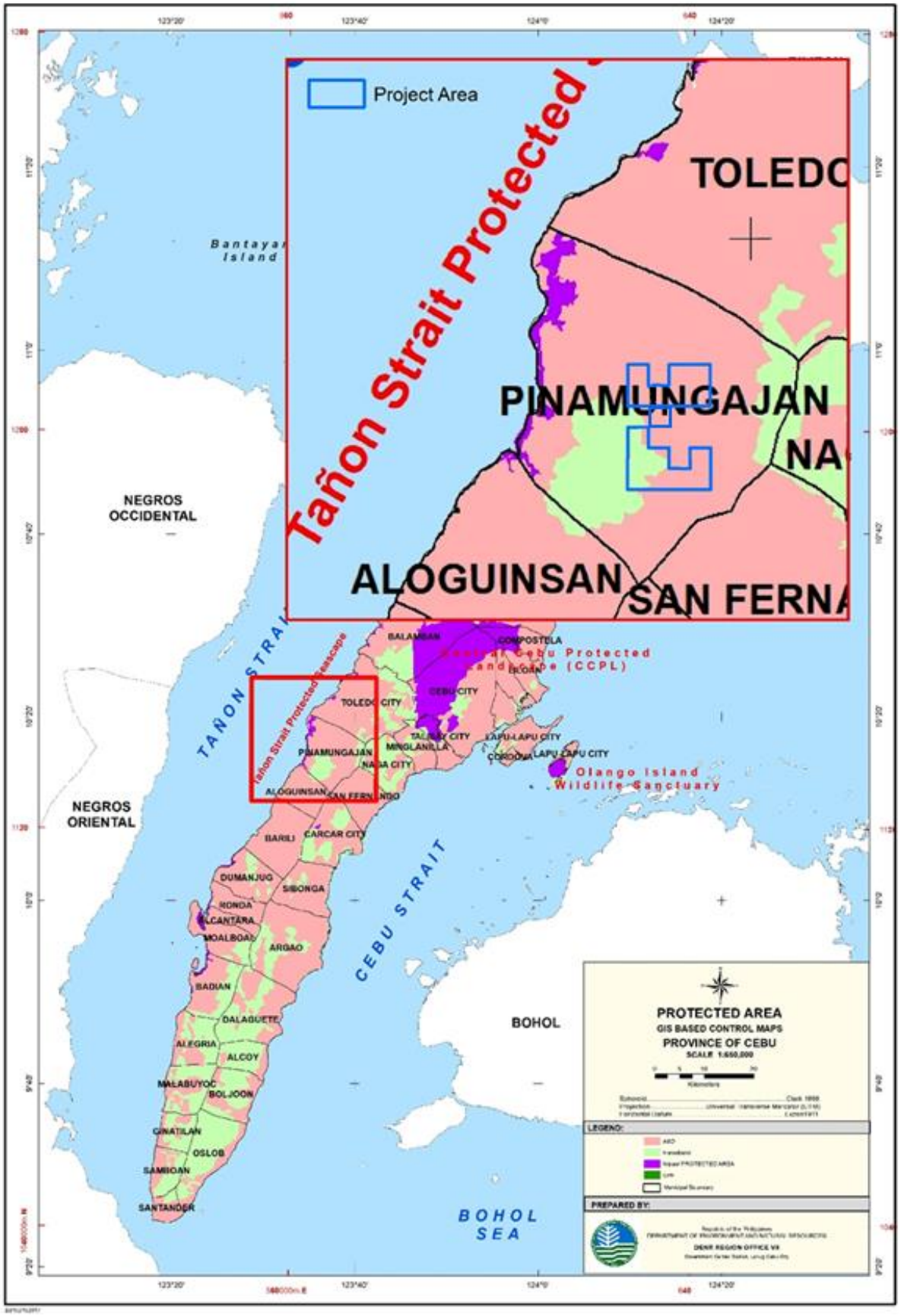


Figure 2-4. Protected Areas in Cebu
(Source: DENR Region VII)

Table 2-2. Assessment of Presence or Absence of Environmentally Critical Areas (ECAs) in the Project Area

ECA CATEGORIES		TECHNICAL DESCRIPTION (BASED ON ANNEX 2-1A OF THE REVISED PROCEDURAL MANUAL OF DAO 2003-30)	PRESENT IN PROJECT AREA?	REMARKS
1	Areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries	The laws referred to by this provision are Presidential Decree No. 705, as amended, otherwise called as the Revised Forestry Code, Republic Act 7586 or the NIPAS Act, and other issuances including other proclamations, executive orders, local ordinances, and international commitments and declarations.	No	Present **outside** the Project Area. The project barangays are more than 15 kilometers away from the protected area (**Figure 2-4**).
2	Areas set aside as aesthetic potential tourist spots	Aesthetic potential tourist spots declared and reserved by the DOT or other appropriate authorities for tourism development.	No	There are no existing tourist spots declared or reserved by the DOT or LGU within the project area.
3	Areas that constitute the habitat of any endangered or threatened species of Philippine wildlife (flora and fauna)	This refers to areas considered as wilderness areas and areas identified by the PAWB to be natural habitats of endangered or threatened, rare, and indeterminate species of flora and fauna, as defined by PAWB.	No	There are no wilderness areas or natural habitats of ecologically significant species as identified and defined by PAWB.
4	Areas of unique historic, archaeological, or scientific interest	This refers to areas that are more than 100 years old (now superseded by new law RA 10066, reduced to 50 years old) and declared by the National Historical Institute, National Museum, or National Commission for Culture and the Arts, through national or local laws or ordinances as areas of cultural, historical, and scientific significance to the nation, (e.g., declared national historical landmarks, geological monuments, and paleontological and anthropological reservations).	No	There are no cultural heritage areas within the project site.

ECA CATEGORIES		TECHNICAL DESCRIPTION (BASED ON ANNEX 2-1A OF THE REVISED PROCEDURAL MANUAL OF DAO 2003-30)	PRESENT IN PROJECT AREA?	REMARKS
5	Areas that are traditionally occupied by cultural communities or tribes	This refers to all ancestral lands of the National Cultural Communities in Section 1 of Presidential Decree No. 410 and settlements designed, implemented, and maintained by the PANAMIN for national minorities (non-Muslim hill tribes referred to in Presidential Decree No. 719) as may be amended by Republic Act 8371 or the Indigenous Peoples Rights Act of 1997 and its Implementing Rules and Regulations.	No	There are no CADT/CALC areas and no IP communities within the project area.
6	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)	The area shall be so characterized if any of the following conditions exist: - Geologic hazard areas: This refers to all areas identified by the Mines Geosciences Bureau (MGB) as geologic hazard areas. - Flood-prone areas: This refers to low-lying areas usually adjacent to large active water bodies experiencing inundation of at least 2 m, twice a year for the last five years prior to the year of reckoning. For example, a determination made in 2007 will consider the weather records from 2002 to 2006. - Areas frequently visited or hard-hit by typhoons: This refers to all areas where typhoon signal No. 4 was hoisted for at least twice a year during the last five years prior to the year of reckoning. - Areas prone to volcanic activities/ earthquakes: This refers to all areas identified as such by the Philippine Institute of Volcanology and Seismology (PHIVOLCS)	Yes	Risk to climatological hazards: - Low risk to flooding (flooding will be limited to the mining pit) - High risk to rain-induced landslide of mining slopes and benches. Risk to geologic hazards: - High risk to earthquake-induced landslides of mining slopes and benches - Ground shaking – PEIS Intensity VI destructive ground shaking - No risk to volcanic eruptions - Low susceptibility to liquefaction

ECA CATEGORIES		TECHNICAL DESCRIPTION (BASED ON ANNEX 2-1A OF THE REVISED PROCEDURAL MANUAL OF DAO 2003-30)	PRESENT IN PROJECT AREA?	REMARKS
		(e.g., areas within permanent exclusion zones of active volcanoes or areas within the required minimum buffer zone of fault zones as determined by PHIVOLCS).		
7	Areas with critical slopes	This refers to all lands with slopes of 50% or more classified as geohazard by MGB. Such slope conditions favor their natural susceptibility to geohazards such as landslides.	Yes	The project area has steep slopes more than 50% at elevations ranging from 0 to 200 masl
8	Areas classified as prime agricultural lands	Prime agricultural lands refer to lands that can be used for various or specific agricultural activities and can provide optimum sustainable yield with minimum inputs and development costs as determined by the Department of Agriculture.	No	There are no prime agricultural lands within the project area.
9	Recharge areas of aquifers	Refers to sources of water replenishment where rainwater or seepage actually enters the aquifers. Areas under this classification shall be limited to all local or non-national watersheds and geothermal reservations.	No	There are no recharge areas of aquifer within the project site.
10	Water bodies characterized by one or any combination of the following: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities	Water bodies shall refer to waters that are tapped for domestic purposes or those which support wildlife and fishery activities within declared protected areas, including the buffer zones.	No	There are no water bodies that are tapped for domestic purposes

ECA CATEGORIES		TECHNICAL DESCRIPTION (BASED ON ANNEX 2-1A OF THE REVISED PROCEDURAL MANUAL OF DAO 2003-30)	PRESENT IN PROJECT AREA?	REMARKS
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	Mangrove areas shall be characterized by one or any combination of the following conditions: - With primary pristine and dense young growth - Adjoining mouth of major river systems; - Near or adjacent to traditional productive fry or fishing grounds; - Areas that act as natural buffers against shore erosion, strong winds and storm floods; and - Areas on which people are dependent for their livelihood, pursuant to and taking into consideration *Republic Act 7161*, which prohibits the cutting of mangrove species.	No	The project is more than 3 kilometers away from the nearest coastal area (**Figure 2-4**).
12	Coral reefs characterized by one or any combination of the following conditions: - With 50% and above live coralline cover; - Spawning and nursery grounds for fish; - Act as natural breakwater of coastlines	Characterized by one or any combination of the following conditions: - With 50% and above live coralline cover; Spawning nursery grounds for fish; and Act as natural breakwater of coastlines.	No	The project is more than 3 kilometers away from the nearest coastal areas (**Figure 2-4**).

2.1.1.3 IMPACTS AND MITIGATING MEASURES

2.1.1.3.1 IMPAIRMENT OF VISUAL AESTHETICS

The proposed Silica Sand Quarry Expansion project is perceived to cause impairment of visual aesthetics in the area. Progressive Rehabilitation is to be conducted to minimize visual impacts as well as gradually assist the area's recovery. Upon mine closure, facilities and structures will either be decommissioned or removed from the quarry site or be transferred to the community or LGU for their own beneficial use depending on the agreed closure plan. Visual amenity is defined by the community expectations. Hence, the rehabilitation plan shall be consulted with the host community.

2.1.1.3.2 LAND DEVALUATION DUE TO IMPROPER WASTE MANAGEMENT

Solid waste generation is expected due to normal routine of employees and quarry operations. SEDC strictly implements the company's Waste Management Procedure to ensure proper segregation according to waste category, and consistency on collection schedules. The segregation and collection schedules will be strictly supervised by the Pollution Control Officer. Color-coded receptacles or trash bins were regularly provided to accommodate different type of wastes: biodegradable, non-biodegradable and recyclable wastes. Biodegradable wastes are subjected to Kiln Feeding while Non-biodegradable are collected by responsible LGUs. Recyclable wastes, debris from construction and demolition are collected by an outsourced scrap buyer. Hazardous and Electronic wastes are disposed through a DENR-accredited Treater.

The SEDC Waste Management Procedure is formulated in compliance with the Republic Act 9003-Ecological Waste Management Act, and Republic Act 6969- Hazardous, Nuclear, and Chemical Waste Management Act.

2.1.2 GEOLOGY

2.1.2.1 LOCAL GEOLOGY

The middle Miocene Luka Formation underlies an area along the mid-section of the valley. It is along the axis of the north-northeast trending anticline. The formation is composed of sandstone and mudstone interbeds with conglomerate and limestone lenses (BMG, 1983). Conformably overlying the Luka Formation is the middle Miocene Uling Limestone. It occupies portions of the northeastern blocks of the claim (approx. 60 hectares). The limestone is generally hard and locally bedded. It exhibits various shades of color from cream to reddish. It is partly porous and coralline. The Uling Limestone is one of the sources of raw materials in the furniture and marble industry in Cebu.

The middle Miocene Toledo Formation mainly occupies the northeast blocks and a portion of the southeast blocks of the claim. It consists of thin to thick bedded sandstone and shale with occasional lenses of conglomeratic limestone and calcarenite. Exposures show cream colored calcareous siltstone and fine-grained sandstone intercalation. The formation also has a tuffaceous facies. Unconformably overlying the older formations is the late Miocene Maingit Formation. The formation is composed of granule to cobble conglomerate with intercalated shale, sandstone, limestone and conglomeratic limestone in the lower part (BMG, First Edition, 1983). The sandstones are generally fine-grained and show variuo colors ranging from dirty white to orange brown. The conglomerates are matrix supported and clasts have smooth edges. The formation occupies the middle portion of the northern blocks of the claim and portions of two blocks of the southern blocks of the claim. Approximate total area occupied by the formation is 215 hectares.

A small portion (approximately 14 hectares) in the southernmost section of the claim is underlain by the late Miocene to Pliocene Upper Marl Member of the Barili Formation. It is poorly bedded, brown, and slightly sandy with thin limestone lenses. It shows various colors from cream to light gray. The beds are calcareous and have micro-fossils (forams). The formation unconformably overlies the older rock formations.

The eastern and southern section of the blocks is underlain by the Plio-Pleistocene Carcar (Limestone) Formation. Except for the Barili Formation, the Carcar Formation unconformably overly the older rock formations. Carcar Formation is dominantly a coralline limestone and poorly bedded to massive. Inclination of bedded facies range from almost flat to 30° which generally dips towards the coastline (northwest). The formation contains abundant micro and mega fossils. Large and small caverns and other types of solution cavities characterized the formation.

Exposures show small cavities and sharp surfaces and edges. The limestone in the Carcar Formation is the main raw material in the manufacture of cement in the province. Quaternary Alluvium covers portions of the northern blocks of the claim and a small section in the south. It is composed of detrital deposits of varying size (clay to gravel) laid along and adjacent to Duangan Creek.

On a macro level, the Maingit Formation appears to occupy the western lower flank of a 4-5 km. wide valley. Clastic sedimentary rock formations mainly underlie the valley section while the upper flanks are occupied by the Plio-Pleistocene Carcar Formation (western and south sides) and Middle Miocene Uling Limestone (eastern side). It is apparent that the clastic sedimentary rocks are more readily eroded compared to the limestone formations on the upper flanks of the valley. Soil cover in the area range from 10.0 cm. to 40.0 cm. The flat lying areas and portions adjacent to the creeks or rivers are cultivated and planted with rice.

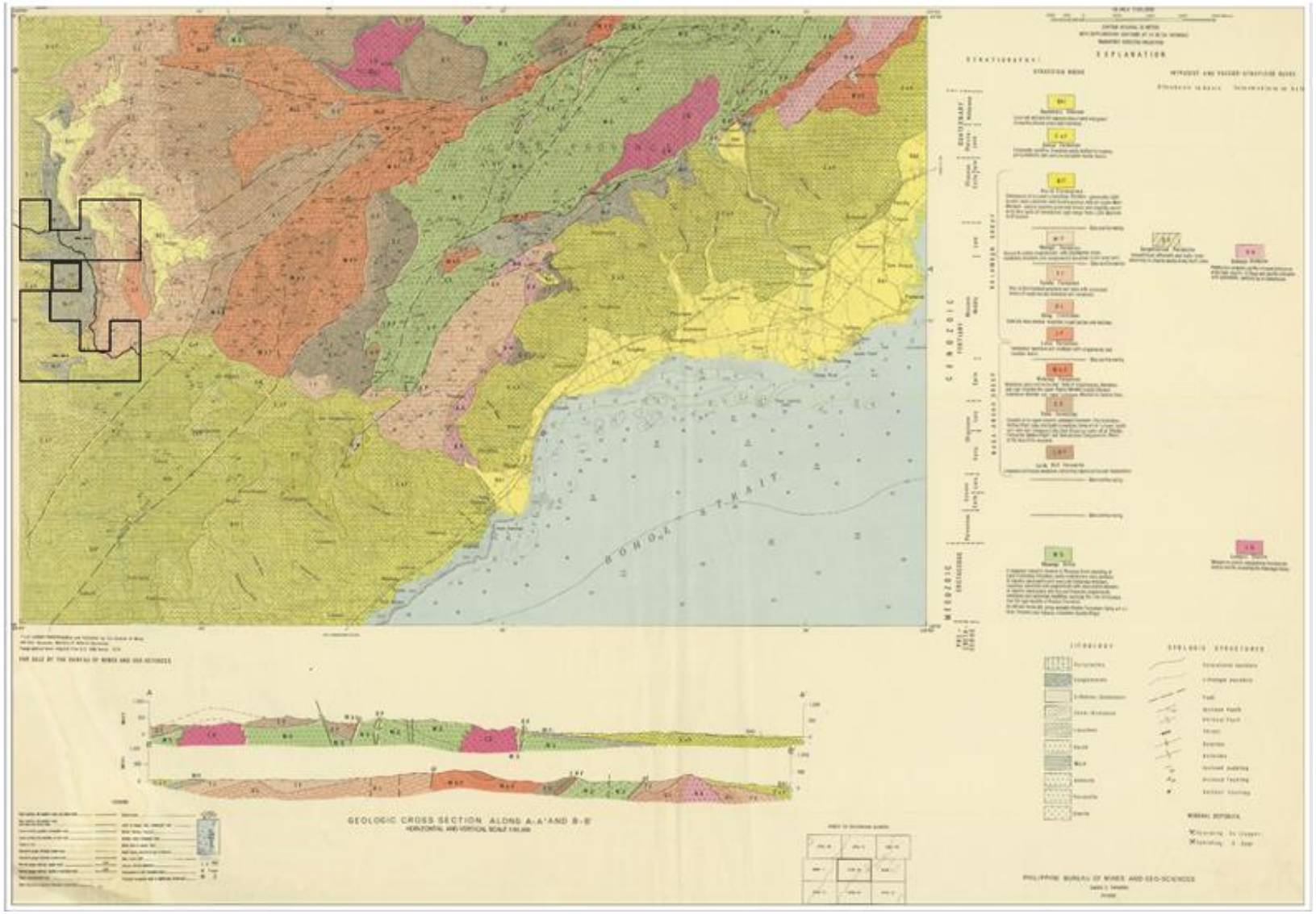


Figure 2-5. Geologic Map of Cebu

2.1.2.2 TOPOGRAPHY

Generally, Cebu province has a rugged topography characterized by highlands that are especially dominant in the central area of the province with narrow land strips along its coast. 62% of the province is identified to be hilly to mountainous with slopes greater than 18% while the remaining 38% is accounted for the flat and rolling lands.

The Municipality of Pinamungajan has mixed topographic reliefs. Inland areas are predominantly hilly but with decreasing elevation and steepness towards the coast. The project area is in the mid to upland portion of Pinamungajan and sits within 75 to 110 masl. The project area has steep slopes more than 50%.

Figure 2-6 shows the topographic features of the project area Pinamungajan, Cebu.

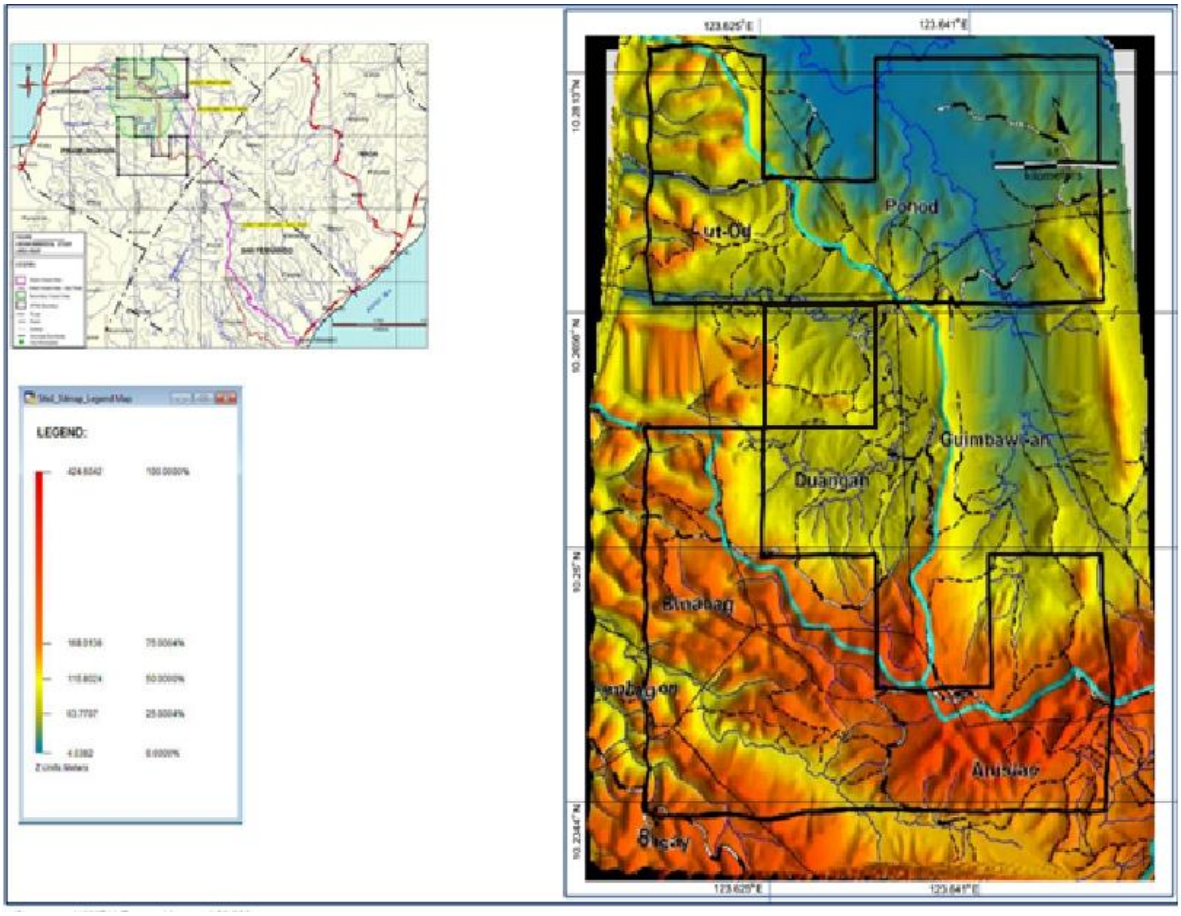


Figure 2-6. 3D Map of Topographic Features of the Project Area

2.1.2.3 GEOMORPHOLOGY

The Cebu mainland narrowly extends 200 kilometers north to south and 20 to 40 kilometers east to west; and is about 40 kilometers wide. The mainland is centrally located in the Philippine physiographic province and surrounded by the Visayan Sea Basin. Bohol Strait separates the Cebu Island from Bohol Island while Negros is separated by the Tañon Strait. Likewise, Leyte is separated from Cebu by the Camotes Sea.

Cebu mainland has mountainous backbone sustained on NNE-SSW axis, parallel to arc-trench system of Sulu Zamboanga-Masbate. The center line or axis of Cebu is approximately 160 kilometers long. This is bordered by intermediated highlands and is heavily dissected by deep narrow valleys with steep slopes. The mountainous backbone was separated into two by slow saddles of about 300 meters high at the narrow waist of the Cebu Island. Maximum elevation in the northern part is 1,013 meters and 884 meters in the Southern part (MGB, 1981). Structurally, it is divided into three areas by Northeast-Southwest trending faults accompanied by minor but vital fault structures. These structural faults dominantly had vertical movements between Cretaceous to Tertiary but later exhibited left-lateral strike-slip displacement during the Pliocene period.

As for the Central highland area, rotational movement of a rhombic fault block consisting of basement rock units has been recorded. Despite of the intrusion of Utopian Diorite, the locus of serpentinite slivers and occurrence of metallic mineralization were controlled by faulting and rifting in the geologic past. The folding of the Pliocene-Pleistocene sediments generally follows the Northeastern trend of fold axes. Meanwhile, the Northern Cebu follows the northwest to north-south fold axes. The coastal plains are limited with coastlines with straight and few harbors– indicating a young wave erosion stage. The shallow marine sedimentary rocks capping the island confirms that a record of emergence towards the Southern part of the Visayan Sea Basin. According to the report of Bureau of Soils, the following are the major landforms and soil types that developed in Cebu:

1. Active Tidal Flats - Having soil material composed of mix river and sea current deposits, characterized by deep, submerged soils with organic fragments such as animal, plant and pronounced micro relief.
2. Broad Alluvial Plains - Whose slope ranges from 0 to 3% - clayey to clay loam, soil accumulation of clay, silt, sand, gravel and fragments of mix volcanic and sedimentary origin, composed of upper river terrace, lower river terrace and coastal alluvial plain.
3. Residual slopes - Nearly level to gently sloping, elevation in limestone area and coastal limestone terrace ranging from 50 to 200 meter above sea level (masl) with slope up to 14%, with clay loam to clay texture. Erosion is slight to moderate.
4. Foot slopes - With elevations ranging from 20 to 25 masl. Erosion is slightly hazardous. Soil at lower foot slope lies on shale/sandstone. Soil is silt loam to clayey soil.
5. Karst Plain Type Rock - Consisting of boulders/stoniness, escarpments and sinkholes in limestone.
6. Plateau - This landform is formed through erosion from higher areas. Elevation ranges from 300 to 365 masl. Sedimentary plateau is moderately deep to very deep soils of clay to clay loam. Erosion is very slight.
7. Sedimentary Hills - Have significant relief and formed by folding and margins of rocks being uplifted by tectonic and volcanic forces. Consisting of slightly dissected limestone hills with low relief, with clay to clay loam; moderately dissected terrain hills with steep escarpments; slightly dissected terrain on limey shale/sandstone low relief; moderately

dissected terrain on limey shale/sandstone; High Relief, soils developed from shale and sandstone ranging from 6 to 38%, soils are moderate to well drained silty clay loam,clay loam to clay; minor karst with predominant sinkhole and infilled, narrow valleys, clay to clay loam soils are severely to excessively eroded; and High Denudation Limestone and Igneous Rock form small and large hills, moderately to highly dissected terrain, shallow soils severely eroded with rock outcrops, slope ranging from 25% to 35% and with elevation ranging from 77 to 170 masl. Major Karst occurs in Pinamungajan Municipality over shallow areas with rock boulders in the surface; and Meta-Sedimentary Rock units with very steep topography and severely eroded boulders; and

8. Mountains - that are well-drained clayey soils consisting of Highly Dissected Steep to Very Steep Limestone Mountain and Highly Steep and Sharp Peaked/Ridge Meta-Volcanic Mountains that are severely eroded with 40 to 60% slopes and with shallow clayey soil.

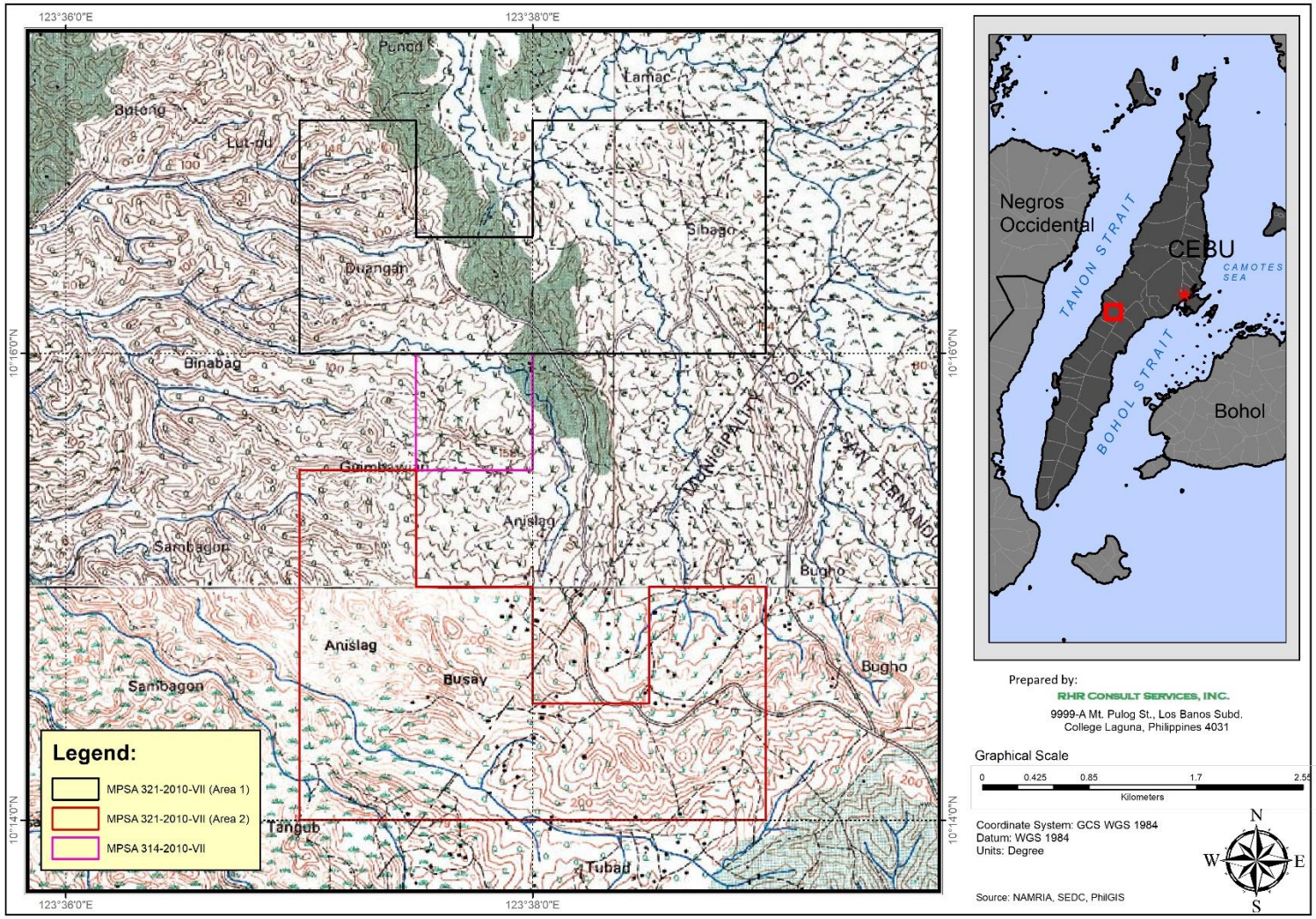


Figure 2-7. Topographic Map of the Project Area

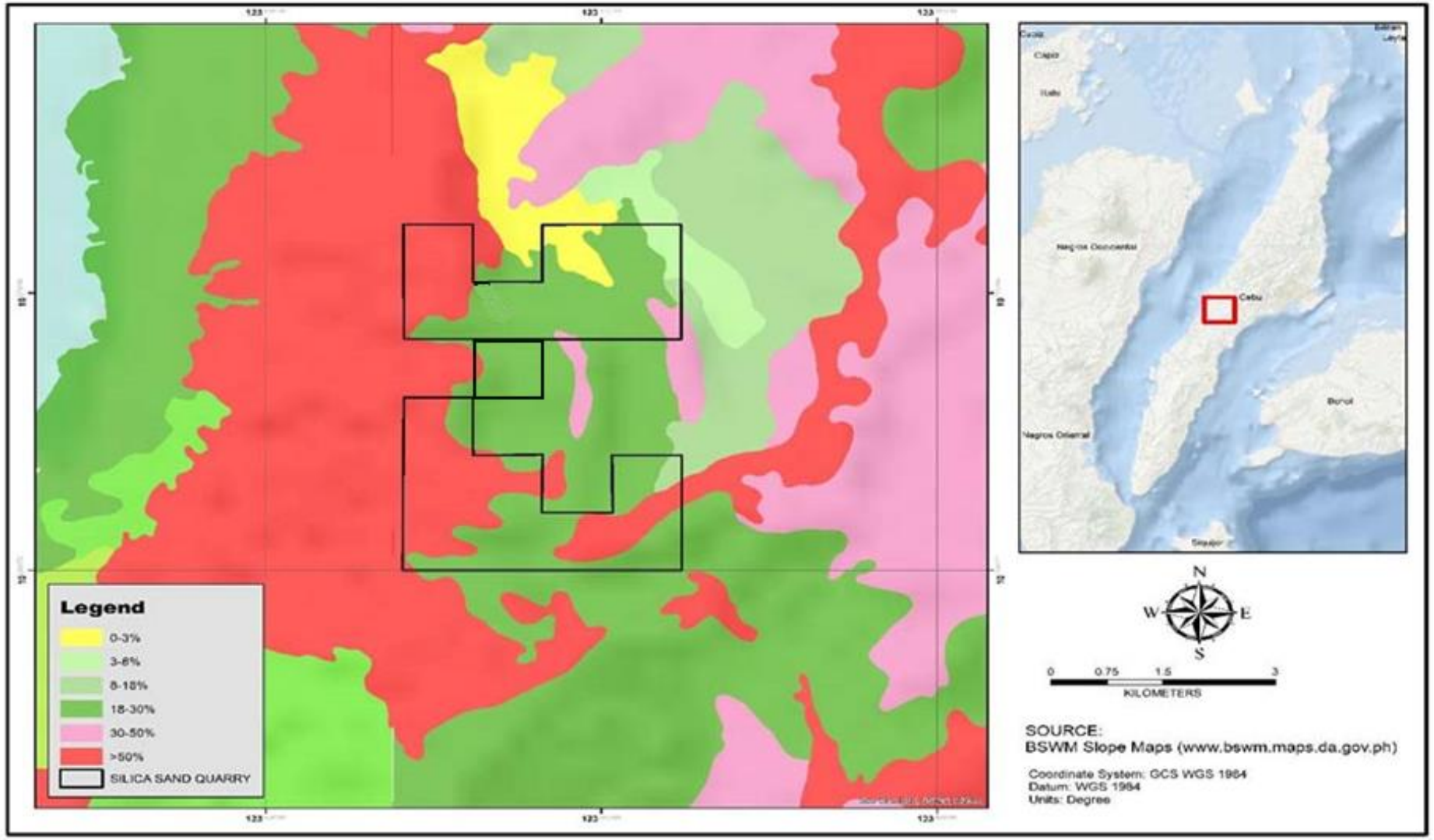


Figure 2-8. Slope Map of the Project Area

2.1.2.4 LITHOLOGY/STRATIGRAPHY

The Lithology and Stratigraphy Column of Cebu (**Figure 2-9**) shows that the province's pre-cretaceous basement rock is represented by metamorphic Jurassic Tunlob Schist comprising chlorite, mica, and amphibolite. The Jurassic Tunlob is carpeted by Cretaceous ophiolite rocks and Mananga Group with inter-tonguing units of Early Cretaceous Cansi Volcanic comprised by massive flows, breccias, and pillow lavas. The Cretaceous rocks are covered by the Tertiary Paleocene Eocene, Oligocene, Miocene, and Pliocene sedimentary formations; consisting of Paleocene Pandan Formation comprised of shallow marine sediments and limestone with intercalated volcanic flows, Eocene-Baye Formation, Early Oligocene-Lutak Hill Formation, and Late Oligocene Cebu Formation, Early-Miocene Malubog/Linut-od Formation, Middle-Miocene Toledo Formation and Bulacao Andesite and Late Miocene Maingit Formations with Talamban Diorite Peridotite; and Pliocene-Barili Formation with limestone; and Quaternary Pleistocene Carcar Formation with Limestone, and Quaternary Holocene Alluvium.

Resurgences of island arc volcanism are indicated by the extrusion of the Bulacao Andesite and intrusions of the Talamban, Bulacao, and Lutopan intrusions and volcanics. Subsequent emergence and submergence of the Visayan Sea basin is stipulated by the series of deposition and erosion of the sedimentary rock formations during Tertiary Era to Pleistocene Epoch. Recent and Quaternary Alluvium are dispersed in the coastal, deltaic and alluvial plains and riverbeds. The notable difference between the coastal limestone and the limestone in the interior highlands is a clear evidence of subsequent submergence and emergence influenced by diastrophism.

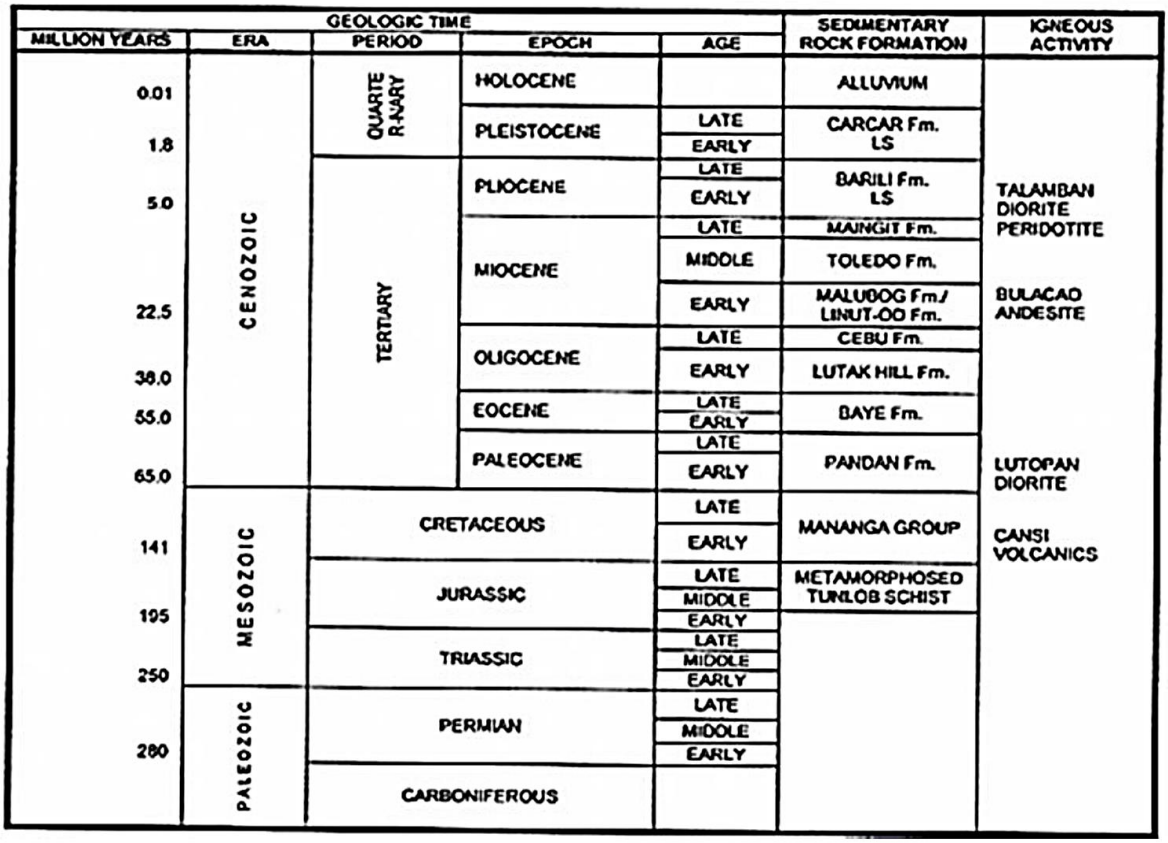


Figure 2-9 Lithographic and Stratigraphic Column of Cebu

The Mines and Geoscience Bureau (MGB) of DENR conducted quadrangle geologic mapping to validate the lithological delineations existing in Pinamungajan, Cebu:

Table 2-3. Rock Formations in Pinamungajan, Cebu

ROCK FORMATION	PERIOD	DESCRIPTION
Quaternary Alluvium (QAI)	Recent	The alluvium is detrital materials, from weathering, erosion and transportation as silt, sand and gravel in riverbanks.
Carcar Formation (CaF)	Pliocene-Pleistocene	The Formation is dated Plio-Pleistocene and overlies unconformably the Maingit Formation and is found on both flanks of the island. It is a dominantly coralline limestone, poorly bedded to massive and partly dolomitic.
Maingit Formation	Late Miocene	Unconformable overlying the Uling limestone and Toledo Formation are granule to cobble conglomerates with inter-bedded shale, sandstone, limestone and conglomeratic limestone in the lower part.
Uling Limestone	Middle Miocene	This limestone is generally hard, massive, partly porous and coralline with a pinkish to reddish colored facie at places.
Toledo Formation	Middle Miocene	As described in the MGB VII report, the formation is composed of granule to cobble conglomerate with interbedded shale, sandstone, limestone and conglomeratic limestone in the lower part.

2.1.2.5 TECTONICS

The Philippine Archipelago is in a dynamic setting due to the convergence of the Pacific and Philippine Sea Plates in the East with the Continental Eurasian and Indo-Australian Plates from the West and Southwest of the Proto-Philippine Island Arc (**Figure 2-10**). The uplifting movement of the Philippine plate is caused by the tectonic activities of its surrounding plates (**Figure 2-11**). This results to various formations such as oceanic trenches, mountain ranges, and volcanic belts. Cebu is tectonically bounded on the east side by the sinistral Philippine Fault system also known as the left-lateral slip. It is also bounded on the west by the West-Facing Quaternary Volcano-Plutonic arc which is connected to the Negros Trench.

2.1.2.6 EARTHQUAKE GENERATORS

Within 200 kilometer radius from the project site, at least 5 earthquake generators were identified by Philippine Institute of Volcanology and Seismology (PHIVOLCS) with four (4) active trenches: Philippine Fault Zone (middle segment), Negros Trench (west of Negros Island), Philippine Trench, and Cotabato Trench (**Figure 2-12**).

Figure 2-13 shows the map of the active fault and trenches in the Philippines while **Figure 2-14** shows the active faults and trenches specific in VII. As observed, there is no major fault line that crosses the project site, which indicates that the area is relatively stable.

2.1.2.7 SEISMICITY

Table 2-4 contains the PHIVOLCS Earthquake Intensity Scale (PEIS) providing the perceived shaking and description per intensity level. **Table 2-5** shows the 4 destructive earthquakes recorded by

PHIVOLCS as observed in Cebu from 1948-2014. The strongest earthquake that hit the Visayan region occurred on January 1948 which recorded a magnitude of 8.3. There are no registered earthquakes of volcanic origin.

Table 2-4. The PHIVOLCS Earthquake Intensity Scale (PEIS)

Intensity Scale	Shaking	Description
I	Scarcely Perceptible	Perceptible to people under favorable circumstances. Delicately balanced objects are disturbed slightly. Still Water in containers oscillates slowly.
II	Slightly Felt	Felt by few individuals at rest indoors. Hanging objects swing slightly. Still Water in containers oscillates noticeably.
III	Weak	Felt by many people indoors especially in upper floors of buildings. Vibration is felt like one passing of a light truck. Dizziness and nausea are experienced by some people. Hanging objects swing moderately. Still water in containers oscillates moderately.
IV	Moderately Strong	Felt generally by people indoors and by some people outdoors. Light sleepers are awakened. Vibration is felt like a passing of heavy truck. Hanging objectsswing considerably. Dinner, plates, glasses, windows and doors rattle. Floors and walls of wood framed buildings creak. Standing motor cars may rock slightly. Liquids in containers are slightly disturbed. Water in containers oscillate strongly. Rumbling sound may sometimes be heard.
V	Strong	Generally felt by most people indoors and outdoors. Many sleeping people are awakened. Some are frightened, some run outdoors. Strong shaking and rocking felt throughout building. Hanging objects swing violently. Dining utensils clatter and clink; some are broken. Small, light and unstable objects may fall or overturn. Liquids spill from filled open containers. Standing vehicles rock noticeably. Shaking of leaves and twigs of trees are noticeable.
VI	Very Strong	Many people are frightened; many run outdoors. Some people lose their balance. motorists feel like driving in flat tires. Heavy objects or furniture move or may be shifted. Small church bells may ring. Wall plaster may crack. Very old or poorly built houses and man-made structures are slightly damaged though well-built structures are not affected. Limited rockfalls and rolling boulders occur in hilly to mountainous areas and escarpments. Trees are noticeably shaken.
VII	Destructive	Most people are frightened and run outdoors. People find it difficult to stand in upper floors. Heavy objects and furniture overturn or topple. Big church bells may ring. Old or poorly-built structures suffer considerably damage. Some well-built structures are slightly damaged. Some cracks may appear on dikes, fish ponds, road surface, or concrete hollow block walls. Limited liquefaction, lateral spreading and landslides are observed. Trees are shaken strongly. (Liquefaction is a process by which loose saturated sand lose strength during an earthquake and behave like liquid).
VIII	Very Destructive	People are panicky. People find it difficult to stand even outdoors. Many well-built buildings are considerably damaged. Concrete dikes and foundation of bridges are destroyed by ground settling or toppling. Railway tracks are bent or broken. Tombstones may be displaced, twisted or overturned. Utility posts, towers and monuments mat tilt or topple. Water and sewer pipes may be bent, twisted or broken. Liquefaction and lateral spreading cause man- made structure to sink, tilt or topple. Numerous landslides and rockfalls occur in mountainous and hilly areas. Boulders are thrown out from their positions particularly near the epicenter. Fissures and faults rapture may be observed. Trees are violently shaken. Water splash or stop over dikes or banks of rivers.
IX	Devastating	People are forcibly thrown to ground. Many cry and shake with fear. Most buildings are totally damaged. bridges and elevated concrete structures are toppled or destroyed. Numerous utility posts, towers and monument are tilted, toppled or broken. Water sewer pipes are bent, twisted or broken. Landslides and liquefaction with lateral spreadings and sandboils are widespread. the ground is distorted into undulations. Trees are shaken very violently with some toppled or broken. Boulders are commonly thrown out. River water splashes violently on slops over dikes and banks.
X	Completely Devastating	Practically all man-made structures are destroyed. Massive landslides and liquefaction, large scale subsidence and uplifting of land forms and many ground fissures are observed. Changes in river courses and destructive seiches in large lakes occur. Many trees are toppled, broken and uprooted.

Table 2-5. Destructive Earthquakes observed in Cebu

TIME	DATE	INTENSITY	MAGNITUDE	EPICENTER	ORIGIN
-	01-01-1948	VII	8.3	Antique	Tectonic
7:30 PM	01-11-1971	VI	5.5	86 km NNW Cebu	Tectonic
3:15 PM	02-08-1990	VI	6.5	24 km from Tagbiliran Bohol	Tectonic
8:12 AM	10-15-2013	VII	7.2	09.86°N; 124.07°E- 6 km S24°W of Sagbayan, Bohol	Tectonic

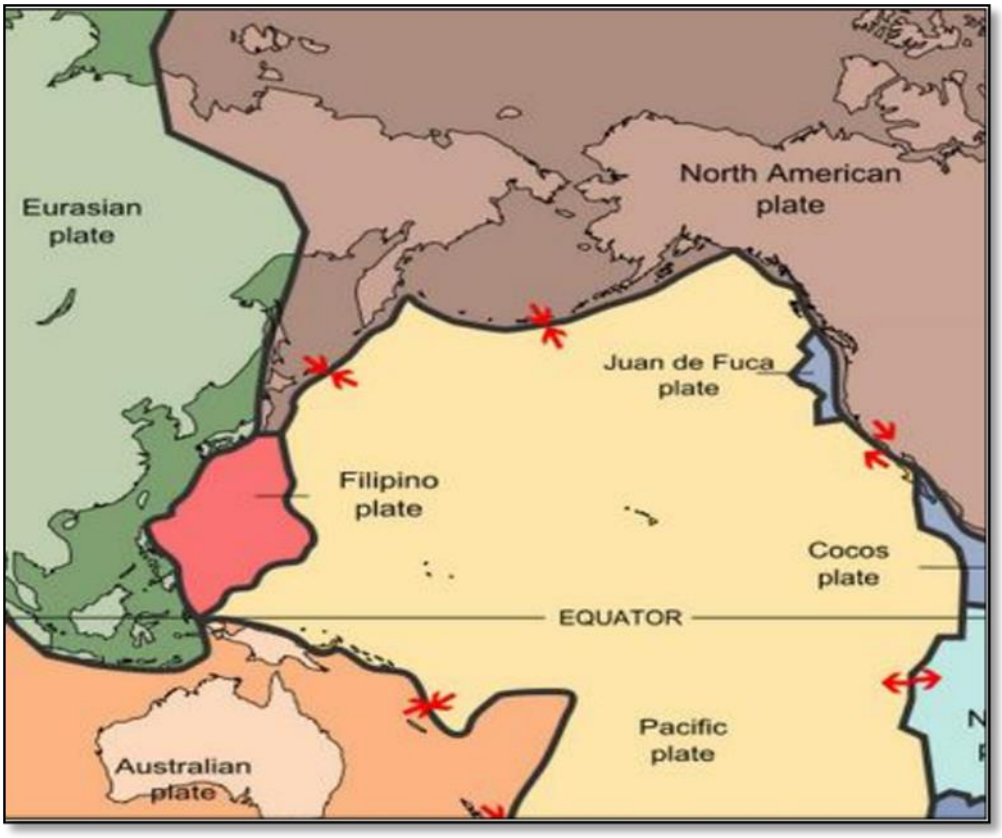


Figure 2-10. Tectonic Plates Surrounding the Philippine Plate

Source: USGS (http://pubs.usgs.gov/publications/text/slabs.html)

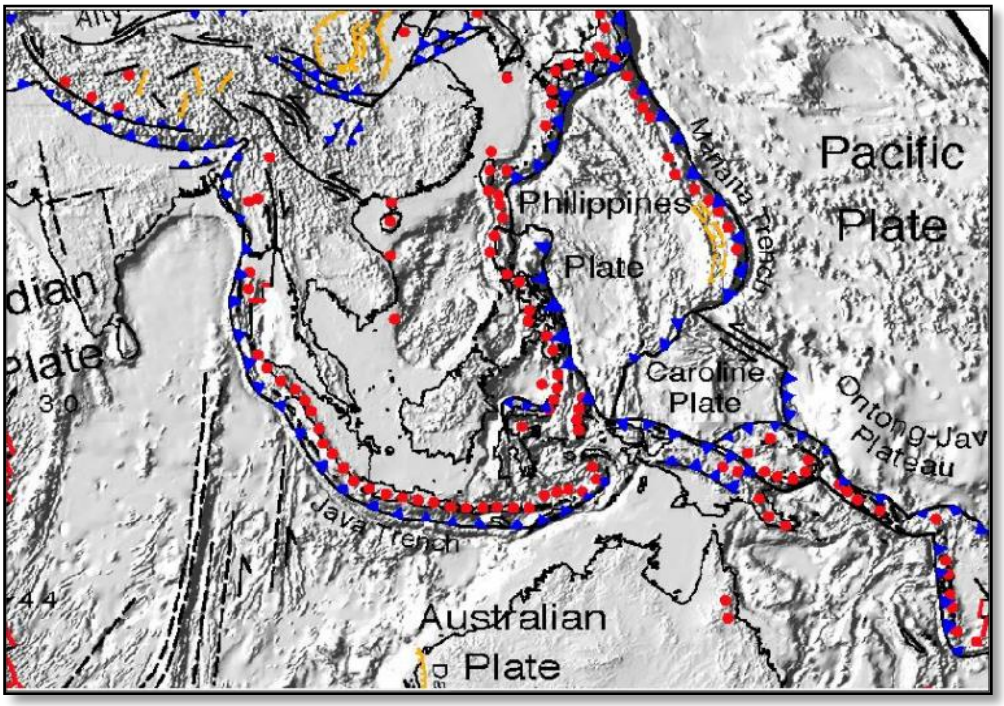


Figure 2-11. Digital Tectonic Activity Map of Earth

Source: National Aeronautics and Space Administration

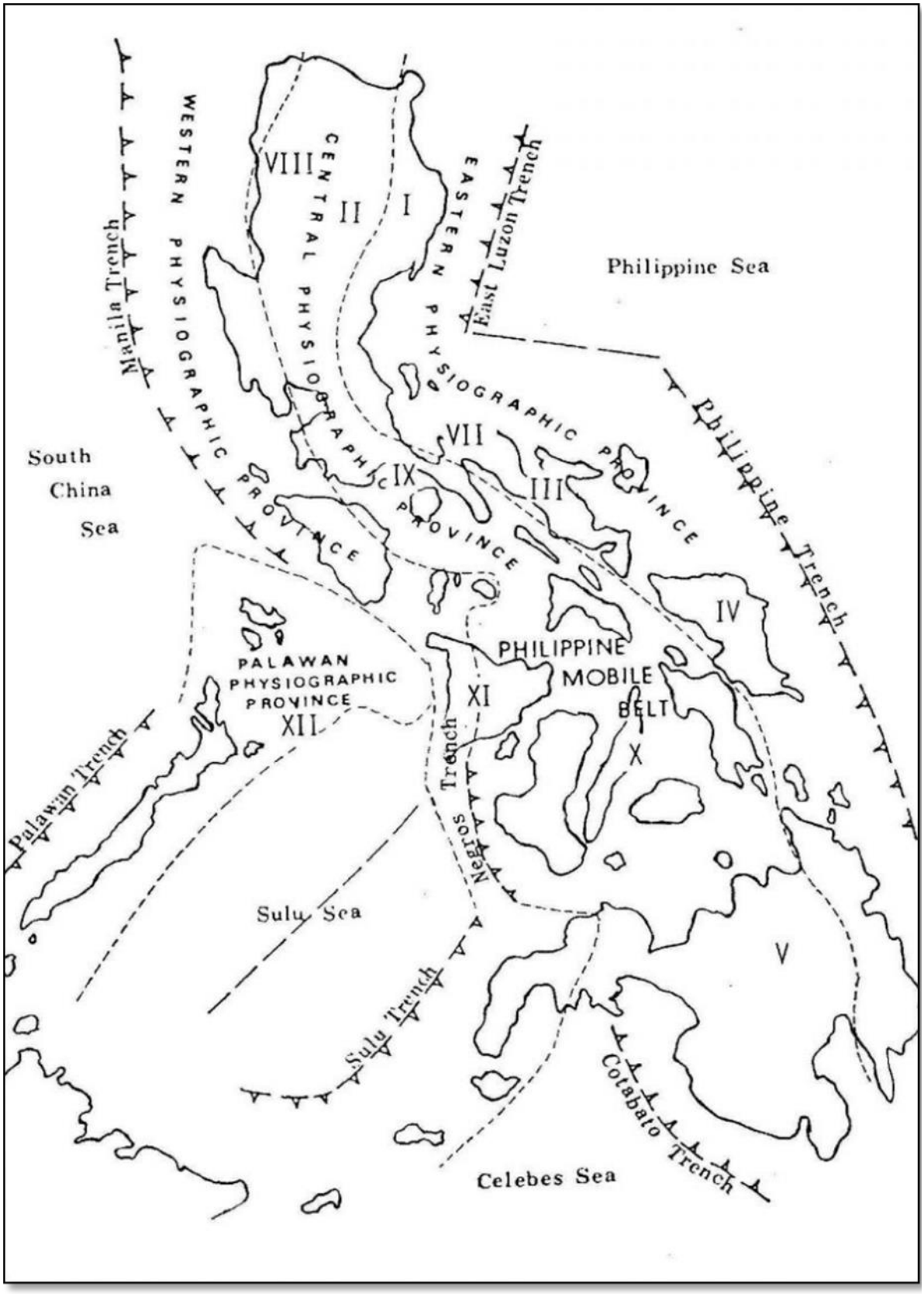


Figure 2-12. Philippine Mobile Belt

Source: Philippine Institute of Volcanology and Seismology

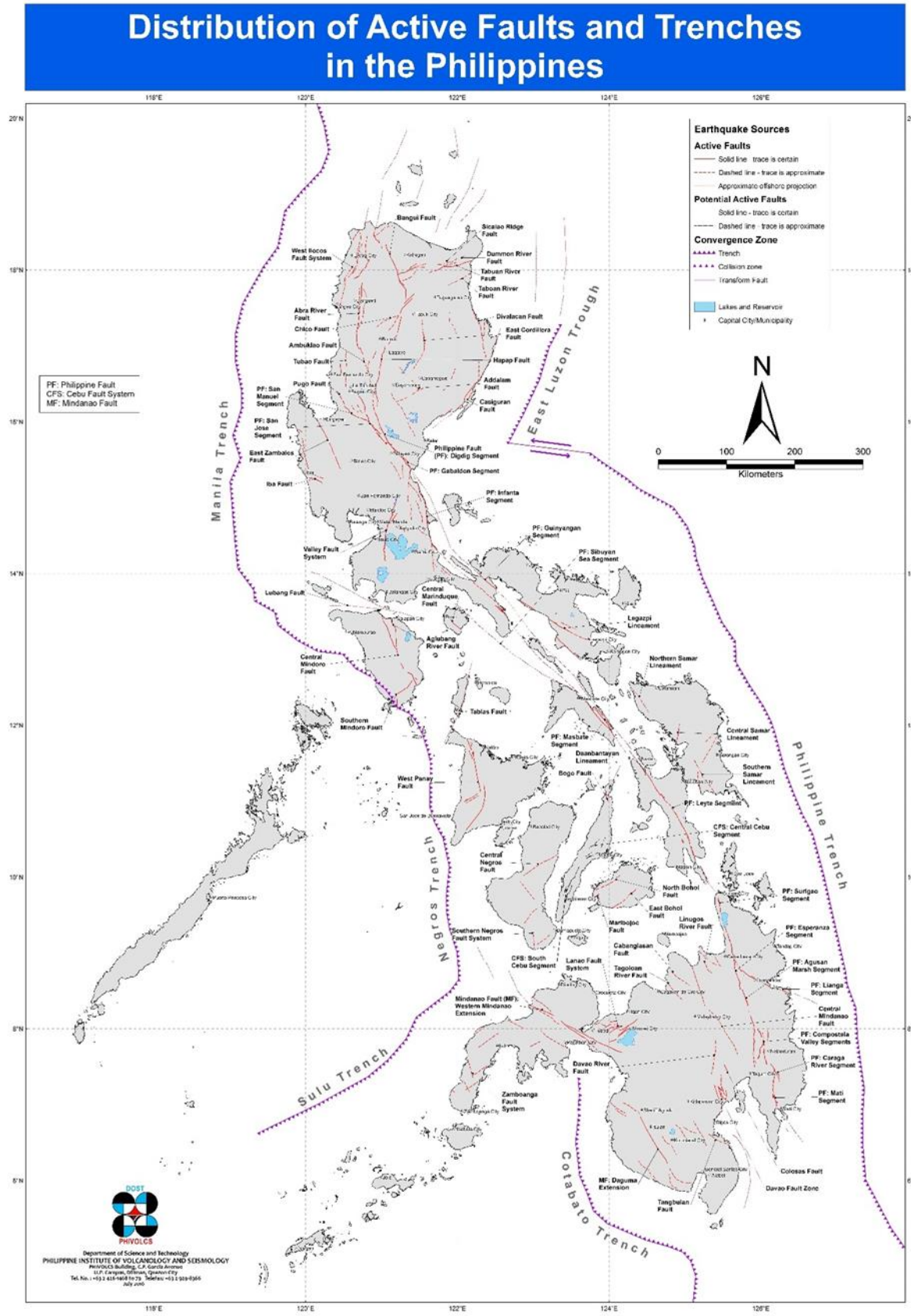


Figure 2-13. Active Faults and Trenches Map of the Philippines
Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

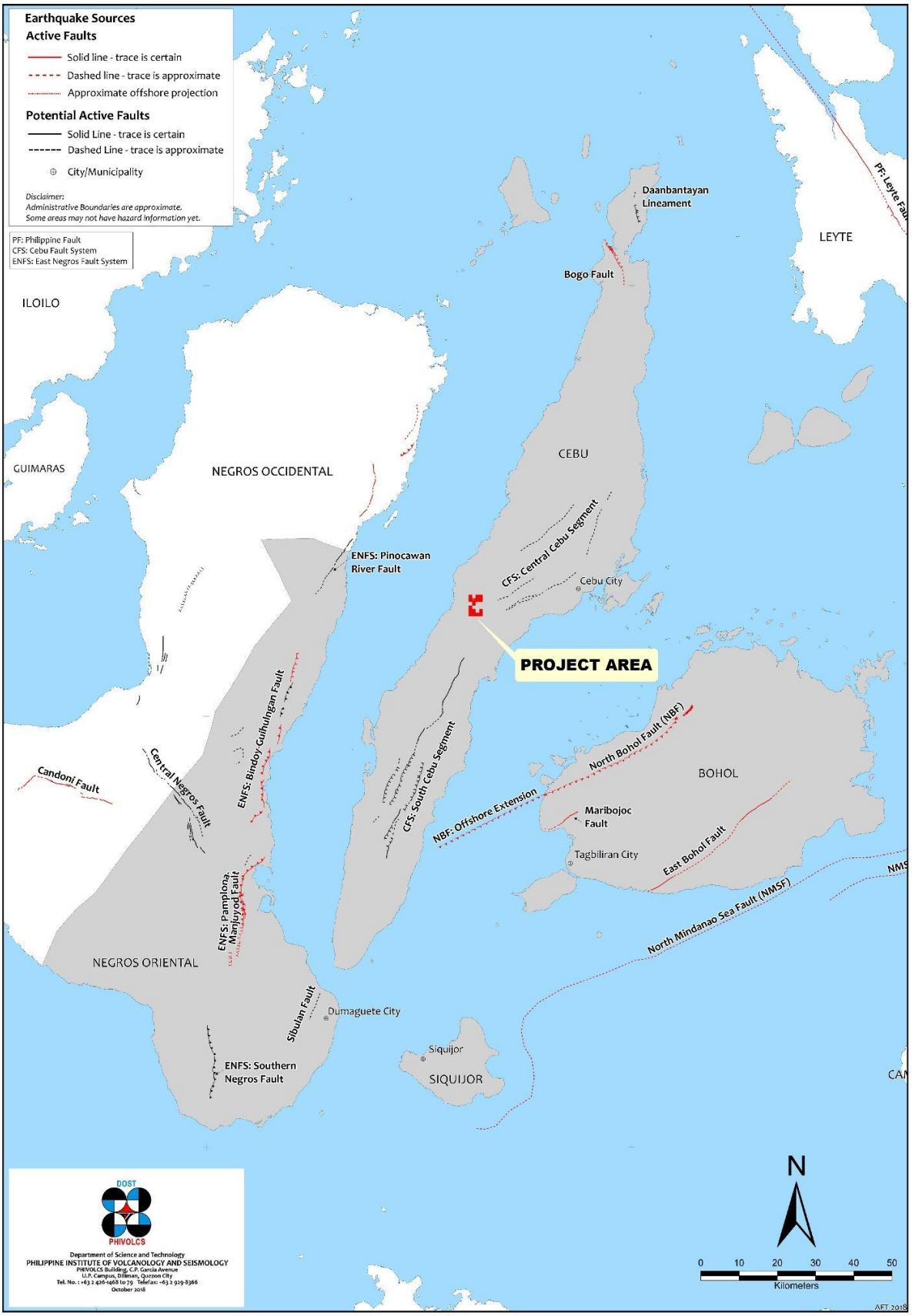


Figure 2-14. Distribution of Active Faults in Region VII

Source: PHIVOLCS (2018)

2.1.2.8 SITE GEOLOGY

The dominant geologic formation underlying the general area of Pinamungajan is the Carcar Formation (CaF), the Maingit Formation (MiF), the Toledo Formation (Tf), the Quarternary Alluvium (QAl) and the Barili Formation (BiF). The rocks underlying the MPSA 314 and 323 areas include:

Carcar Formation (541 ha or 40.4%), followed by the Maingit Formation (357.7 ha or 26.7%), Toledo Formation (220.1 ha or 16.4%), Quarternary Alluvium (118.5 ha or 8.8%), Barili Formation (82.5 or 6.1%) and Uling and Luka Formations (0.9% and 0.7% respectively). There are only two rocks found underlying the production area, the dominant of which is the Maingit Formation (BIF) with a total surface area of 206.8 ha (90.1% of total area), and the Carcar formation (CaF) with a surface area of 22.7 ha (9.9% of total area). **Table 2-6** contains the details of the geologic formation found within the Project MPSAs and the Production area.

Quarternary Alluvium (QAl) is composed of coral reef and detrital deposits, mostly sand and gravel in beaches, alluvial plains and riverbeds. Carcar Formation (CaF) which makes up most of the MPSA area are dominantly coralline limestone; poorly bedded to massive, partly dolomitic and contains abundant marine fossils.

Maingit Formation (MiF) which mostly underlines the production area, are granule to cobble conglomerate with interbedded shale, sandstone, limestone and conglomeratic limestone in the lower part. The Toledo Formation (Tf) on the other hand, is thin to thick bedded sandstone and shale with occasional lenses of conglomeratic limestone and calcarenite. Barili Formation (BIF) is composed of a Lower Limestone Member – generally light brown, hard, coralline and locally porous; and an Upper Marl Member – poorly bedded, generally brown and slightly sandy with thin beds of limestone; age range from Late Miocene to Pliocene. The Uling Limestone (UL) is generally hard, massive limestone; in part porous and coralline, while the Luka Formation (LF) is interbedded sandstone and mudstone with conglomerate and limestone lenses.

MPSA 330 and MPSA 348 Area Geological Map (**Figure 2-5**) shows the areal extent of the two (2) geological formations present within the area namely; the Maingit Formation and the Carcar Formation.

Table 2-6. Geologic Formations within the MPSAs Area

Code	Geologic Formation	MPSA 314-2010-VII		MPSA 323-2010-VII		% of Total MPSA Area	% of Total Production Area
		MPSA Area	Production Area	MPSA Area	Production Area		
BIF	Barili Formation	--	--	82.5	0	6.1	--
CaF	Carcar Formation	11.0	11.0	530.3	11.7	40.4	9.9
Tf	Toledo Formation	--	--	220.1	--	16.4	--
UL	Uling Limestone	--	--	12.1	--	0.9	--
MiF	Maingit	73.1	73.1	284.6	133.7	26.7	90.1

Code	Geologic Formation	MPSA 314-2010-VII		MPSA 323-2010-VII		% of Total MPSA Area	% of Total Production Area
		MPSA Area	Production Area	MPSA Area	Production Area		
	Formation						
Lf	Luka Formation	--	--	9.1	--	0.7	--
QAl	Quarternary Alluvium	--	--	118.5	--	8.8	
Total		**84.1**	**84.1**	**1,257.2**	**145.4**	**100**	**100**

2.1.2.9 MINERALIZATION

The major mineral deposits within MPSA 314 and 323 are silica sand, clay, and limestone.

2.1.2.9.1 SILICA DEPOSIT

There are two types of silica deposits in the area namely the detrital deposit and siliceous sedimentary rocks. To facilitate discussion, the former will be referred to as Type A and the latter as Type B.

Type A deposits are likely products of mechanical weathering of the rocks belonging to the Maingit Formation. Type A is usually deposited along or near creeks, creek banks and drainage channels. The silica along the creek and drainage channels has dirty white color. These are primarily fine to coarse-grained silica sand and can be considered as washed. Type A also includes the detrital pebble to cobble size siliceous rocks noted in some areas within the claim. The rocks (stones) are rounded with smooth edges and can be considered as semi-precious. The semi-precious stones include chert (reddish), chalcedony, opal, agate and other varieties of quartz. Accordingly, locals used to gather the silica sand using shovels and sell them to buyers from the town proper. Presently, silica sand is still gathered occasionally for personal use.

Type B deposits refer to the siliceous sandstone, conglomeratic sandstone and conglomerate within the Maingit Formation. The sandstone is fine to coarse grained and color range from dirty white to brownish orange.

The grains are mainly quartz in composition with minor occurrence of dark colored minerals. Outcrops from an abandoned and an active small-scale quarry show an intercalation of siliceous sandstone and conglomeratic sandstone. The pebble to cobble size clasts of the conglomeratic sandstone are rounded with smooth edges indicating a provenance far from the area. The clasts are composed of chert, agate, chalcedony, opal and other varities of quartz. The siliceous materials were likely derived from the weathering of the older rock formations in Central Cebu area. A small-scale quarry for silica is operating at the northeast section of the block. The silica is mainly delivered to the cement plant of Taheiyo Cement Philippines, Inc., located in South Poblacion, San Fernando, Cebu, Philippines.

2.1.2.9.2 LIMESTONE DEPOSIT

The limestone deposit belongs to Plio-Pleistocene Carcar Formation and the middle Miocene Uling Limestone. The former occupies the eastern and southern portions of the claim. The limestone is coralline, porous and bedded to massive. Bedded sections generally trend towards the northeast and dips 15° to 30° northwest. Color varies from white, cream, beige and light brown. Roadcut exposures

show rubbly and marly facies. Close examination shows the rocks have abundant mega and micro fossils. The mega fossils are mainly corals and mollusks. Exposed bedrock is usually hard and characterized by small solution cavities. Highest elevation in areas occupied by the formation is more than 300 meters above mean sea level. Total area occupied by the limestone deposit is approximately 687 hectares.

The limestone deposit of the Uling Limestone (Formation) is generally hard and massive. Bedded sections are also noted. Color of the limestone varies from cream to pinkish red. The limestone shows a smooth surface when cut, resembling marble. Sliced or cut surfaces show presence of fossils which indicate the rock is not marbleized. The limestone is a popular source of raw materials in the marble and furniture industry. Adjacent areas (outside of the claim) are presently quarried. The formation occupies portions of northeastern blocks of the claim. Highest elevation occupied by the limestone is about 155 meters above mean sea level. Approximate area occupied by the deposit is 60 hectares.

2.1.2.9.3 CLAY DEPOSIT

Areas underlain by the Middle Miocene Toledo Formation and Late Miocene to Pliocene Upper Marl Member of the Barili Formation are possible sources of the clay component in cement manufacture. Megascopically, the clastic rock members of the two rock formations show various shades of color from cream to gray. The grayish colored facies are likely to have higher organic matter content. The rocks are generally calcareous and contains abundant forams (micro fossils). Highest elevation occupied by the Toledo Formation is 220 meters above mean sea level at the southeastern section of the claim while the Upper Bsrili Marl is about 260 meters above sea level at the mid-south section of the claim. Approximate area occupied by the clastic rocks is 175 hectares. The company has active quarry sites (San Fernando) in areas underlain by these two rock formations.

2.1.2.10 GEOLOGIC HAZARDS

Geologic Hazards are extreme natural events in the Earth's crust posing threat to life and properties. Examples are volcanic eruptions, tsunamis, flooding, landslides, and earthquake hazards. **Table 2-7** and **Table 2-8** show the hazard assessments for the direct impact barangays in Pinamungajan, Cebu. These assessments are generated using the Hazard Hunter PH- a tool that can be used to generate indicative hazard assessment reports on the user's specified location. It is helpful as a reference of property owners, buyers, land developers, planners, and other stakeholders needing immediate hazard information and assessment. It aims to increase people's awareness to natural hazards and advocates the implementation of plans to prepare for and mitigate the effects of hazards.

All information used for the calculation of hazard assessment results are based on the most recent updates provided by the corresponding mandated government agencies through the GeoRiskPH Integrated System. GeoRisk Philippines is a multi-agency initiative led by DOST-PHIVOLCS and participated by DOST-PAGASA, DOST-ASTI, DENR-MGB, DENR-NAMRIA, DND-OCD, and DepEd. GeoRiskPH acknowledges the valuable contribution of the Geological Survey of Japan for training the team in developing the application.

Table 2-7. Hazard Assessments of Direct Impact Barangays (Duangan, Lut-od, and Punod) in Pinamungajan, Cebu

Barangay Duangan		Barangay Lut-od		Barangay Punod	
SEISMIC HAZARD ASSESSMENT		**SEISMIC HAZARD ASSESSMENT**		**SEISMIC HAZARD ASSESSMENT**	
Nearest Active Fault	Cebu Fault System: Central Cebu Fault (7.1 km)	Nearest Active Fault	Cebu Fault System: Central Cebu Fault (5.6 km)	Nearest Active Fault	Cebu Fault System: Central Cebu Fault (4.4 km)
Ground Rupture	Safe	Ground Rupture	Safe	Ground Rupture	Safe
Ground Shaking	Prone; Intensity VII	Ground Shaking	Prone; Intensity VII	Ground Shaking	Prone; Intensity VII
Earthquake-Induced Landslide	Safe	Earthquake-Induced Landslide	Prone; Low Susceptibility	Earthquake-Induced Landslide	Safe
Liquefaction	Safe	Liquefaction	Safe	Liquefaction	Safe
Tsunami	Safe	Tsunami	Safe	Tsunami	Safe
VOLCANIC HAZARD ASSESSMENT		**VOLCANIC HAZARD ASSESSMENT**		**VOLCANIC HAZARD ASSESSMENT**	
Nearest Active Volcano	Kanlaon (56.3 km)	Nearest Active Volcano	Kanlaon (57.1 km)	Nearest Active Volcano	Kanlaon (58.2 km)
Pyroclastic Flow	Safe	Pyroclastic Flow	Safe	Pyroclastic Flow	Safe
Lava	Safe	Lava	Safe	Lava	Safe
Lahar	Safe	Lahar	Safe	Lahar	Safe
Permanent Danger Zone	Outside	Permanent Danger Zone	Outside	Permanent Danger Zone	Outside
Nearest Potentially Active Volcano	Mandalagan (59.8 km); No immediate volcanic hazard threat	Nearest Potentially Active Volcano	Mandalagan (59.5 km); No immediate volcanic hazard threat	Nearest Potentially Active Volcano	Mandalagan (60.1 km); No immediate volcanic hazard threat
Nearest Inactive Volcano	Pan de azucar (124.2 km); No immediate volcanic hazard threat	Nearest Inactive Volcano	Pan de azucar (123.1 km); No immediate volcanic hazard threat	Nearest Inactive Volcano	Pan de azucar (123.4 km); No immediate volcanic hazard threat
HYDRO-METEOROLOGICAL HAZARD ASSESSMENT		**HYDRO-METEOROLOGICAL HAZARD ASSESSMENT**		**HYDRO-METEOROLOGICAL HAZARD ASSESSMENT**	
Flood (MGB)	Most likely suitable for development, needs further validation	Flood (MGB)	Most likely suitable for development, needs further validation	Flood (MGB)	Most likely suitable for development, needs further validation
Rain-Induced Landslide (MGB)	Moderate Susceptibility; Possible landslide occurrence	Rain-Induced Landslide (MGB)	Moderate Susceptibility; Possible landslide occurrence	Rain-Induced Landslide (MGB)	Moderate Susceptibility; Possible landslide occurrence
Storm Surge (PAGASA)	Data are being updated	Storm Surge (PAGASA)	Data are being updated	Storm Surge (PAGASA)	Data are being updated
Severe Wind (PAGASA)	117.1 - 220kph (20-year return period); 117.1 - 220kph (500-year return period)	Severe Wind (PAGASA)	117.1 - 220kph (20-year return period); 117.1 - 220kph (500-year return period)	Severe Wind (PAGASA)	117.1 - 220kph (20-year return period); 117.1 - 220kph (500-year return period)

Source: HazardHunterPH (https://hazardhunter.georisk.gov.ph/)

Table 2-8. Hazard Assessments of Direct Impact Barangays (Guimbawian and Sibago) in Pinamungajan, Cebu

Barangay Guimbawian		Barangay Sibago	
SEISMIC HAZARD ASSESSMENT		**SEISMIC HAZARD ASSESSMENT**	
Nearest Active Fault	Cebu Fault System: Central Cebu Fault (5.0 km)	Nearest Active Fault	Cebu Fault System: Central Cebu Fault (3.6 km)
Ground Rupture	Safe	Ground Rupture	Safe
Ground Shaking	Prone; Intensity VII	Ground Shaking	Prone; Intensity VII
Earthquake-Induced Landslide	Safe	Earthquake-Induced Landslide	Safe
Liquefaction	Safe	Liquefaction	Safe
Tsunami	Safe	Tsunami	Safe
VOLCANIC HAZARD ASSESSMENT		**VOLCANIC HAZARD ASSESSMENT**	
Nearest Active Volcano	Kanlaon (58.5 km)	Nearest Active Volcano	Kanlaon (59.7 km)
Pyroclastic Flow	Safe	Pyroclastic Flow	Safe
Lava	Safe	Lava	Safe
Lahar	Safe	Lahar	Safe
Permanent Danger Zone	Outside	Permanent Danger Zone	Outside
Nearest Potentially Active Volcano	Mandalagan (61.5 km); No immediate volcanic hazard threat	Nearest Potentially Active Volcano	Mandalagan (62.3 km); No immediate volcanic hazard threat
Nearest Inactive Volcano	Pan de azucar (125.3 km); No immediate volcanic hazard threat	Nearest Inactive Volcano	Pan de azucar (125.6 km); No immediate volcanic hazard threat
HYDRO-METEOROLOGICAL HAZARD ASSESSMENT		**HYDRO-METEOROLOGICAL HAZARD ASSESSMENT**	
Flood (MGB)	Most likely suitable for development, needs further validation	Flood (MGB)	Most likely suitable for development, needs further validation
Rain-Induced Landslide (MGB)	Moderate Susceptibility; Possible landslide occurrence	Rain-Induced Landslide (MGB)	Moderate Susceptibility; Possible landslide occurrence
Storm Surge (PAGASA)	Data are being updated	Storm Surge (PAGASA)	Data are being updated
Severe Wind (PAGASA)	117.1 - 220kph (20-year return period); 117.1 - 220kph (500-year return period)	Severe Wind (PAGASA)	117.1 - 220kph (20-year return period); 117.1 - 220kph (500-year return period)

Source: HazardHunterPH (https://hazardhunter.georisk.gov.ph/)

2.1.2.10.1 FLOODING

An analysis of the flooding potential in the project site was undertaken though a review of the topographic contours of the area hosting the project, the result shown in **Figure 2-15**.

As observed, a small portion, of 121 hectares or 9.02% of the MPSAs area is slightly susceptible to flooding (F1) due to slopes 0-3%. The baseline condition of the production area is totally without risk of flooding (F0). The larger portion of the MPSA area has mostly no susceptibility to flooding at 1,220.29 hectares representing 90.98% (F0) of total area owing to attendant slopes of 3-8% and above which provide good drainage features.

The flooding potential in the area will not be increased with the alteration of land slope gradients. It is part of the quarry plan to maintain the waterways and lead the drainage ways created within the quarry site, to the settling pond before these drain toward the natural waterways.

2.1.2.10.2 RAIN-INDUCED LANDSLIDES

A small portion of the MPSA 323-2010-VII lies within the flood prone zone specifically along the main tributary of the Cabiangon River (**Figure 2-15**). The production area is not affected by the flooding hazard and is mostly within low and moderate susceptibility to landslide areas. Based on the assessments generated by Hazard Hunter PH, all direct impact barangays are moderately susceptible to rain-induced landslides.

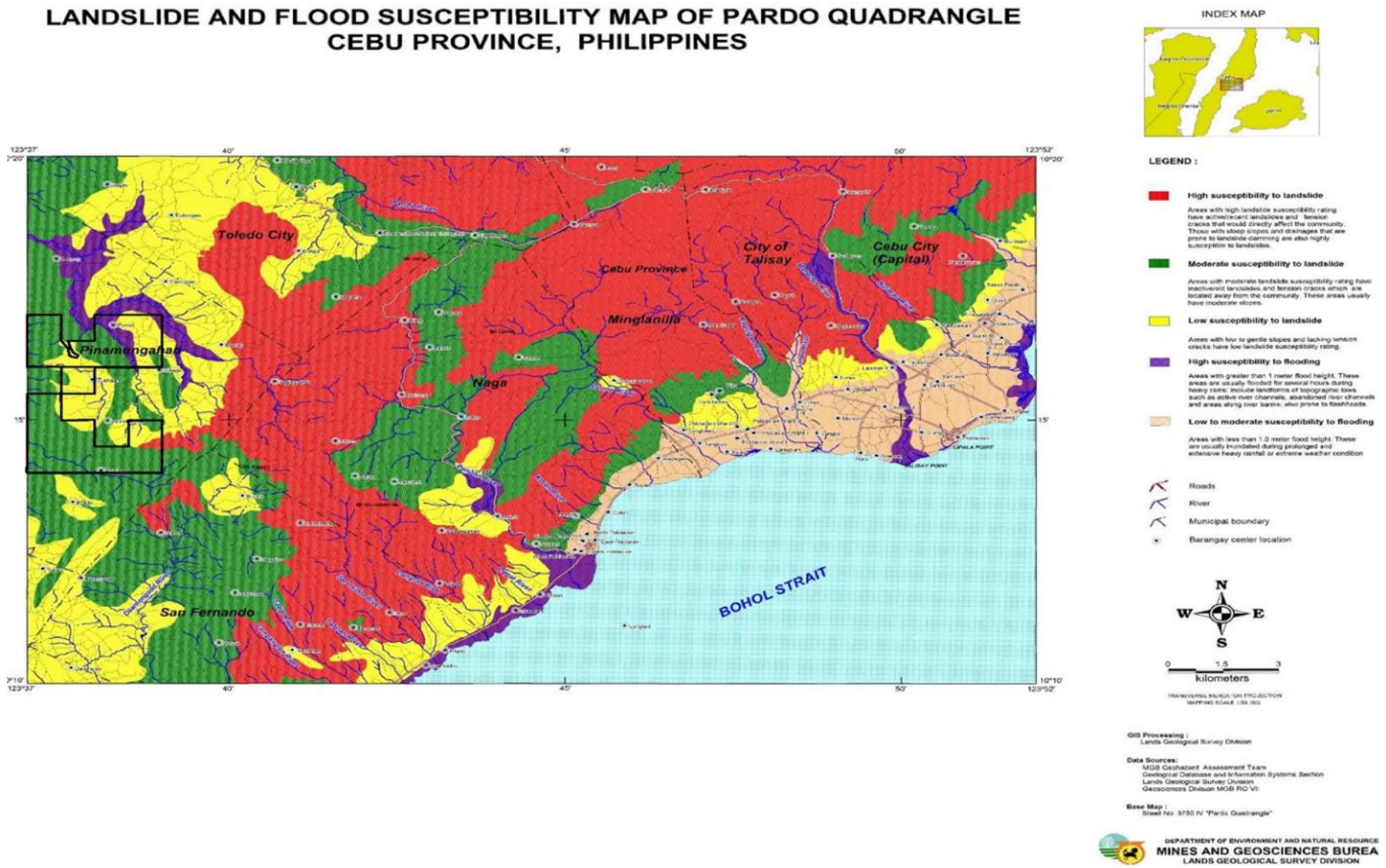


Figure 2-15. Landslide and Flood Susceptibility Map

2.1.2.10.3 EARTHQUAKE AND SEISMIC HAZARDS

2.1.2.10.3.1 TSUNAMIS

Tsunamis are defined by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) as series of waves commonly generated by earthquakes under the sea. These waves can reach more than 5 meters in height. It can occur when earthquake is shallow-seated and strong enough to displace seabed parts and disturb mass of water over it. Aside from under the sea earthquakes, it can also be produced by underwater landslides, volcanic eruptions, and very rare meteorite impacts in the ocean. Tsunamis are usually mistaken for tidal waves and storm surges. There are two types of tsunami generation: Local Tsunami and Far Field or Distant Tsunami. The coastal areas in the Philippines especially those facing the Pacific Ocean, South China Sea, Sulu Sea and Celebes Sea can be affected by tsunamis that may be generated by local earthquakes. Local tsunamis are confined to coasts within a hundred kilometers of the source usually earthquakes and a landslide or a pyroclastics flow. It can reach the shoreline within 2 to 5 minutes. While Far Field Tsunamis are mainly coming from countries bordering the Pacific Ocean and can travel from 1 to 24 hours before reaching the coast of nearby countries.

Philippines is frequently visited by tsunamis. On 17 August 1976, a magnitude 7.9 earthquake in Moro Gulf produced up to 9-meter high tsunamis which devastated the southwest coast of Mindanao and left more than 3,000 people dead, with at least 1,000 people missing. The Mindoro Earthquake on 15 November 1994 generated tsunamis that left 49 casualties.

Figure 2-17 shows the Tsunami Prone Areas in the country. As observed, Cebu Province is prone to offshore fault and submarine landslide related tsunamis. **Figure 2-16** shows the Tsunami Hazard Map of Pinamungajan. The Municipality of Pinamungajan may experience tsunami inundations with height of 1 meter to 4.9 meters. The project sites in Barangay Sibago and Guimbawi-an in Pinamungajan is in central portion which is approximately 7 to 9 kilometers away from the coasts, making it less prone as well.

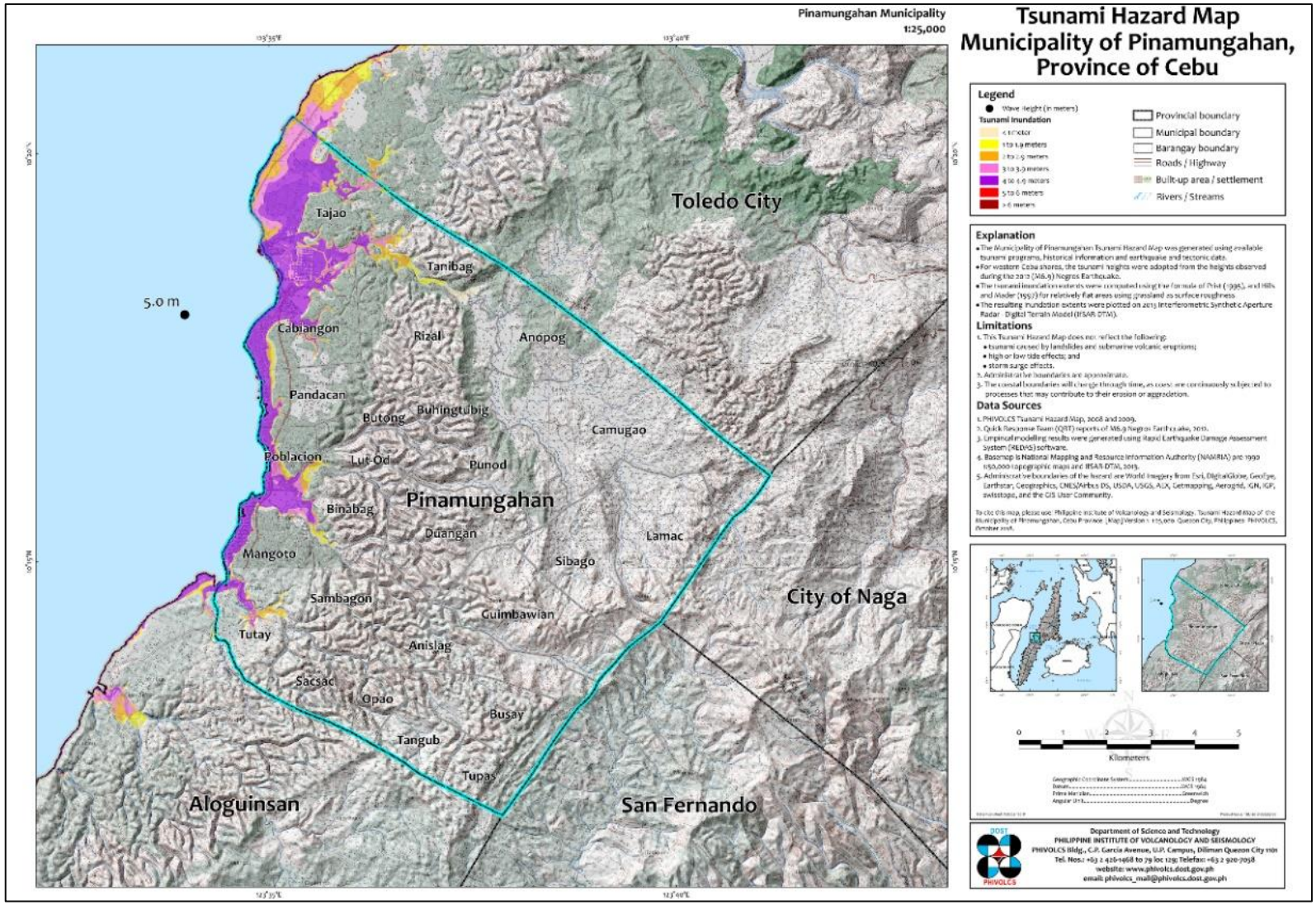


Figure 2-16. Tsunami Hazard Map of Pinamungajan, Cebu

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

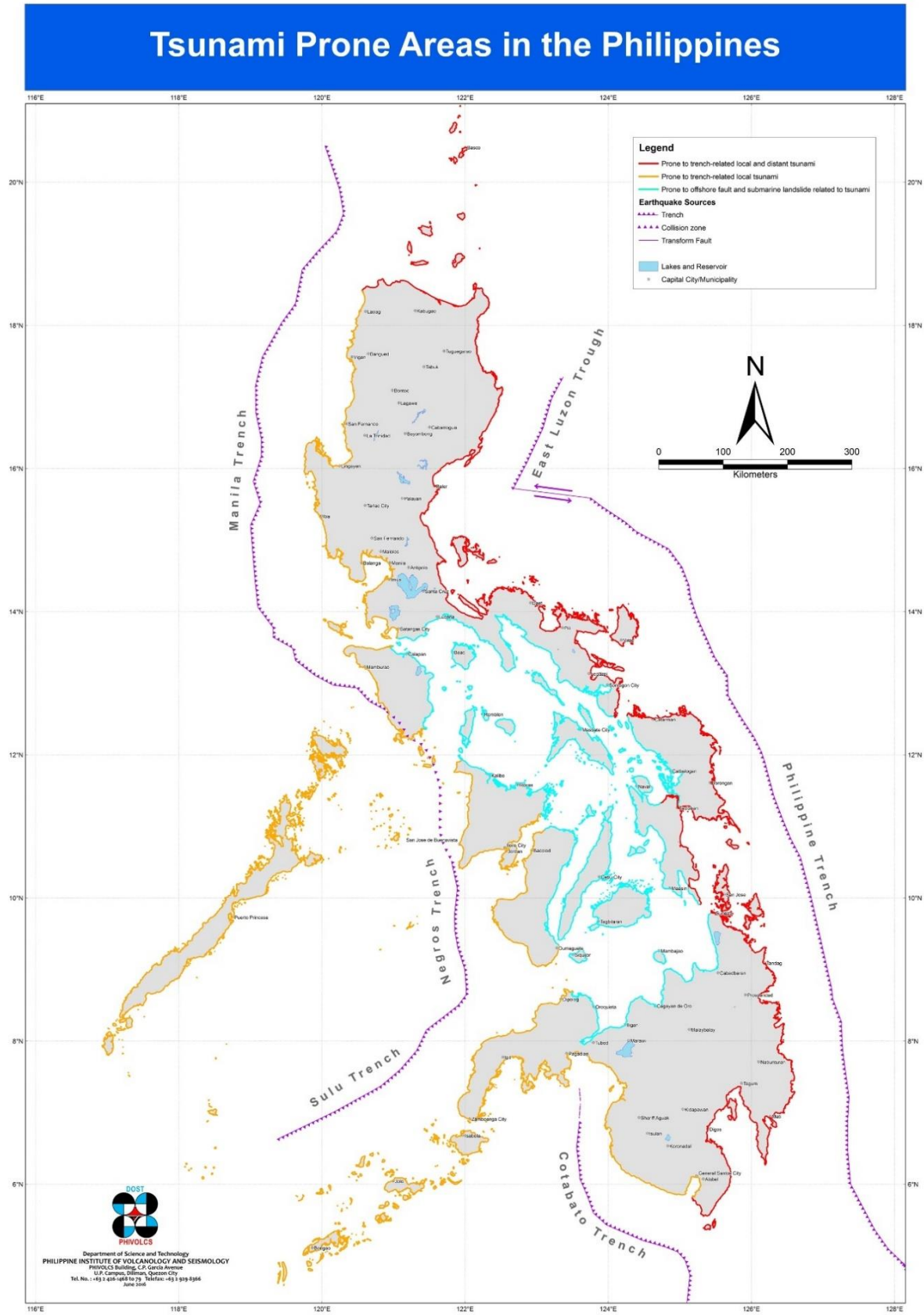


Figure 2-17. Tsunami Prone Areas Map of the Philippines

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

2.1.2.10.3.2 GROUND RUPTURE AND GROUND SHAKING

Ground rupture is the primary earthquake hazard. This is the deformation on the ground when the fault rupture extends to the earth's surface. The HazardHunterPH revealed that project sites in Pinamungajan are safe from ground rupture hazards.

Ground shaking is the second earthquake hazard described as the disruptive upward and downward movement and sideways vibrations of the ground during an earthquake. This may result to damage and collapse of structures and may consequently cause hazards such as liquefaction and landslides. The intensity of ground shaking depends on the magnitude of the earthquake, distance of the epicenter, and the soil conditions of the site. Ground shaking is more intense when the earthquake's magnitude is high, the epicenter is near the site, and if the ground is composed of loose materials.

On 16 July 2012, a magnitude 8.2 earthquake occurred with the epicenter in Bohol. No unusual strong ground shaking was observed in the project site. However, the PHIVOLCS (HazardHunterPH) revealed that Pinamungajan is prone to ground shaking with intensity VII as its highest level.

The Ground Shaking Hazard Map in **Figure 2-18** support the assessment produced by the PHIVOLCS.

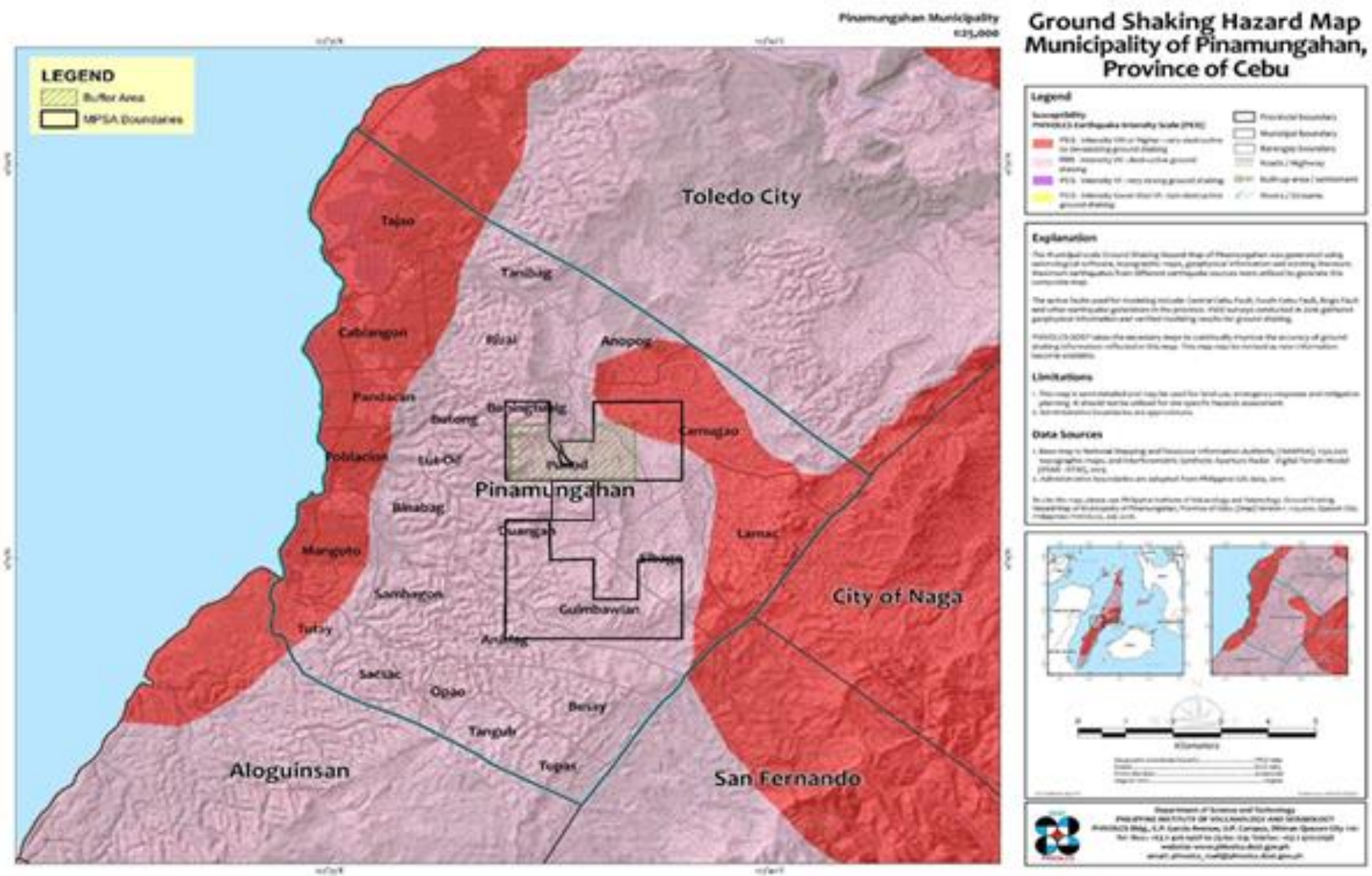


Figure 2-18. Ground Shaking Hazard Map of Pinamungajan, Cebu

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

2.1.2.10.3.3 EARTHQUAKE-INDUCED LANDSLIDES

Earthquake-Induced Landslide is the down slope movement of rocks, solid, and other debris as triggered by strong shakings caused by earthquakes.

In **Figure 2-19**, Pinamungajan is also lowly to moderately susceptible to earthquake-induced landslides. Barangays Duangan, Lut-od, and Guimbawian have most areas with low to moderate susceptibility to earthquake-induced landslides as compared to Barangay Punod and Sibago with only few areas having same susceptibility level.

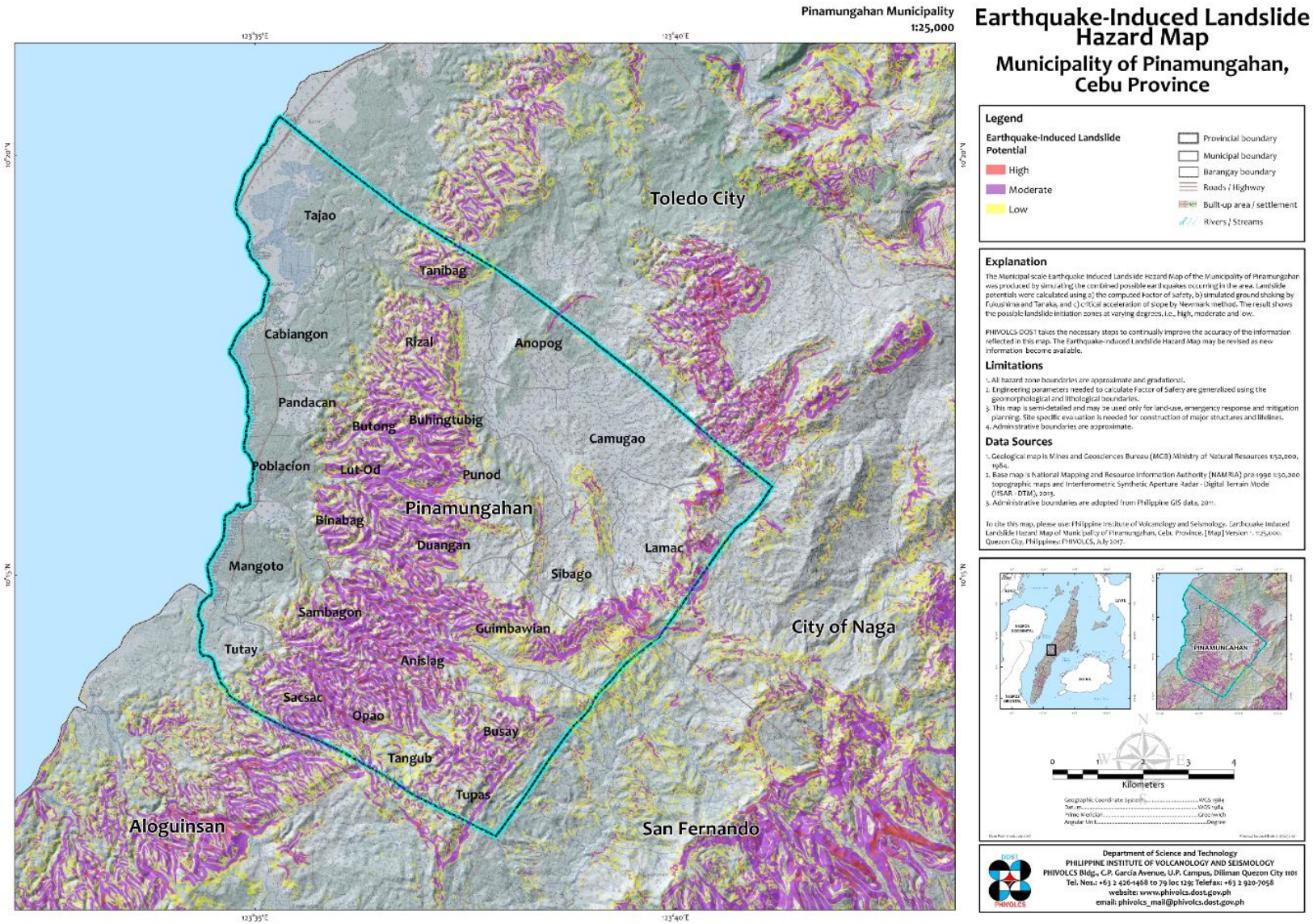


Figure 2-19. Earthquake-induced Landslide Hazard Map of Pinamungajan, Cebu

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

2.1.2.10.3.4 LIQUEFACTION

A seismic hazard phenomenon wherein sediments that are near bodies of water behave like liquid like a quicksand. Liquefaction results to sinking or tilting of structures standing above the sediment. This may also result to fissuring and sand boil. **Figure 2-20** show that project sites in Pinamungajan are safe from liquefaction hazard due to its distance from the coast. The host barangays are centrally located making them less prone to the said hazard.

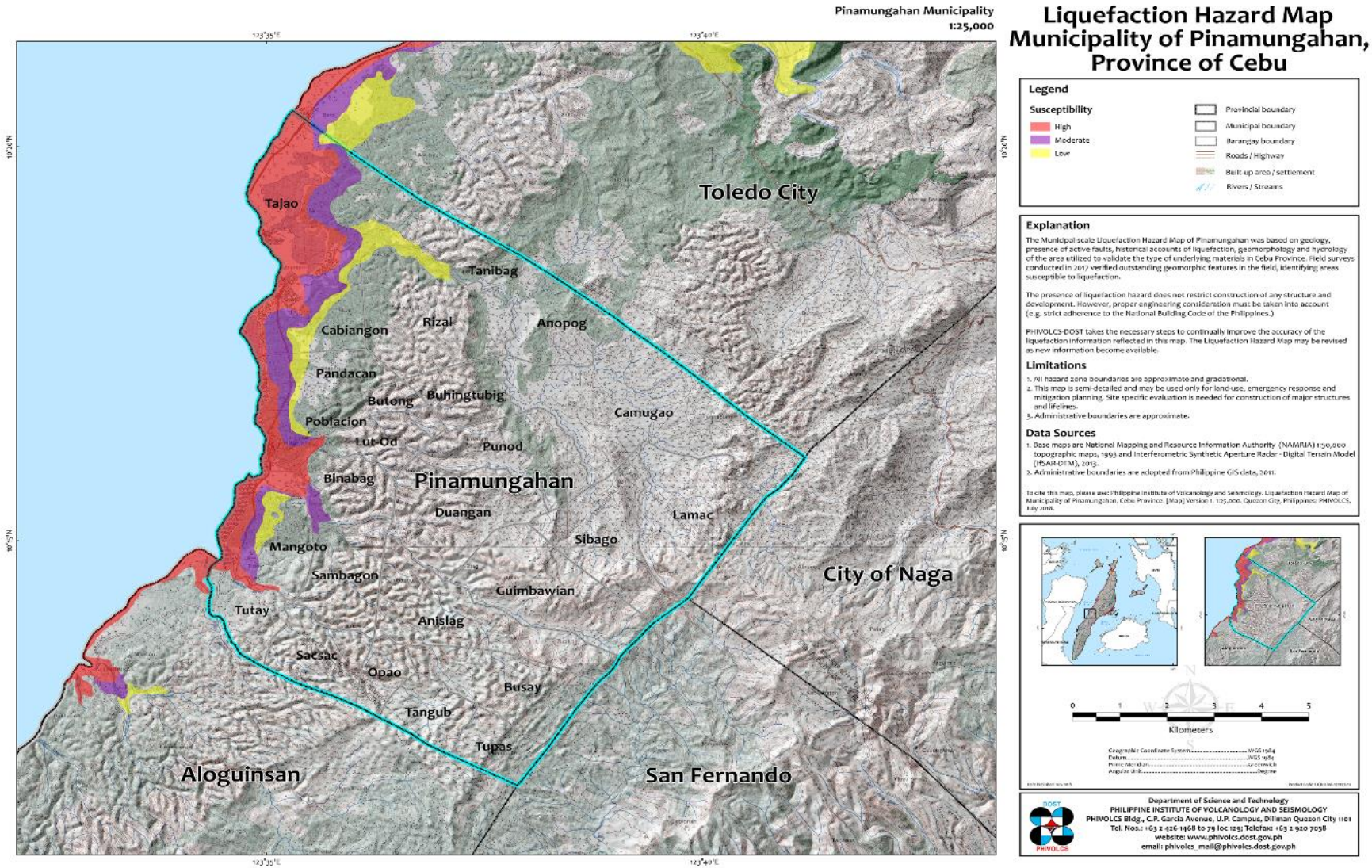


Figure 2-20. Liquefaction Hazard Map of Pinamungajan, Cebu

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

2.1.2.11 VOLCANIC HAZARDS

Figure 2-21 shows the active and potential active volcanoes in the Philippines. As observed, the nearest active volcano to San Fernando and Pinamungajan is the Mount Kanlaon. Mount Kanlaon is a stratovolcano located in Negros Oriental, Philippines.

Based on the Volcanic Hazard Assessments in **Table 2-9**, Mount Kanlaon is about 58 to 60 kilometers away from the host barangays in Pinamungajan and approximately 62 to 64 kilometers away from the host barangays in San Fernando. The project sites are outside the Permanent Danger Zone; Hence, are safe from lahar, lava, and pyroclastic flow. No earthquakes of volcanic origin were recorded.

Table 2-9. Volcanic Hazards Assessment of Pinamungajan, Cebu

VOLCANIC HAZARDS ASSESSMENT					
BARANGAY	NEAREST ACTIVE VOLCANO	LAHAR	LAVA	PYROCLASTIC FLOW	PERMANENT DANGER ZONE
Duangan	Mount Kanlaon (56.3 km)	Safe	Safe	Safe	Outside
Lut-od	Mount Kanlaon (57.1 km)	Safe	Safe	Safe	Outside
Guimbawian	Mount Kanlaon (58.5 km)	Safe	Safe	Safe	Outside
Punod	Mount Kanlaon (58.2 km)	Safe	Safe	Safe	Outside
Sibago	Mount Kanlaon (59.7 km)	Safe	Safe	Safe	Outside

Source: HazardHunterPH (https://hazardhunter.georisk.gov.ph/)

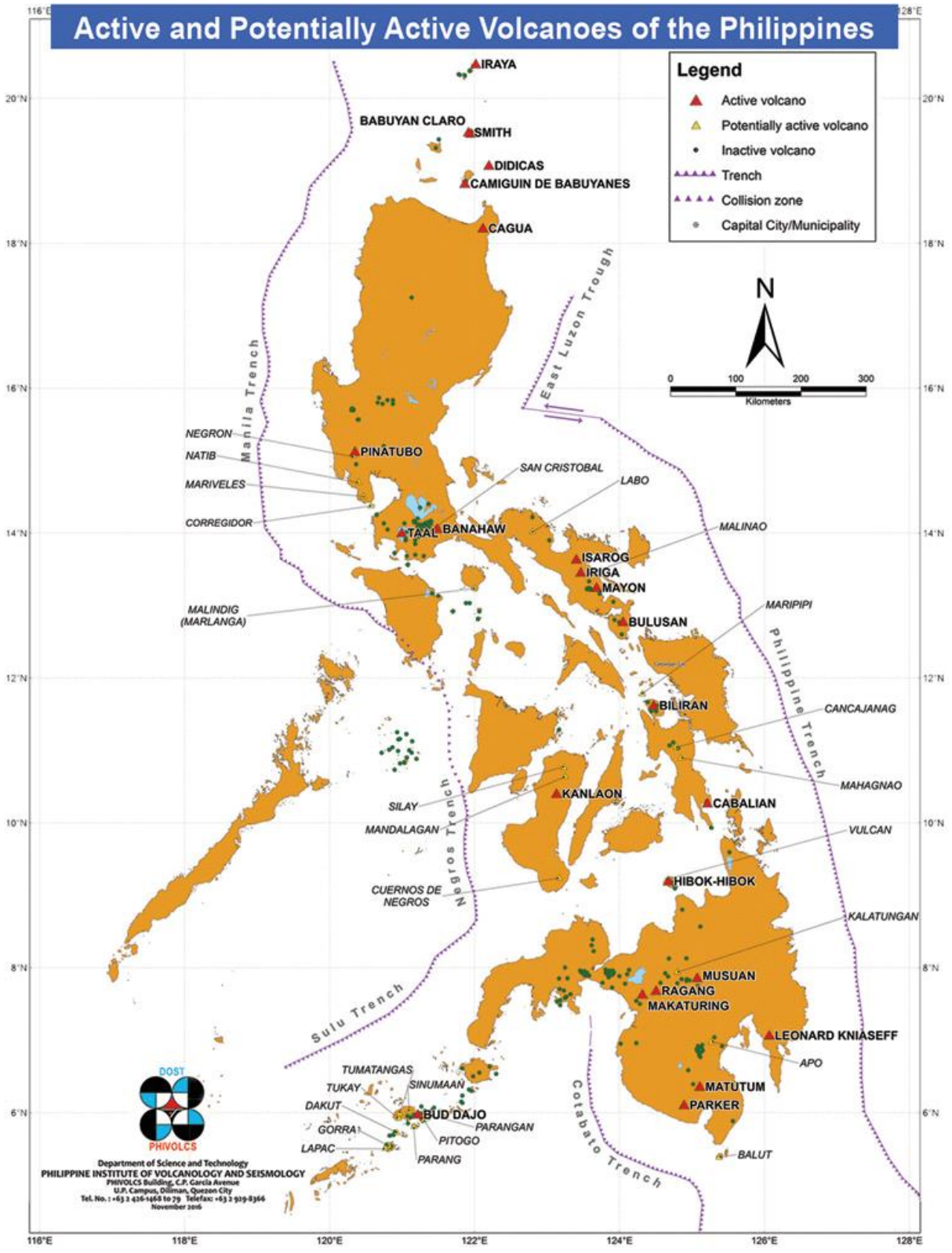


Figure 2-21. Active and Potentially Active Volcanoes in the Philippines

Source: Philippine Institute of Volcanology and Seismology (PHIVOLCS)

2.1.2.12 Mass Movements

Mass movements refer to creeps and slides. Creep is the gradual or slow movement of a ground mass through gravity, regardless if its rock or soil, or a combination of the two. On the other hand, Slide is the rapid movement of ground materials as stimulated by water flow. The former may occur in gullies that were filled during site grading activities while the latter may occur in steep slopes rendered by cutting.

No landslides leading to any mass movement have been experienced and recorded within the SEDC mine area in San Fernando since the beginning of the quarry operations. The project engineers claimed that this is due to the stiff soil material of the project site. Similarly, Pinamungajan has not recorded any mass movement incidents in the quarry area.

The proponent shall prevent potential landslides and mass movements through careful and methodical slope excavation and by sophisticated designing of drainage, contour canals, and water ways. The contour canals shall maintain a 2-3% vertical alignment of slope to hasten the draining process of surface run-off towards the settling pumps and manage the infiltration of actively quarried slopes. Naturally steep slopes will be modified and stabilized. A batter height of 5 meters with bench width of 5 meters will reduce area susceptibility to landslide by reducing the sections with critical slopes (more than 18% gradient).

2.1.3 Pedology

Soils are critical component of landscapes and terrestrial ecosystems. It is the mixture of minerals, organic matter, gases, liquids, and organisms that has developed over geologic time with the interaction of climatic elements, relief (elevation, aspect or orientation, and terrain slope), biotic activities, and parent materials (origin minerals). Over time, soils develop characteristics that are location-specific which are associated to climate and vegetation that were acted upon by numerous physical, chemical, and biological processes (e.g. weathering, erosion, and sedimentation).

Soil performs four important functions: 1) medium for plant growth- a means for water absorption, storage, supply and purification; 2) modifier of atmosphere; 3) habitat for organisms that take part in decomposition of organic matter and the creation of a habitat for new organisms, and 4) management of which are all essential to environmental sustainability of post-mine site rehabilitation. The interactions between the abiotic (geo-system) and the biotic (bio-system) components of ecosystems coupled with human influence (anthropogenic/socio-economic system) produce soil in an ecosystem. Because soil formation is a very slow process (Jenny, 1941), the soil is deemed as a non-renewable natural resource and a fragile component of a certain ecosystems such as watersheds.

2.1.3.1 Soil Types in Pinamungajan

The municipality of Pinamungajan is covered by 7 soil types as shown in **Table 2-10**. Almost half of the total municipal land area is covered by the Lugo Clay which is the residual soil developed from lime and shale. It has a characteristic of black surface soil that is thin averaging to 15 cm. deep. This soil type is usually found in upland roughly rolling to hilly areas which is dissected by numerous gullies and creeks. Though the soil becomes easily wet, water logging or stagnant water in the area do not exist. Soil erosion is severe on this soil type that a greater part of the surface soil, especially along the slopes, has been washed down. The absence of stone or rock outcrops and fine granular structure of the surface make plowing easy, but this plowing causes the high erodibility of the soil. Lugo Clay is highly

suitable for sugar cane, coconut, tobacco, and banana. Banana seems to grow well when grown along gullies.

Manduae Clay Loam is light brown to dark color depending on the amount of organic matter and moisture content. It ranges from 25 to 30 cm in thickness. It is friable when moist, thick, sticky and soft when wet and hard when dry. The substratum is made up of compact clay loam. The greater part of this soil type is planted to lowland rice. The other part which is better drained is devoted to corn, coconut, cassava, and sugar cane or fruit trees.

Beach Sand is an accumulation of wave and current erosion materials from the sea. The scarring effect of the wave against the shores causes the rocks to peel off into fine materials. Such materials are carried by the sea currents, which sort and grind them and later unload them along the shoreline. This soil type is less suitable for agriculture instead it affords excellent site for habitation. The common types of vegetation which grow in this soil type are the creeping legume vines, Bermuda grass, arena shrubs, api-api and wild maguey. Coconut seems to be very well adapted to this soil type Vegetables fertilized and irrigated, also may do well.

Hydrosol type is accumulation or deposit of fine silt, clay and sand forming themselves into a low delta. This have a very poor agricultural value because of their poor drainage and high salt content. The plant accumulation found is the mangrove type consisting of bakuan, api-api, pagatpat, tangal, langoray, nipa palms, and lagolo.

The Faraon Clay Steep Phase is characterized to have very steep slopes as much as 100% with narrow and sharp hill tops. This type is well-drained and is generally more elevated than Faraon Clay type. On the other hand, the Faraon Clay type is with black soil derived from the decomposition of coralline limestone. Water is drained more externally but internal drainage occurs as well. Due to the bulk of water externally drained, the surface soil becomes very plastic and sticky when wet with 10-15 cm in depth. Sugarcane and legumes grow in this soil type due to acid and alkaline reactions taking place in the soil. However, the principal crop grown by local communities are coconut due to its commercial importance; nevertheless, it also helps in protecting soil from erosion.

Bolinao's Clay is clayey, red to bright red in color, with 15 to 20 cm in depth. This soil type is moderately friable, granular when dry, slightly sticky when wet, but does not shrink or crack in open drying. Bolinao's Clay is rich in iron content and organic matter. Hence, can cultivate wide varieties of economically important crops. However, coconut does not grow well in this soil type unless planted near the seashore.

Table 2-10. Soil Types and Area Covered in Pinamungajan, Cebu

SOIL TYPE	AREA IN HECTARES	% TO TOTAL LAND AREA
Lugo Clay	5,793.35	49.4094
Bolinao Clay	2,253.15	19.2162
Faraon Clay Steep Phase	1,513.00	13.5413
Faraon Clay	1,122.75	9.7555
Beach Sand	459.15	3.9159
Mandaue Clay Loam	355.95	3.0357
Hydrosol	153.15	1.3062
TOTAL	**11,725.25**	**100%**

Source: Pinamungajan CLUP 1996-2005

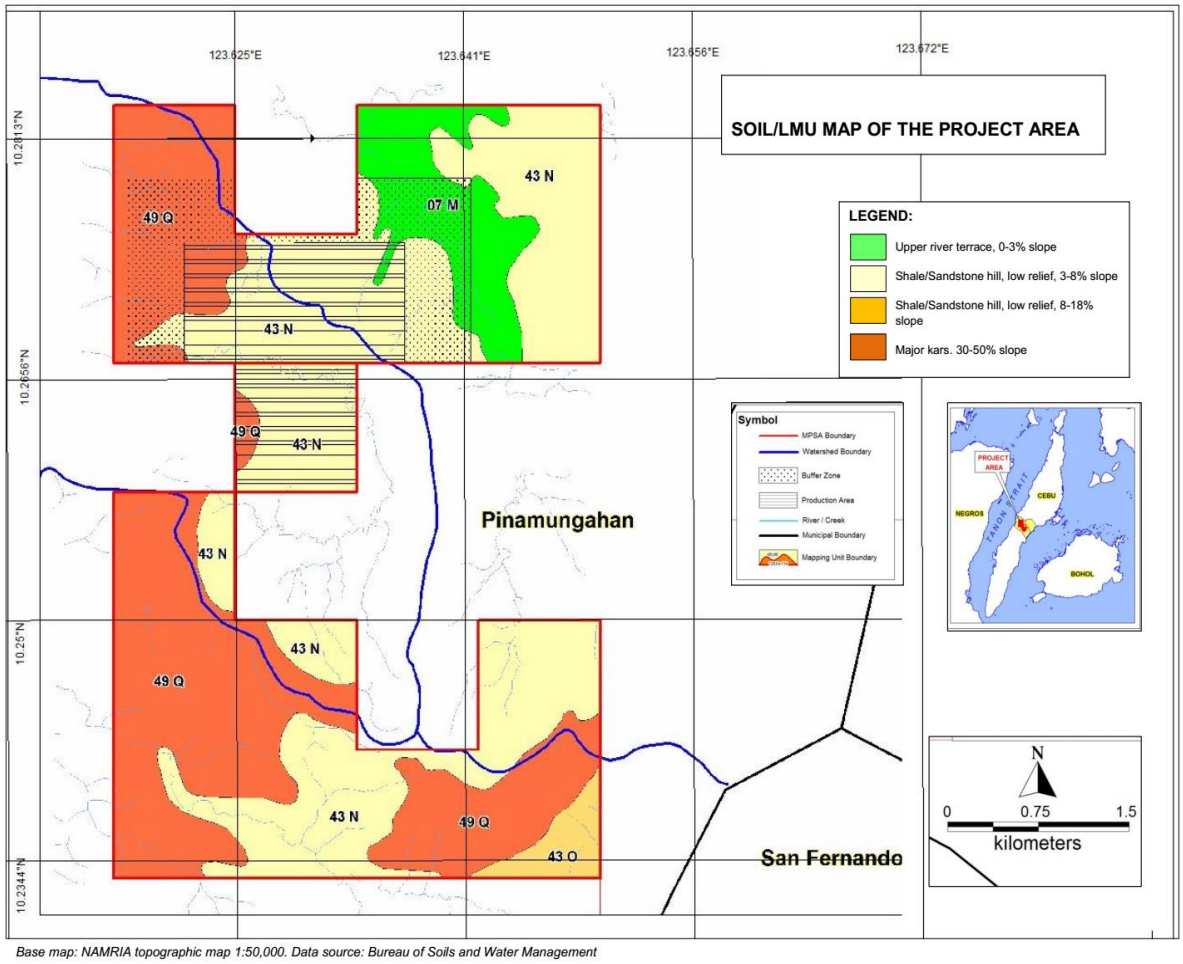
2.1.3.2 SOIL TYPES IN PROJECT AREA

A review of information from the Bureau of Soils and Water Management indicate that the MPSAs largely straddle areas within the "Shale/Sandstone hills", and Major Karst". The "Shale/sandstone" is further divided into two slope categories namely, according to importance: a) Shale / Sandstone Hill with Low Relief with 3-8% slope of 653.2 hectares (48.7% of MPSAs); and b) Shale / Sandstone Hills with Low Relief having 8-18% slopes encompassing 31.42 hectares (2.34% of MPSAs). The Major karst with slopes between 30-50% makes up 535.66 hectares (39.94% of MPSA). The other land management unit category found within the MPSAs is the "Upper River Terrace" with slopes 0-3% with slopes 3-8% slope comprising 121.04 hectares or 9.02% of the MPSAs.

The soil types within the low elevations in the production area belong to the Bolinao clay and Faraon clay series associated with shale and sandstone hills and soils in higher elevations (>250 masl), are members with association to karst parent material. The soil characteristics, as influenced by slope aspect and the parent material are the major factor in determining the Land Management Units (LMUs). A land management unit (LMU) is a recurring pattern of land that possesses similar physical characteristics such as landform, parent material, slope, erosion potential, elevation, soil and surface conditions associated with a relatively uniform land use suitability and vegetation cover.

The Project area is predominantly on low relief sandstone hill (48.7% of MPSA area) and the production area is likewise mostly on low relief shale/sandstone hills (80% of production areas). Inasmuch as only the production area will be inevitably changed, focus is trained on the production area whose remaining parts are 20% steep (30-50% slope) major karst.

Table 2-11 details the land management units in the Project Area while **Figure 2-22** provides a graphical representation of the information.



Base map: NAMRIA topographic map 1:50,000. Data source: Bureau of Soils and Water Management

Figure 2-22. Soil/LMU Map of Project Area

Table 2-11. Land Management Units in the Project Area

Slope (%)	LMU	MPSA 323-2010-VII		MPSA 323-2010-VII			TOTAL AREA			%		
		MPSA Area	Production Area	MPSA Area	Production Area	Buffer Zone	MPSA Area	Production Area	Buffer Zone	MPSA Area	Production Area	Buffer Zone
0-3	7 M	-		124.9	2.2	39.6	124.9	2.2	39.6	9.1	0.90	24.0
3-8	43 N	78.7	78.7	585.9	122	54.5	664.6	200.7	54.5	48.3	86.7	33.1
8-18	43 O	-	-	33.1	-	-	33.1	-	-	2.4	0.00	0.00
18-30	44 P	-	-	-	-	-	-	-	-	0.00	0.00	0.00
30-50	49 Q	8.5	8.5	546	20	70.8	554.5	28.5	70.8	40.3	12.30	42.9
>50	88 R	-	-	-	-	-	-	-	-	0.00	0.00	0.00
Total		87.2	87.2	1,289.8	144.2	164.8	1,377.0	231.4	164.8	100	100	100

Source: Bureau of Soil and Water Management, Department of Agriculture

Legend: 07 M Upper River Terrace; 41 N- Limestone Hill, Low Relief; 43 N - Shale / Sandstone Hill, Low Relief, 43 O - Shale / Sandstone Hill, Low Relief; 44 P - Shale / Sandstone Hill, High Relief ; 88 P - Major Karst; 49 Q -Meta-Volcanic Mountain; 88 R - Meta-Volcanic Mountain

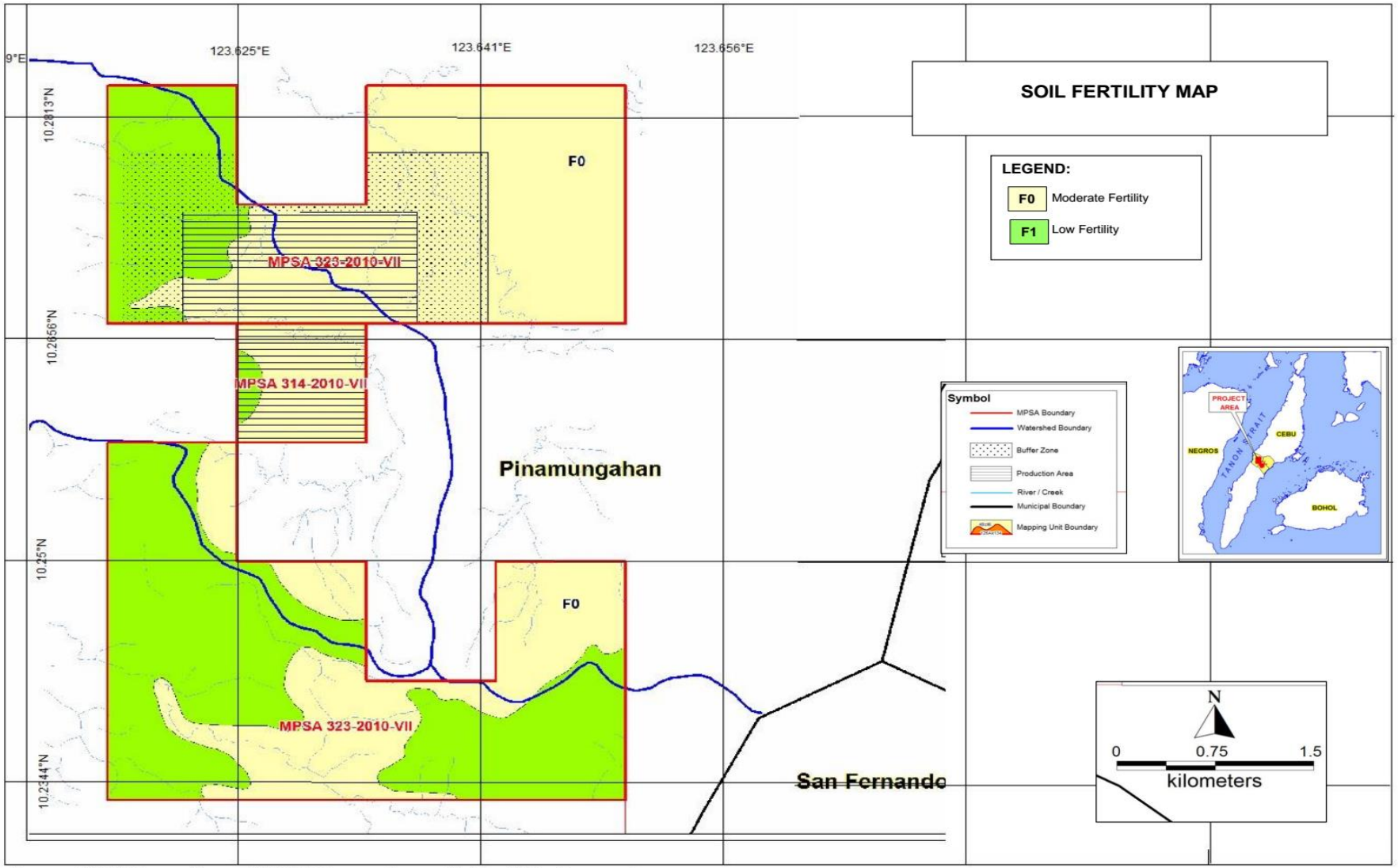
2.1.3.3 Soil Fertility

Area slope, soil parent material, aspect, utilization, land use and cover all influence soil fertility level, the major factors being the parent material, slope and land cover. Based on information from the BSWM-DA, slightly more than half 743.2 hectares of the project area (55.4% of MPSAs) have moderate fertility, while the remaining 598.1 hectares (44.6%) has naturally low fertility level. It can be further

noted that most of the Production area (201.2 ha or 87.6%) fall within the section with moderate fertility level. **Figure 2-23** shows the soil fertility map, while **Table 2-12** provides details on the soil fertility for all portions of the MPSA areas.

Table 2-12. Soil Fertility

Slope (%)	Tag 2	MPSA 323-2010-VII		MPSA 323-2010-VII			TOTAL AREA			%		
		MPSA Area	Production Area	MPSA Area	Production Area	Buffer Zone	MPSA Area	Production Area	Buffer Zone	MPSA Area	Production Area	Buffer Zone
3-8	Moderate Fertility	75.8	75.8	667.4	125.4	94.8	743.2	201.2	94.8	55.4	87.6	57.1
30-50	Low Fertility	8.4	8.4	589.7	20	71.2	598.1	28.4	71.2	44.6	12.4	42.9
	TOTAL	84.1	84.1	1257.2	145.4	166	1341.3	229.6	166	100	100	100



Base map: NAMRIA topographic map 1:50,000. Data source: Bureau of Soils and Water Management

Figure 2-23. Soil Fertility Map

2.1.3.4 SLOPE

The table below shows the Slope Categories and area covered in Pinamungajan, Cebu.

Table 2-13. Slope Categories and Area Covered in Pinamungajan, Cebu

SLOPE (%)	DESCRIPTION	AREA	% TO TOTAL
0-3	Level to nearly level	2,040.00	17.40
3-8	Gently sloping to undulating	1,860.00	15.86
8-18	Undulating to rolling	1,215.00	10.36
18-30	Rolling to steep	1,365.00	11.64
30-50	Steep	1,935.00	16.50
50 and above	Very steep	3,242.77	27.66
	Built-up Area	67.50	0.58
TOTAL		11,725.27	100.00

Source: Pinamungajan CLUP 1996-2005

2.1.3.5 EROSION POTENTIAL

The table below shows the erosion potential categories and area covered in Pinamungajan, Cebu.

Table 2-14. Erosion Potential Categories and Area Covered in Pinamungajan, Cebu

DESCRIPTION	AREA (in has)	% TO TOTAL AREA
No Erosion	2,264.20	19.31
Slightly	86.60	0.75
Moderately	525.27	4.47
Severely	8,849.20	75.47
TOTAL	11,725.27	100%

Source: Pinamungajan CLUP 1996-2005

2.1.3.6 POTENTIAL IMPACTS TO SOIL AND MITIGATION MEASURES

2.1.3.6.1 CHANGE IN SOIL FERTILITY AND PRODUCTIVITY

The previous small-scale quarry operations have altered the surface soil conditions of the area. The changes in soil conditions are because of the removal of surface materials with relatively higher organic contents. The underlying soil which is rich in CaO and SiO2 is exposed but this is not beneficial for plant growth. This results to decline of soil productivity.

To address this, surface soil restoration with intervention of soil conservation measures will be performed to allow the plant growth and develop a new or re-establish a land use that is beneficial to the local communities. It is expected that population and development pressure from Cebu City will require the development of more areas for mixed use such as for residential purpose, food production, forestation, and institutional structures. Areas identified for food production and agro-forestation will be capped with one-meter thick organically enriched topsoil (through mulching, introduction and maintenance of earthworms, and mixing with bacteria-rich soil from creeks and stream beds) to enable these designated areas support healthy vegetation as planned. The topsoil is important in rehabilitating quarry areas; hence, the removed topsoil during the operation will be used for rehabilitation.

2.1.3.6.2 CHANGE IN SOIL CHARACTERISTICS (SLOPE, AGGREGATION, AND POROSITY)

Quarrying will involve land modification of land surface topography; hence, affecting slope characteristics of the area. Stripping of topsoil, clearing of vegetation, and quarrying may cause accelerated erosion especially on areas with steep slopes. Land cover serves as protection from erosion; thus, clearing and grubbing of vegetation will increase soil erosion by exposing the bare soil to erosive agents such as run-off. The stripped topsoil is loose and highly erodible if no intervention is applied. The exposed soil is more erodible due to low organic matter content and poor soil structure.

The removal of overburden will result to unproductive area which is not suitable for vegetative growth. The excavation activities also compromise the soil aggregation and porosity. Movement of trucks and large machineries is expected to lead to soil compaction causing the infiltration and percolation rates to decline. Furthermore, as the run-off or water is unable to percolate down the soil, it will move across the landscape as surface run-off which increases the possibility of contamination of proximal water bodies or aquatic systems.

To minimize these projected erosion and impacts, progressive rehabilitation must be implemented with proper soil conservation measures. Unnecessary removal of vegetation and land cover shall be avoided. Diversion canals and water ways will be established in disturbed areas to protect them from surface run-off. Lastly, drainage canals shall be constructed to drain “contact run-off” within the disturbed areas.

2.1.4 TERRESTRIAL ECOLOGY

2.1.4.1 TERRESTRIAL FLORA

The proposed Silica Sand Quarry Expansion is to be located at Barangays of Duangan, Guimbawian, Lut-od, Punod, and Sibago in the Municipality of Pinamungajan.

For this study, the following were employed: (1) vegetation analysis of direct and indirect impact areas to conduct inventory of floral species present in the area; (2) assessment and evaluation the existing vegetation, specifically, determination of the biodiversity of the area through computation of applicable and biodiversity indices; (3) review of publicly available information about the project (e.g. previous EIS, monitoring reports, etc) (4) use of baseline data and review of information gathered to determine the possible impacts the project may induce, (4) recommendation of prevention and mitigation measures.

2.1.4.1.1 METHODOLOGY

2.1.4.1.1.1 SITE DESCRIPTION

The sampling was done on June 29-30, 2019 on the direct and indirect impact areas of the proposed project. Two (2) transects with at least three (3) plots each were established within the Project Area and its vicinity to determine the characteristic of the existing vegetation in consideration of the site’s forest cover, land use, and land classification.

As required in Section 1.4 of the approved Technical Scoping Checklist (TSC) for the Project dated 29 April 2019, quadrat sampling was employed for the study. Nestled plots of 10 x 10 m, 5 x 5 m, and 1 x 1 m were laid out according to the vegetation stratification (layers). The distance between sampling plots was approximately 0.5 km depending on the accessibility and terrain of each transect.

The three layers in a forest or vegetation, namely: Canopy/overstorey, intermediate, and understorey/ undergrowth layers were assessed. **Table 2-15** presents the criteria used for plant layer classification. For the canopy layer, a 10 m x 10 m plot was used and trees greater than or equal to 15 cm diameter at breast height (DBH) were measured and recorded. For the intermediate layer, a 5 m × 5 m plot was established randomly inside the canopy plot. Shrubs and saplings were recorded inside the intermediate plot. Lastly, a 1 m × 1 m plot for the understorey layer inside the intermediate plot was established randomly to account for the number of species that included wildlings, herbs, vines, grasses, and shrubs.

Table 2-15. Criteria for the Plant Classification

CLASSIFICATION	DBH (cm)	HEIGHT (m)
Trees	≥ 15 DBH	≥ 3
Saplings, intermediate species*	< 15 DBH	≥ 1
Saplings, undergrowth species**	< 15 DBH	≤ 1

Note: * Tree species and shrubs ** Wildlings of trees, herbs, shrubs, vines, and grasses

Flora species outside established plots were also documented to characterize the vegetation type of the sampling area but not included in computations of ecological parameters. Tracks and coordinates of the sampling stations were recorded using a handheld GPS. Geotagging of photos was also taken as a visual reference of the site.

Table 2-16 presents the geographic coordinates of the flora sampling plots for each transect. Meanwhile, the flora sampling map is presented in **Figure 2-24**.

Table 2-16. Flora Sampling Stations

TRANSECT	PLOT	NORTHING	EASTING
1	1	N 10° 16' 4"	E 123° 38'3"
	2	N 10° 16' 13"	E 123° 37' 45"
	3	N 10° 16' 27"	E 123° 37' 38"
	4	N 10° 16' 11"	E 123° 37' 44"
	5	N 10° 15' 49"	E 123° 38' 14"
2	1	N 10° 14' 40"	E 123° 38' 19"
	2	N 10° 14' 25"	E 123° 38' 20"
	3	N 10° 14' 13"	E 123° 38' 10"

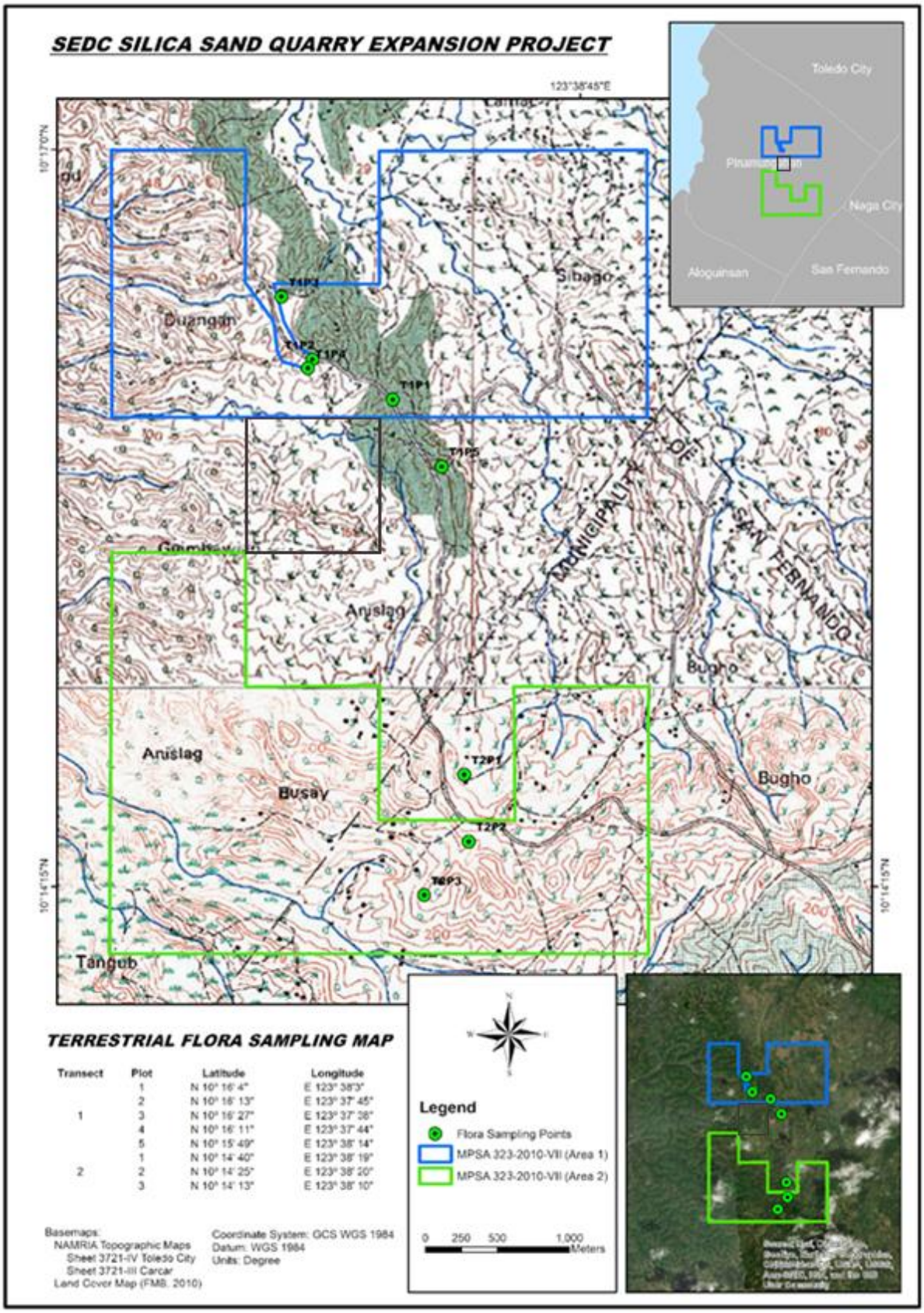


Figure 2-24. Flora Sampling Map

2.1.4.1.1.2 VEGETATION CHARACTERIZATION

A desktop review of publicly available information was conducted to have an overview of the existing vegetation of the Project area. Reviewed data were validated during the field assessment. Using the results of baseline data and desktop review, vegetation cover was described, and the sites were characterized i.e. secondary forest, grassland, and agro-ecosystem type.

Plants found in each sampling plot were identified and classified either as trees or saplings using the criteria in **Table 2-15**. Species that could not be identified onsite were documented properly. Photos of and description of morphological features of the plant were recorded and verified using available published taxonomic literature and the National Herbarium images to identify the species.

Conservation Status

After species identification, the conservation status of each species was checked using the DENR Department Administrative Order (DAO) 2017-11 list and the latest International Union for Conservation of Nature (IUCN) Red List of Threatened Species (www.iucnredlist.org). Conservation status pertains to the probability of a species to survive in the present and in the future with two major categories: threatened and non-threatened. IUCN defined a threatened species as those that fall under categories of either Vulnerable, Endangered, or Critically Endangered. Other categories used by the IUCN are Near Threatened, Least Concern, and Data Deficient.

Endemism

Endemism refers to the restriction of a taxon or species to a particular geographical area of the world. A species is classified as endemic if it is unique to a particular geographic location, i.e., province or country. An indigenous species, on the other hand, is found elsewhere. Introduced species or exotic species are plants that are not native in the area but are planted or cultivated.

The species recorded on the sampling sites were classified into Endemic (En), Indigenous (Ind) and Introduced (Int) based on books and online sources (IUCN database, 2019).

Invasiveness

Invasive species are species that colonize in an area that usually outcompete the naturally growing vegetation. Their presence may result in potential damage to the environment, human economy, or human health.

Using the latest Global Invasive Species Database (www.iucngisd.org), species recorded in the project site were classified as Invasive or Non-invasive.

Biodiversity Indices

The purpose of determining diversity indices is simply to have a quantitative comparison between habitats/ecosystems. In this case, species richness and evenness are the common concepts used.

i. **Species richness** (n) is a number of plant species in a given area[1]
   Species richness (n) = $\frac{number\ of\ species}{transect\ line}$

ii. Shannon diversity index (H')

[1] Wilsey, B. J. and Potvin, C. (2000), Biodiversity and Ecosystem Functioning: Importance of Species Evenness in an Old Field. Ecology, 81: 887–892. doi:10.1890/0012-9658(2000)081[0887:BAEFIO]2.0.CO;2

$$\text{Diversity Index}(H') = -\sum n_i \ln\left(\frac{n_i}{N}\right)$$

iii. **Evenness** (e') refers to how well-distributed the individuals within a community over different species.

Evenness (e') = $\frac{H'}{lnln\ (S)}$

Indices for plant species diversity and evenness were classified using Fernando et al (1998) diversity relative values categories presented in **Table 2-17**.

Table 2-17. Relative values for plant species diversity (Fernando et. al, 1998)

Relative values	Species diversity (H')	Evenness index (e')
Very high	3.50 – 4.00	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	1.99 and below	0.14 and below

Importance Value Index (IV)

Importance value (IV) index is used to determine the overall importance of each species in the community structure. It reflects the influence a species exerts on the ecosystem. The formulas adapted from Magurran (1988) were used to compute for the following parameters:

Population Density is the population count, density per 100 m²

Population Density (De) = $\frac{total\ number\ of\ individuals\ from\ all\ species}{100\ m^2\ or\ hectares}$

Relative Density (RDe) = $\frac{density\ of\ a\ species}{total\ density\ for\ all\ species}$

Frequency is the number of times the species encountered

Absolute Frequency (Fr) = $\left(\frac{No.of\ species\ occurence\ in\ a\ transect}{no.of\ plots\ in\ each\ transect}\right) x\ 100$

Relative Frequency (RF) = $\frac{Absolute\ frequency\ of\ a\ species}{Total\ frequency\ for\ all\ species}$

Species Dominance is the coverage/basal area of a species

Species Dominance (Do) = $0.7854\ (DBH\ in\ cm^2 or\ basal\ area)$

Relative Dominance (RDo) = $\left(\frac{dominance\ of\ a\ species}{dominance\ value\ for\ all\ species}\right) x\ 100$

Importance Value

Importance Value IV = RDe + RF + RDo

2.1.4.1.2 RESULTS

2.1.4.1.2.1 EXISTING VEGETATION

The proposed Silica Sand Quarry Project is located in Barangays Lut-od, Punod, and Duangan in the Municipality of Pinamungajan. Based on the Land Cover Map of Pinamungajan, Cebu (**Figure 2-25**),

the project area is composed of perennial crop and shrubland. This has been confirmed during field sampling as agro-ecosystem, composed of both annual and perennial crop, was observed in most of the project area. Shrub areas were also observed within the steep area and near the river system. Complete photo documentation of the project area is presented in the following discussions.

Plate 2-1. Transect 1 Photos

Transect 1 is a direct impact area traversing the quarry area and its adjacent vegetation. In general, the ecosystem in this area can be described as agro-ecosystem. Planted mangoes (*Mangifera indica*), coconut (*Cocos nucifera*) and farmland of banana (*Musa* sp.) were recorded. Communities or local settlement were also present in the project site hence agricultural activities are common. The quarry area was already stripped of vegetation but patches of Auri (*Acacia auriculiformis*) were still recorded.

Plate 2-2. Transect 2 Photos

Transect 2 is an indirect impact area with agro-ecosystem. It is located south of the project area. Perennial crops such as banana and coconut were common in this area. Planting of annual crops such as maize and cassava were also recorded.

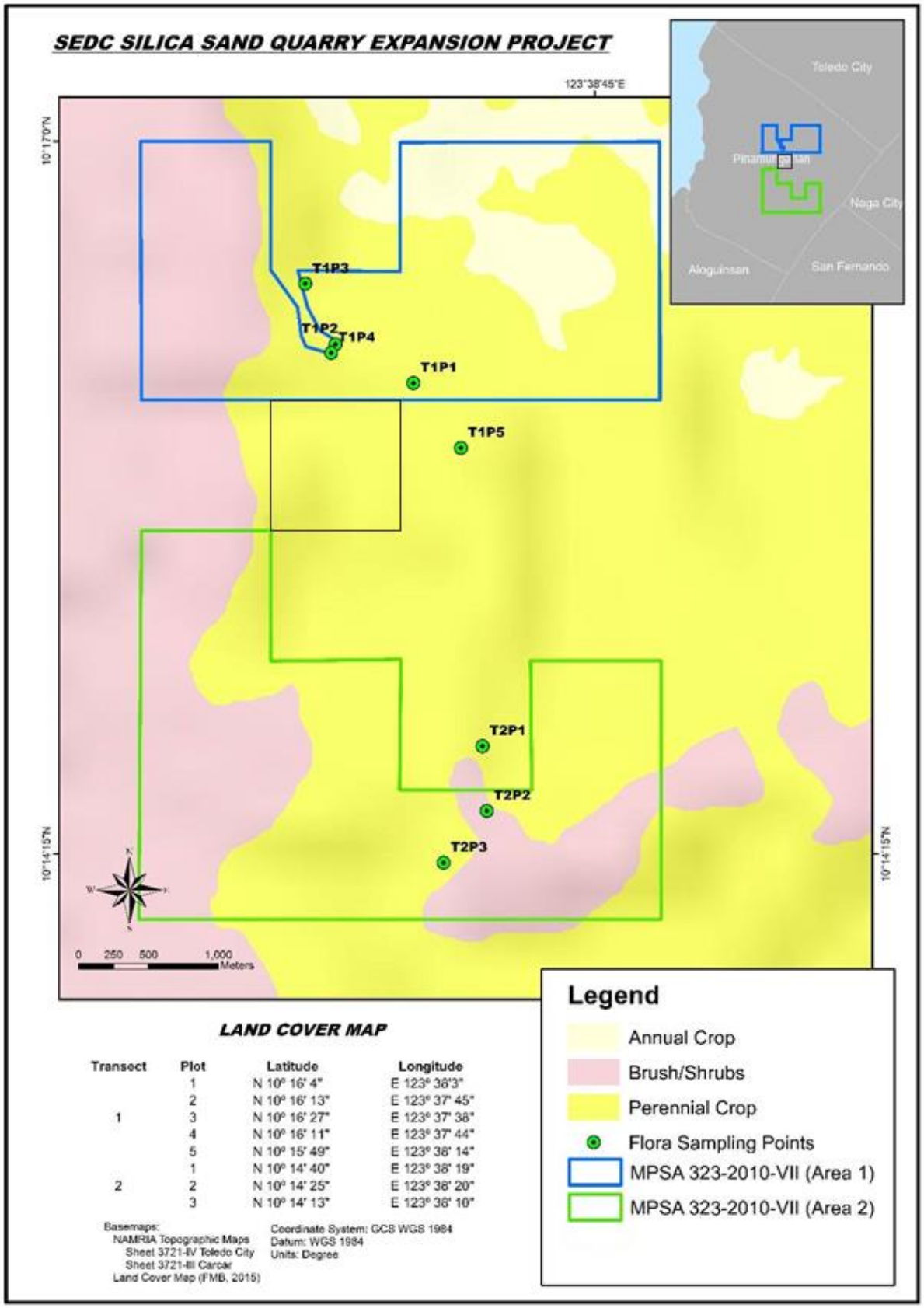


Figure 2-25. Land Cover Map Showing Flora Sampling Stations

Floral Taxonomy

There are at least 442 individuals recorded during the field assessment, 43 species belong to 38 genera under 27 families (**Table 2-18**). Most of the species recorded belong to Family MORACEAE (16.3% of the total number of species) which mostly consist of genus *Ficus*. It was followed by EUPHORBIACEAE and MYRTACEAE (9.3% and 7.0%, respectively, of the total number of species) that mainly composed of trees (**Figure 2-26**). A complete list of species recorded within established transects in the project area is presented in Appendix A.

Table 2-18. Taxa Richness

Category	Count
Individuals	442
Species	43
Genus	38
Family	27

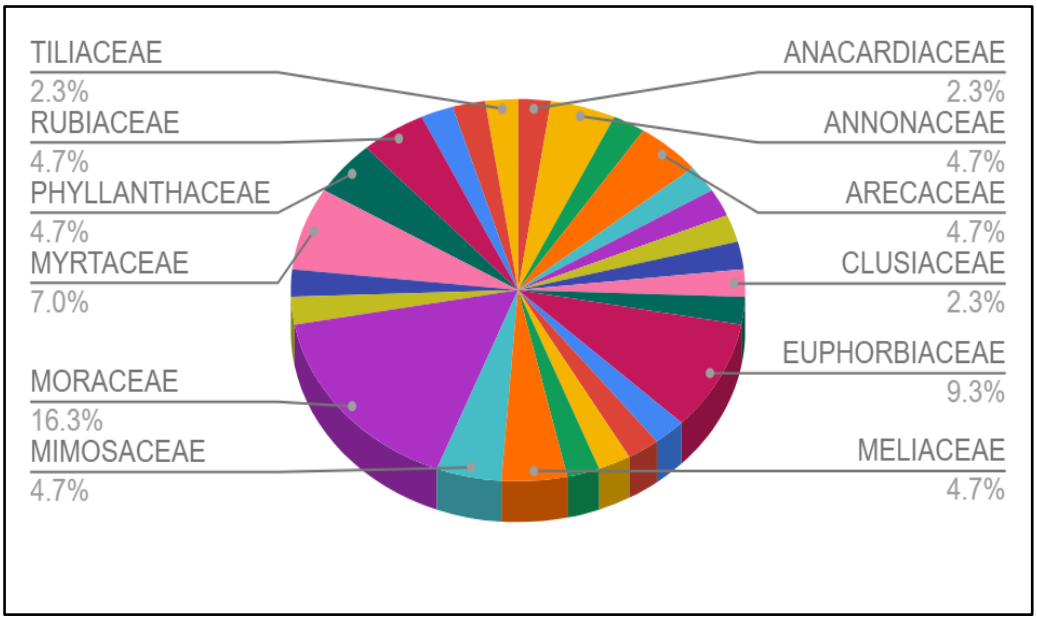


Figure 2-26. Family distribution of flora species recorded

Habit

Among the plant habit groups, trees have the largest percentage with 81.4% of the total observed species in the sampling sites. These trees, however, do not necessarily have 15 cm and above DBH, rather some are at the sapling and seedling stage that were observed within the understorey and intermediate layer. Another plant group with a large number of individuals are herbs (21.3%) which are mainly composed of groundcover.

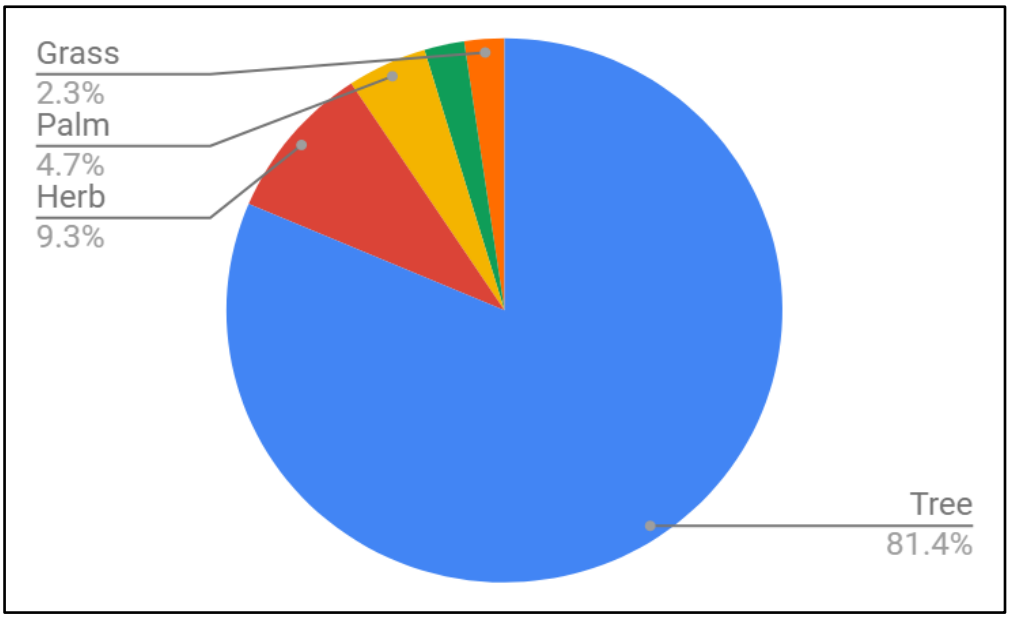


Figure 2-27. Plant habit

2.1.4.1.2.2 EXISTENCE OF IMPORTANT LOCAL SPECIES

Majority or 57.5% of the total species in the project area are indigenous while 35% is comprised of exotic or introduced species. Antipolo (*Artocarpus blancoi*), is-is (*Ficus ulmifolia*) and toog (*Petersianthus quadrialatus* Merr.) were the only endemic species (7.5%) out of the total 43 species recorded in the project area. Antipolo is widespread across the country in the lowland seasonal forest and thicket. Fruits and seeds of this species are traditionally cooked and eaten. Is-is is a shrub to small tree species distributed in different provinces in the country. The puberulous leaves of this species are very hard and rough commonly used for cleaning cooking utensils and scouring hardwood floors, stairs, windowsills as an alternative to sandpaper[2]. Toog, however, abounds in Agusan, Surigao, Davao del Norte, Leyte, Samar, Negros and Masbate and fairly common and scattered in primary rainforests, near riverbanks or on the hillside, in swampy and cool places. Toog, or the Philippine rosewood, is known for its high-quality wood[3].

[2] http://www.tropical.theferns.info/viewtropical.php?id=Ficus+ulmifolia

[3] Florido, H (2004). Research Information Series on Ecosystems, Vol 16 Jan-Apr 2004. Retrieved June 16, 2017 from erdb.denr.gov.ph/files/publications/rise/r_v16n1.pdf

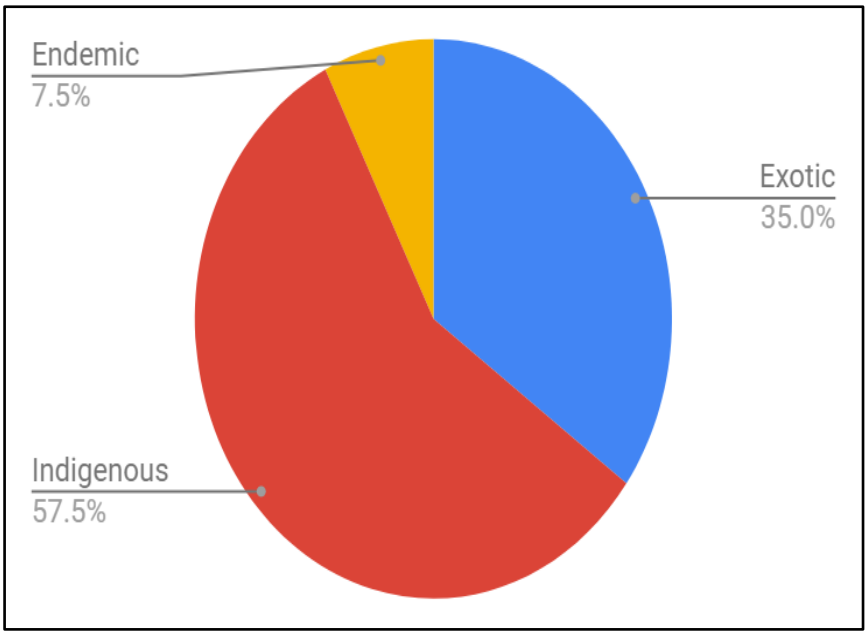


Figure 2-28. Ecological distribution of flora species recorded

Conservation Status

Three (3) threatened species that were recorded in the sampling sites fall under the "vulnerable" category of IUCN Red List of Threatened Species: Antipolo (*Artocarpus blancoi*) in transect 1, Is-is (*Ficus ulmifolia*) in transect 2 and Mahogany (*Swietenia macrophylla*) in all transects. All three species are widespread across the country. Antipolo fruits and seeds, as mentioned earlier, are being eaten and cooked while Mahogany is a priced wood for their wood quality. Mahogany is an introduced plantation species being used also as reforestation species by the government. No species was recorded as threatened based on DAO 2017-11 or the Updated National List of Threatened Philippine Plants and Their Categories.

Table 2-19. List of threatened species recorded within the project area and its vicinity

Scientific Name	Common Name	Family Name	Conservation Status		Transect
			IUCN Red List	DAO 2017-11	
Artocarpus blancoi	Antipolo	MORACEAE	Vulnerable	-	1
Swietenia macrophylla	Mahogany	MELIACEAE	Vulnerable	-	1,2
Ficus ulmifolia	Is-is	MORACEAE	Vulnerable	-	2

Invasive Species

Seven (7) species found on the project site were classified as invasive by the IUCN- Global Invasive Species Database (IUCN-GISD) as presented in **Table 2-20**. Invasive species were present in all transects established. Transect 1 has the most number of invasive species present. Guava (*Psidium guajava*) were found in all four transects.

Table 2-20. List of invasive species recorded in the project area

Scientific Name	Family	Common Name	Count	Transect
Acacia mangium Willd.	MIMOSACEAE	Mangium	1	1

Scientific Name	Family	Common Name	Count	Transect
Leucaena leucocephala (Lam) de Witt	MIMOSACEAE	Sablot	9	1
Litsea glutinosa (Lour.) C.B. Rob.	LAURACEAE	Binunga	1	1
Melia azedarach L.	MELIACEAE	Bagalunga	2	1
Psidium guajava L.	MYRTACEAE	Guava/ Bayabas	15	1,2
Ricinus communis	EUPHORBIACEAE	Castor plant	2	2
Spathodea campanulata Beauv.	BIGNONIACEAE	African tulip	1	2

2.1.4.1.2.3 ECOLOGICAL PARAMETERS AND DIVERSITY INDICES

Diversity and Indices

Based on Fernando et al (1998) relative measure of diversity scale, the diversity of the Project site ranges from very low to moderate (H'=1.127 – 2.854) as presented in **Figure 2-29**.

Overstorey layer ranged from H'=2.533 – 2.854, intermediate layer H'=2.308 to 2.637, understorey H'=1.127 to 2.254. The low flora diversity values may be primarily affected by land use, which is mostly agro-ecosystem as well as the presence of invasive plant species. Vila et al (2011) stated that invasive species can reduce the local plant species diversity[4] of an area. Prolonged dry season this year may also have contributed to the low diversity of plant, especially on the undergrowth layer that has shallow roots and can be easily affected by the dry season.

Species evenness (e') recorded in four transects is found to have very high (0.813 to 0.979) evenness. High values of evenness indicate that the flora species are well distributed in the area.

[4] Vilà, M., Espinar, J. L., Hejda, M., Hulme, P. E., Jarošík, V., Maron, J. L., Pergl, J., Schaffner, U., Sun, Y. and Pyšek, P. (2011), Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. Ecology Letters, 14: 702–708. doi:10.1111/j.1461-0248.2011.01628.x

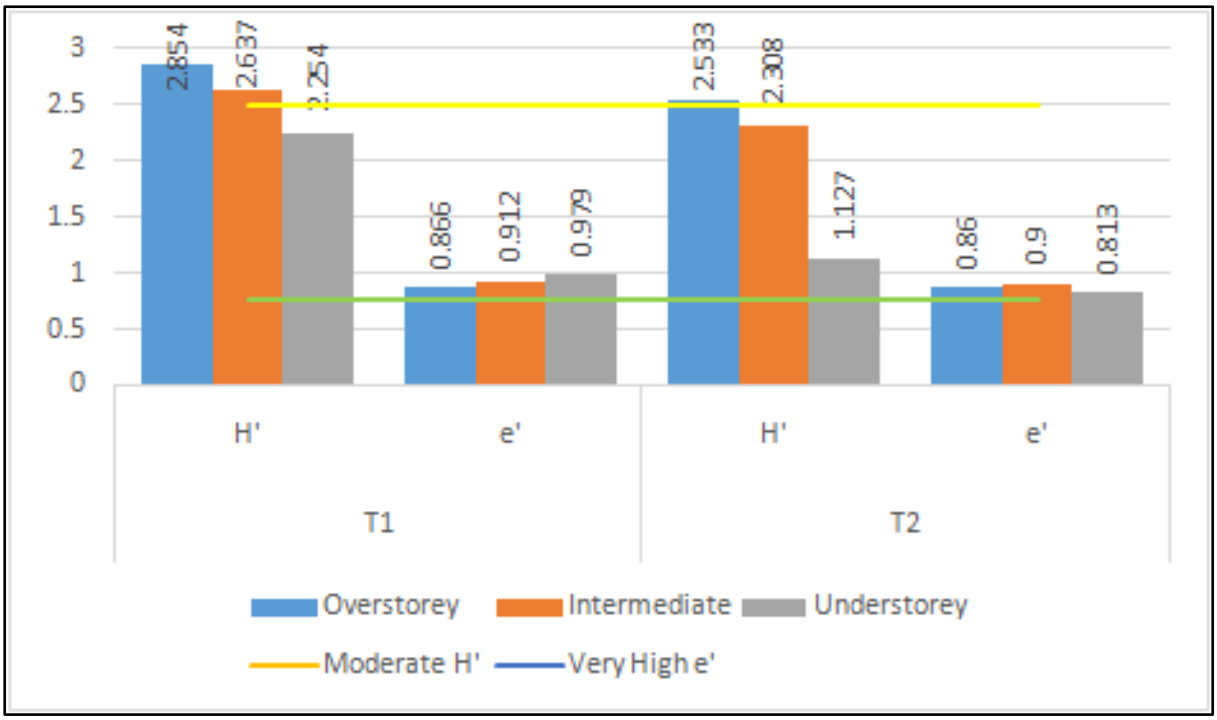


Figure 2-29. Diversity indices

Importance Value (IV)

Importance value (IV) index is used to determine the overall importance of each species in the community structure. It reflects the influence a species exerts on the ecosystem. It takes into account the density, frequency, and basal area for the overstorey layer (Curtis, 1959). The intermediate and undergrowth layers only require density and frequency. List of species with highest recorded IV is presented in **Table 2-21**.

Most of the dominant species recorded are agroforestry plants that are being cultivated in the area. Banana (*Musa* sp.*)* and Mahogany were the dominant overstorey species in transects 1 and 2, respectively. For the intermediate layer, pioneer forest species such as subiang (*Bridelia* sp.) and paguringon (*Cratoxylum sumatranum* (Jack) Blume), were the dominant intermediate species. Undergrowth species such as Hauili (*Ficus septica Burm.f.*), and malunggay (*Moringa oleifera* Lam.) were the dominant species.

Table 2-21. List of species with highest IV within established transects

Transect/ Layer	Family	Scientific name	Common name	IV
T1 (10x10)	MUSACEAE	*Musa* sp.	Banana	67.5
T1 (5x5)	PHYLLANTHACEAE	*Bridelia* sp.	Subiang	26.7
T1 (1x1)	MORACEAE	*Ficus septica* Burm.f. var. *septica*	Hauili	33.3
T1 (1x1)	MORINGACEAE	*Moringa oleifera* Lam.	Malunggai	33.3
T2 (10x10)	MELIACEAE	*Swietenia mahogani* (L.) jacq.	Mahogany	91.5
T2 (5x5)	CLUSIACEAE	*Cratoxylum sumatranum* (Jack)	Paguringon	31.6

Transect/ Layer	Family	Scientific name	Common name	IV
		Blume		
T2 (1x1)	MORACEAE	*Ficus septica* Burm.f. var. *septica*	Hauili	90.0

2.1.4.1.2.4 BIODIVERSITY PERFORMANCE

Results of 2019 flora assessment recorded a decrease in terms of the number of species as compared to March 2016 EIS. Similarly, the number of recorded endemic species and threatened species also decreased. This can be attributed to the method employed, level of effort, season and location of sampling activities and disturbances occurred in the area. The 2019 flora sampling used the TSC required method (quadrat sampling) with two transects established.

Diversity values, on the other hand, cannot be compared as the previous study was presented on a transect basis while the latest results were presented on forest layer basis in each transect.

Dominant species in 2017 and 2019 flora sampling were both agroforestry species suggesting that the project area maintained the land cover with dominantly production area or agro-ecosystem.

Table 2-22. Performance of biodiversity within impact areas

Parameters	March 2016	July 2019
Taxa Richness	• 176 species	• 442 individuals • 43 species • 38genera • 27 families
Endemism	• Anubing (*Artocarpus ovatus* Blanco) • Pugahan (*Caryota cumingii* Lodd.) • Takipan (*Caryota rumphiana* C Martius) • Is is (*Ficus ulmifolia* Lamk) • Mali-mali (*Leea guineensis* G. Don) • Hamindang (*Macaranga bicolor* Muell.-Arg.) Toog (*Petersianthus quadrialatus* Merr.) • Bayag-usa (*Voacanga globosa* (Blanco) Merr.) • Salagong (*Wikstroemia lanceolata* Merr.)	• Is is (*Ficus ulmifolia* Lamk) • Antipolo (*Artocarpus blancoi*) • Toog (*Petersianthus quadrialatus*)
Threatened species	• Hamindang (*Macaranga bicolor* Muell.-Arg.) • Is is (*Ficus ulmifolia* Lamk) • Molave (*Vitex parviflora* Juss.) • Banuyo (*Wallaceodendron celebicum* Koord.) • Narra (*Pterocarpus indicus*) • Antipolo (*Artocarpus blancoi*)	• Antipolo (Artocarpus blancoi) • Mahogany (Swietenia macrophylla) • Is is (Ficus ulmifolia Lamk)

Parameters	March 2016	July 2019
Dominant plant habit	Trees (48.8%) and Herbs (14.7%)	Trees (81.4%) and Herbs (9.3%)
Diversity indices	High to Very High	Very Low to Moderate
Evenness	Very high	Very High
Importance value	• Niog (*Cocos nucifera*) • Bayabas (*Psidium guajava*) • Balat buaia (*Fagraea racemosa* Jack ex Wall.)	Overstorey: • Mahogany (*Swietenia macrophylla*) and Banana (*Musa* sp.) Intermediate: • Subiang (*Bridelia* sp) and paguringon (*Cratoxylum sumatranum* (Jack) Blume) Undergrowth: • Hauili (*Ficus septica* Burm.f. var. *septica*)

2.1.4.2 TERRESTRIAL FAUNA

2.1.4.2.1 METHODOLOGY

Available secondary data on fauna species within and nearby the project site were reviewed to initially determine and characterize the fauna assemblage likely to be recorded on site. Google earth and actual site reconnaissance were conducted to determine strategic sampling sites for the fauna assessment vis-a-vis the location of proposed developments. Primary sampling was conducted on 29 June to 02 July 2019.

2.1.4.2.1.1 SAMPLING SITES

Geographically, the project is located in the central part of Cebu Island, which covers parts of three barangays namely Lut-od, Punod, Guimbawian, Sibago, and Duangan within the Municipality of San Fernando, Province of Cebu. The coordinates of the transects surveyed in the 2016 EIA was not available in the EIS and were not surveyed in this study. Hence, two new transects were established to assess the existing fauna assemblage within the direct and indirect impact areas (**Table 2-23**). Indicative location of the sampling sites is presented in **Figure 2-30**.

Table 2-23. Fauna Transect locations

Transect	Coordinates	Locality	Description	Photo
T1	10.263611° N, 123.637222° E 10.275210° N, 123.625600° E	Barangays Lut-od and Punod, Pinamungajan, Cebu	This is the direct impact area characterized by an agro-ecosystem, which is mostly coconut, banana, and mango farms.	
T2	10.247171° N, 123.646305° E 10.247147° N, 123.654758° E	Barangay Sibago, Pinamungajan, Cebu	This is an indirect impact area characterized by perennial crops (i.e. coconut, banana) intercropped with annual crops (i.e. corn).	

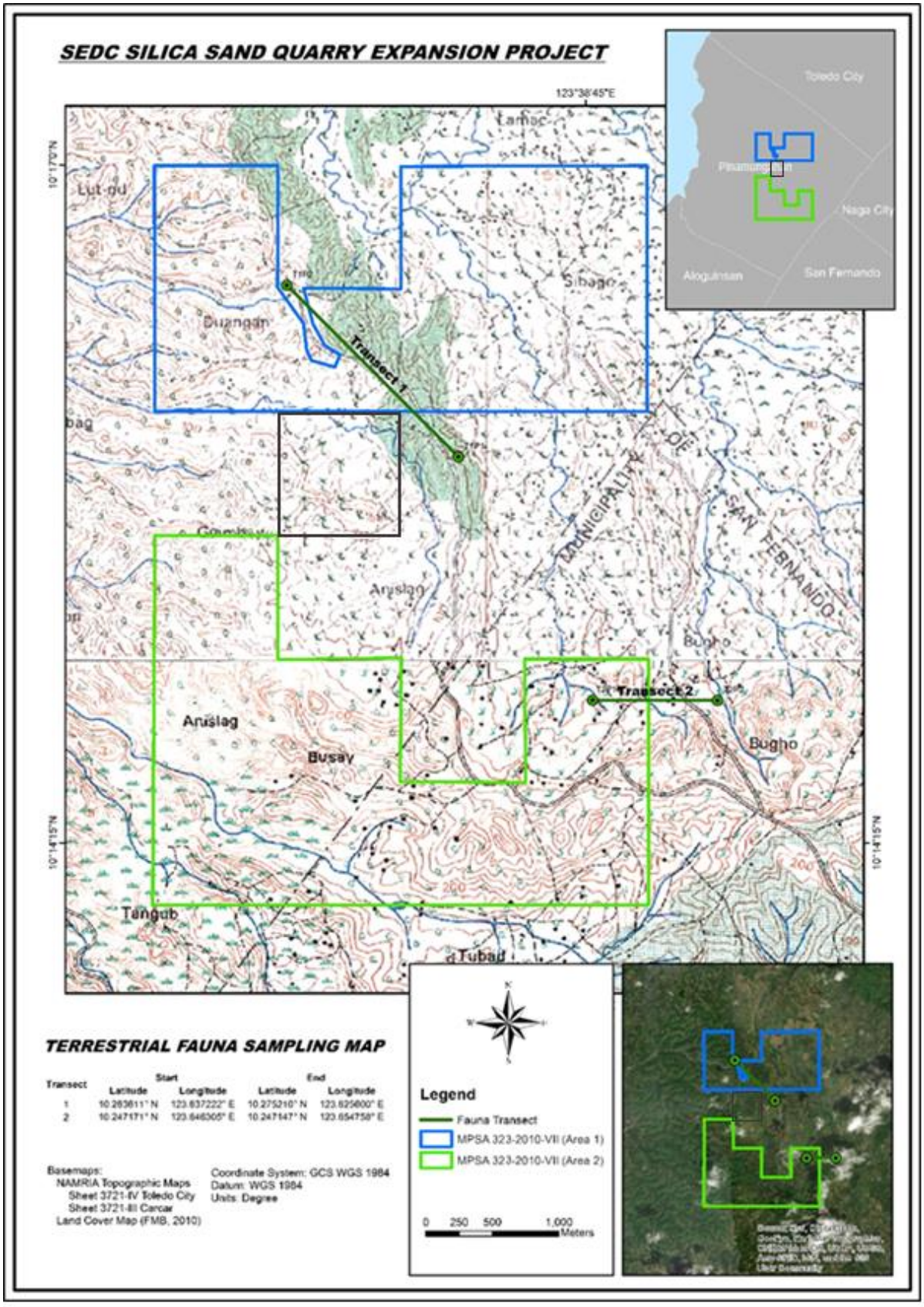


Figure 2-30. Fauna Sampling Map

2.1.4.2.1.2 SAMPLING METHODS

Transect surveys were conducted to assess the fauna assemblage within the project site particularly birds and other fauna groups. Transects were established along access roads and trails in areas were fauna especially birds are likely to aggregate. All birds seen and/or heard were listed, counted and identified to lowest possible taxa. Opportunistic species listing was also implemented to record other fauna groups such as mammals, amphibians, and reptiles during the survey period.

Meanwhile, mist nets and traps for birds and mammals were set in possible routes, passage, and flyways. These were left overnight and retrieved for trapped individuals early the following morning. Species were identified to lowest possible taxa, photo-documented and then released back in the wild (if any).

Additional information on the fauna assemblage within the project site was collected through interview with the locals.

2.1.4.2.1.3 CONSERVATION STATUS

The conservation status of each species recorded during the fauna assessment was determined using the Department of Environment and Natural Resources (DENR) DAO 2004-15 National List of Threatened Fauna Species and their Categories, International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices.

2.1.4.2.2 RESULTS

2.1.4.2.2.1 EXISTING CONDITION

A total of 41 fauna species was recorded during the fauna survey. It is composed of 34 birds; four mammals, and three herpetofauna (amphibians and reptiles) see **Figure 2-31**. Appendix B lists the fauna species recorded during the fauna survey.

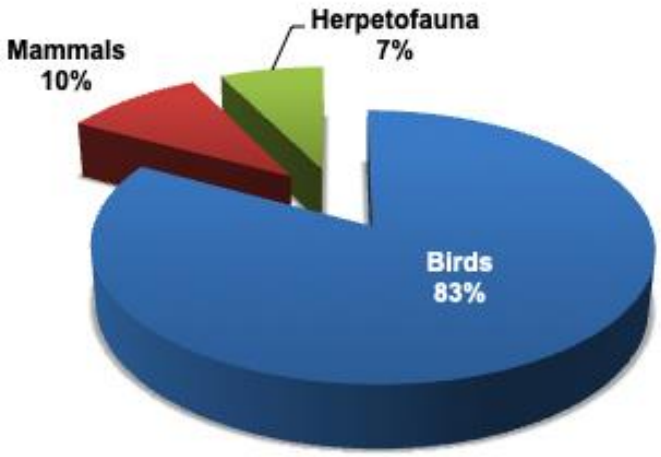


Figure 2-31. Percent composition of fauna groups recorded during the survey

In terms of distribution, most of the species recorded are resident/native (27) to the Philippines followed by endemic (11), introduced (2) and the least by migrant (1), see **Figure 2-32**. Resident/native species are common, widespread, and naturally distributed in the Philippines and other countries. Endemics are species that can only be found within the Philippines. Introduced are species not naturally distributed in the Philippines but were deliberately or inadvertently brought to the

Philippines while migrants are species that travel across long-distance during certain times of the year in response to seasonal changes from its place origin.

It was expected that resident/native species would dominate the list since these species are widespread and are adapted to a wide range of habitats from forests to disturbed habitats. Unlike resident/native species, endemics are species with limited distribution and usually have certain ecological requirements for survival. The presence of endemic species on-site indicates the availability of suitable habitats. This may also indicate minimal or insignificant impact of the project operation to fauna species. Introduced species indicate the presence of human settlements and anthropogenic activities. A migrant species was recorded despite that the survey was conducted during off-migration season because the recorded migrant species has resident populations in the Philippines.

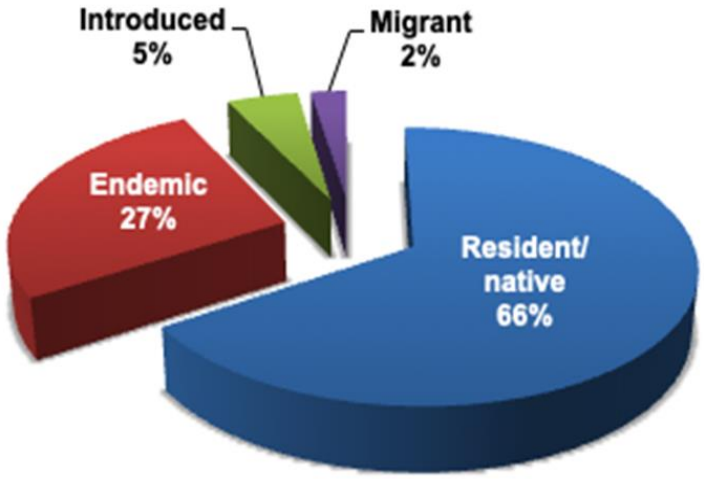


Figure 2-32. Distribution of fauna species recorded during the survey

Birds

Thirty-four (34) bird species was recorded during the fauna survey. This is the most represented fauna group when compared with mammals and herpetofauna since they are the most conspicuous group. As expected, majority of the birds recorded are resident (23) followed by endemic (9), and the least by introduced and migrant with one species each (**Figure 2-33**). High abundance of resident species reflects their widespread distribution and capability to occupy a wide range of habitats. Presence and abundance of endemic species indicates the availability of suitable habitats that cater the ecological requirements of these species despite the project operation. The presence of introduced species is expected due to the existence of human settlements and anthropogenic disturbances. In addition, the migrant species recorded has resident populations in the country hence it was recorded although the survey was during off migration season.

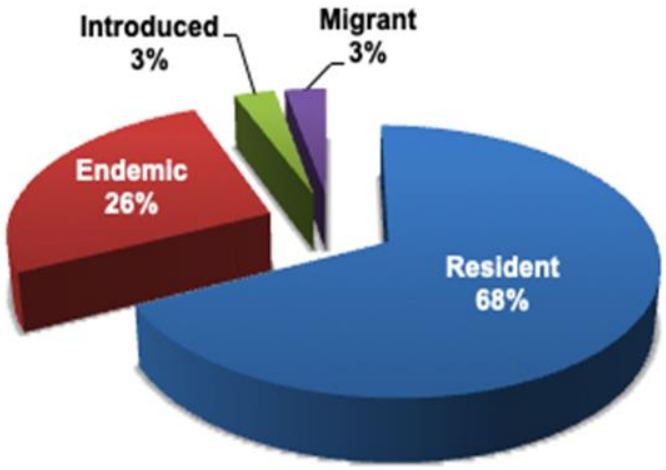


Figure 2-33. Distribution of birds recorded during the fauna survey

Mammals

Only four species of volant (flying) mammals particularly bats were recorded during the fauna survey. Trapping of non-volant mammals was conducted but resulted in zero capture. The four species recorded are frugivorous bats, which are common in the habitat types (i.e. agro-ecosystem) present in the area. Three of the four species are native and the other one is an endemic namely the musky fruit bat (*Ptenochirus jagori*). Based on the 2016 study, rodents, which pester agricultural productivity in the area were also recorded.

Herpetofauna

Three species of herpetofauna were recorded during the fauna survey. These are the tokay gecko (*Gekko gecko*), giant marine toad (*Rhinella marina*), marbled water monitor (*Varanus marmoratus*). The tokay gecko is native species, the marbled water monitor is an endemic species while the giant marine toad is an introduced species. These species are adapted in occupying disturbed habitats such as those present within the project site and often near communities. Plate 2-3 shows some of the fauna species recorded during the survey.

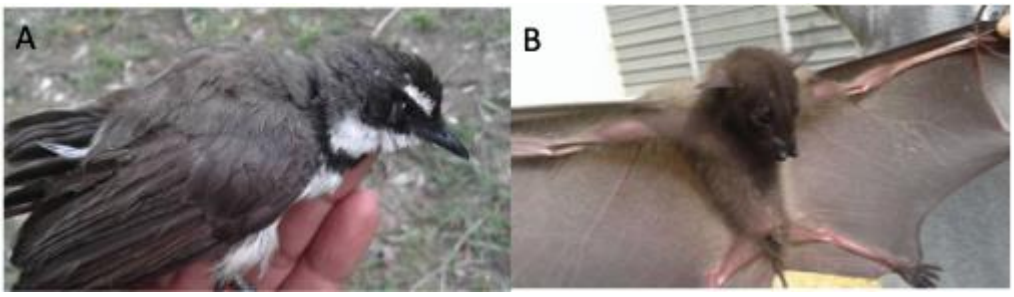


Plate 2-3. Fauna species recorded during the survey. A-Philippine fantail, B-musky fruit bat

2.1.4.2.2.2 DIVERSITY INDICES

Birds

Overall avian diversity was moderate with an index of 2.94. Transect 1 and 2 have moderate diversity with index values of 2.74 and 2.89, respectively. The moderate diversity can be attributed to the high species richness (34) and the very few species outnumbering other species across transects. In terms of evenness, index values recorded in Transect 1 (0.85) and 2 (0.87) were very high due to absence of dominant species. Consequently, dominance indices were low with values of 0.11 and 0.09 for Transect 1 and 2, respectively.

Mammals

There were only four mammalian species recorded during the fauna survey, which reflects very low diversity. With the disturbed conditions and the agro-ecosystem habitat in the area, it is expected that there would be low mammalian diversity. Only common and disturbance-resilient species such as those recorded during the fauna survey will thrive.

Herpetofauna

Only three herpetofauna species was recorded during the fauna survey, which may indicate low diversity. The low species richness recorded during the survey could just be due to seasonal conditions. It should be noted that potential habitats (i.e. swamps, rivers, streams) for herpetofauna were dry during the survey. Sampling during the wet season may result to relatively higher species diversity.

2.1.4.2.2.3 SPECIES OF CONSERVATION IMPORTANCE

There are two noteworthy species recorded during the fauna survey namely, the brahminy kite (*Haliastur indus*) and the marbled water monitor (*Varanus marmoratus*). These species were assessed as least concern under the IUCN Red List of Threatened Species but were listed under Appendix II of the CITES which qualifies them to be categorized as Endangered species under the DENR DAO 2004-15 or also known as the list of terrestrial threatened species and their categories, and the list of other wildlife species. Both species are threatened by hunting for sports or as food to locals and pet trade.

2.1.4.2.2.4 HISTORICAL OCCURRENCE OF FIRE OR PEST INFESTATION

No major forest/grass fire occurrence and/or pest infestation was recorded on site.

2.1.4.2.2.5 COMPARISON OF FAUNA DATA ON THE 2016 EIS AND 2019 STUDY

The coordinates of the transects surveyed during the 2016 EIA were not available in the EIS hence, these transects were not covered in the 2019 study. This limits comparability of the two data. A total of 52 fauna species was recorded in 2016 while only 41 species was recorded on the 2019 study. The difference in species richness can be attributed to different transects surveyed for each sampling period, drier conditions in rivers/streams in the 2019 study which limited the record of herpetofauna, and observer bias. Nevertheless, species composition in the 2016 study is almost similar with the 2019 study. A notable mention in the 2016 study is the record of a tortoise wherein fact that there is no naturally occurring population of tortoise in the Philippines. It could be a terrestrial turtle likely the Southeast Asian box turtle (*Cuora amboinensis*). Endemic and threatened species remain present on site despite the operation of the project indicating insignificant impact of the project to fauna assemblage on site.

In terms of diversity, birds recorded in the 2016 study was highly diverse with an index value of 3.05 while a moderate diversity was recorded in the 2019 study with an index value of 2.94. Difference in diversity indices can be due to the abundance of several species, which outnumbers other birds during the 2019 study. In other words, bird populations are more evenly distributed during the 2016 study and/or a result of observer bias.

2.1.4.3 IMPACTS AND MITIGATION MEASURES

The proposed expansion only involves an increase in production rate and no additional footprint is expected other than those project components detailed in the 2016 EIS. Impacts identified in the 2016 EIS were vegetation removal, loss of habitat, threat to existence. This study showed that the flora

species and land cover of the project were still agro-ecosystem. The fauna assemblage on-site and that species were minimally or insignificantly affected by the operations of the project, which can be due to effective mitigation measures in place. SEDC should continue to implement the following measures as suggested in the 2016 EIS to conserve fauna species in the area:

- Securing of Tree Cutting Permit prior to the cutting of any affected trees and use of a DENR-Permitted Chain Saw from the Community Environment and Natural Resources Office in charge of Pinamungajan Municipality located in Argao Municipality.
- Save as much as practicable young trees by earth balling, transplanting and nurturing them to the designated reforestation zones in higher elevations at the perimeter of the quarry area
- Develop and Protect portions of the Buffer zone and areas feasible in terms of poor mineral content with well-preserved vegetative cover will be converted into a nature park, a gene bank for important local plant species, as a habitat for wildlife and ecotourism area useful for educational tours to showcase how responsible mining and environmental protection with the support of the Barangay Government Unit.
- Rehabilitate the banks of the Banban creek outside of the MPSA area by replanting the area with appropriate bamboo species, and conduct regular maintenance activities until the bamboo plants have grown and stabilized
- Whenever possible, wildlings of endangered, vulnerable and threatened endemic flora will be collected from the site, carefully transferred to the nursery, and maintained to become genetic stock for the propagation of planting materials that will be replanted into areas needing land rehabilitation
- Avoidance/minimization of unnecessary clearing of fauna habitats especially vegetated areas
- Forest and habitat protection/enhancement through tree planting
- Maintenance of nursery as a source of seedlings for reforestation
- Establishment and maintenance of buffer zones as a refuge for fauna species
- Prohibition on hunting, gathering, and buying of wildlife resources
- Wildlife rescue particularly on endangered, vulnerable and threatened species
- Establishment/maintenance of permanent transects for impact monitoring and eco-tourism purposes
- Implementation of speed limits
- Conduct Information, Education, and Communication (IEC) programs focusing on biodiversity value and conservation

2.2 WATER

2.2.1 HYDROLOGY AND HYDROGEOLOGY

The Project site is located at the headwaters of 3 rivers which drain westward toward the Tañon Strait. The watersheds straddled by the project area with waters flowing into the Tañon Strait are the Banban, Cabiangon and Mangoto watersheds. The Cabiangon watershed is the biggest watershed in the project area with a total catchment area of 66.98 km^2 (6,698 hectares) followed by the Banban watershed with 15.07 km^2 (1,507 hectares), and the Mangoto watershed with 23.86 km2 (2,386 hectares). Much of the Project site (MPSA 314-2010-VII and MPSA 323-2010-VII) are located in the headwaters of the Cabiangon river (505.2 km2) which drain 37.6% of total MPSA area. The next largest watershed within the MPSA is drained by the Mangoto River (437.9 hectares or 32.6% of total project area). **Figure 2-34** contains the watershed catchment map of MPSA 314-2010-VII and MPSA 323-2010-VII.

The watersheds of Cabiangon, Mangoto and Banban Rivers are all elongated in shape with Westward direction, and all drains into the Tañon Strait at the shores of the Municipality of Pinamungajan. Furthermore, the Cabiangon River is the longer of the two other natural drainages. The Cabiangon and Mangoto rivers start at the highlands of San Fernando municipality and flow for about ten kilometers westward toward Tañon Straight thru the municipality of Pinamungajan. The Banban River originates in Pinamungajan, with dendritic tributaries from within this Municipality, extending westward and drains also to Tañon Straight about seven (7) kilometers from the production site.

Approximately seventy four percent (74.4%) of production site or about 1.62 km2 is located in 2 Banban sub catchments, occupying 10.8%% of the total watershed area. The remaining portion of the Production Area (0.557km2 or 55.7 hectares or 25.6%) is found in the watershed of Cabiangon River. About 120.6 hectares (74.5%) of the quarry area is located in two sub catchments of the Banban River. This sub catchment has two sections, A and B (**Table 2-24**) with area of 20.77 hectares and 99.84 hectares respectively. The remaining portion of the quarry area (41.3 hectares or 25.5%) is located within a sub catchment of the Cabiangon River. Details of the watersheds and proportion of the MPSA Area, the Production area and the Quarry Area within these catchments and sub catchments are found in **Table 2-24**. **Figure 2-34 to Figure 2-35** are maps showing the watershed boundaries of the watershed catchments around the MPSA areas, the surface water flow directions in watersheds hosting the MPSA and the surface flow directions in the quarry area, respectively.

Table 2-24. Watersheds in the Project Area

Name of River	Watershed Catchment Affected by MPSA		Sub catchments Affected by Production and Quarry Area						
	Watershed Number	Total Watershed Area (has)	Sub catchment No.	Sub catchment Total Area (has)	% Sub catchment in Total Watershed	Production Area in Sub catchment (has)	% Production Area	Quarry Area in Sub catchment (has)	% Quarry Area
Banban River	1	1,507	1A	396.7	26.3	22.7	10.4	20.77	12.8
	1	1,507	1B	617.9	41.0	139.4	64.0	99.84	61.7
Cabiangon River	2	6,698	2	774.0	11.6	55.7	25.6	41.30	25.5
Mangoto	3	2,386	None	None	NA	NA	NA	NA	NA

Name of River	Watershed Catchment Affected by MPSA		Sub catchments Affected by Production and Quarry Area						
	Watershed Number	Total Watershed Area (has)	Sub catchment No.	Sub catchment Total Area (has)	% Sub catchment in Total Watershed	Production Area in Sub catchment (has)	% Production Area	Quarry Area in Sub catchment (has)	% Quarry Area
River									

Data source: measurements from NAMRIA topographic map 1:50,000

2.2.1.1 WATER RESOURCES

2.2.1.1.1 SPRING INVENTORY

No springs were found within the proposed quarry area.

2.2.1.1.2 WELLS

An inventory of springs and wells in Pinamungajan from LGU data was undertaken and it was found that there is no private or public well within the quarry zone (Silica Sand Quarry Project EIS, 2016). A review of the data on wells, springs and any other note-worthy water resources in Pinamungajan, Cebu from the National Water Resources Board NWRB (see Annex 9) indicated that a lone well is registered in NWRB in Pinamungajan and the location is outside of the MPSA. The NWRB well data summary indicates twenty eight (28) wells existed in Pinamungajan (1982), mostly located in the lower elevations along the coastal corridor with average static water level of a little over eighteen (18.57) meters below ground surface. Random interviews with residents near and within the production area revealed that while water supply is not abundant in Pinamungajan, water available from artisan and deep wells are sufficient for household needs. The SEDC personnel declared that there are no wells within the production area; the wells used by the populace are outside of the boundary of MPSA 314 and 323.

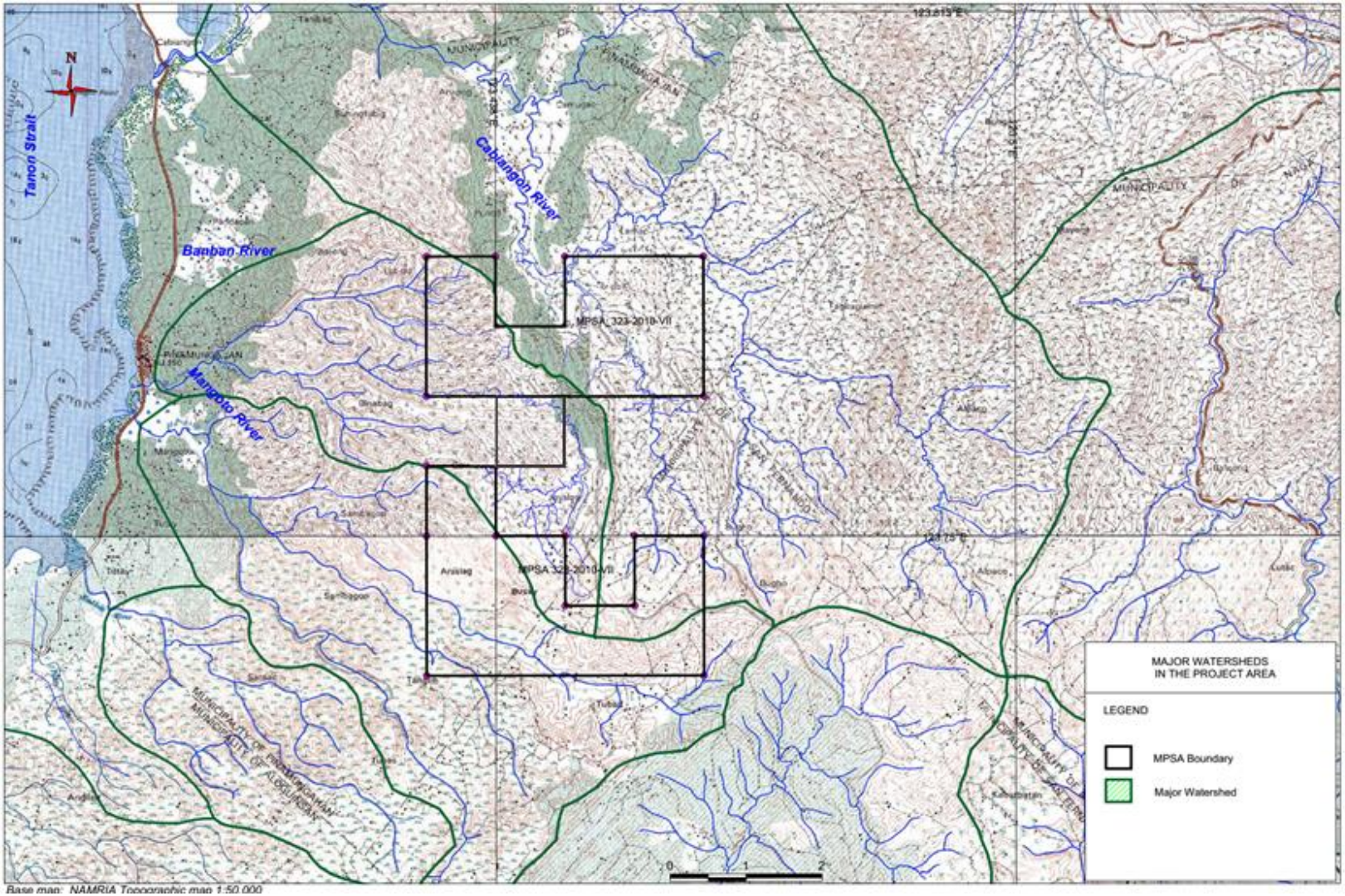


Figure 2-34. Major Watershed in the Project Area

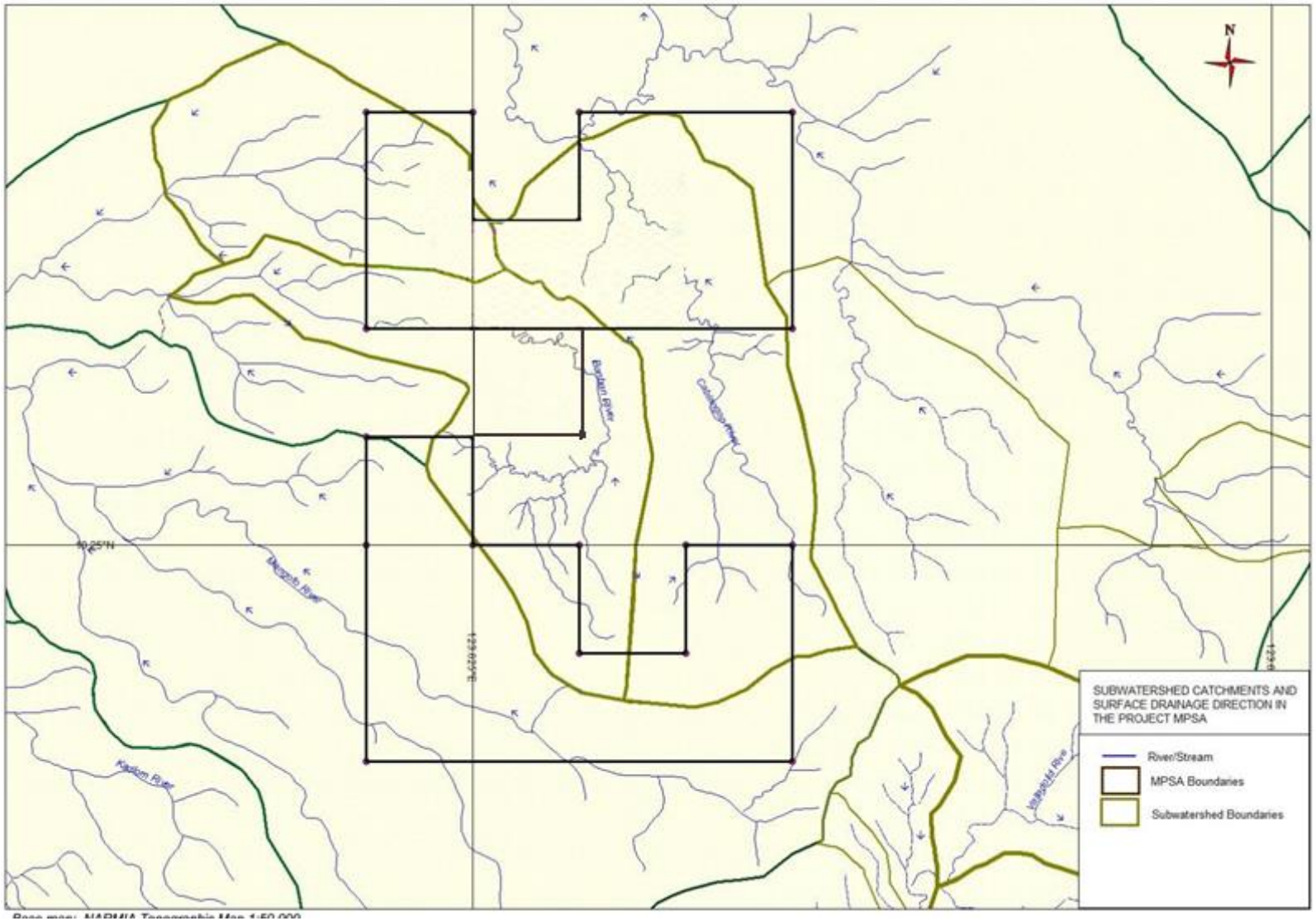


Figure 2-35. Subwatershed Catchments and Surface Drainage Direction in the Project MPSA

2.2.1.1.3 GROUND WATER RESOURCES

The production area is within sub catchment A of Banban Watershed (**Figure 2-35**). The ground water resources of catchment A of Banban Watershed is ample. Banban watershed also hosts the proposed natural water source. The ground water recharge of catchment A of Banban watershed is estimated in **Table 2-25** using the Soil Moisture Balance approach.

Table 2-25. Estimation of Annual Ground Water Recharge Potential of Subcatchment A of Cabiangon Watershed

Recharge	Values
a. Rainfall	
Annual Precipitation (R)	1.5645
Precipitation Coef. (p)	0.75
Infiltration Coef. (N)	0.25
Catchment (A, m2)	4,615,000.00
Recharge from rainfall (Qr)	1,353,781.41
b. River Seepage	1,353,781.41
Annual Precipitation (R)	1.5645
Infiltration coef. (i)	0.55
Infiltration Volume/unit length (q)	0.860475
River length (l)	2,785.00
Wet day per year (t)	146
River Seepage (Qrv)	349,877.74
TOTAL ANNUAL RECHARGE (mt)	**1,703,659.15**

While the recharge potential of subcatchment A of Banban watershed is considerable, much of this resource is not readily accessible to the population in the host community. The ground water resources are largely accessed through wells and springs in lower elevations because of poor aquifer underlying much of the island of Cebu.

2.2.1.1.4 COMPUTATION OF PEAK RUN OFF VOLUME

Peak run-off volume in Banban catchment area and in the quarry area is roughly estimated to derive reference in deciding on the quarry drainage design to enable project facilities detain a reasonable degree of sediment-laden run-off from in extreme climate, allow sufficient residence time the larger portion of storm drain as a measure in managing quarry discharge water quality. The Rational Method was used in calculating peak run-off using extreme climate data in **Table 2-31**.

The Rational Formula: Q= C*I*A

Where:

Q = runoff rate [m^3/sec]

C =Runoff coefficient of 0.5 (for “Other land, cultivated, perennial crop”)

I = Rainfall intensity [mm/hr.], maximum in **Table 2-31**, divided by 24 hrs. +20% adjustment for climate change conditions

A = Drainage area [m^2]

- Assumptions in this assessment
- Banban sub catchment A and B are considered as separate single units,
- the flow volume is estimated at the most downstream point of the quarry area
- that rainfall is uniformly distributed over the watershed sub catchment in an event;
- that the predicted peak discharge has the same probability of occurrence (return period) as the used rainfall intensity (I),
- that the runoff coefficient (C) is constant during the rain, and
- That the recession time is equal to the time of rise.

Table 2-26. Computed Peak Run-Off Volume

PEAK RUN OFF VOLUME ON QUARRY SITE		
	MPSA 323-2010-VII	**MPSA 314-2010-VII**
Peak Hourly Rainfall	13.81 mm	13.81
Precipitation Coef. (p)	0.75	0.75
Run off Coef. (N)	0.45	0.45
Area of Quarry Section (A)	500,000 m^2	220,000 m^2
In sub-subcatchment		
Run off	2,329.59 m^3/hr.	1,025.02 m^3/hr.
Per Opened Square Meter (m^3) /hr.	0.004659	0.004659

Assuming that a cut-off channel is provided to divert background surface run-off toward natural waterways and away from opened quarry areas, the quarry site as proposed herein, through its settling ponds and properly-sized contour canals, can have sufficient capacity to provide residence time for storm run-off to drop sediments and for quarry drainage water to comply with DAO 34 Class C beneficial use water quality standard suitable to agricultural irrigation.

2.2.2 WATER QUALITY

A small stream traverses the Production area, originating from an intermittent stream within the quarry zone (**Figure 2-36**). This natural drainage feature is part of the headwaters of the Banban River, which flows into the Tañon Strait. The current use of these waterways is for drainage of adjacent agricultural areas, and channel for domestic waste disposal. The water quality of this small stream was determined thru the laboratory analysis of samples taken in two separate seasons. The dry season samples taken on 29 April 2013 yield a Class A water quality for the small creek for most of all the selected physical analytical parameters, except for the bacteriological analysis. The amount of fecal and total coliform far exceeds the DENR Class D standards. It is most probable that the stream is used as disposal channel for black water or septage. Details of the dry season water quality analysis are found in **Table 2-27** and **Figure 2-36** is a map showing the water quality sampling locations. There are two other small intermittent streams that flow from the Production area based on old maps; however, these had no water during two seasons of water sampling.

Table 2-27. Water Quality of Waterways in the Production Area during the Dry Season

Parameters	Unit	Sampling Stations		DENR Class A Standard	DENR Class D Standard	Remarks
		W1	W2			
Oil & Grease	mg/l	<1	<1	1	5	Class A

Parameters	Unit	Sampling Stations		DENR Class A Standard	DENR Class D Standard	Remarks
		W1	W2			
Total Suspended Solids (TSS)	mg/l	<1	<1	50	*	Class A
Dissolved Oxygen (DO)	mg/l	6	6	5	3	Class A
Biological Oxygen Demand (BOD)	mg/l	3	10	5	10 (15)	W1 Class A; W2 Class D
Hexavalent Chromium	mg/l	<0.025	<0.025	0.05	-	Class A
Arsenic	mg/l	<0.01	<0.01	0.05	0.01	Class A
Mercury	mg/l	<0.0005	<0.0005	0.002	0.002	Class A
Cadmium[2]	mg/l	<0.0005	<0.0005	0.01	0.05	Class A
Lead	mg/l	<0.01	<0.01	0.05	-	Class A
Potassium	mg/l	1.5	2.3	-	-	-
Nitrogen	mg/l	<0.2	<0.2	10	-	Class A
Phosphorus	mg/l	0.08	0.5	0.1	-	W1 Class A
Total Coliform	MPN	2,400	7,900	1,000	5,000	W1 Class D; W2 fails Class D
Fecal Coliform	MPN/ml	790	460	100	-	Fails Class D

*Not more than 60mg/l increase

Table 2-28. Water Quality of Waterways in the Production Area during the Wet Season

Parameters	Unit	Sampling Station		DENR Class A Standard	DENR Class D Standard	Remarks
		W1	W2			
Total Suspended Solids (TSS)	mg/l	30	29	50	+60mg/L	Class A
Dissolved Oxygen (DO)	mg/l	7.9	7.4	5	3	Class A
Biological Oxygen Demand (BOD)	mg/l	7	5	5	10 (15)	W1 Class D; W2 Class A
Oil and Grease	mg/l	<1	<1	1	5	Class A
Total Coliform	MPN	2018	2200	1,000	5,000	Class D
Fecal Coliform	MPN/ml	520	600	100	-	Fails Class D

Wet season water quality sampling was conducted on 23 January 2014. Two samples were taken from the stream within the Production site, corresponding to locations upstream and downstream of the Production area. This stream bounds the northeast portion of the quarry zone that will produce from 2016 to 2021. This time, only the project impact parameters were requested for laboratory analysis. The results of the test show that the surface water samples almost meet DENR Class A standards, except for BOD_5 of station 1 (upstream of Production area) which has a value of 7mg/l which is exceeds the threshold limit of 5mg/l. Field observation revealed that there were lot of waste sources (i.e. from farm animals, human waste).

Since the project is still in the acquisition of the Declaration of Mining Project Feasibility (DMPF), a water quality sampling was conducted last 30 July 2019 to update the baseline water quality of

the project area. Results of the water sampling are indicated **Table 2-29** while the location of the stations are shown in **Figure 2-38**.

Table 2-29. 2019 Water Quality Sampling Results

Parameter	SW1 10° 16' 46.0' N 123° 37' 52.5" E	SW2 10° 15' 45.8" N 123° 38' 04.5" E	SW3 10° 13' 46.4" N 123° 40' 01.3" E	SW4 10° 13' 21.6" N 123° 39' 37" E	SW5 10° 12' 43.9" N 123° 39' 14.8" E	DAO 08-2016 Class C WQG
pH	8.11	8.18	7.61	7.94	8.12	**6.5-9.0**
Temp, °C	30.4	31.1	29.6	31.7	30.9	**25-31**
DO, mg/L (minimum)	6.62	6.07	5.19	5.31	5.46	**5**
Color (CU)	5	10	5	5	10	**75**
Phosphate, mg/L	0.05	<0.01	0.13	0.07	<0.01	**0.5**
Surfactants, mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	**1.5**
Ammonia, mg/L	<0.03	0.04	0.05	0.03	<0.03	**0.05**
Nitrate, mg/L	0.40	0.19	1.14	0.36	0.26	**7**
BOD_5, mg/L	2	1	2	2	2	**7**
COD, mg/L	7	9	7	12	13	**NGV**
TSS, mg/L	14	12	5	4	20	**80**
Oil and Grease, mg/L	<1	<1	<1	1	<1	**2**
Chloride, mg/L	18.6	18.6	18.6	13.9	11.4	**350**
Fecal Coliform, MPN/100 mL	>8.0	>8.0	>8.0	8.0	4.6	**200**
Chromium, mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	**NGV**
Lead (Pb), mg/L	<0.01	<0.01	<0.01	0.05	<0.01	**0.05**
Zinc, mg/L	0.028	0.042	<0.003	0.034	<0.003	**2**
Cadmium (Cd), mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	**0.005**
Copper (Cu), mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	**0.02**

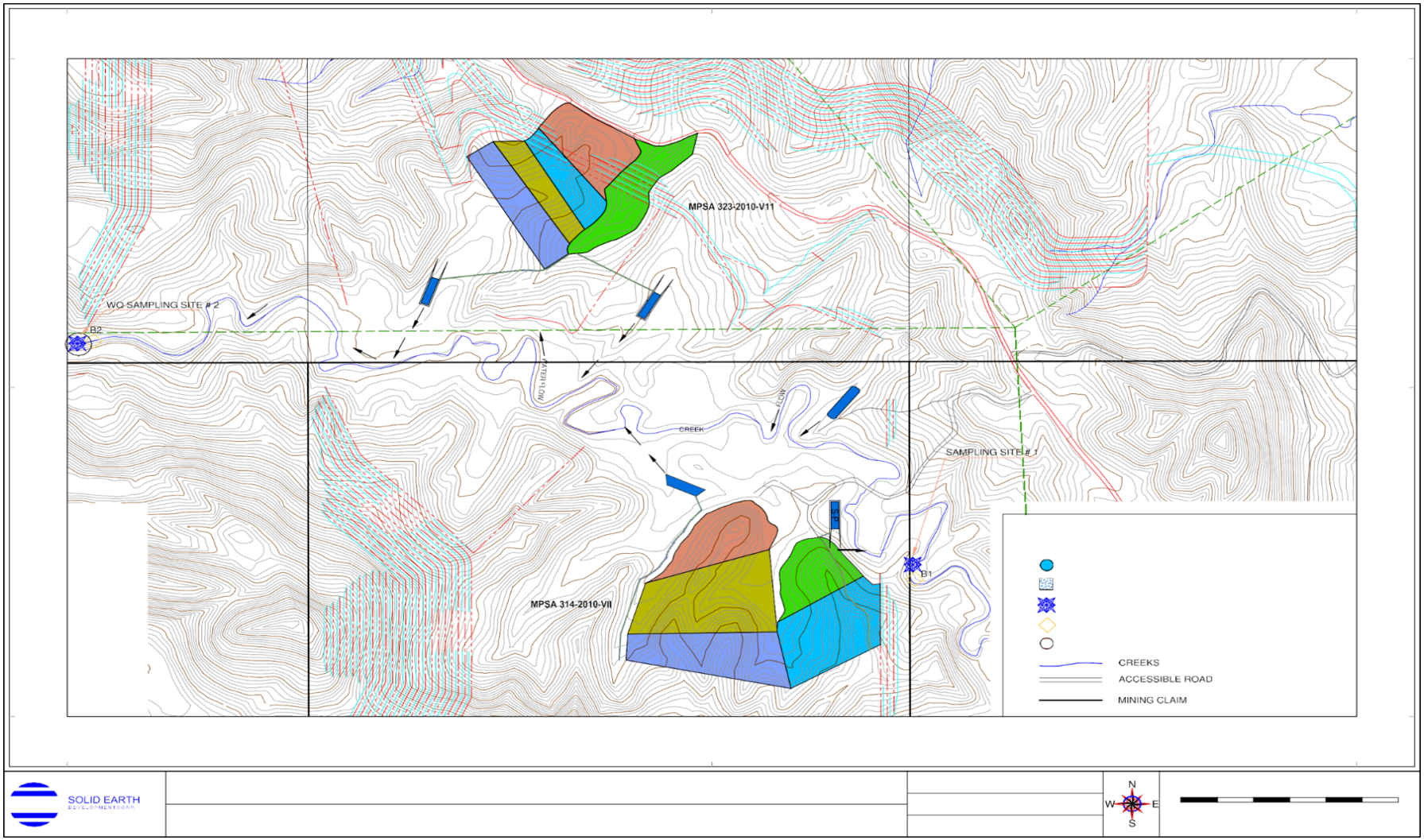


Figure 2-36. Water Quality and Benthos Sampling Location

Figure 2-37. Water Quality Sampling Station W2, Wet Weather Condition

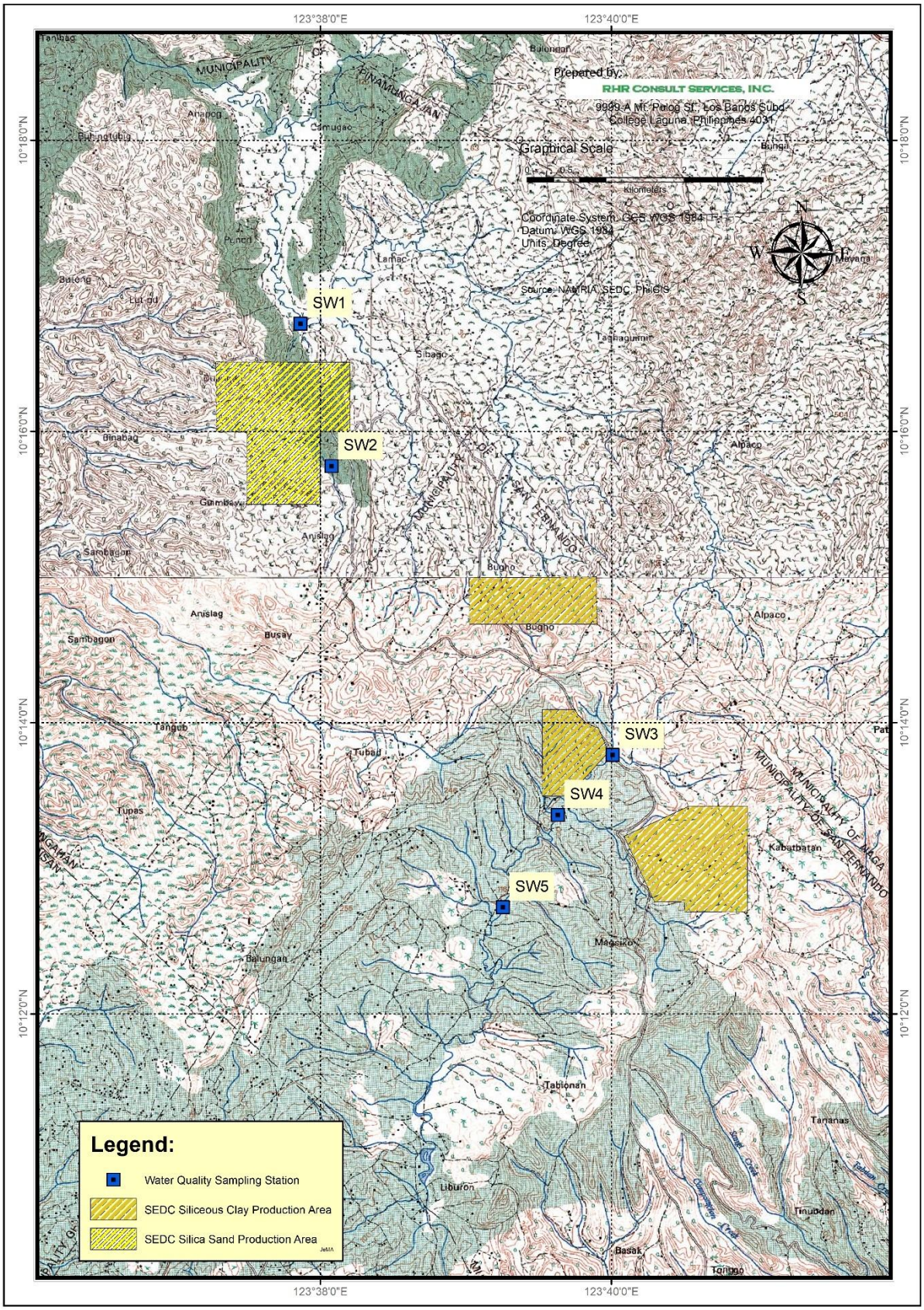


Figure 2-38. 2019 Water Quality Sampling Map

2.2.2.1 IMPACT ASSESSMENT

2.2.2.1.1 SEDIMENT TRANSPORT

The natural rate of silt deposition within production area is governed by pre-development land uses within the catchment areas and the slope of the land. In calculating the empirical sediment influx, the mean sediment yield of a particular land use is considered in proportion to the extent of the affected area. Using the Modified Universal Soil Loss Equation (modified USLE), the average sediment yield for each type of land surface was computed and multiplied by the area of each catchment to determine the annual sediment yield. The total silt contributed by each catchment that may enter the public drainage system as a result of natural erosion amounts to about 372.18 m^3 per year in Year 5.

Aside from natural erosion, minor sediment sources are also considered. About 75.5 hectares in the Production area are used for subsistence agriculture. Cassava and corn cultivation loosen the soil which in turn are susceptible to transport by surface-water run-off towards the existing waterways such as the stream traversing the Production area. On flat lands, insignificant amounts of siltation are introduced into the streams. The natural low topography along the streams restricts downward migration of sediments toward the flood plains, forming small depositional basins. Cultivation on existing 2.17 has. area (0-3% slope) found within the production area is expected to have caused a negligible amount of sediment, while those farm areas within the 200.70 ha. of the production area with 3-8% slope, yield sediments around 1.05 MT/ha. per year.

2.2.2.1.2 SEDIMENT IN QUARRY AREA

Open surfaces render soil materials vulnerable to wind and rain erosion. Vehicular and equipment movement within the quarry will further add to land vulnerability to erosion. Erosion is undesired due to its potential to shallow downstream streams and creeks alter surface run-off patters which can damage crops and agricultural areas.

The estimated sediment yield in quarry area is 372.18 mt per year starting year five (5). The quarry area falls within the Banban and Cabiangon sub catchments which finally drains into the Banban and Cabiangon Rivers. The settling ponds for the entire 14.2-hectare initial quarry area will be regularly desilted to maintain silt holding capacity. The primary agent in water quality deterioration through sedimentation is heavy rainfall which triggers strong run-off velocity. Run-off velocity decelerators such rock/stone baffles / mounds in contour canals and sumps to trap large sediments, will help control sediment flow from quarry area.

To reduce peripheral load on the settling ponds in the quarry area, a cut-off channel or berm ditch is recommended to be made at the boundary of the quarry zone, to divert background surface run-off toward a separate settling pond and reduce scouring elements from further eroding open quarry surfaces and increase downstream sedimentation.

2.2.2.1.3 AQUATIC ECOLOGY

The Banban creek is used as disposal area of farm wastes, mostly coming from a nearby small scale pig farm. Interviews of local residents as to food materials harvested from Banban creek revealed that no edible materials are taken from Banban creek. In view of the present water resource use of Banban creek and its limited structure, only a study of the baseline benthos population was made.

Siltation of the aquatic habitat will be the major threat to the aquatic fauna not only for vertebrate fauna but also for the invertebrate fauna present in the area. Most of the frogs inhabit clear streams and rivers especially on the larval stage of the organism as it is entirely dependent on water for growth and development. Fishes will also be affected by the changes on the physical characteristic of the river/streams. During the survey, a single fish was caught from the stream that crisscrossed Brgy. Duangan. Organisms that are dependent on water downstream will also be affected in case siltation will occur.

Aquatic species are most sensitive to habitat removal/destruction since their movement is limited only within similar habitat. The distributional range also of the organism is also dependent on the size of the available habitat. Removal/destruction of habitat will also increase the organism's chances of being a target for predation.

The Project will restore the waterways within the quarry zone that will be affected by the lowering of land surface as a result of quarry. The aquatic species that will be affected by altered riverbed and soil nutrient conditions as a result of the quarry will continue to exist in downstream areas of Banban River if sedimentation of waterways is controlled. The settling ponds, contour canals and inverse elevated benches are intended to control waterway siltation. Regular monitoring of water quality and sedimentation of the section of Banban River as it exits the MPSA will be undertaken.

2.2.2.1.4 RESOURCE USE COMPETITION

Cebu has limited water resources due to its porous limestone substrate. The water resources proposed to be used for the minimum project requirements of 288.8 m3 daily will be from harvested rainwater, accumulated from rainfall.

The effective rainfall and run-off volume will be adequate to meet project requirements for dust control and irrigation. At 3 meter depth, the settling ponds can fully serve as the primary source of water for road dust suppression in the dry months of February to May. Water requirement will be reduced to serve only nursery and vegetation maintenance, and the demand can also be managed to support controlled drip irrigation to some farms downstream of the quarry by gravity through perforated hose, which may be purchased under the SDMP.

The settling ponds will be adequate to detain at least 80% of the eroded sediments (surface soil lost) and retard / detain the accelerated flow of peak storm run-off from the quarry areas to downstream sections to mitigate accelerated surface run off when quarry surfaces are cleared and leveled.

A large allowance for sediment storage in the settling pond is recommended, to avoid sediment overflow that is complained by the public as gleaned from the household survey responses and focus group discussions, and provide allowance to disturb accumulated silt in a protracted length of rainy days when it is difficult to desilt the settling ponds.

2.3 AIR

2.3.1 METEOROLOGY

2.3.1.1 SCOPE

This section presents the following as required in the Technical Scoping Checklist for this project.

- Change in local micro-climate – presented are the climatological normal and extremes, specifically on monthly average rainfall, air temperature, and wind speeds and wind directions. Wind rose diagrams and frequencies of tropical cyclones are also discussed as required. Also presented are the climate change projections in the project area using the recent climate study by PAGASA (2018); and
- Contribution in terms of greenhouse gas (GHG) emissions (or GHG mitigation potential)

2.3.1.2 METHODOLOGY

Meteorological data from the weather station of Philippine Atmospheric Geophysical Services Administration (PAGASA) in Mactan Island, Cebu (herein referred as "PAGASA-Mactan Station"), which is located about 35 km northeast of the project site (**Figure 2-39**), were used to characterize the climatological normals and extremes of rainfall, air temperature, wind speeds, and wind directions, including the projected change of climate of the said climatic factors.

In addition, prognostic meteorological data generated by Lakes Environmental Software, Inc. for the project using the Pennsylvania State University/National Center for Atmospheric Research Mesoscale Model (or MM5) were used to determine the prevailing annual and monthly wind flows, including the three-hourly wind patterns. RHR Consult Services, Inc. purchased the prognostic MM5 data covering the period January 1, 2014 to December 31, 2016 from Lakes Environmental Software, Inc. **Table 2-30** shows the list of meteorological data used in the study.

Table 2-30. Meteorological data and information used in this study

Data	Period Covered
Climate map of the Philippines (1951 to 2010)	1951 to 2010
Climatological normals for PAGASA-Mactan Station (Table 2-20)	1981 to 2010
Climatological extremes for PAGASA-Mactan Station (Table 2-21)	As of 2014
Climate projections of rainfall, temperature and extreme weather events	Climate projections
MM5 data	January 1, 2014 to Dec. 31, 2016
Tropical cyclone map	PAGASA and Manila Observatory

Figure 2-39. Locations of PAGASA-Mactan Station and the project site

Table 2-31. Climatological Normals for Cebu City (1981-2010)

Month	Rainfall		Temperature (°C)						Vapor Pressure (mbar)	%RH	MLSP (mbar)	Wind		Cloud Amt. (okta)	No. of Days	
	Amount (mm)	No. of Rainy Days	Max	Min	Mean	Dry Bulb	Wet Bulb	Dew Pt.				Direction (16pt)	Speed (m/s)		TSTM	LTNG
JAN	105.2	12	29.8	23.9	26.8	26.7	24.4	23.6	29.0	83	1012	NE	3	6	1	0
FEB	69.6	9	30.2	24	27.1	26.9	24.4	23.5	28.8	81	1012	NE	3	5	1	1
MAR	58.6	8	31.1	24.5	27.8	27.8	24.9	23.9	29.5	79	1012	NE	3	5	1	1
APR	48.1	6	32.3	25.4	28.8	28.9	25.6	24.5	30.5	77	1011	NE	3	4	3	2
MAY	95	10	32.8	25.8	29.3	29.3	26.1	25.1	31.6	78	1010	E	2	5	9	8
JUN	175.6	14	32.1	25.4	28.8	28.6	25.9	25	31.5	81	1010	SW	2	6	11	9
JUL	192.9	16	31.5	24.9	28.2	28	25.6	24.8	31.2	82	1009	SW	2	6	13	9
AUG	143.5	14	31.7	25	28.4	28.1	25.5	24.6	30.8	81	1009	SW	3	6	11	7
SEP	179.6	15	31.8	24.9	28.3	28.1	25.6	24.8	31.1	82	1010	SW	2	6	14	10
OCT	194.8	16	31.4	24.8	28.1	27.9	25.6	24.8	31.2	83	1010	NE	2	6	14	10
NOV	161.9	14	31	24.7	27.8	27.7	25.4	24.6	30.8	83	1010	NE	3	6	6	6
DEC	139.7	14	30.2	24.3	27.3	27.1	24.9	24.1	30.0	84	1011	NE	3	5	3	2
Annual	1564.5	146	31.3	24.8	28.1	27.9	25.3	24.4	30.5	81	1010	NE	3	6	87	65

Source: Climate and Agrometeorology Division, PAGASA

Coordinates and Elevation of PAGASA-Mactan Station
Latitude: 10°19'20.8" N
Longitude: 122°58'48.47" E
Elevation: 25.703 m
Notes:

1) RH – relative humidity
2) MSLP – mean sea level pressure
3) TSTM – thunderstorm
4) LTNG – lightning

Table 2-32. Climatological Extremes for Mactan International Airport in Mactan, Cebu City (as of 2014)

Month	Temperature (°C)				Greatest Daily Rainfall (mm)		Highest Wind (m/s)			Sea Level Pressure (mb)			
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date	High	Date	Low	Date
Jan	33.5	01-03-1988	19.8	01-21-1997	126.6	01-08-1999	30	NE	01-24-1975	1019.8	01-29-1998	995.3	01-24-1975
Feb	33.4	02-12-2011	20.0	02-16-2004	107.2	02-08-2012	22	E	02-18-1988	1019.8	02-01-1998	1003.8	02-18-2001
Mar	33.9	03-31-2004	20.0	03-02-2000	141.3	03-26-1982	25	SW	03-26-1982	1018.9	03-23-1998	996.0	03-26-1982
Apr	35.6	04-15-1992	22.1	04-01-2003	174.0	04-04-1994	30	SW	04-04-1994	1018.1	04-05-1998	998.1	03-26-1982
May	37.0	05-31-2010	22.0	05-27-2007	106.0	05-27-2000	20	W	05-17-1987	1015.4	05-02-1998	1000.2	05-21-1976
Jun	36.4	06-07-2010	20.2	06-20-1997	87.8	06-09-1984	18	SW	06-25-1992	1016.5	06-07-1997	1000.5	06-29-2004
Jul	35.3	07-20-1973	20.8	07-05-1990	135.0	07-08-2012	20	SE	07-17-1998	1015.9	07-11-1979	997.9	07-03-2001
Aug	35.6	08-27-1998	21.1	08-19-1981	96.6	08-17-1982	25	SW	08-15-1986	1015.7	08-11-1997	1001.5	08-01-1986
Sep	34.6	09-06-1978	21.5	09-18-1972	127.0	09-26-1989	48	NE	09-02-1984	1015.8	09-28-1997	983.4	09-02-1984
Oct	34.4	10-22-1987	22.0	10-13-2009	166.1	10-28-1995	25	SW	10-28-1995	1016.8	10-05-1987	996.8	10-28-1995
Nov	33.8	11-02-1993	20.4	11-22-1998	276.1	11-12-1990	55	S	11-12-1990	1017.4	11-08-1997	971.1	11-12-1990
Dec	34.0	12-01-2006	20.0	12-28-1996	185.4	12-05-2001	42	S	12-26-1993	1018.3	12-12-2002	995.1	12-26-1993
Annual	37.0	05-31-2010	19.8	01-21-1997	276.1	11-12-1990	55	S	11-12-1990	1019.8	01-29-1998	971.1	11-12-1990
										1019.8	02-01-1998		
Period of Record	1972 - 2014				1972 - 2014		1972 - 2014			1972 - 2014			

Source: Climate and Agrometeorology Division, PAGASA

Coordinates and Elevation of PAGASA-Mactan Station:
Latitude: 10°19'20.80''N
Longitude: 123°58'48.47''E
Elevation: 25.703 m

2.3.1.3 CHANGE IN LOCAL CLIMATE

2.3.1.3.1 BASELINE METEOROLOGICAL DATA

2.3.1.3.1.1 CLIMATE

The climate of the project site belongs to Type III climate based on the Modified Coronas Classification of Philippine Climate (**Figure 2-40**). There is no pronounced maximum rain period for areas zoned as Type III climate. Dry season for Type III climate lasts generally from one to three (3) months.

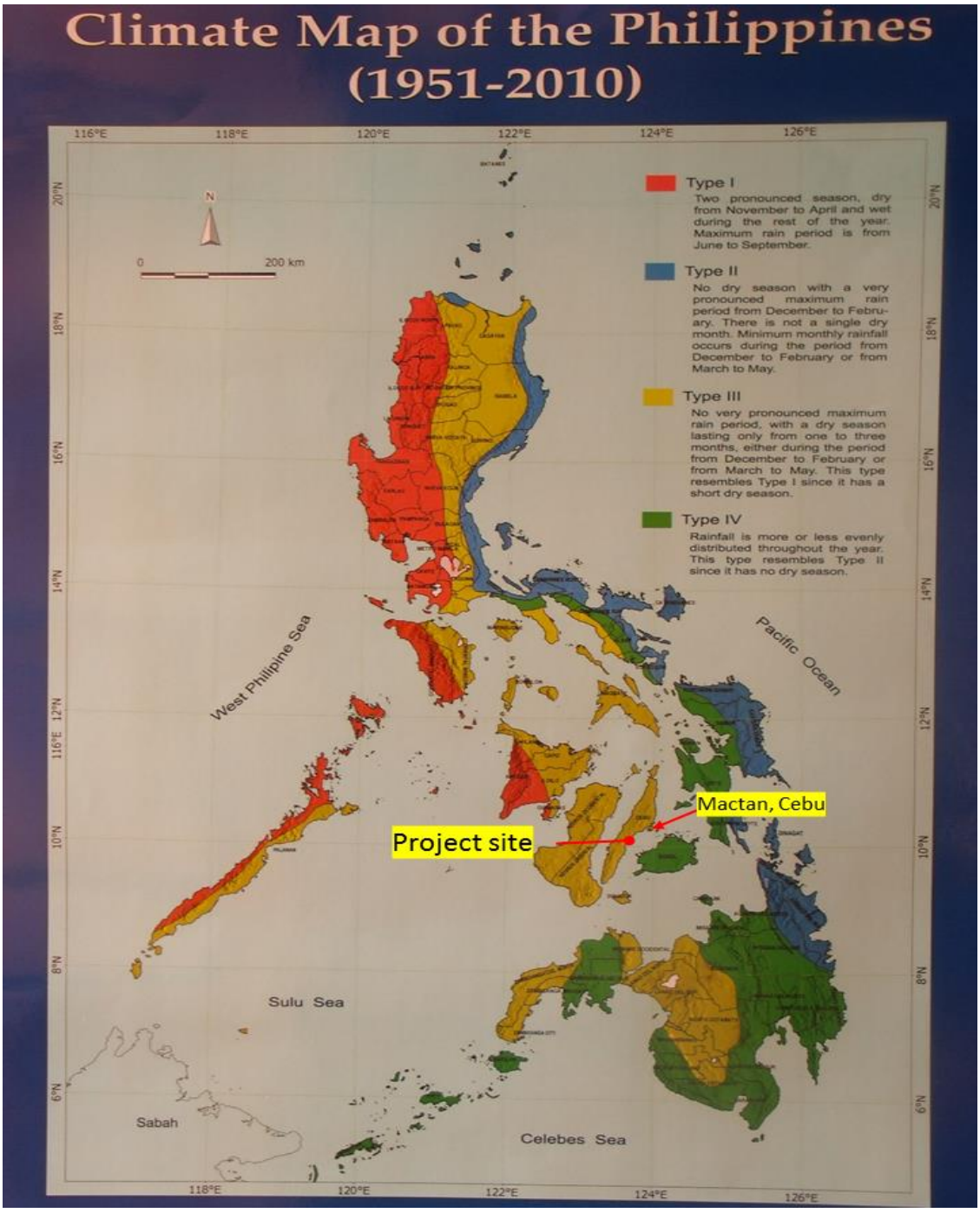
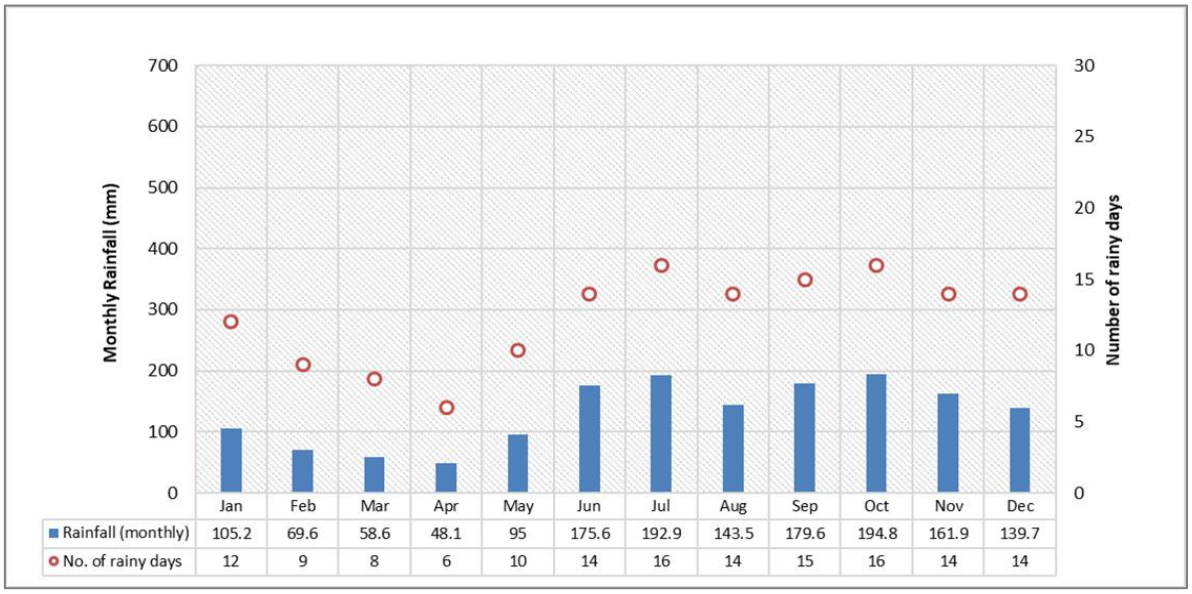


Figure 2-40. Climate map of the Philippines showing the locations of the project site and PAGASA-Mactan Station (Source: PAGASA 2015)

2.3.1.3.1.2 RAINFALL

The annual average rainfall at PAGASA-Mactan Station of 1564.5 mm is lower than the average annual rainfall in the Philippines of 2,562.5 mm. The highest average monthly rainfall at PAGASA-Mactan Station is 194.8 mm in October followed by 192.9 mm in July (**Figure 2-41**). It appears that months with relatively higher rainfall fall within the southwest monsoon (June to September) and during transition period from October to December.

The month with least rainfall is April with 48.1 mm and the second lowest is March with 58.6 mm of mean monthly rainfall. These months fall within the dry season of the year. Months with higher number of rainy days are also those months with higher monthly rainfall. Rainy days are days with rainfall (from 8:00 A.M. to 8:00 A.M of next day) with recorded rainfall of at least 0.1 mm.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (monthly)	105.2	69.6	58.6	48.1	95	175.6	192.9	143.5	179.6	194.8	161.9	139.7
No. of rainy days	12	9	8	6	10	14	16	14	15	16	14	14

Figure 2-41. Monthly average rainfall and number of rainy days from 1981 to 2010

Extreme Recorded Rainfall Events

Based on rainfall recorded at PAGASA-Mactan Station from 1972 to 2014, the highest recorded rainfall was 276.1 mm on November 12, 1990. This was due to the passage of Typhoon Mike (or otherwise known in the Philippines as Typhoon Ruping) that crossed Cebu in November 1990 (**Figure 2-42**). The second highest recorded daily rainfall occurred on April 4, 1994, which is within the dry season. This unusual high rainfall during dry season was due to Typhoon Bising (Owen), which crossed Visayas in April 1994.

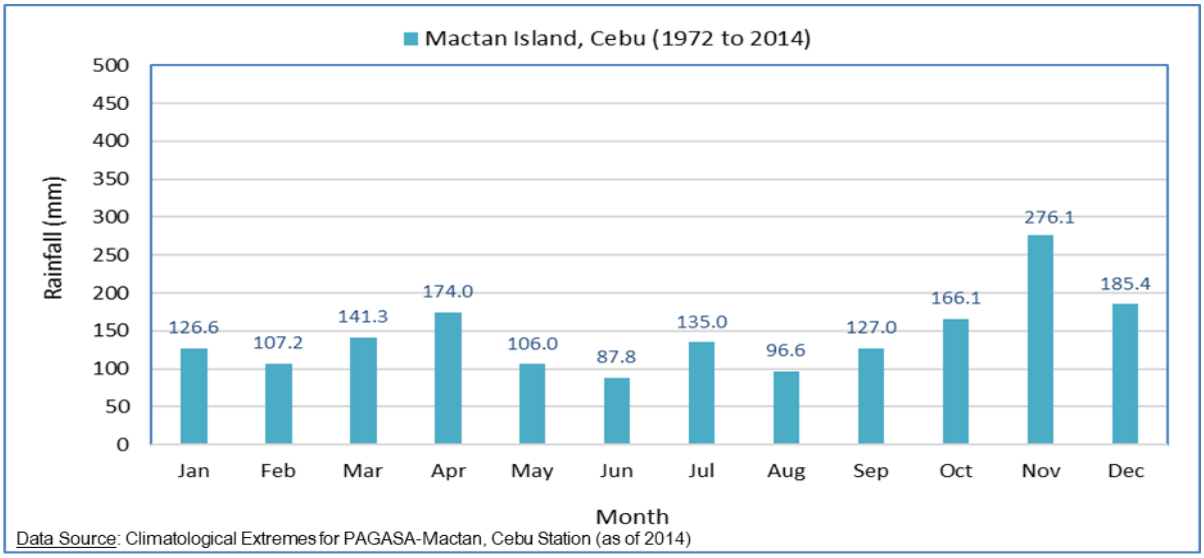
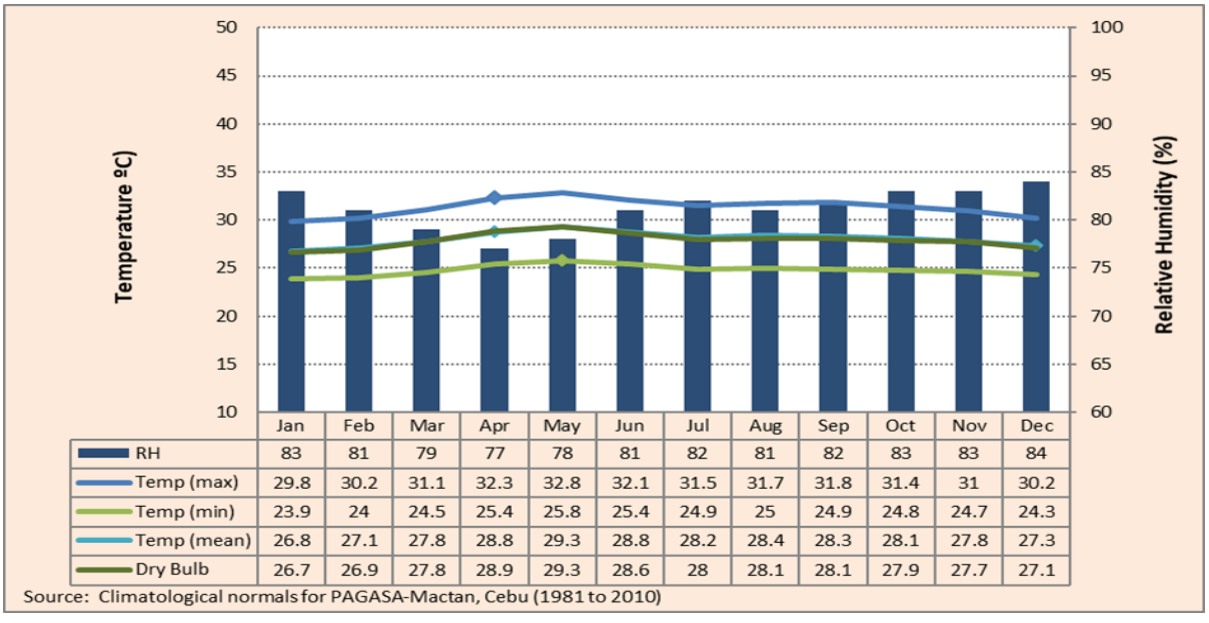


Figure 2-42. Plot of monthly extreme recorded rainfall

2.3.1.3.1.3 AMBIENT AIR TEMPERATURE

Mean temperature is the average of the minimum and maximum air temperatures recorded in a day. This differs with the dry bulb temperature, which is the air temperature at the time of observation. At PAGASA-Mactan Station, the annual average minimum and maximum air temperatures are 31.3 and 24.8 ºC, respectively (**Figure 2-43**). The annual average mean temperature of 28.1 ºC follows closely with the annual dry bulb temperature of 27.9 ºC. Relatively humidity is highest during colder months (December and January) and lowest during relatively hotter months. Warmer air requires more moisture to become saturated than colder air.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RH	83	81	79	77	78	81	82	81	82	83	83	84
Temp (max)	29.8	30.2	31.1	32.3	32.8	32.1	31.5	31.7	31.8	31.4	31	30.2
Temp (min)	23.9	24	24.5	25.4	25.8	25.4	24.9	25	24.9	24.8	24.7	24.3
Temp (mean)	26.8	27.1	27.8	28.8	29.3	28.8	28.2	28.4	28.3	28.1	27.8	27.3
Dry Bulb	26.7	26.9	27.8	28.9	29.3	28.6	28	28.1	28.1	27.9	27.7	27.1

Source: Climatological normals for PAGASA-Mactan, Cebu (1981 to 2010)

Figure 2-43. Plot of mean monthly air temperature and relative humidity for PAGASA-Mactan Station

Extreme Temperature Events

Based on air temperature recorded from 1971 to 2014 at PAGASA-Mactan Station, the highest recorded air temperature was 37 ºC on May 31, 2010. The second highest was 36.4 ºC on June 7, 2010,

and the third highest was 35.6 ºC April 15, 2004. These observed extreme temperature readings generally occurred during months with high mean temperature, as shown in **Figure 2-44**.

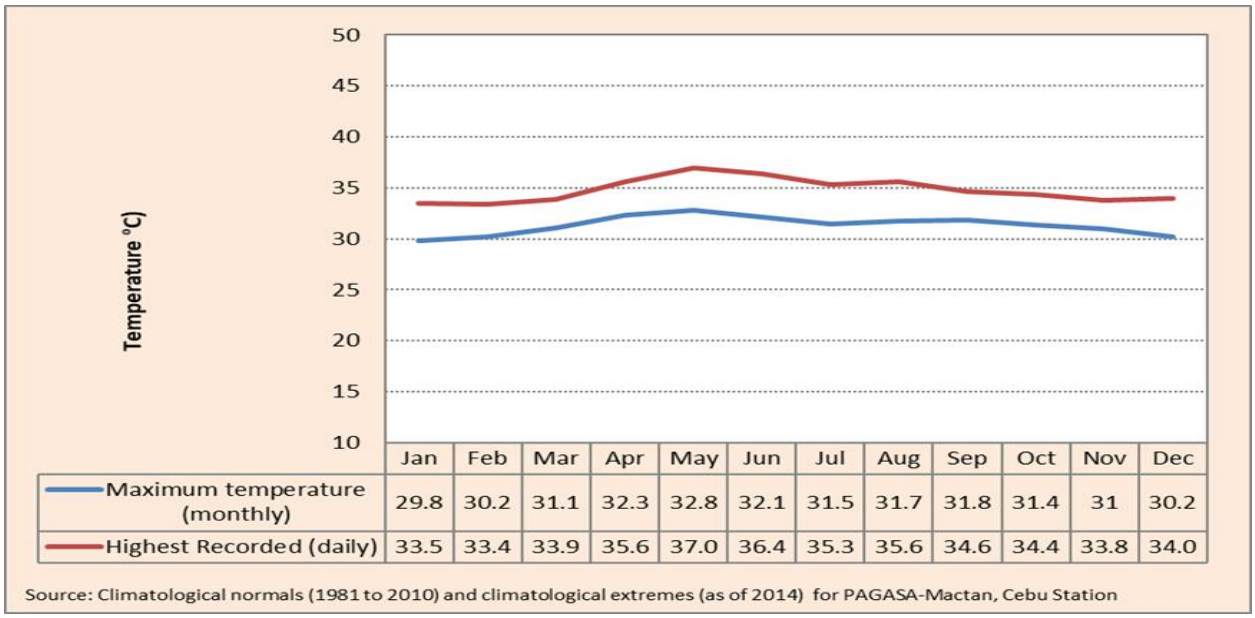


Figure 2-44. Highest recorded daily temperature and mean maximum monthly temperature for PAGASA-Mactan Station

2.3.1.3.1.4 Wind Speed and Wind Directions

Climatological normals of wind speeds and wind directions for PAGASA-Mactan Station (**Table 2-33**) show prevailing winds from the northeast (NE) from October to April and southwest (SW) from June to September. Easterly winds prevail in May. Mean monthly wind speeds range from 2 to 3 m/s.

Table 2-33. Climatological monthly average wind speed and directions at PAGASA-Mactan Station (1981 to 2010)

Month	Wind Direction	Wind Speed (m/s)
January	NE	3
February	NE	3
March	NE	3
April	NE	3
May	E	2
June	SW	2
July	SW	2
August	SW	3
September	SW	2
October	NE	2
November	NE	3
December	NE	3
Annual	NE	3

Data Source: PAGASA Climatological Normals

Annual Wind Roses

Based on the three-year sequential hourly prognostic meteorological data (2014 to 2016) generated by Lakes Environmental Software for the project, the most prevailing winds are light to moderate winds coming from the East, which occurred about 18% of time (**Figure 2-45**). Light to moderate winds from the east-northeast were the second most dominant winds occurring about 15% of the time.

In 2014 and 2015, easterly and east-northeasterly winds prevailed over the area at 14 and 16% of the time. In 2015, east-northeasterly winds reduced to 6% while the easterly winds increased to about 25% (**Figure 2-45**).

Light winds (1 to 5 m/s) generally prevailed at the project site, which occurred about 77% of the time (**Figure 2-46**). Moderate winds from 5 to 9 m/s occurred about 17% of the time while calms (winds less than 1 m/s) at 6.1%. Strong winds (winds greater than 9 m/s) only occurred about 0.2% of the time.

Monthly Wind Roses

The monthly wind roses appear to follow the seasonal wind flow patterns in the country, although wind directions at the project site slightly deflect from those recorded at PAGASA-Mactan Station (**Figure 2-47** and **Figure 2-48**).

The dominant winds from November to May are from the east and east-northeast. In June, winds prevail from the southeast, and from the southwest and west-southwest in July and August, respectively. Winds from the west tend to dominate in September.

In October, which is usually the transition month from southwest to northeast monsoons, winds from the east increase in frequency, although winds from the S-W quadrant appear to dominate during this month

In terms of monthly wind class frequency distribution (**Figure 2-49** and **Figure 2-50**), light winds from 1 to 5 m/s dominate over the area throughout the year. Moderate winds from 5 to 9 m/s are the second most dominant winds, except in June and September wherein calms (winds less than 1 m/s) are more frequent than the former.

Three-hourly wind roses

Three-hourly wind roses were also generated to possibly determine occurrences of local wind circulation patterns, such as land and sea breezes. As shown in **Figure 2-51** and **Figure 2-52**, there appears an increase of easterly winds from early morning (4:00 A.M. to 6:00 A.M.) at 14% to about 15% in early afternoon (1:00 P.M. to 3:00 P.M.). In late afternoon (4:00 P.M. to 6:00 P.M.) until nighttime, winds from the west (or from the land) appear to slightly increase during this period.

The foregoing wind occurrences or patterns generally follow the characteristics of land and sea breezes, which locally occur over coastal areas due to formation of high and low pressure areas over the land and sea during daytime, respectively, and reverses in direction at nighttime.

Extreme Recorded Winds

The greatest recorded wind speed at PAGASA-Mactan station was 55 m/s on November 1990 (

Table 2-32). This was due to Typhoon Mike (or otherwise known in the Philippines as Typhoon Ruping) that crossed Cebu in November 1990. Highest recorded rainfall at PAGASA-Mactan Station also occurred during passage of Typhoon Ruping.

Frequency of Tropical Cyclones

Figure 2-53 shows the monthly average tropical cyclone tracks and the frequency of tropical cyclones that entered the Philippine Area of Responsibility (PAR). The monthly average tropical cyclone tracks and its frequencies appear closer and higher in the province of Cebu from October to December. The cyclone tracks are also in vicinities of Cebu from January to April, but at lower frequencies. During the southwest monsoon season, the tropical cyclone tracks are generally on the northern part of Luzon and Visayas.

Based on risk maps of the Manila Observatory and the DENR, the province of Cebu is within a zone classified as low risk to typhoons.

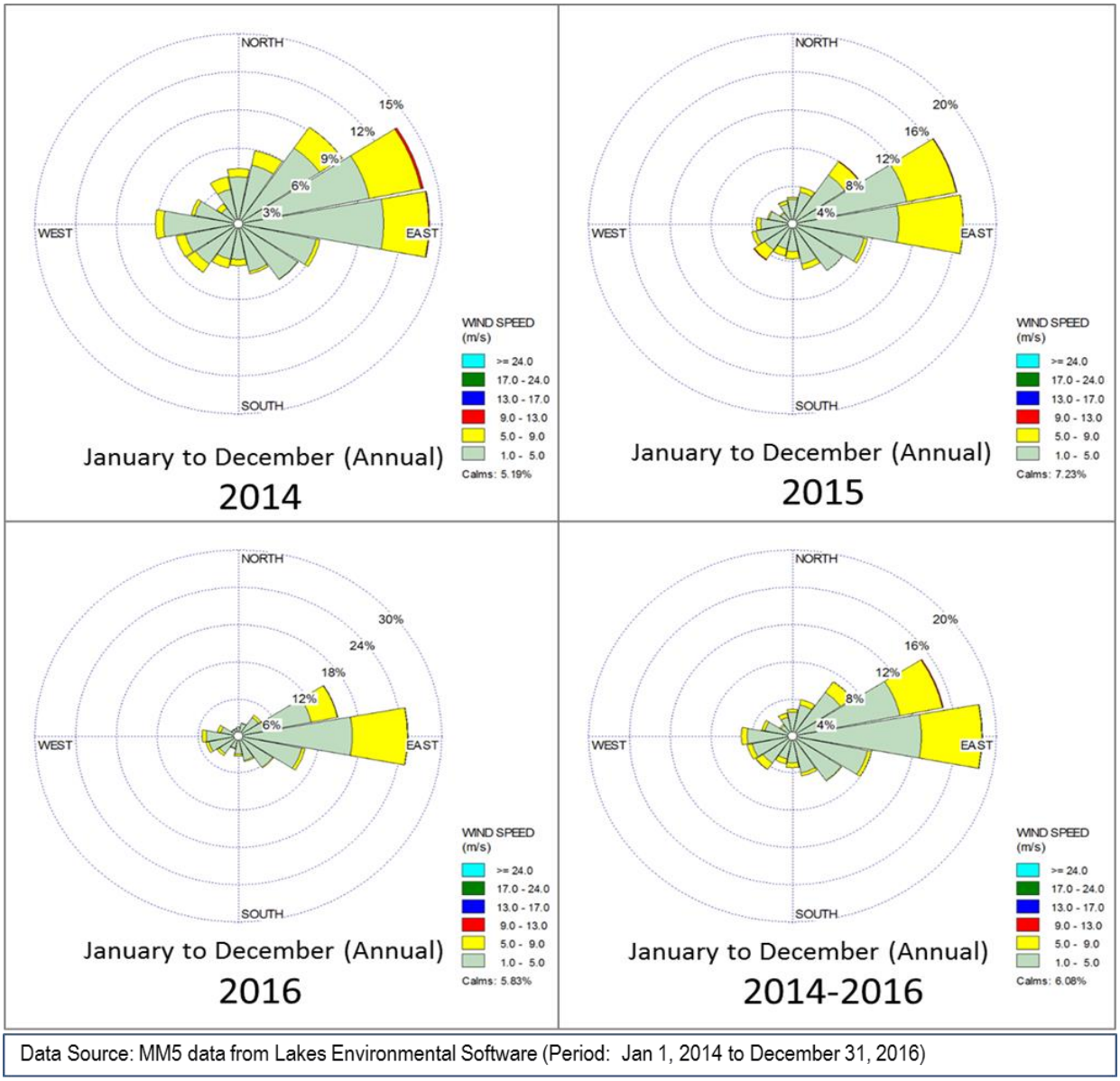


Figure 2-45. Annual wind rose diagrams for the project site

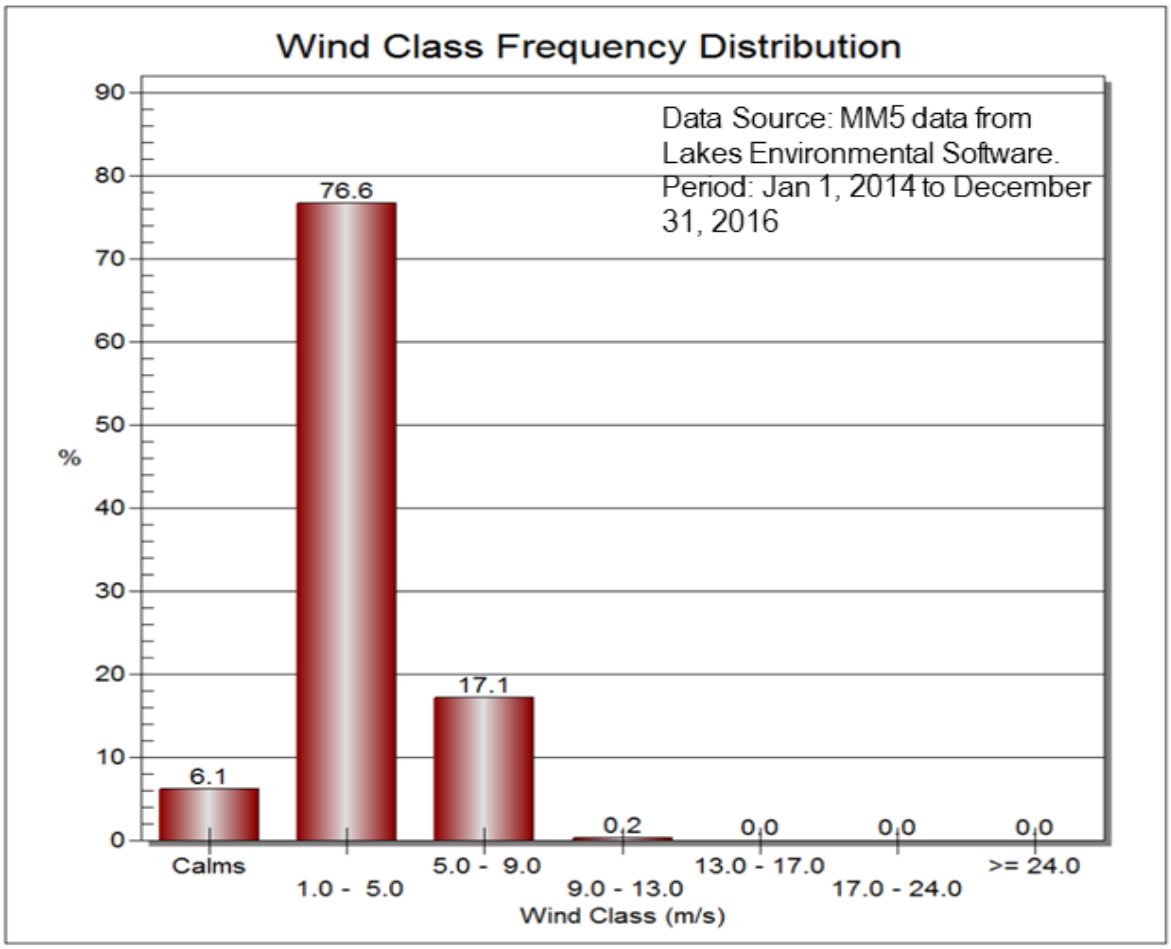


Figure 2-46. Annual wind class frequency distribution for the project site

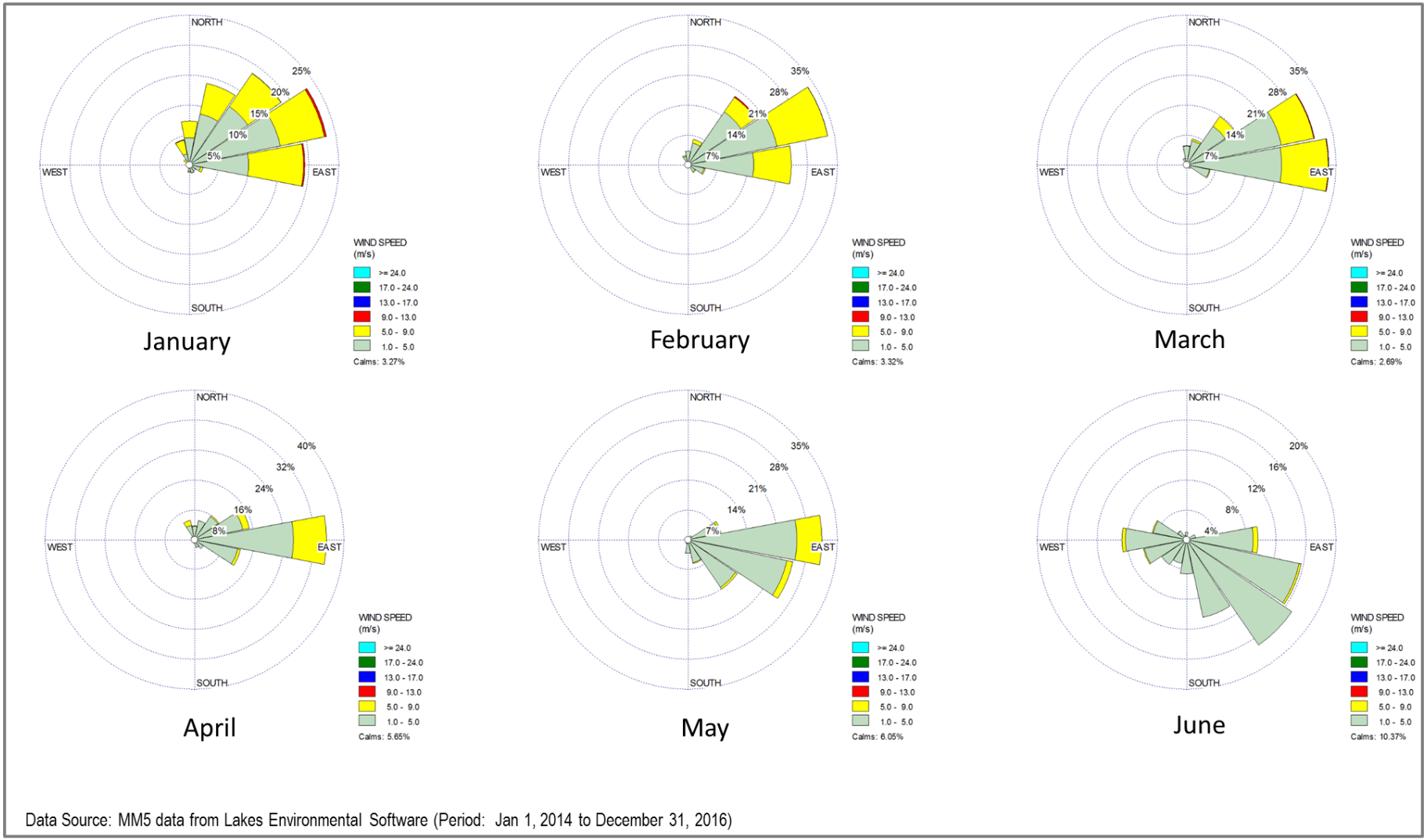


Figure 2-47. Wind roses for the project site from January to June

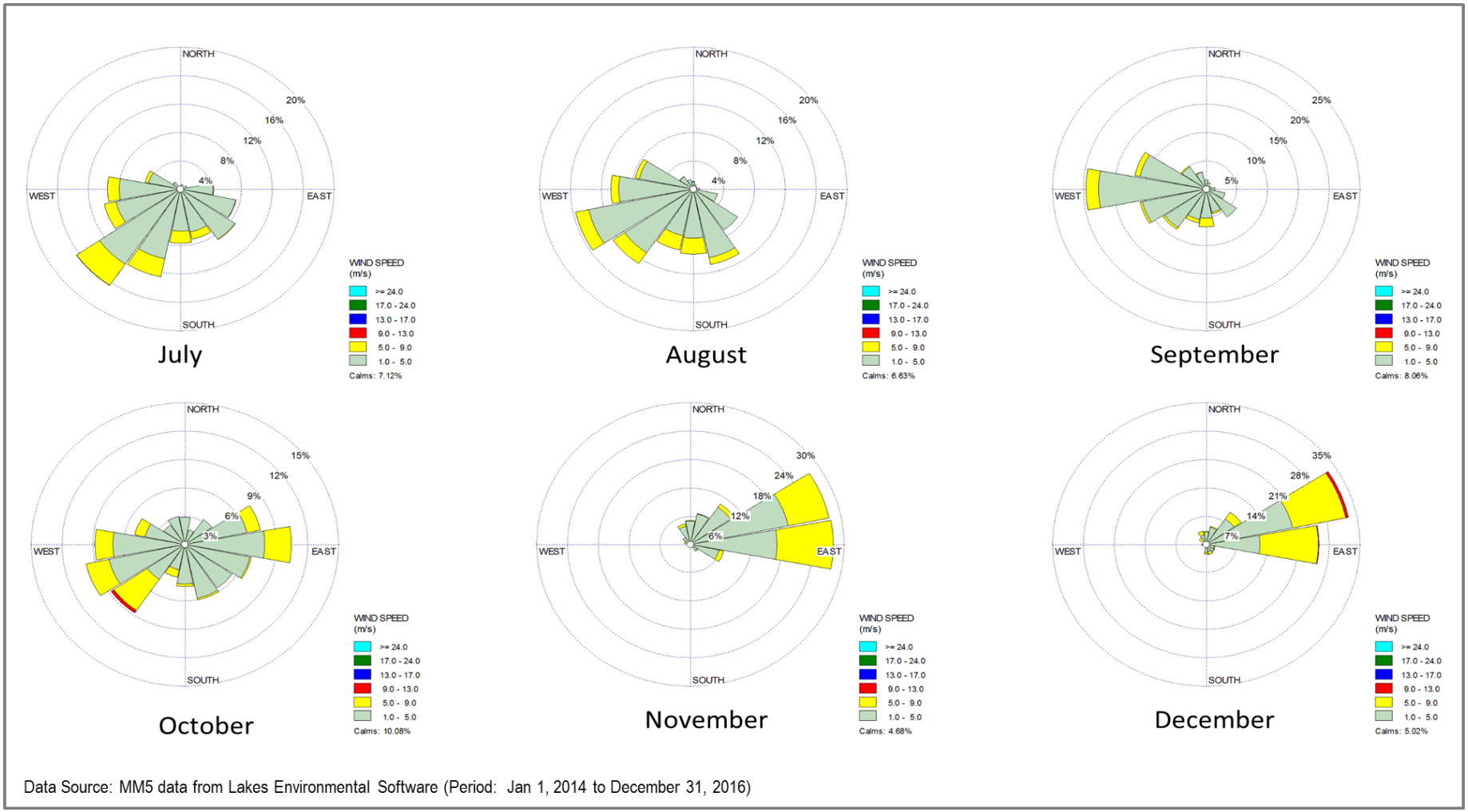


Figure 2-48. Wind roses for the project site from July to December

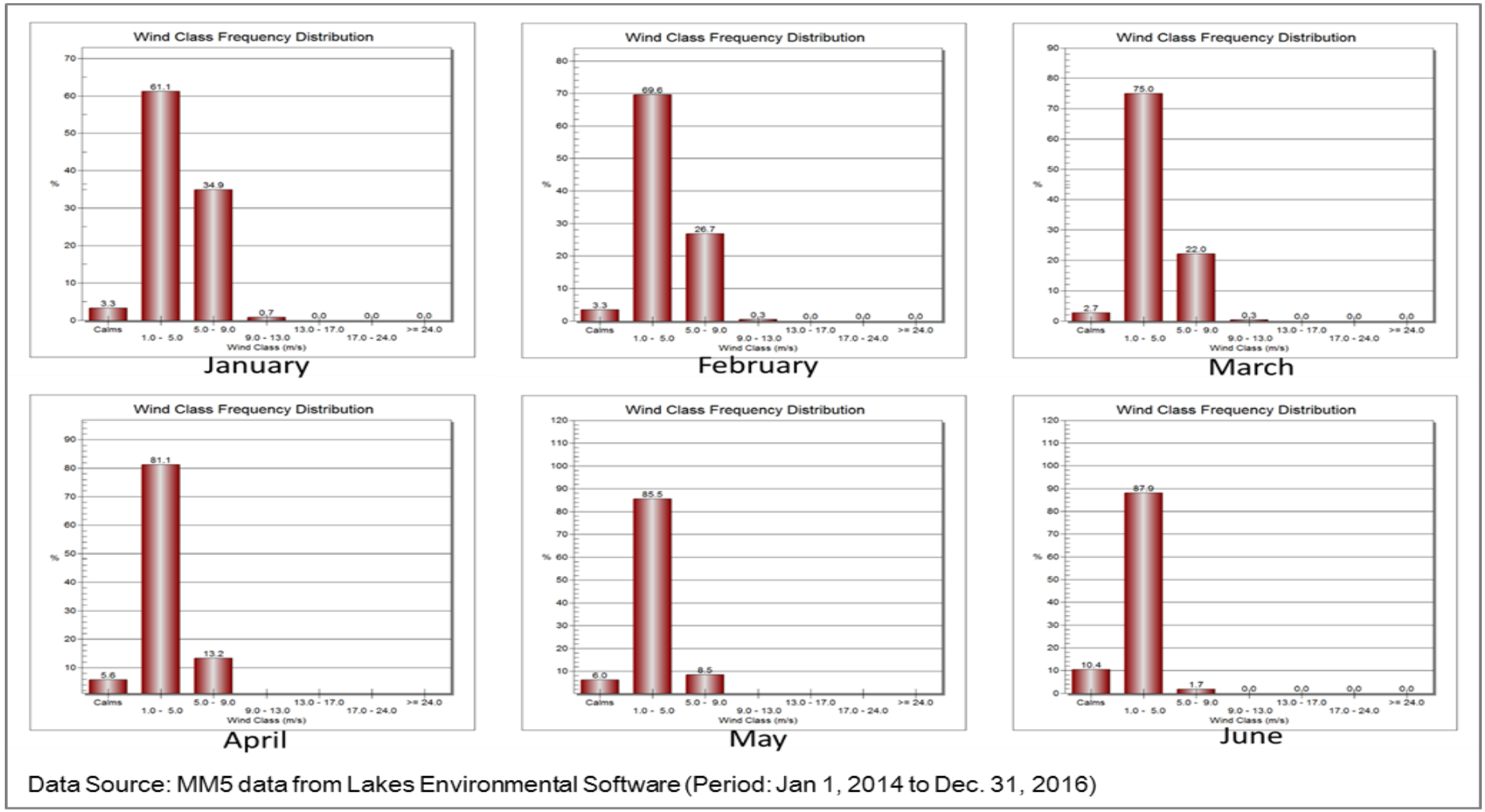


Figure 2-49. Wind class frequency class distribution for the project site for January to June

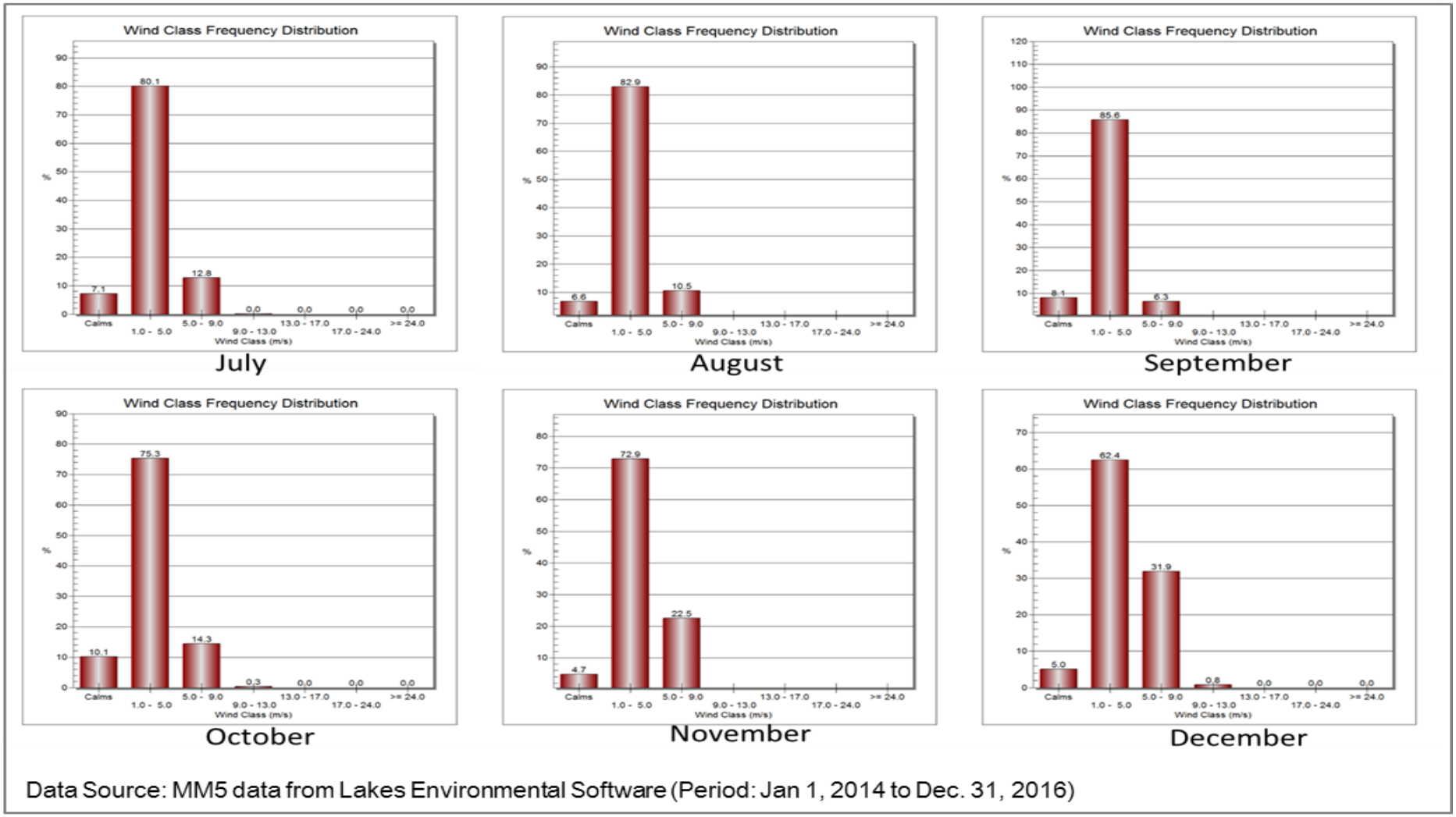


Figure 2-50. Wind class frequency distribution for the project site from July to December

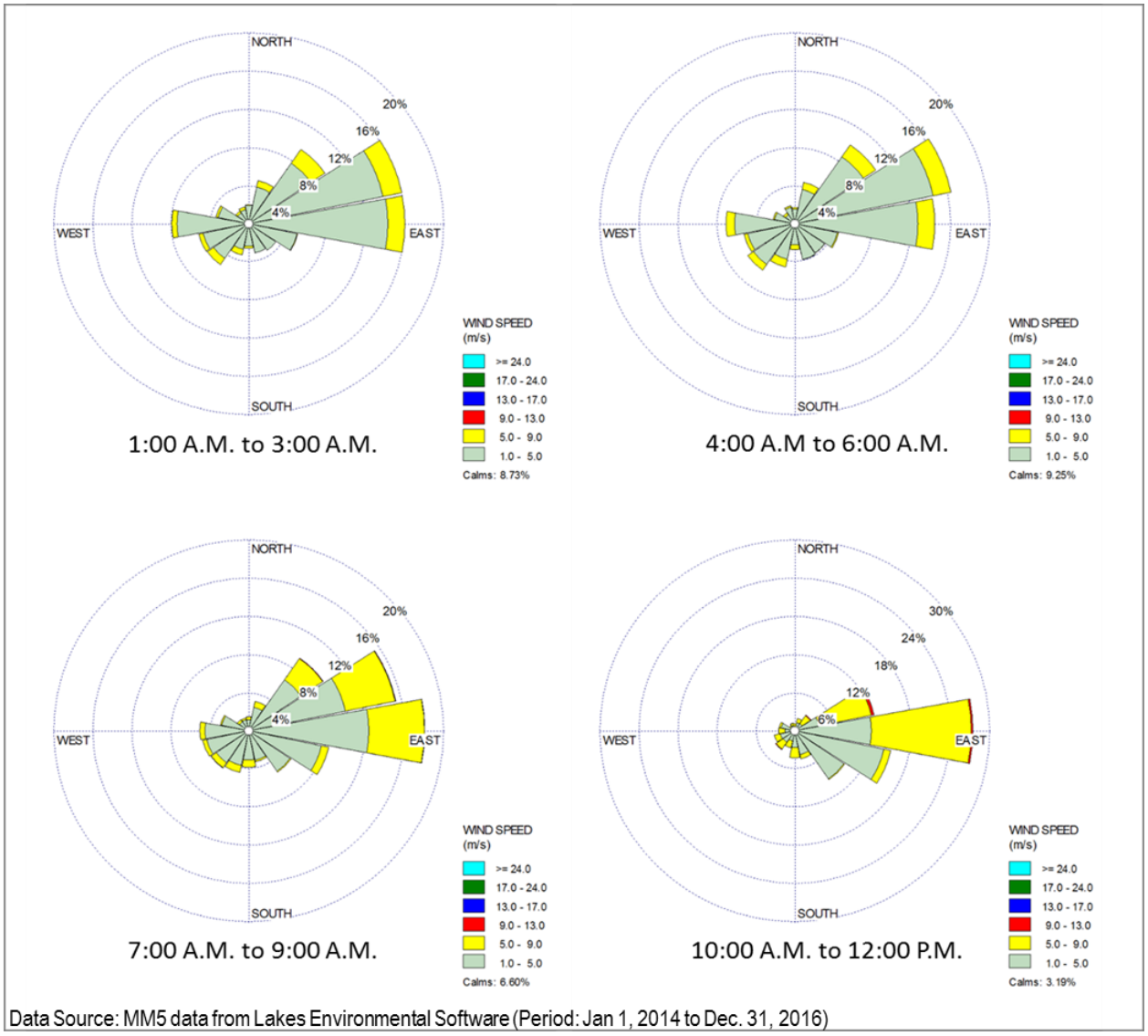


Figure 2-51. Three-hourly wind roses for the project site from 1:00 A.M. to 12:00 P.M.

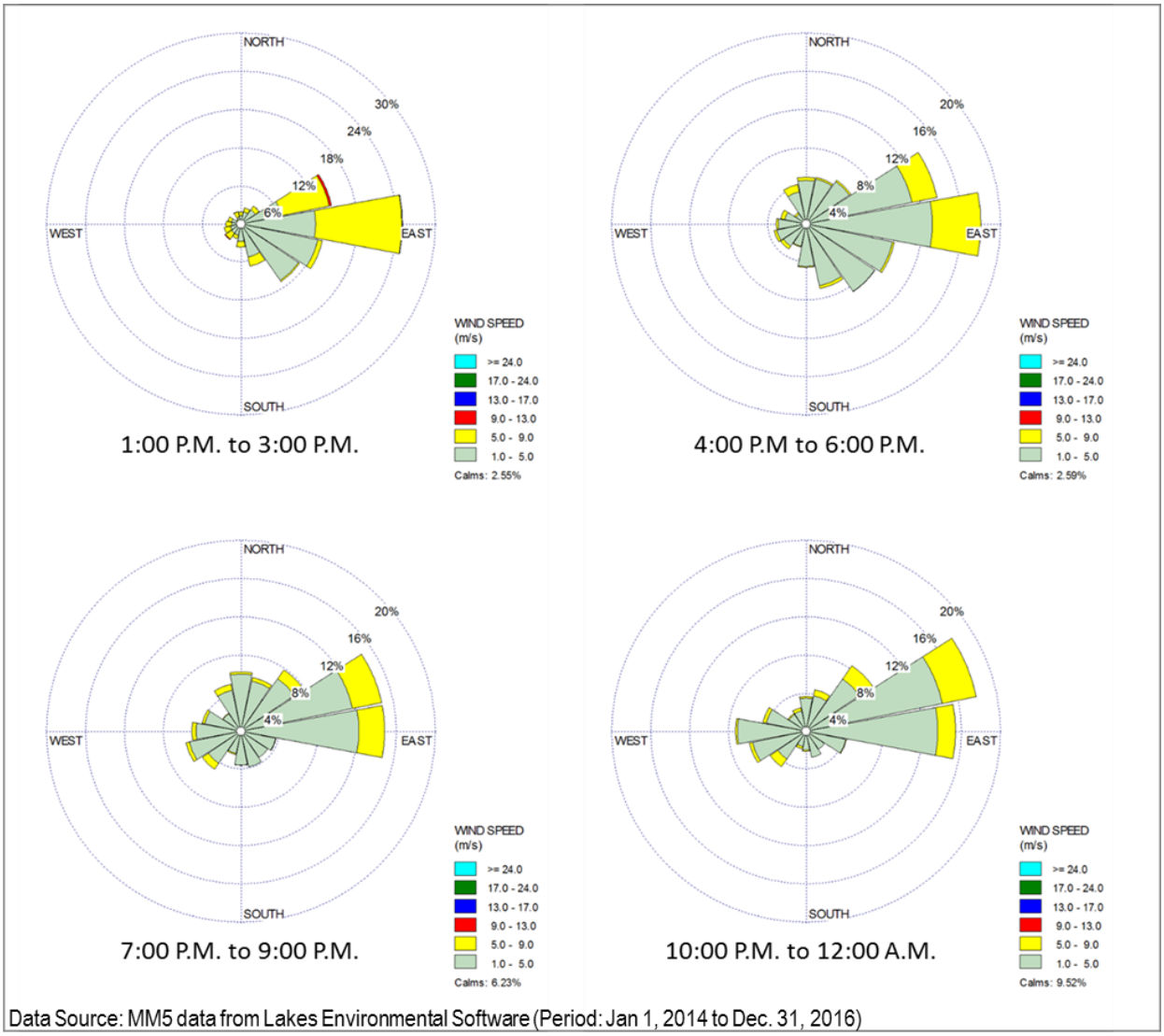


Figure 2-52. Three-hourly wind roses for the project site from 1:00 P.M.to 12:00 A.M.

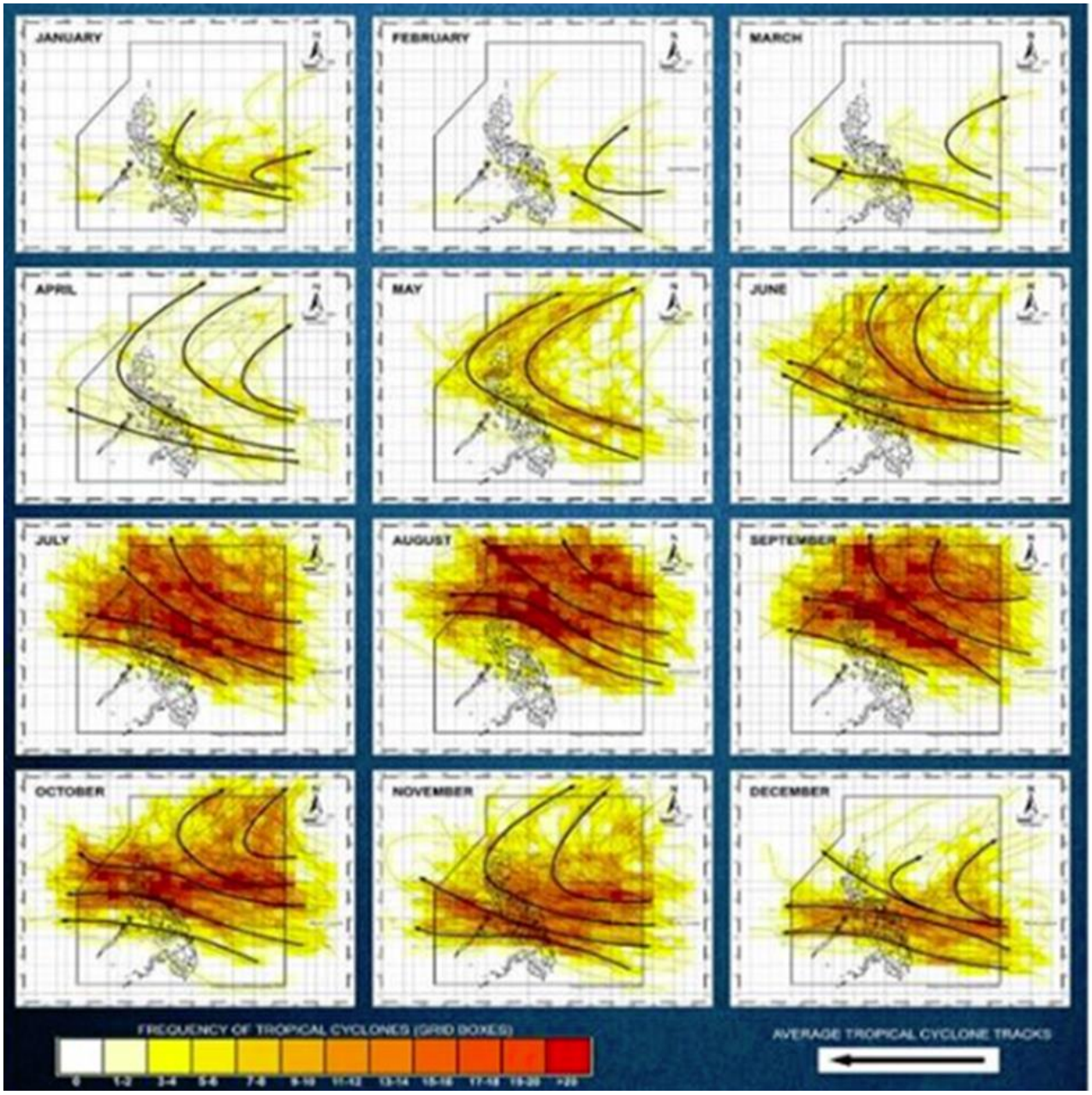


Figure 2-53. Frequency of tropical cyclones

2.3.1.3.2 PROJECTED CHANGE IN CLIMATE

2.3.1.3.2.1 PROJECTED CHANGE OF RAINFALL IN 2036 TO 2065

PAGASA (2018) noted that the western sections of Visayas, northern sections of Luzon and central and western sections of Mindanao have declining rainfall trend from1951 to 2010 in three (3) periods, as follows:

- March to May,
- June to August, and
- September to November

The western section of Visayas included Cebu, which has declining rainfall trend based on data from 1971 to 2010.

Rainfall in Cebu is projected to increase in all periods (upper bound) and in December to February and March to May (median) under moderate emission scenario, but tend to decrease in June to August and September to November (lower and median) (**Figure 2-54**). There is no consistent trend, however, as regard to increase or decrease of rainfall (medium and high emission scenarios).

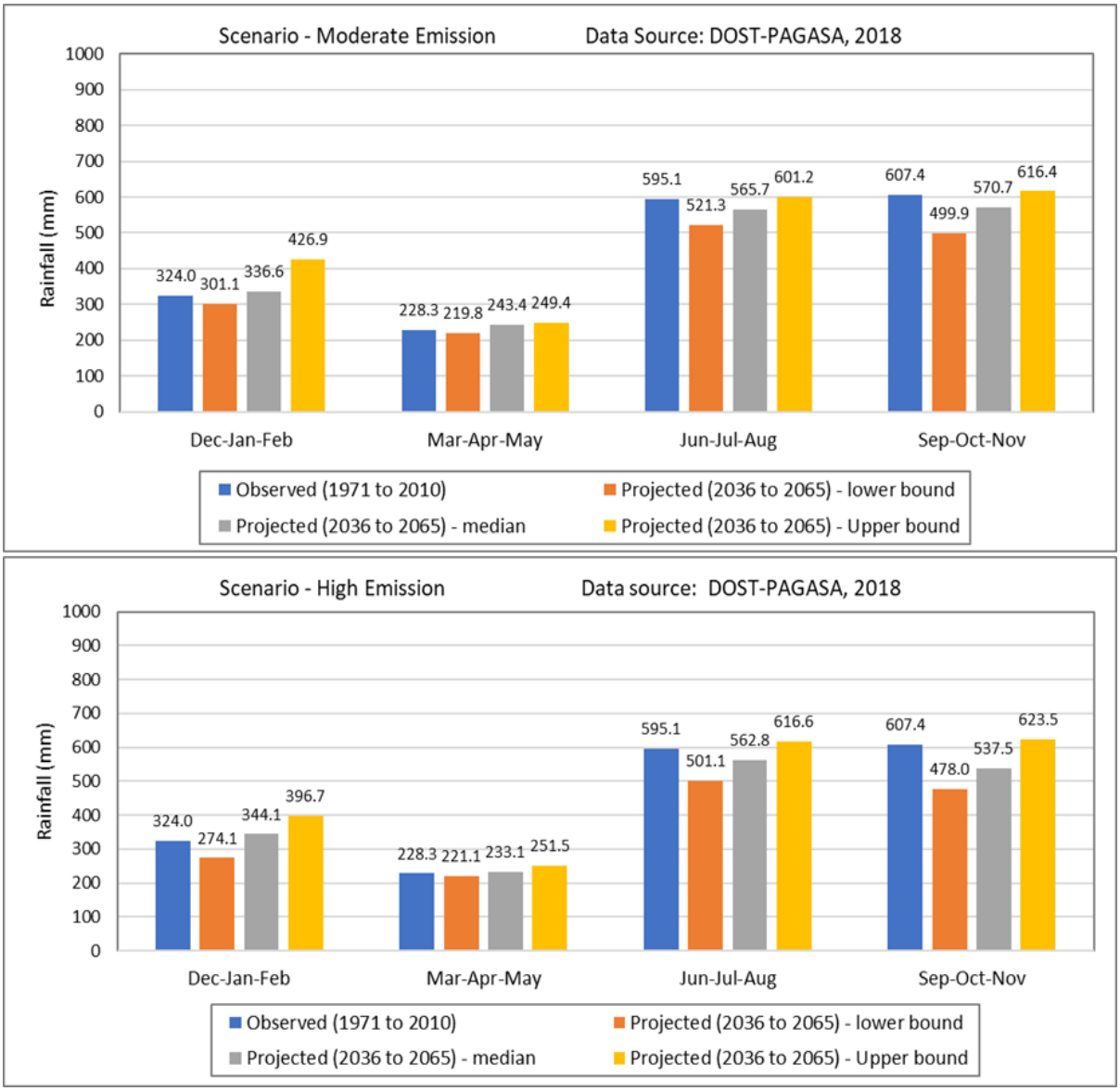


Figure 2-54. Project change in rainfall for the province of Cebu (Data Source: PAGASA, 2018)

2.3.1.3.2.2 PROJECTED CHANGE OF AIR TEMPERATURE IN 2036 TO 2065

PAGASA (2018) noted that air temperature is projected to increase uniformly and minimally across the Philippines under moderate and high emission scenarios. In Cebu, air temperature is projected to increase in all periods (lower to upper bounds) (**Figure 2-55**). The projected increase in temperature are as follows:

- Moderate emission scenario – 1.1 to 1.2 °C (median) and 1.1 to 1.7 (upper bound)
- High emission scenario – 1.1 to 1.6 °C (median) 2.1 to 2.2 °C (upper bound)

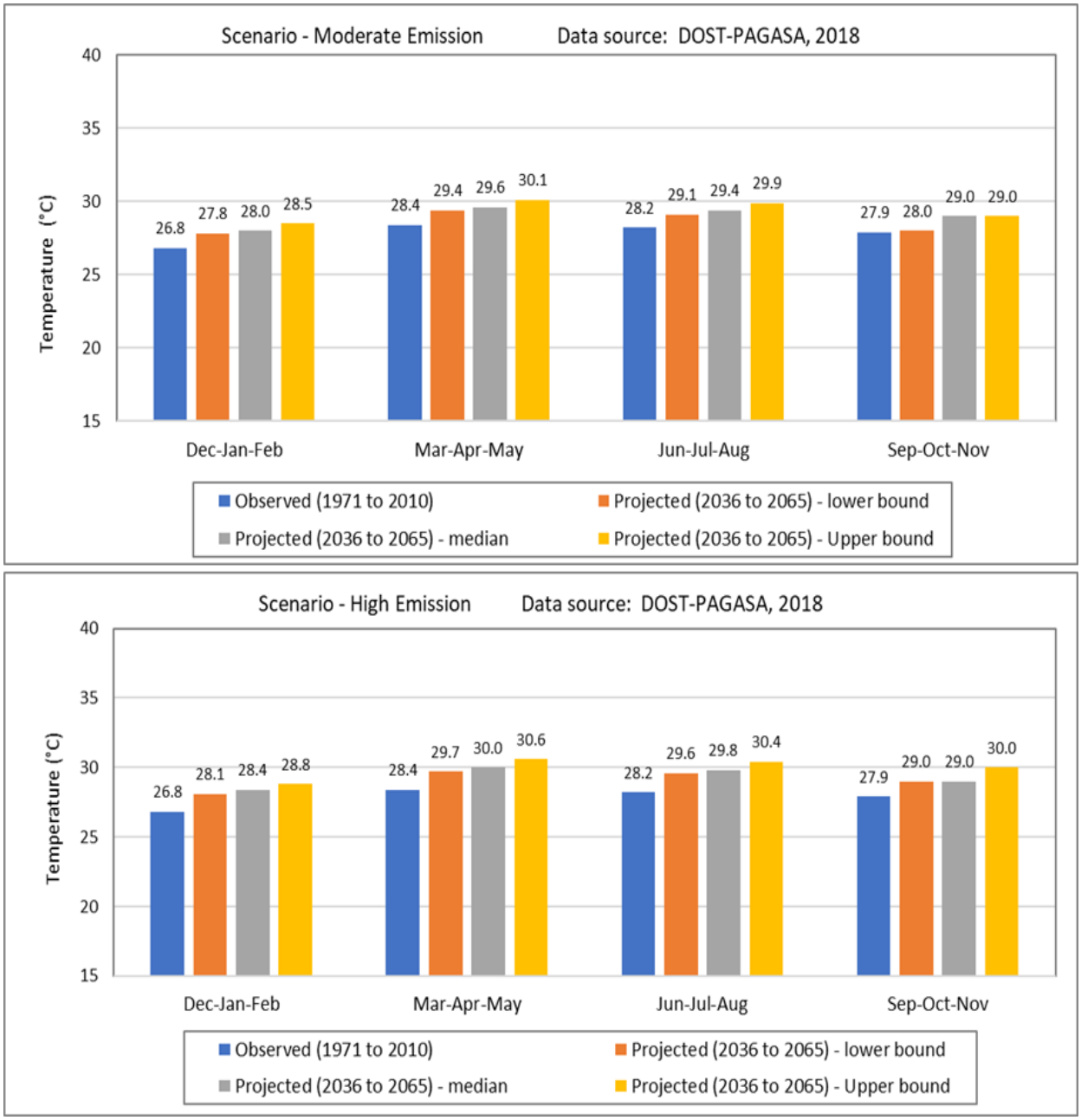


Figure 2-55. Projected change in temperature for the province of Cebu (Data Source: PAGASA, 2018)

2.3.1.4 CONTRIBUTION IN TERMS OF GREENHOUSE GAS EMISSIONS

2.3.1.4.1 SCOPE

This section presents the a) estimated greenhouse gases (GHG) of the project using spreadsheets developed by the World Research Institute (WRI), and the b) mitigation measures or practices by the project proponent to reduce GHG emissions. Recommended measures to further lessen GHG emissions are also discussed in this section.

2.3.1.4.2 METHODOLOGY

Emission of GHG focused on the equipment to be used for the quarry project, regardless of whether it is directly or indirectly owned by the proponent. GHG emissions were estimated using the WRI

(2015): GHG Protocol tool for mobile combustion. Version 2.6 – computation of GHG emissions from mobile sources (heavy equipment, trucks, and other vehicles).

The above-mentioned tool can provide good estimate of GHG emission by providing the type fuel and the estimated fuel consumption per year. On estimating the fuel consumption for each vehicle type, this was done using the method by Klanfar, et. al. (2016). This reference provides good estimates of fuel consumption rate based on calculated load factor.

2.3.1.4.3 GHG EMISSIONS OF THE PROJECT

The estimated GHG emissions for the current and proposed productions are 3,277.371 and 3,707.199 tons per year of CO_2e, respectively (**Table 2-34**). The proposed production is projected to increase CO_2e emissions by about 11.6%.

The list of equipment, corresponding fuel consumption and the screenshots of the estimated GHG emissions are presented in Annex A and Annex B.

Table 2-34. Estimated GHG emissions (tons of CO_2e per year) for the current and proposed production

Sources	Current Production	Proposed Production
Quarry equipment	3,277.371	3,707.199

2.3.1.5 MITIGATION MEASURES AND MONITORING PROGRAM

The proponent is yet to establish a comprehensive program on GHG accounting and reduction, although there are practices that are noted to reduce GHG emissions. These are as follows, including the proposed mitigation and monitoring program on GHG.

i. Optimize location of run-of-mine (ROM) and overburden to limit the amount of haul distance, and consequently, fuel consumption;
ii. Regular maintenance of haul roads to reduce rolling resistance;
iii. Regular schedule of vehicles and heavy equipment used in quarrying and hauling;
iv. Offset GHG emissions by implementing reforestation program for the project;
v. Reduce idling time of vehicles and heavy equipment;
vi. Minimize opening of vegetated areas and use of existing bare areas (if any);
vii. Replenish or replant opened space cleared for quarrying as soon as necessary; and
viii. Implement monitoring program on GHG by regular recording (i.e., daily) of the following.
    - Vehicle type;
    - Vehicle ID (e.g., plate number or body number);
    - Location and hours of operation;
    - Fuel consumption (liters per day).; and
    - Maintenance schedule

2.3.2 AIR QUALITY

2.3.2.1 DEGRADATION OF AIR QUALITY

2.3.2.1.1 SCOPE

This air quality modular report focused on the following as provided in the Screening Form for the project

- Characterization of the background air quality at the project site and vicinities; and
- Determination of impact on the air environment, and proposed mitigation measures and monitoring program – details on estimation of emissions of particulates and other regulated air pollutants are included in the assessment

2.3.2.1.2 METHODOLOGY

2.3.2.1.2.1 ENVIRONMENTAL PERFORMANCE/BACKGROUND AIR QUALITY MONITORING

TSP Monthly Monitoring

The environmental performance of the project (SEDC) on ambient air quality was assessed based on the air quality monitoring data from 2017 to 2018. SEDC has been conducting monthly and/or quarterly monitoring of total suspended particulates (TSP) at and in vicinities for its quarry site in San Fernando.

Table 2-35 and **Figure 2-56** present the description and sampling locations of the monitoring stations, respectively. Note that all of the air monitoring stations is included in the assessment as expected increase of air emissions emanating from the operation of the silica quarry project includes areas in vicinities of the haul roads from the project site in Pinamungajan, Cebu to the cement plant in San Fernando, Cebu.

Air monitoring by SEDC involved sampling using a high-volume sampler. Samples of particulates were collected for one-hour using the high-volume sampler and were brought to a DENR-EMB accredited laboratory for analysis.

Table 2-35. Locations and descriptions of monitoring stations

Station ID	Station Name	Latitude (deg)	Longitude (deg)
Stn 1	Upper Tonggo		
Stn 2	LowerTonggo	10.161748	123.69294
Stn 7	Tinubdan Basketball Court		
Stn 8	Upper Kapangian		
Stn 12	Sitio Tapon		
	Bugho Clay Quarry		
	Magsico Clay Quarry		
	Silica Sand Quarry		

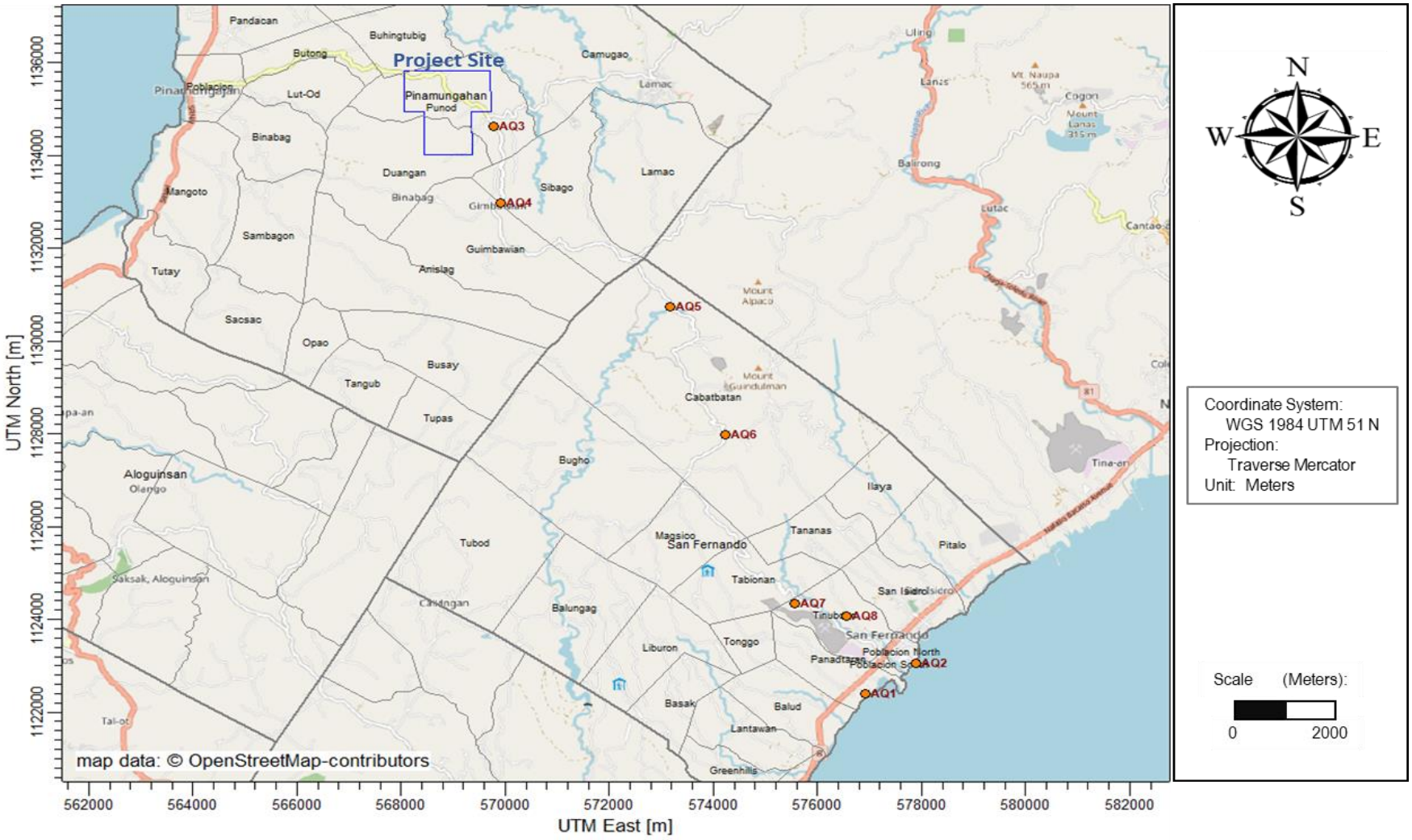


Figure 2-56. Locations Of Monitoring Stations

Monitoring on July 2019

ACES Distribution & Consulting Services, Inc. (ACES) was commissioned by RHR Consult Services, Inc. to conduct ambient air of TSP, PM10, SO2, and NO2 at eight (8) locations (**Figure 2-56** and **Table 2-36**). **Table 2-37** shows the methods of air sampling and analysis, the details of which are presented below. Plate 2-4 to Plate 2-11 show the photographs of the air samplers at the monitoring stations. Annexes A to C show the calibration certificates of the air samplers, field data sheets and laboratory certificates of analysis.

Table 2-36. Locations and descriptions of monitoring stations

Station	Location	Date / Time of Sampling	Description of Location
AQ1	Panadtaran, San Fernando	July 29, 2019 / 1437H-1537H	Located on grassy road area and no rainfall was observed during sampling.
AQ2	Sitio Pantalan South Poblacion	July 29, 2019 / 1610H-1710H	Located on a cemented area beside a road; no rainfall was observed during sampling.
AQ3	Daungan, Pinamungajan Elem. School.	July 30, 2019 / 0924H-1024H	Located on a rocky and grassy area beside a road; no rainfall was observed during sampling.
AQ4	Brgy. Guimbawian, Pinamungajan Covered Court	July 30, 2019 / 1045H-1145H	Located on cemented beside a road; no rainfall was observed during sampling.
AQ5	Brgy. Bugho San Fernando	July 30, 2019 / 1220H-1320H	Located on rocky road area and no rainfall was observed during sampling.
AQ6	Magsico Basketball Court San fernando	July 30, 2019 / 1345H-1445H	Located on cemented road area and no rainfall was observed during sampling.
AQ7	Tinubdan, Elementary School	July 30, 2019 / 1510H-1610H	Located on cement road area and no rainfall was observed during sampling.
AQ8	Sitio Kapangian, Brgy. South Poblacion,San Fernando	July 30, 2019 / 1647H-1747H	Located on a grassy road area and no rainfall was observed during sampling.

Weather conditions at the time of monitoring were also recorded. These included the sky condition, occurrence of rainfall, and wind speed and wind directions. **Table 2-38**and **Table 2-39** show the criteria in determining cloud condition and rainfall description, respectively

Table 2-37. Methods of ambient air sampling and analysis

Parameters	Methodology / Analysis
Total Suspended Particulates (TSP)	High Volume – Gravimetric Method
Particulate Matter 10 (PM_{10})	High Volume – Gravimetric Method
Sulfur Dioxide (SO_2)	Bubbler – Pararosaniline Method
Nitrogen Dioxide (NO_2)	Bubbler – Griess-Saltzman Reaction Method
Reference: USEPA 40 CFR, Part 50	

Sulfur Dioxide (SO_2)

SO_2 samples were taken using a handy gas sampler by aspirating air into a solution of sodium tetrachloromercurate (TCM) through an impinger. Samples were then brought to a DENR accredited laboratory for analysis. SO_2 concentration was determined by the difference between the absorbance

of the sample and blank multiplied by the calibration factor and divided by the total volume of air sampled corrected to normal temperature and pressure.

Nitrogen Dioxide (NO_2)

NO_2 samples were taken using a handy gas sampler by aspirating air into an azo dye forming reagent. The difference between the absorbance of the sample and the blank multiplied by the calibration factor over the total volume of air sampled gave the concentration of NO_2 in ambient air.

Total Suspended Particulates (TSP)

TSP samples were taken using a high-volume sampler by drawing air through a glass-fiber filter paper and desiccated for 24-hours after sampling and prior to final weighing. The concentration of TSP in ambient air was calculated by dividing the total weight of particulates collected by the normal volume of air sampled.

Particulate Matter Less Than 10 Microns (PM_{10})

PM_{10} samples were taken using a high-volume sampler with a specially shaped cyclone inlet where larger particulates were separated from PM_{10} size range. The filter paper with retained particulates was recovered after sampling and desiccated for 24 hours prior to weighing. The concentration of PM_{10} in ambient air was the weight of the particulates collected divided by the total normal volume of air sampled.

Table 2-38. Cloud Description

Sky Condition	Definition / Description
Clear or Sunny Skies	• State of the sky when it is cloudless, totally clear or with a few small light clouds visible. • Has a total cloud cover of less than one octa.
Partly Cloudy	• State of the sky is within 2-5 octa's total cloud cover or has between 30% to 70% cover of the celestial dome.
Partly Cloudy to at Times Cloudy	• Mostly partly cloudy but there are times when more than 70% of the celestial dome is covered with clouds.
Mostly or Mainly Cloudy	• The sky is mostly covered with clouds but with possible brief periods of sunshine. • The total cloud cover is ranges between 6 to 8 octas.
Cloudy	• The sky is covered with clouds between 6 to 8 octa's or has more than 70% cloud cover. • Predominantly more clouds than clear sky. • For a longer period during the day, the sun is obscured by clouds.
Overcast	• The sky is totally or completely covered with thick and opaque clouds, 8 octa's or around 100% cloud cover.

Source: PAGASA

Table 2-39. Rain Description

Rain Description	Definition / Description
Very Light Rains	• Scattered drops that do not completely wet an exposed surface regardless of duration.
Light Rains	• The rate of fall is from trace to 2.5 mm per hour. • Individual drops easily identified and puddles (small muddy pools) form slowly. • Small streams may flow in gutters.
Moderate Rains	• The rate of fall is between 2.5 mm to 7.5 mm per hour.

Rain Description	Definition / Description
	• Puddles rapidly forming and down pipes flowing freely.
Heavy Rains	• The rate of fall is greater than 7.5 mm per hour. • The sky is overcast, there is a continuous precipitation. • Falls in sheets, misty spray over hard surfaces. • May cause roaring noise on roofs.
Monsoon Rains	• Heavy and continuous precipitation attributed to either the Southwest or Northeast Monsoon.
Occasional Rains	• Not frequent but is recurrent precipitation.
Widespread Rains	• Precipitation occurring extensively throughout an area.
Frequent rains	• Precipitation occurring regularly and often throughout the time duration.
Intermittent Rains	• Precipitation which ceases at times and re-occur again.

Source: PAGASA

Plate 2-4. Station AQ1 – Panadtaran, San Fernando

Plate 2-5. Station AQ2 – Sitio Panatalan, South Poblacion

Plate 2-6. Station AQ3 – Daungan, Pinamungajan Elementary School

Plate 2-7. Station AQ4 – Barangay Guimbawian, Pinamungajan Covered Court

Plate 2-8. Station AQ5 – Barangay Bugho, San Fernando

Plate 2-9. Station AQ6 – Magsico Basketball Court

Plate 2-10. Station AQ7 – Tinubdan Elementary School

Plate 2-11. Station AQ8 – Sitio Kapangian, Barangay South Poblacion, San Fernando

2.3.2.1.2.2 EMISSION ESTIMATES

Emission rates of air pollutants were estimated using emission factors of the U.S.EPA and the National Pollution Inventory (NPI) of the Australian Government. Emission estimates focused on fugitive emissions or particulates as the significant air emissions generated by quarrying, and the emissions of gaseous air pollutants (CO, NO_X, SO_2, and total) emanating from tailpipes of the quarrying equipment.

i. Bulldozing

The emission factors of TSP, PM_{10} and $PM_{2.5}$ (in kg/hr) arising from bulldozing activities were based on AP-42 Emission factor (Table 11.9-2), as follows:

$$EF_{TSP(bulldozing)} = \frac{2.6s^{1.2}}{M^{1.3}} \quad \text{Equation 1}$$

$$EF_{PM10(bulldozing)} = 0.75x\frac{0.45\ s^{1.5}}{M^{1..4}} \quad \text{Equation 2}$$

$$EF_{PM2.5(bulldozing)} = 0.105\ x\ E_{TSP} = \frac{0.273\ s^{1.2}}{M^{1.3}} \quad \text{Equation 3}$$

where: s, is the material silt content (%) and, M is the material moisture content (%).

ii. Materials Handling

Emission factors for TSP, PM_{10} and $PM_{2.5}$ (in kg/ton) arising from movement of haul-trucks and front-end loaders/shovels for the unloading/loading of materials were estimated using Section 13.2.4 of AP-42, as follows.

$$EF_{Materials\ Handling} = k\ (0.0016)\ \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$ Equation 4

where U and M are the mean wind speed (m/s) and the material moisture content (%), respectively. The particle size multiplier, k, is 0.74 for TSP, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$.

iii. Grading

Emission factors for TSP (in kg/vehicle kilometer travelled) for grading and scraping of unpaved roads were based on Table 11.9-2 of AP-42, as follows:

$$E_{TSPgrading-scraping} = 0.0034\ x\ S^{2.5}$$ Equation 5

where, S, is the mean vehicle speed (km/h). For PM_{10}, the emission factor (in kg/vehicle kilometer travelled) is,

$$E_{PM10grading-scraping} = 0.6\ x\ 0.0056\ x\ S^{2.0}$$ Equation 6

iv. Haul Trucks Along Unpaved Roads

Emission factors arising from operation of trucks (e.g., hauling of materials) along unpaved access roads (in lb/vehicle mile travelled) were obtained from Chapter 13.2 of AP-42, as follows:

$$EF_{UnpavedRoad} = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$ Equation 7

where k, a, and, b, are constants shown in **Table 2-40**.

Table 2-40. Constants used on emission factors for unpaved roads

Constant	Industrial Roads		
	PM_{30}*	PM_{10}	$PM_{2.5}$
K (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45
*Assumed equivalent to total suspended particulate matter (TSP) Source: Table 13.2.2-2 of AP-42			

The above equations and constants were converted to metric units to obtain the emission factors in vehicle kilometer travelled (or kg/VKT).

The emission factor (Equation 7) was adjusted to account for the natural mitigation by rainfall using the formula,

$$E_{Funpaved(cor)} = EF_{unpaved}\left(\frac{365-P}{365}\right)$$ Equation 8

Where:

- $EF_{unpaved(cor)}$= the annual size specific emission factor extrapolated for natural mitigation (lb/VMT), and
- P = number of days in a year with at least 0.254 mm (0.01 in) of rainfall

v. Paved Roads

Emissions of haul trucks passing along unpaved roads (in g/VKT) were obtained from AP-42 (Chapter 13.2), as follows:

$$E_{pavedRoad} = k\ (sL)^{0.91}(W)^{1.02}$$ Equation 9

Where:

K = particle size multiplier for particle size range
sL = road surface silt loading (g/m^2);
W = average weight (tons) of the vehicles travelling the road

The particle size multiplier for TSP and PM_{10} are 3.23 and 0.62, respectively.

The emission factor (Equation 6) was adjusted to account for the natural mitigation by rainfall using the formula,

$$E_{pavedRoad(cor)} = k\ (sL)^{0.91}(W)^{1.02}(1 - \frac{P}{4N})$$ Equation 10

Where:

P = number of "wet" days with at least 0.254 mm (0.01 in) of rainfall, and
N = number of hours in the averaging period

vi. Motor Vehicle Combustion

Tailpipe emissions emanating from operation of heavy equipment were estimated using emission factors prescribed in *NPI Emission Estimation Technique l for Combustion Engine V3.0 (June 2008)*. **Table 2-41** shows list of heavy equipment used for quarry operation, engine rated power, average load factor and emission factors based on NPI.

Table 2-41. Rated power, average load factor, and emission factor of quarrying equipment

Source	Rated Power (kW)	Average Load Factor	Emission factor (kg/kWH)							Reference
			Total Particulates	PM_{10}	PM2.5	CO	NOX	SO_2	Total VOC	
Existing Production										
Backhoe CAT330	204	0.56	0.001144	0.00088	0.00081	0.003	0.012	0.0000075	0.0015	Table 32 of NPI
Backhoe CAT 330 (spare)	204	0.56	0.001144	0.00088	0.00081	0.003	0.012	0.0000075	0.0015	Table 32 of NPI
Dumptruck (Isuzu)	257	0.23	0.00234	0.0018	0.0017	0.0068	0.023	0.000017	0.0018	Table 21 of NPI
Proposed Production										
Backhoe CAT330	204	0.56	0.001144	0.00088	0.00081	0.003	0.012	0.0000075	0.0015	Table 32 of NPI
Backhoe CAT 330 (spare)	204	0.56	0.001144	0.00088	0.00081	0.003	0.012	0.0000075	0.0015	Table 32 of NPI
Dumptruck (Howo)	257	0.23	0.00234	0.0018	0.0017	0.0068	0.023	0.000017	0.0018	Table 21 of NPI
Payloader	140.9	0.50	0.00143	0.0011	0.00099	0.0036	0.012	0.0000075	0.0016	Table 31 of NPI
Grader	100.7	0.50	0.001092	0.00084	0.00077	0.0021	0.0096	0.0000075	0.00048	Table 30 of NPI

2.3.2.1.3 ENVIRONMENTAL PERFORMANCE/BACKGROUND AIR QUALITY

The environmental performance of the silica quarry project ambient air quality was assessed based on the monitoring data from 2017 to 2018 and the air monitoring in July 2019.

2.3.2.1.3.1 MONTHLY MONITORING OF TSP

Figure 2-57 shows the measured TSP concentrations at nine (9) locations located in Pinamungajan and San Fernando, Cebu. The monitoring stations in San Fernando, Cebu were included as hauling of materials from the silica project is expected to generate air emissions along and in vicinities of the haul roads. The statistics of results are presented in **Table 2-42**.

Results show that measured concentrations of TSP were all within the ambient air quality standard set for TSP at 300 µg/Nm^3. The lowest TSP concentration was 12.9 µg/Nm^3 and the highest was 222.3 µg/Nm^3. The average concentrations of TSP range from 31.8 to 128.2 µg/Nm^3.

The plots of measured TSP concentrations show relatively higher levels during the dry season, particularly in February 2018 and April 2018.

Table 2-42. Statistics of measured TSP (in µg/Nm^3)

Station ID	Station Name	Minimum	Maximum	Average
Stn 1	Upper Tonggo	54.8	145.7	113.9
Stn 2	LowerTonggo	18.4	222.3	110.1
Stn 6	Lower Panadtaran	44.5	214.3	128.2
Stn 7	Tinubdan Basketball Court	70.2	89.0	78.3
Stn 8	Upper Kapangian	55.4	109.3	77.1
Stn 9	(Sitio Kapangian	25.8	160.9	84.5
Stn 12	Sitio Tapon	17.7	189.6	121.3
	Bugho Clay Quarry	85.1	118.4	96.8
	Silica Sand Quarry	12.9	50.0	31.8
NAAQS for TSP = 300 µg/Nm^3				

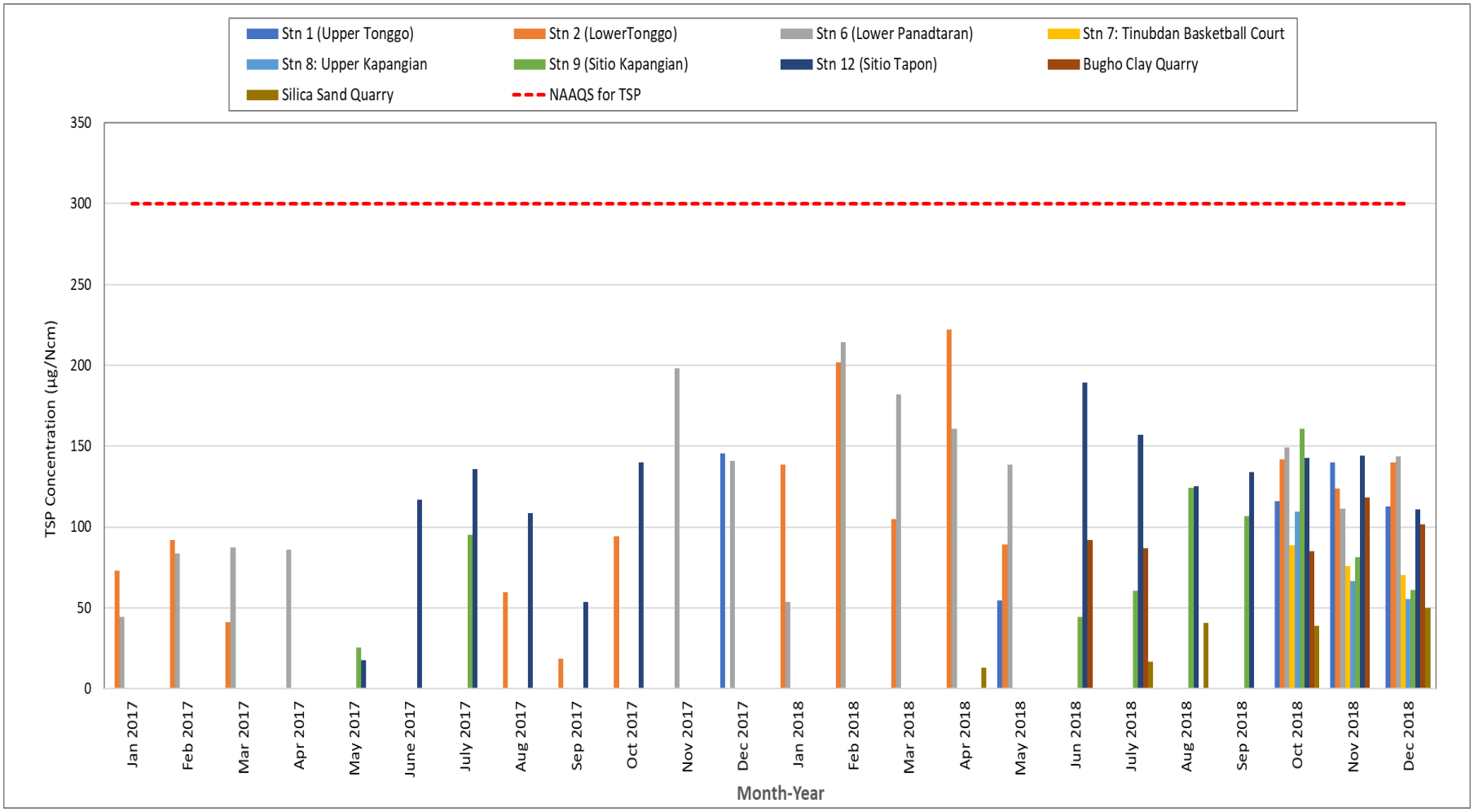


Figure 2-57. Measured TSP concentrations at the ten (10) monitoring stations

2.3.2.1.3.2 JULY 2019 MONITORING

Table 2-43 shows the measured concentrations of TSP, PM_{10}, SO_2, and NO_2 on July 29-30, 2019 at eight (8) locations. Particulate air pollutants range from 12.8 to 147.1 µg/Nm^3 and 18 to 5.5 µg/Nm^{3}for TSP and PM_{10}, respectively. These concentrations are way below the ambient standards set at 300 and 200 µg/Nm^3 for TSP and PM_{10}, respectively.

For the gaseous air pollutants (SO_2 and NO_2), measured concentrations were generally less than the detection limits.

Light air (Beaufort number 1) coming from the S-W were the prevailing winds at the time of monitoring (**Table 2-44**). There was no occurrence of rainfall during monitoring with sunny to partly cloudy skies.

Table 2-43. Measured concentrations of TSP, PM_{10}, SO_2 and NO_2 (µg/Nm^3)

Station	Location	Date / Time of Sampling	TSP	PM_{10}	SO_2	NO_2
AQ1	Panadtaran, San Fernando	July 29, 2019 / 1437H-1537H	47.6	3.7	13.2	< 3.1
AQ2	Sitio Pantalan South Poblacion	July 29, 2019 / 1610H-1710H	34.7	5.5	< 8.7	< 3.1
AQ3	Daungan, Pinamungajan Elem. School.	July 30, 2019 / 0924H-1024H	21.8	1.8	< 8.6	< 3.1
AQ4	Brgy. Guimbawian, Pinamungajan Covered Court	July 30, 2019 / 1045H-1145H	48.2	1.9	< 10.9	< 3.2
AQ5	Brgy. Bugho San Fernando	July 30, 2019 / 1220H-1320H	16.8	1.9	< 8.9	< 3.2
AQ6	Magsico Basketball Court San fernando	July 30, 2019 / 1345H-1445H	12.8	1.8	< 8.7	< 4.7
AQ7	Tinubdan, Elementary School	July 30, 2019 / 1510H-1610H	38.3	1.8	< 10.6	4.3
AQ8	Sitio Kapangian, Brgy. South Poblacion,San Fernando	July 30, 2019 / 1647H-1747H	147.1	10.8	< 8.7	< 3.1
DENR NAAQS for Source Specific Air Pollutants based on 60 minutes averaging time			300	200	340	260
Note: The detection limit value of the parameters was used for the computation of non-detected concentrations						

Table 2-44. Observed meteorological condition during sampling on 1-Hr Ambient Air Monitoring Locations and Observed Meteorological Conditions

Station	Location	Date/Time	Wind Direction	Wind Speed	Cloud Description	Rain Description
AQ1	Panadtaran, San Fernando	July 29, 2019 / 1437H-1537H	SW	BF1	Partly cloudy	None
AQ2	Sitio Pantalan South Poblacion	July 29, 2019 / 1610H-	SW	BF1	Cloudy	None

Station	Location	Date/Time	Wind Direction	Wind Speed	Cloud Description	Rain Description
		1710H				
AQ3	Daungan, Pinamungajan Elem. School.	July 30, 2019 / 0924H-1024H	SW	BF1	Sunny with partly cloudy skies	None
AQ4	Brgy. Guimbawian, Pinamungajan Covered Court	July 30, 2019 / 1045H-1145H	SW	BF1	Sunny with partly cloudy skies	None
AQ5	Brgy. Bugho San Fernando	July 30, 2019 / 1220H-1320H	SW	BF1	Sunny with partly cloudy skies	None
AQ6	Magsico Basketball Court San fernando	July 30, 2019 / 1345H-1445H	SW	BF1	Sunny with partly cloudy skies	None
AQ7	Tinubdan, Elementary School	July 30, 2019 / 1510H-1610H	SW	BF1	Sunny with partly cloudy skies	None
AQ8	Sitio Kapangian, Brgy. South Poblacion,San Fernando	July 30, 2019 / 1647H-1747H	SW	BF1	Sunny with partly cloudy skies	None

2.3.2.2 Impact Assessment and Mitigation Measures

As discussed in the methodology, estimation of air emissions emanating from the existing and the proposed productions of the project were performed using available emission factors of the U.S.EPA AP-42 and the NPI. Emission estimates focused on particulate emissions (total particulates, PM_{10}, and $PM_{2.5}$) from the following significant quarrying activities.

- Bulldozing;
- Materials handling (mine site);
- Grading;
- Travel of haul trucks along unpaved road;
- Travel of haul trucks along paved road; and
- Tailpipe emissions from vehicles;

Gaseous air pollutants (CO, NOX, SO2, VOC) from tailpipe emissions of vehicles (quarry equipment) were also included in the emission estimates.

A spreadsheet was developed to calculate the above-mentioned air pollutants emanating from current and proposed productions. **Annex D** shows the screenshots of the spreadsheets indicating the assumptions, emission factors, and results of calculations. The results were summarized and presented as graphs in **Figure 2-58** to **Figure 2-65**.

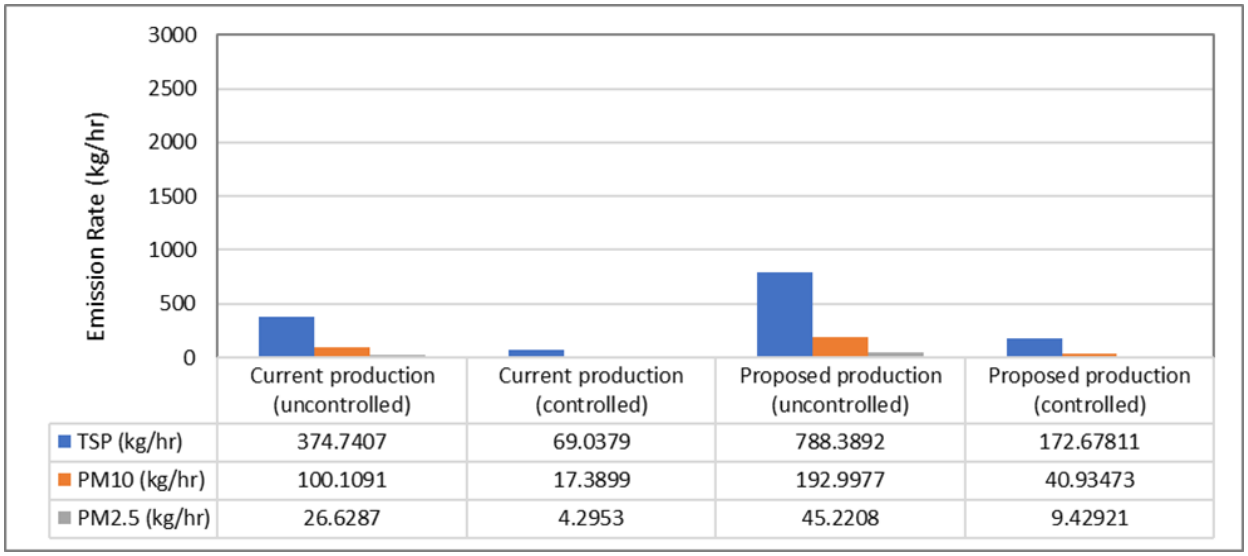
Frequency of dump trucks travelling from the quarry site to the stockpile in the cement plant will increase from 5 dump trucks per hour (current production) to 15 dump trucks per hour (proposed production). Only one (1) backhoe will be added for the proposed production giving total of three (3) backhoes from two (2) backhoes for the current production. The other vehicles/quarry equipment for the silica proposed production are one (1) unit of payloader and one (1) unit of grader. Bulldozer was also included in the proposed production.

Conservative default values for silt content of 15% and moisture content of 0.5% were used in estimating uncontrolled particulate emissions. These values were based from the Emissions Inventory Guidance for Mineral Handling and Processing Industries of Mojave Air Quality Management District published in 2010 (herein referred as Mojave, 2010). Silt content default value for this project, however, was assumed at 15% (50% of 30% based from Mojave, 2010). Estimates of fugitive emissions at varying silt contents, moisture contents and wind speeds are shown in **Figure 2-60** to **Figure 2-62** and **Table 2-45** to **Table 2-47**.

Uncontrolled particulate emissions (TSP) was estimated to increase from its current emission of 777.1 tons per year to about 2502.7 tons per year for the proposed production (**Figure 2-60**) The estimated increase of emission rate of TSP for the proposed production was about 3 times more than the current production. For PM_{10} and $PM_{2.5}$, the estimated increase in emission rates were about 3 and 2.7 times than the existing production

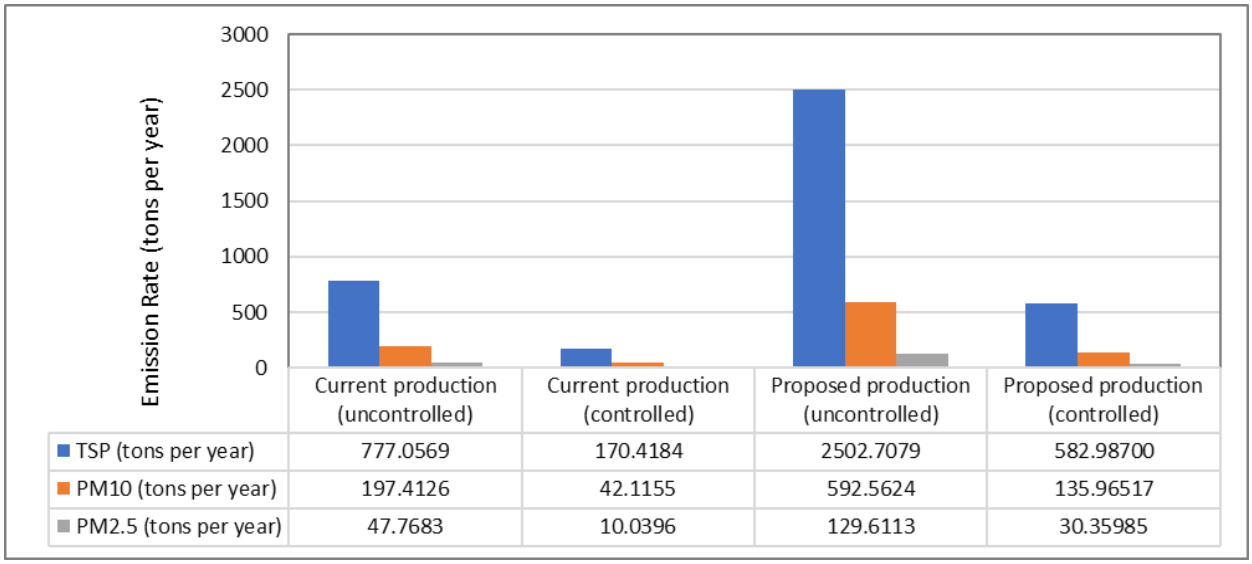
Hauling of materials by dump trucks along roads contributed to large percentage of fugitive emissions (**Figure 2-60** to **Figure 2-65**) with emissions from paved roads representing the highest emissions. This is because of the considerable length of the paved road (access road from silica project site to the cement plant) of about 16.5 km while the unpaved road is about 4.5 km.

By applying mitigation measures to control fugitive particulates wherein control efficiencies range from 75% to 90%, the controlled particulate emissions (TSP) were significantly reduced from 777.1 tons per year to 170.4 tons per year for the current production, and from 2,502.7 tons per year to about 5,823 tons per year for the proposed production. The results show that there is still substantial amount of fugitive emissions as control efficiencies were set from 75% to 90%. This suggest the difficulty of controlling fugitive emissions along roads, particularly during dry weather conditions, and the need to continuously implement dust control measures to minimize fugitive emissions.



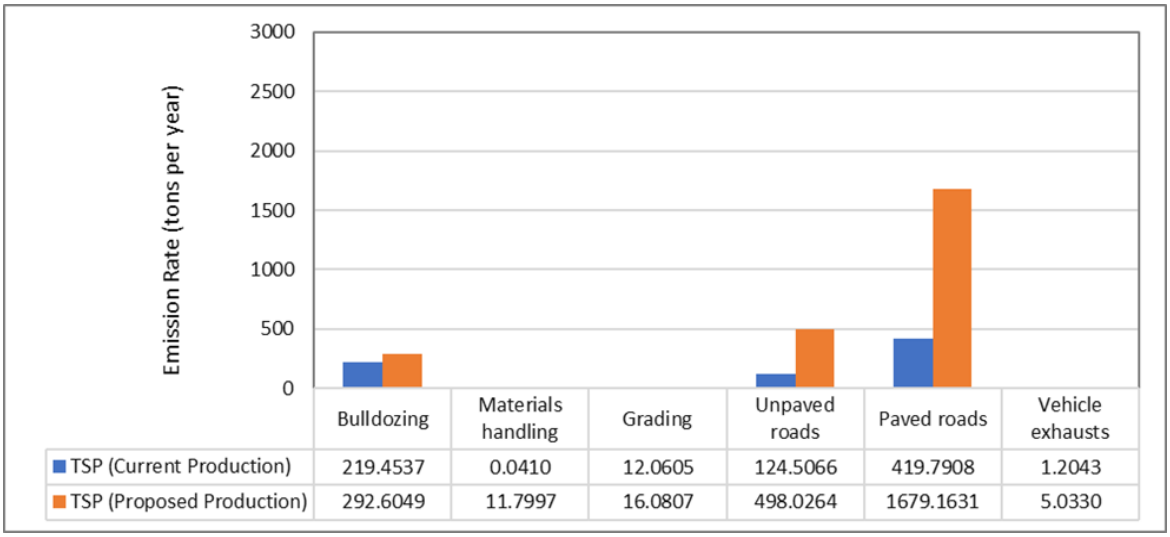
	Current production (uncontrolled)	Current production (controlled)	Proposed production (uncontrolled)	Proposed production (controlled)
TSP (kg/hr)	374.7407	69.0379	788.3892	172.67811
PM10 (kg/hr)	100.1091	17.3899	192.9977	40.93473
PM2.5 (kg/hr)	26.6287	4.2953	45.2208	9.42921

Figure 2-58. Estimated particulate emissions for the current and proposed production (kg/hr)



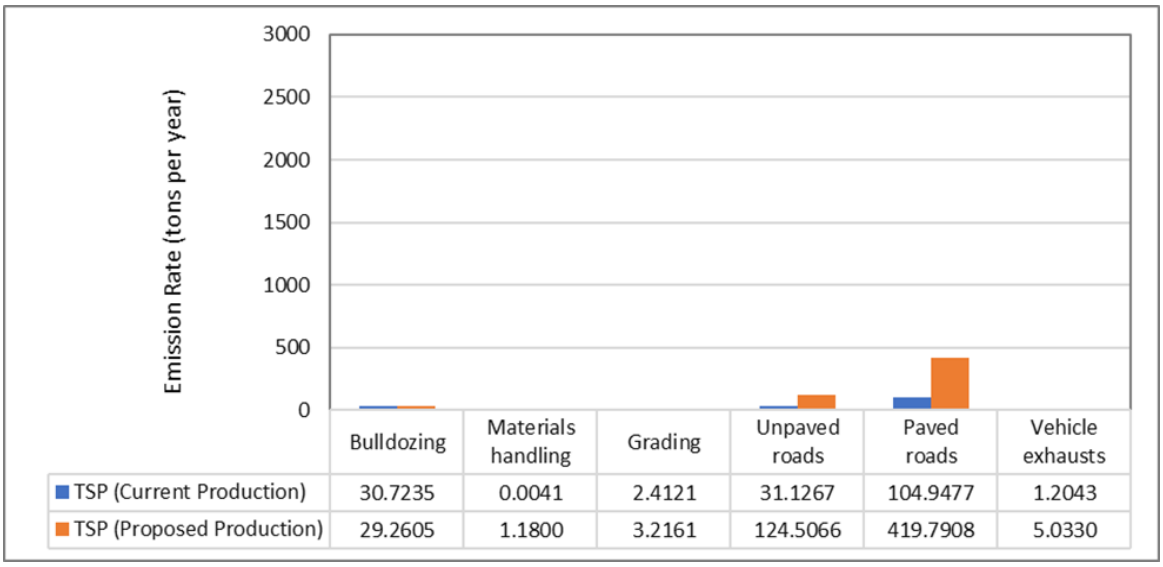
	Current production (uncontrolled)	Current production (controlled)	Proposed production (uncontrolled)	Proposed production (controlled)
TSP (tons per year)	777.0569	170.4184	2502.7079	582.98700
PM10 (tons per year)	197.4126	42.1155	592.5624	135.96517
PM2.5 (tons per year)	47.7683	10.0396	129.6113	30.35985

Figure 2-59. Estimated particulate emissions for the current and proposed production (tons per year)



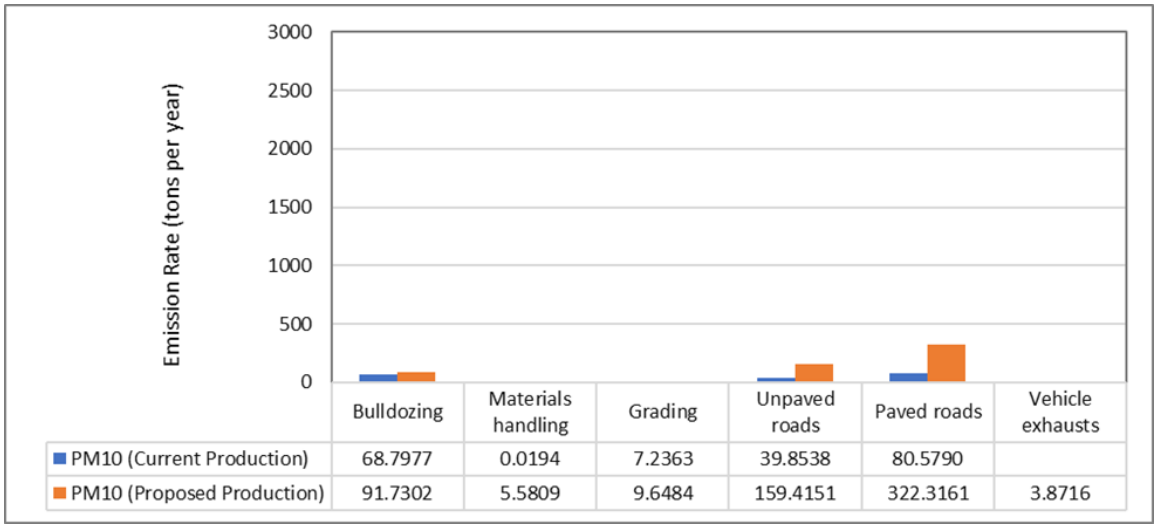
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
TSP (Current Production)	219.4537	0.0410	12.0605	124.5066	419.7908	1.2043
TSP (Proposed Production)	292.6049	11.7997	16.0807	498.0264	1679.1631	5.0330

Figure 2-60. Estimated emissions of total particulates (uncontrolled) for the current and proposed production



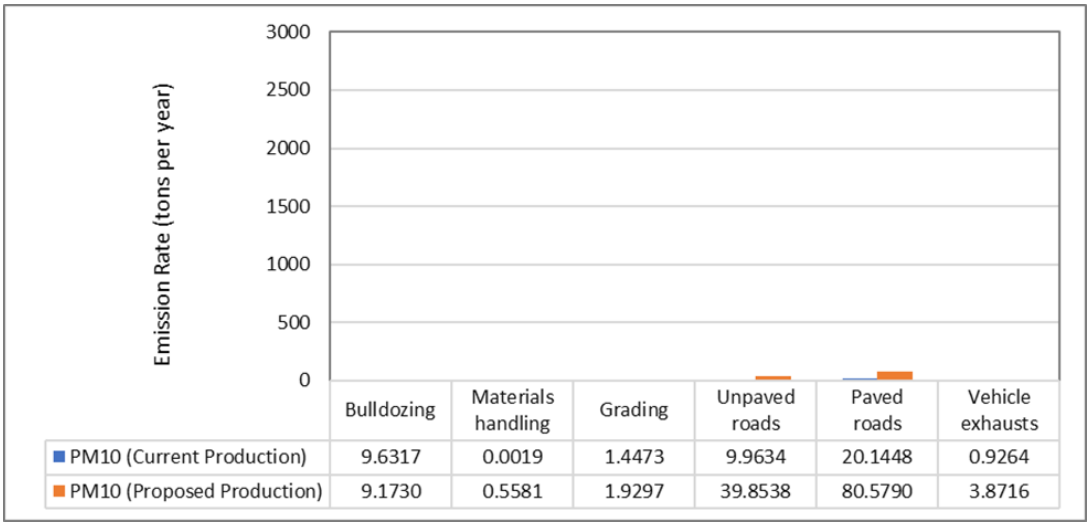
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
TSP (Current Production)	30.7235	0.0041	2.4121	31.1267	104.9477	1.2043
TSP (Proposed Production)	29.2605	1.1800	3.2161	124.5066	419.7908	5.0330

Figure 2-61. Estimated emissions of total particulates (controlled) for the current and proposed production



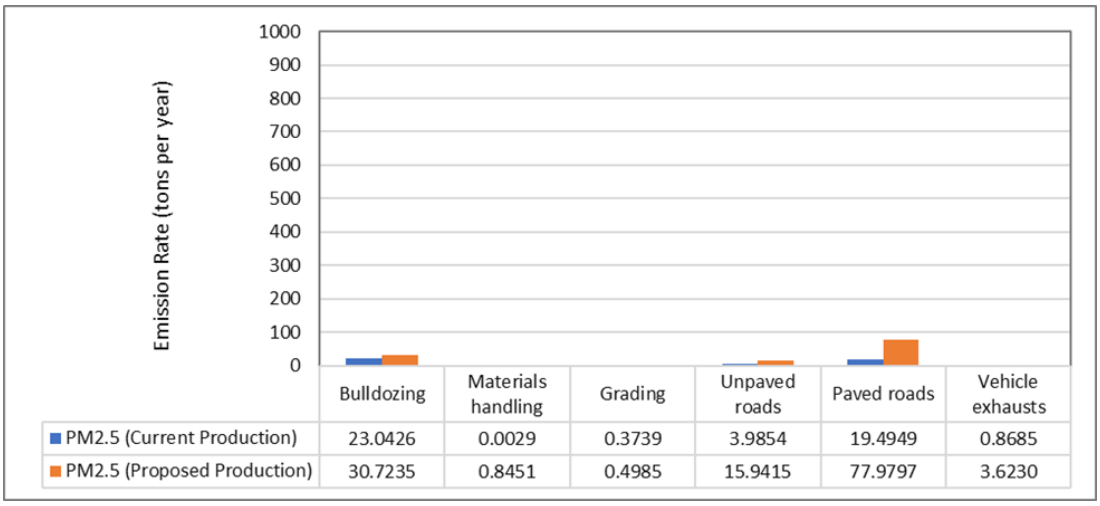
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
PM10 (Current Production)	68.7977	0.0194	7.2363	39.8538	80.5790	
PM10 (Proposed Production)	91.7302	5.5809	9.6484	159.4151	322.3161	3.8716

Figure 2-62. Estimated emissions of PM_{10} (uncontrolled) for the current and proposed production



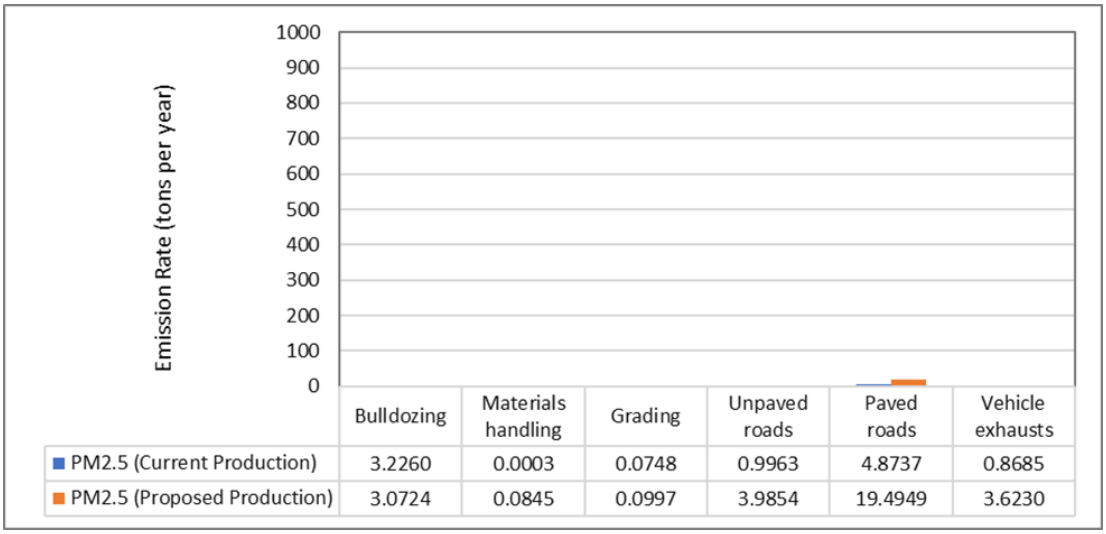
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
PM10 (Current Production)	9.6317	0.0019	1.4473	9.9634	20.1448	0.9264
PM10 (Proposed Production)	9.1730	0.5581	1.9297	39.8538	80.5790	3.8716

Figure 2-63. Estimated emissions of PM_{10} (controlled) for the current and proposed production



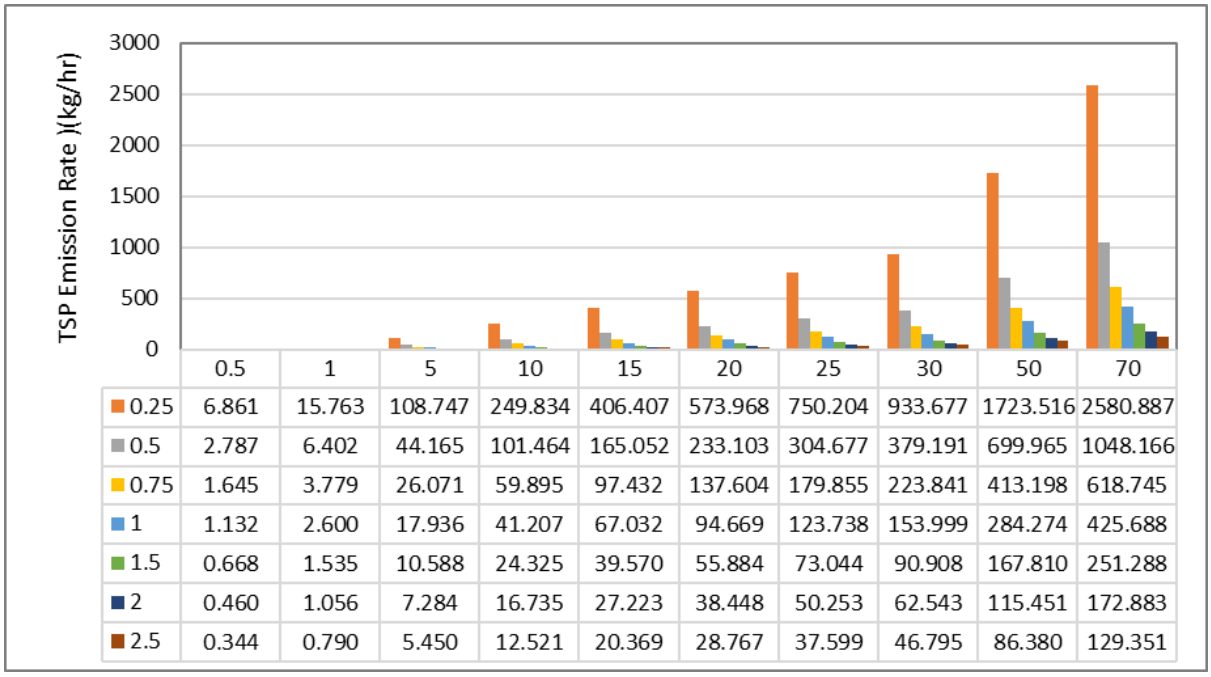
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
PM2.5 (Current Production)	23.0426	0.0029	0.3739	3.9854	19.4949	0.8685
PM2.5 (Proposed Production)	30.7235	0.8451	0.4985	15.9415	77.9797	3.6230

Figure 2-64. Estimated emissions of $PM_{2.5}$ (uncontrolled) for the current and proposed production



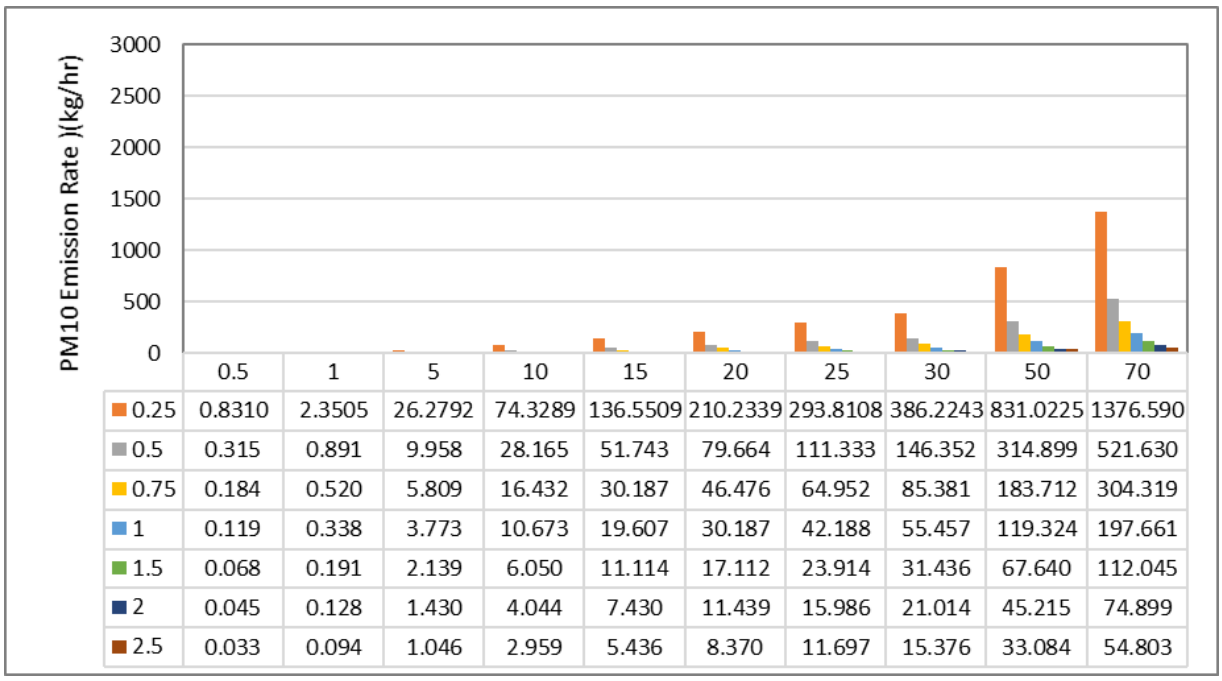
	Bulldozing	Materials handling	Grading	Unpaved roads	Paved roads	Vehicle exhausts
PM2.5 (Current Production)	3.2260	0.0003	0.0748	0.9963	4.8737	0.8685
PM2.5 (Proposed Production)	3.0724	0.0845	0.0997	3.9854	19.4949	3.6230

Figure 2-65. Estimated emissions of $PM_{2.5}$ (controlled) for the current and proposed production



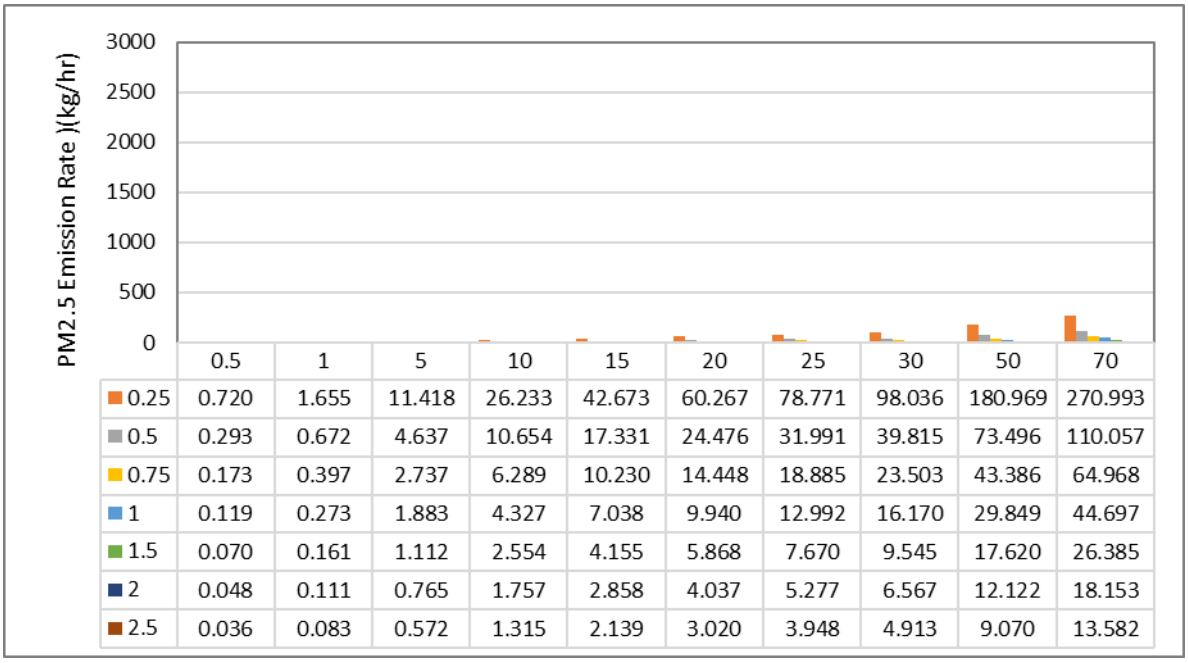
	0.5	1	5	10	15	20	25	30	50	70
0.25	6.861	15.763	108.747	249.834	406.407	573.968	750.204	933.677	1723.516	2580.887
0.5	2.787	6.402	44.165	101.464	165.052	233.103	304.677	379.191	699.965	1048.166
0.75	1.645	3.779	26.071	59.895	97.432	137.604	179.855	223.841	413.198	618.745
1	1.132	2.600	17.936	41.207	67.032	94.669	123.738	153.999	284.274	425.688
1.5	0.668	1.535	10.588	24.325	39.570	55.884	73.044	90.908	167.810	251.288
2	0.460	1.056	7.284	16.735	27.223	38.448	50.253	62.543	115.451	172.883
2.5	0.344	0.790	5.450	12.521	20.369	28.767	37.599	46.795	86.380	129.351

Figure 2-59. TSP emission rates (kg/hr) emanating from bulldozing at various moisture (0.25 to 2.5%) and silt contents (0.5 to 70%)



	0.5	1	5	10	15	20	25	30	50	70
0.25	0.8310	2.3505	26.2792	74.3289	136.5509	210.2339	293.8108	386.2243	831.0225	1376.590
0.5	0.315	0.891	9.958	28.165	51.743	79.664	111.333	146.352	314.899	521.630
0.75	0.184	0.520	5.809	16.432	30.187	46.476	64.952	85.381	183.712	304.319
1	0.119	0.338	3.773	10.673	19.607	30.187	42.188	55.457	119.324	197.661
1.5	0.068	0.191	2.139	6.050	11.114	17.112	23.914	31.436	67.640	112.045
2	0.045	0.128	1.430	4.044	7.430	11.439	15.986	21.014	45.215	74.899
2.5	0.033	0.094	1.046	2.959	5.436	8.370	11.697	15.376	33.084	54.803

Figure 2-60. PM10 emission rates (kg/hr) emanating from bulldozing at various moisture (0.25 to 2.5%) and silt contents (0.5 to 70%)



	0.5	1	5	10	15	20	25	30	50	70
0.25	0.720	1.655	11.418	26.233	42.673	60.267	78.771	98.036	180.969	270.993
0.5	0.293	0.672	4.637	10.654	17.331	24.476	31.991	39.815	73.496	110.057
0.75	0.173	0.397	2.737	6.289	10.230	14.448	18.885	23.503	43.386	64.968
1	0.119	0.273	1.883	4.327	7.038	9.940	12.992	16.170	29.849	44.697
1.5	0.070	0.161	1.112	2.554	4.155	5.868	7.670	9.545	17.620	26.385
2	0.048	0.111	0.765	1.757	2.858	4.037	5.277	6.567	12.122	18.153
2.5	0.036	0.083	0.572	1.315	2.139	3.020	3.948	4.913	9.070	13.582

Figure 2-61. PM2.5 Emission rates (kg/hr) emanating from bulldozing at various moisture (0.25 to 2.5%) and silt contents (0.5 to 70%)

Table 2-45. TSP emission rates (kg/hr) for materials handling at various wind speed (2.2 to 11.2 m/s) and moisture content (0.25 to 2.5%

Moisture Content (%)	Wind speed (m/s)						
	2.2	3.1	4.5	5.6	6.7	8.9	11.2
0.25	5.554	8.601	13.675	18.277	23.165	33.671	45.003
0.50	2.104	3.259	5.182	6.926	8.778	12.759	17.053
0.75	1.193	1.847	2.937	3.926	4.976	7.232	9.667
1.00	0.797	1.235	1.964	2.624	3.326	4.835	6.462
1.50	0.452	0.700	1.113	1.488	1.885	2.741	3.663
2.00	0.302	0.468	0.744	0.994	1.260	1.832	2.449
2.50	0.221	0.342	0.544	0.728	0.922	1.340	1.792

Table 2-46. PM_{10} emission rates (kg/hr) for materials handling at various wind speed (2.2 to 11.2 m/s) and moisture content (0.25 to 2.5%

Moisture Content (%)	Wind speed (m/s)						
	2.2	3.1	4.5	5.6	6.7	8.9	11.2
0.25	2.627	4.068	6.468	8.644	10.957	15.926	21.285
0.50	0.995	1.541	2.451	3.276	4.152	6.035	8.066
0.75	0.564	0.874	1.389	1.857	2.353	3.421	4.572
1.00	0.377	0.584	0.929	1.241	1.573	2.287	3.056
1.50	0.214	0.331	0.526	0.704	0.892	1.296	1.732
2.00	0.143	0.221	0.352	0.470	0.596	0.866	1.158
2.50	0.105	0.162	0.257	0.344	0.436	0.634	0.847

Table 2-47. $PM_{2.5}$ emission rates (kg/hr) for materials handling at various wind speed (2.2 to 11.2 m/s) and moisture content (0.25 to 2.5%

Moisture Content (%)	Wind speed (m/s)						
	2.2	3.1	4.5	5.6	6.7	8.9	11.2
0.25	0.398	0.616	0.979	1.309	1.659	2.412	3.223
0.50	0.151	0.233	0.371	0.496	0.629	0.914	1.221
0.75	0.085	0.132	0.210	0.281	0.356	0.518	0.692
1.00	0.057	0.088	0.141	0.188	0.238	0.346	0.463
1.50	0.032	0.050	0.080	0.107	0.135	0.196	0.262
2.00	0.022	0.034	0.053	0.071	0.090	0.131	0.175
2.50	0.016	0.025	0.039	0.052	0.066	0.096	0.128

2.3.2.2.1 Mitigation Measures

The following are the activities and corresponding mitigation measures that are in placed or to be implemented for the project, specific for SEDC operation.

a) Bulldozing and materials handling – wet suppression or water spraying, reduction of wind speeds by installing temporary wind barriers during high wind condition
b) Grading – wet suppression or water spraying, and phasing with the hauling activities to reduce cumulative increase of fugitive dusts
c) Haul trucks (unpaved roads)
    - Wet suppression or water spraying,
    - Strictly implement speed limits,
    - Provide trucks with appropriate cover, when necessary,
    - Provide wheel washing facilities for vehicles leaving the quarry and project site. The wheel washing facility should be used to remove muds at the tires of trucks and heavy equipment
    - In case of very dry weather condition where wetting of dry surfaces would be effective for short duration, consider re-routing of vehicles away from area sensitive receptors (households or residences), and
    - Regular maintenance of trucks to reduce or maintain tailpipe emissions

2.3.3 Noise Quality

2.3.3.1 Scope

This section deals on the following as required in Item 3.2.2 (Increase in ambient noise level) in the screening form for the project

- Characterization of ambient noise levels; and
- Environmental performance/background noise levels in the vicinities of the project site

2.3.3.2 Methodology

2.3.3.2.1 Ambient Noise Standards

The then National Pollution Control Commission (NPCC) in 1978 established the ambient noise quality standards in general areas, as shown in **Table 2-48**. In 1980, NPCC issued Memorandum Circular No.

2, Series of 1980 (NPCC 1980), which amended Sections 75 to 78 in Article 1 (Noise Control Regulation) of the NPCC (1978) rules and regulations, by inclusion of corrector factors on areas directly facing roads.

There are, however, inconsistencies in NPCC (1980) on the correction factors for areas directly facing roads and the definition of heavy industrial area. NPCC (1980) provided correction factors of +5 dBA and 10 dBA for both four-lane roads, but none for two-lane roads. Further, heavy industrial area is zoned as Class B and Class D in NPCC (1980), however, commercial area should be zoned as Class B as originally defined in NPCC (1978).

Table 2-48. Environmental quality standards for noise in general areas (NPCC 1980)

Category	Maximum Allowable Noise (dBA) by time periods		
	Daytime (9:00 A.M. to 6:00 P.M).	Morning/Evening (5:00 A.M. to 9:00 AM/ 6:00 P.M. to 10:00 P.M.	Nighttime (10:00 P.M. to 5:00 A.M).
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

- Class AA- a section of contiguous area which requires quietness, such as areas within 100 meters from school site, nursery schools, hospitals and special house for the aged
- Class A - a section of contiguous area which is primarily used for residential area
- Class B - a section of contiguous area which is primarily a commercial area
- Class C - a section of contiguous area reserved as light industrial area
- Class D – a section of contiguous area reserved for heavy industrial area

2.3.3.2.2 BACKGROUND NOISE LEVELS

A Peak Meter Sound Level Meter (SLM) was used to measure sound levels from July 29-30, 2019 at eight (8) locations (**Figure 2-66**). Sound measurements were done by manual recording of total of fifty (50) sound levels that appeared in the screen every ten (10) seconds.

Sound level data were then processed and analyzed to determine the equivalent sound levels (Leq), median of the seven (7) highest noise readings, and other noise descriptors. The equivalent noise level (L_{eq}) was calculated using the following formula

$$L_{eq} = 10\log_{10}\left[\frac{1}{N}\sum_{i=1}^{n} 10^{\frac{Li}{10}}\right]$$

where,

L_{eq} = equivalent noise level,
L_i = instantaneous noise level, and
N = total number of noise data

The other noise descriptions are L90 and L10, which are defined as follows:

- L_{90} level – the sound level exceeded 90% of the time. Corresponds to the residual noise level, as defined by Wilson (1989), and
- L_{10} level – the sound level exceeded 10% of the time. This also corresponds to peaks of noise in a particular period

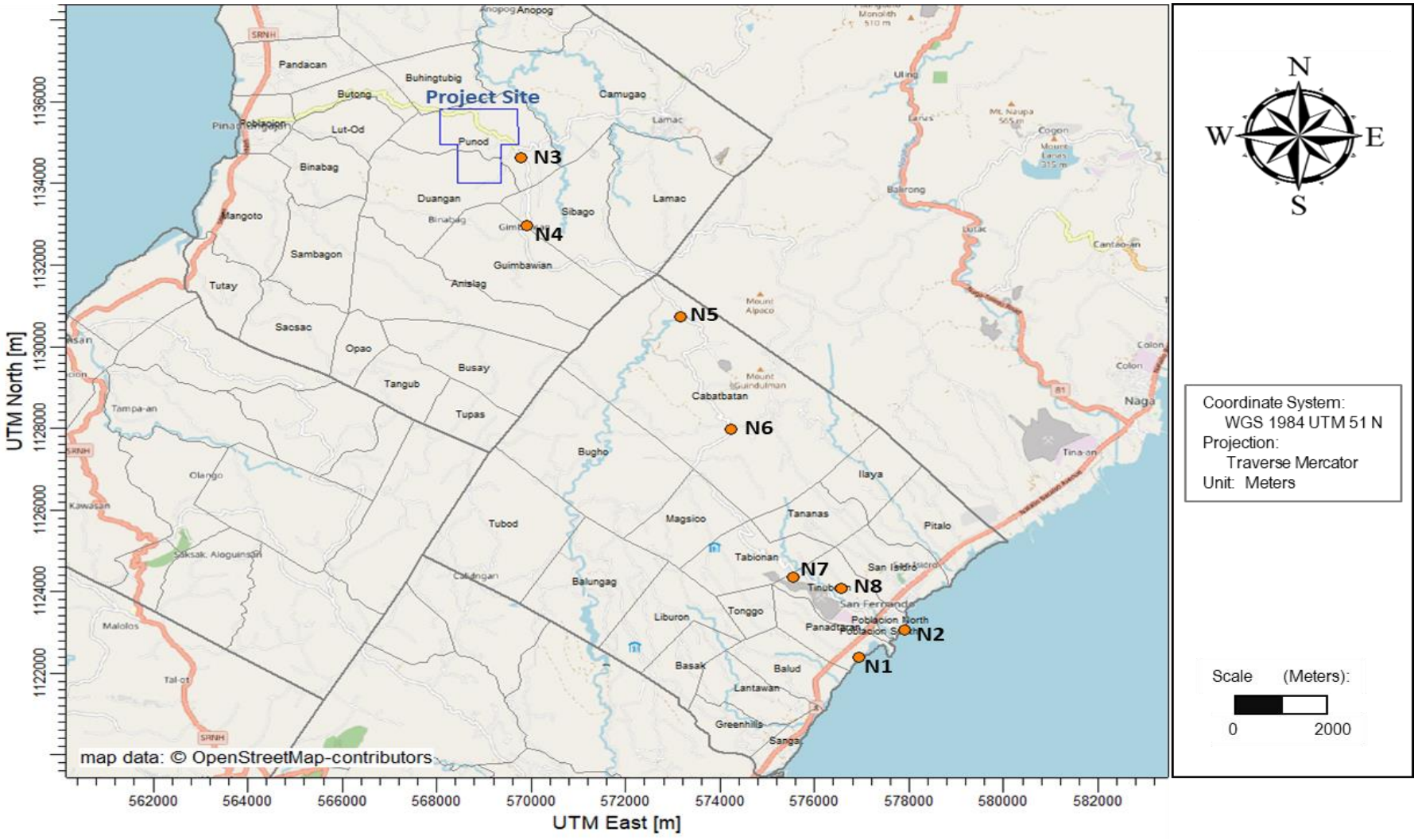


Figure 2-66. Locations of noise sampling stations

2.3.3.3 BACKGROUND NOISE LEVELS

Sound level monitoring was conducted using a Peak SLM eight (8) locations on July 29-30. Measured sound pressure levels shown in **Figure 2-68** to **Figure 2-75** were processed to determine the statiscal noise descriptions, namely: Leq, L10, L90 and median of the seven (7) highest readings. The summary of noise descriptors are shown in **Figure 2-71**.

The L_{eq} at Stations N4, N8, and N1 were 51.8, 54.1 and 54.2 dBA, respectively (**Figure 2-71**). These L_{eq} are lower than the 55 dBA or equivalent to daytime noise standard set for residental areas. The highest L_{eq} was at Station N3 with 76.5 dBA followed by Station N2 (65.6 dBA) and Station N6 (60.7 dBA). Sources of high noise levels at Station N1 were from students practicing drum and lyre and from passing motorcyles (**Table 2-49**). At Station N1, sources of noise were from animals and birds, children playing and from passing motorcycles.

L_{10} sound levels are levels that exceeded 10% of the time. L_{10} levels were all higher than Leq suggesting slight fluctuations of sound levels during noise measurements. The highest L10 level was also at Station N3 with 78 dBA while the lowest also at Station N4 with 54.2 dBA.

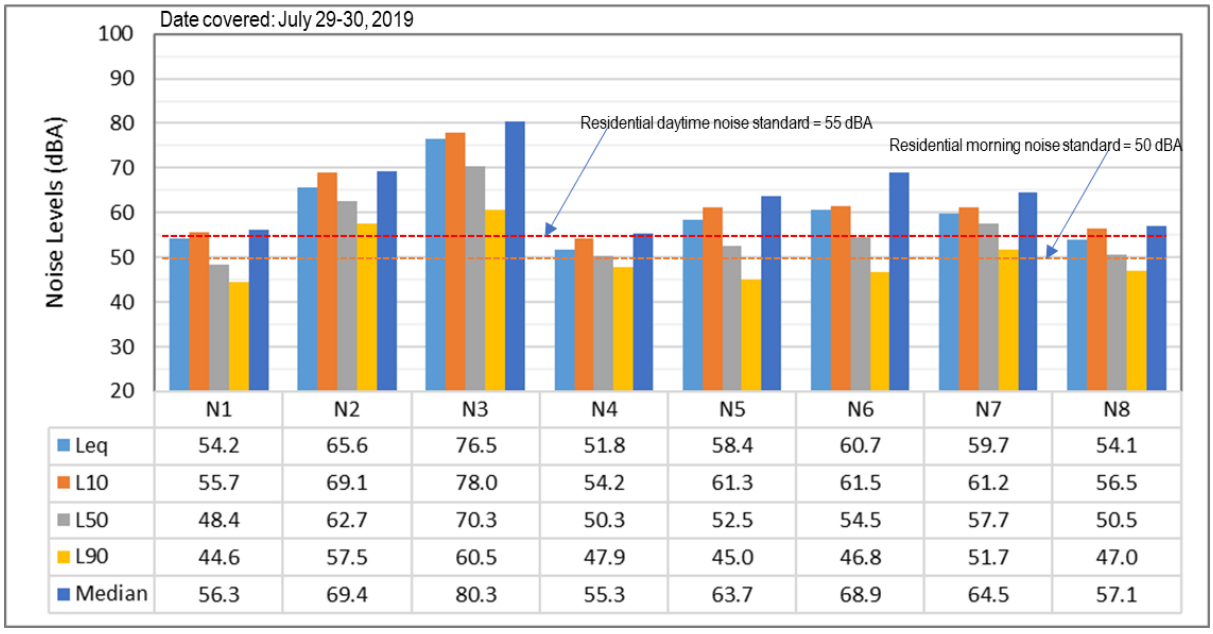
L_{90} sound levels or sometimes referred as "background noise levels" were lower than 50 dBA at five (5) stations and lower than 55 dBA at one (1) station. The stations or locations with L_{90} levels lower than 55 dBA are as follows:

- Station N1 – 44.6 dBA,
- Station N5 – 45 dBA,
- Station N6 – 46.8 dBA,
- Station N8 – 47.0 dBA,
- Station N4 – 47.9 dBA, and
- Station N7 – 51.7 dBA

The above L_{90} levels show that without the temporary or passing high noise sources, i.e., passing motorcycles, the background noise levels (L90) at the above six (6) locations were relatively lower, and with Station N1 and N5 registering L_{90} levels equal or lower than the ambient noise standard for residential areas set at 45 dBA. This suggests that background noise levels could be lower at nighttime and early evening periods, in which there is expected reduction or absence of noise coming from vehicles and from community noise.

In comparison with the ambient daytime noise standard set for residential areas, the medians of the seven (7) highest noise readings at the eight (8) sampling stations were all greater than the corresponding ambient noise standard (**Table 2-49**). It should be noted that the NPCC ambient noise standards are related to "peaks of noise levels" as it only relates to the 4th highest measured noise levels. The NPCC noise standard are also applicable at the property boundaries of the source being monitored or at nearest receptor. For example, for a cement plant, the NPCC standard applies at the property boundary of the cement plant or at the nearest household from the cement plant.

Thus, L_{90} levels are indicators of background noise levels as it specifies sound levels exceeded 90% of the time. This indicates lower sound levels than L_{10}, L_{eq} or the median values.



	N1	N2	N3	N4	N5	N6	N7	N8
Leq	54.2	65.6	76.5	51.8	58.4	60.7	59.7	54.1
L10	55.7	69.1	78.0	54.2	61.3	61.5	61.2	56.5
L50	48.4	62.7	70.3	50.3	52.5	54.5	57.7	50.5
L90	44.6	57.5	60.5	47.9	45.0	46.8	51.7	47.0
Median	56.3	69.4	80.3	55.3	63.7	68.9	64.5	57.1

Figure 2-67. Statistics of noise descriptors at the eight (8) monitoring stations

Table 2-49. Median of 7 highest noise readings in comparison with the noise standards set for residential areas

Station	Location	Date / Time	Noise Level (dBA)	NPCC Standard (dBA)	Remarks
N1	Panadtaran, San Fernando	July 29, 2019 / 1538H-1548H	56.3	55	Greater than NPCC standard
N2	Sitio Pantalan South Poblacion	July 29, 2019 / 1600H-1610H	69.4	55	-do-
N3	Daungan, Pinamungajan Elem. School.	July 30, 2019 / 0914H-0924H	80.3	50	-do-
N4	Brgy. Guimbawian, Pinamungajan Covered Court	July 30, 2019/ 1035H-1045H	55.3	55	-do-
N5	Brgy. Bugho San Fernando	July 30, 2019/ 1210H-1220H	63.7	55	-do-
N6	Magsico Basketball Court San Fernando	July 30, 2019/ 1335H-1345H	68.9	55	-do-
N7	Tinubdan, Elementary School	July 30, 2019/ 1500H-1510H	64.5	50	-do-
N8	Sitio Kapangian, Brgy. South Poblacion,San Fernando	July 30, 2019/ 1637H-1647H	57.1	55	-do-
[A] Class A area (a section which is primarily used for residential purposes) Class AA area (a section which requires quietness)					

Table 2-50. Primary sources of noise during monitoring on July 29-30, 2019

Station	Location	Sources of Noise
N1	Panadtaran, San Fernando	Birds and animal noise (dogs and goat), children playing, and passing motorcycles.
N2	Sitio Pantalan South Poblacion	Passing motorcycles, boats at the sea, and residential activities.
N3	Daungan, Pinamungajan Elem. School.	Students practicing drum and lyre and passing motorcycles.
N4	Brgy. Guimbawian, Pinamungajan Covered Court	Passing light vehicles and birds.
N5	Brgy. Bugho San Fernando	Passing light vehicles and birds.
N6	Magsico Basketball Court San Fernando	Passing light vehicles, chicken and birds.
N7	Tinubdan, Elementary School	Students playing basketball, residential activities, passing motorcycle and birds.
N8	Sitio Kapangian, Brgy. South Poblacion,San Fernando	Passing vehicles, residential activities like playing volleyball and dog barks .

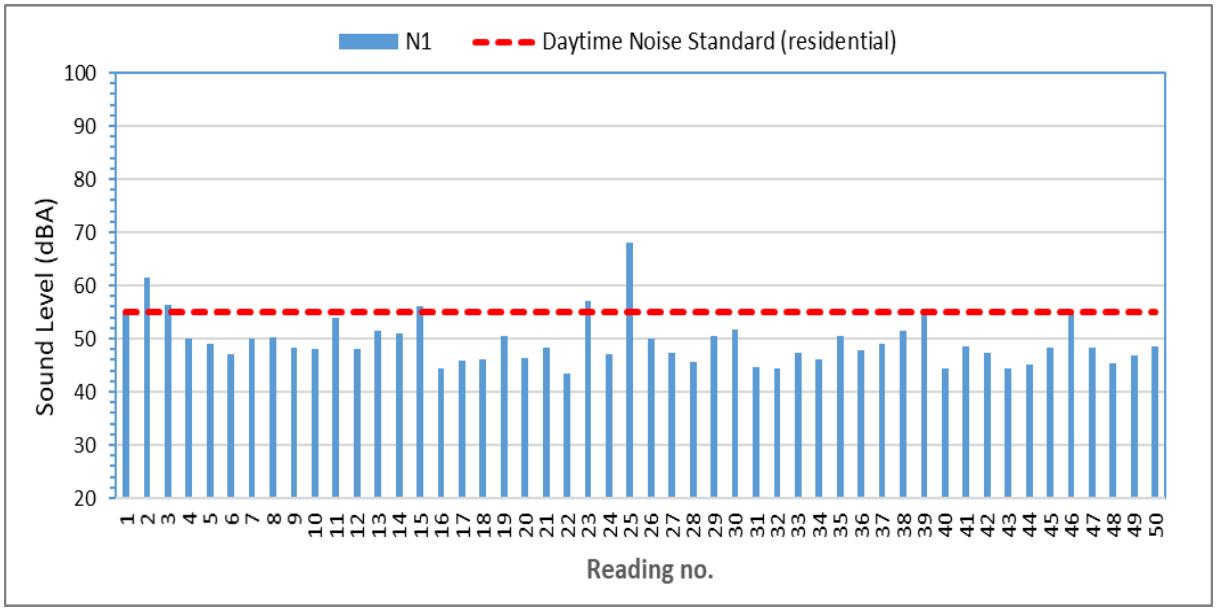


Figure 2-68. Measured sound levels at Station N1

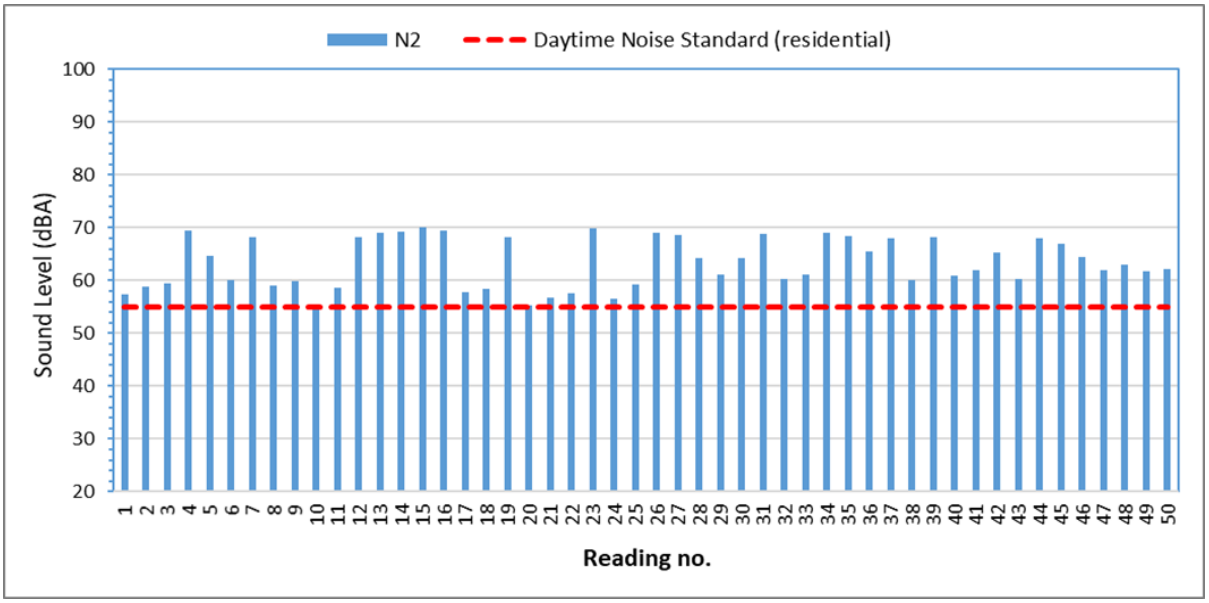


Figure 2-69. Measured sound levels at Station N2

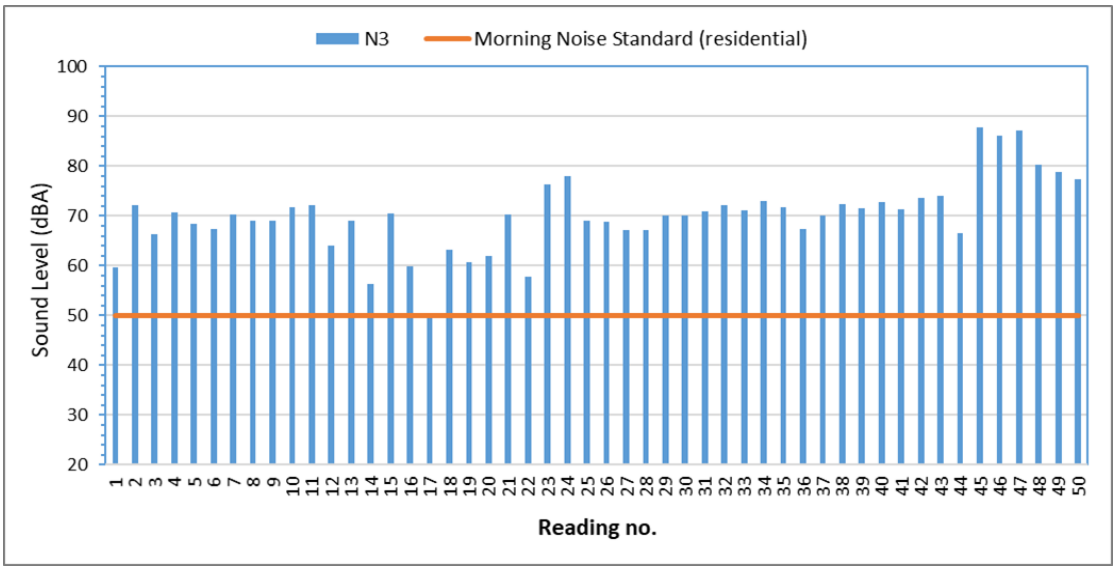


Figure 2-70. Measured sound levels at Station N3

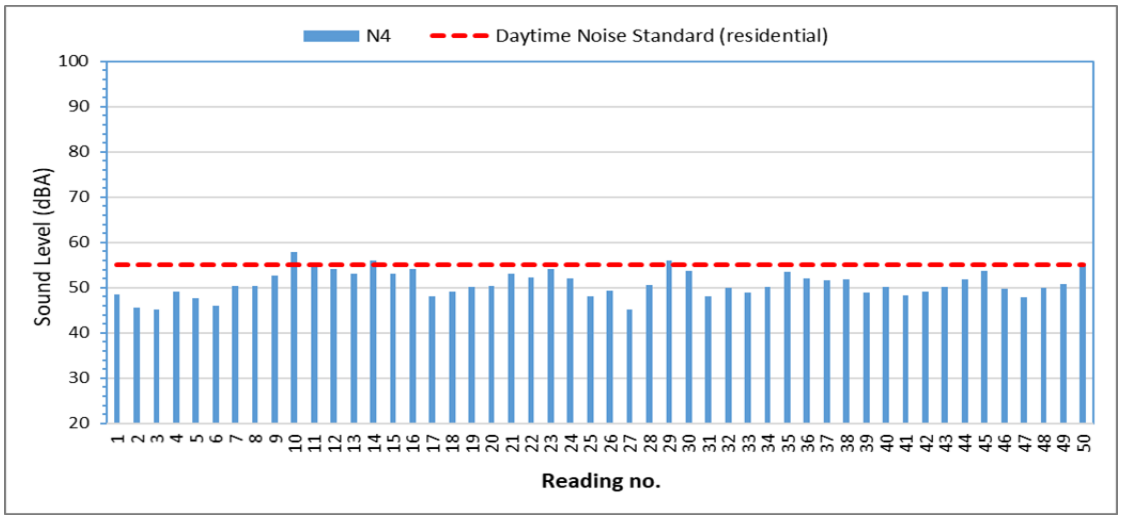


Figure 2-71. Measured sound levels at Station N4

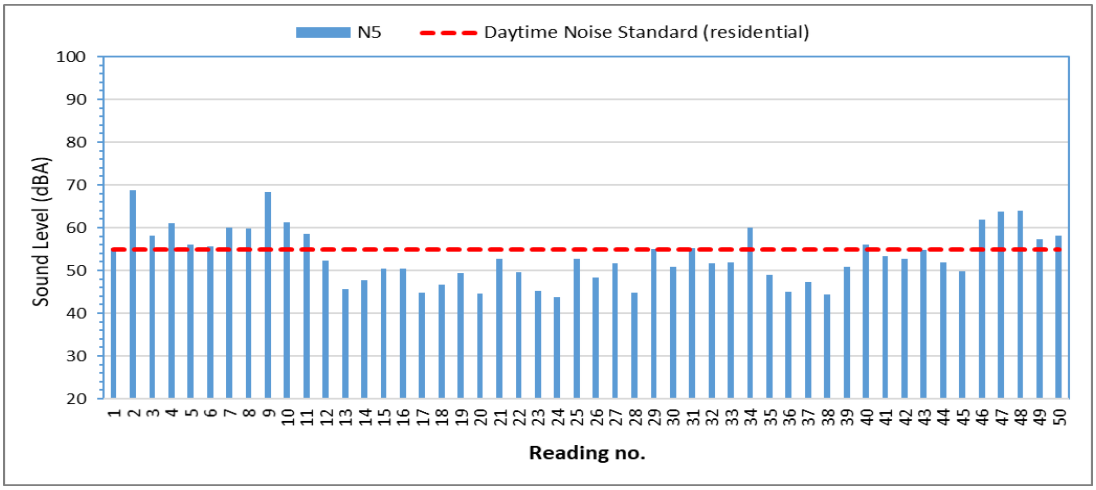


Figure 2-72. Measured sound levels at Station N5

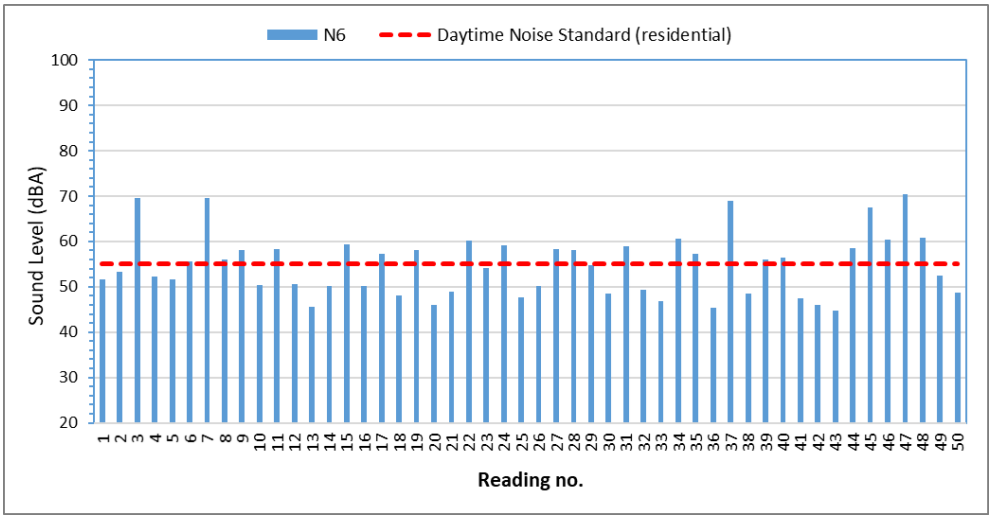


Figure 2-73. Measured sound levels at Station N6

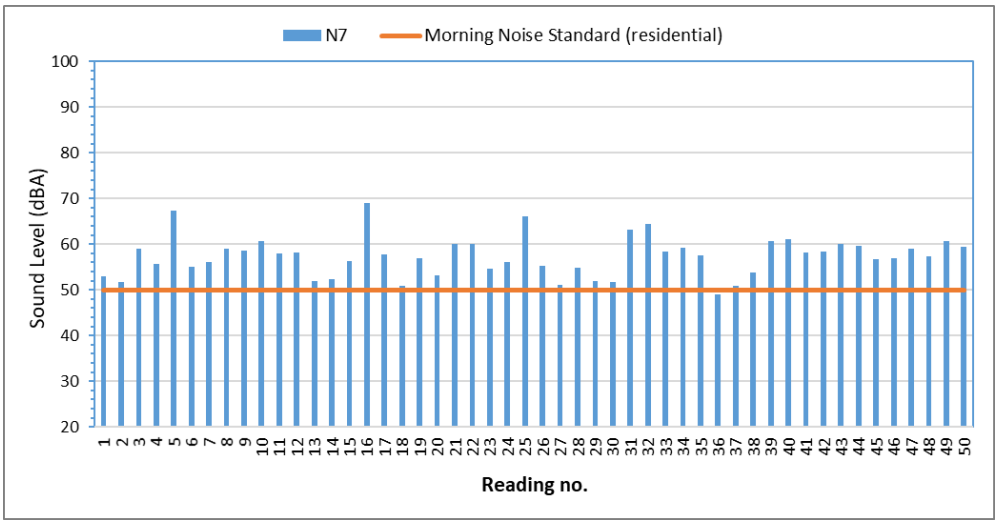


Figure 2-74. Measured sound levels at Station N7

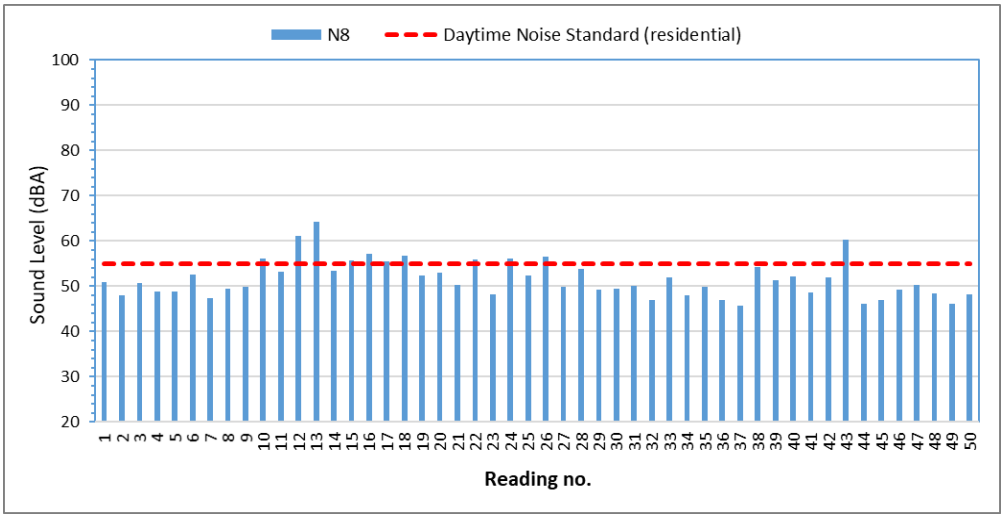


Figure 2-75. Measured sound levels at Station N8

2.3.3.4 IDENTIFICATION AND ASSESSMENT OF IMPACTS

The operation of quarry equipment, e.g., backhoe and payloaders at the silica quarry site, the transport of quarried materials by dump trucks from the project site to the cement plant, and travel of empty dumptrucks to the project site, are expected to increase the background noise levels in the vicinities of the access road and the quarry site.

The increase in background noise levels at the noise sensitive receptors (NSRs) depends on the type of equipment used and the distance between NSRs and the quarrying equipment. At a distance of 50 of 15.24 m from the equipment, sound pressure level for each one one (1) unit of backhoe, dozer, dump truck, front end loader, and grader ranges from 80 to 85 dBA (**Table 2-51**). For the breaker, sound pressure level at the 10 m is about 94 dBA.

Table 2-51. Attenuated noise levels at 50 ft (15.24 m) from quarry equipment

Equipment Description	Specification Lmax at 50 ft
Backhoe	80
Dozer	85
Dump truck	84
Front end loader	80
Grader	85
Breaker	94*
Source: U.S. FHWA Final Report, 2006 *Sound pressure level at 10 m (Source: www.epiroc.om)	

The increase in production capacity will increase the number of dump trucks travelling from the cement plan site to the quarry site (silica). The number of dump trucks in the current production is about 5 trucks per hour and for the proposed production is about 15 trucks per hour. Hence, there is expected increase in background noise levels at households or NSRs adjacent access roads where materials will be transported. At about 15.24 m from the dump truck, the maximum sound pressure

level is 84 dBA, however, though this will immediately cease after the truck travels at considerable distance from the NSRs (say 100 m).

Table 2-52 shows that the noise level increases and the corresponding impact categories. Increase of background noise levels greater than 10 dBA will have significant to severe impact while below 5 dBA with none to minor impact. During nighttime wherein background noise levels are lower, significant increase of background noise levels could cause nuisance to residences residing near the access roads.

Table 2-52. Noise level increases and corresponding impact categories (Source: Wilson, 1986)

Category	Increase (dBA)	Effect
I	< 5	None to Minor
II	5 to 10	Moderate
III	> 10	Significant to Severe

2.3.3.4.1 MITIGATION MEASURES AND MONITORING PROGRAM

Based on assessment above, it appears that the proposed project expansion will have perceived significant increase in background noise levels. It is recommended to provide mitigation measures to avoid nuisance or complaints from households residing along the access road and adjacent quarry site. The following mitigation measures are recommended.

- Require all heavy equipment using internal combustion engines (e.g., dump trucks) install effective mufflers. Mufflers will effectively;
- Strictly impose speed limits at access roads near residential areas;
- Limit use of equipment at nighttime, especially equipment that emits high noise levels, when such activity could cause nuisance at nearby households; and
- Provide enclosures for high noise emitting equipment (e.g., breakers) with temporary barriers and sound absorbing materials, when necessary

It is recommended to conduct ambient noise monitoring at households nearest the quarry and access or haul roads. Noise monitoring should be conducted at four (4) time periods specified in NPCC (1978) and NPCC (1980).

2.4 PEOPLE

The study focuses on the impact areas of the proposed project namely: Barangays Duangan, Lut-od, Punod, Sibago, and Guimbawian of the Municipality of Pinamungahan in Cebu. These barangays are deemed as direct impact areas where the project components are to be located. The following sections present the demographic and socio-economic profile of the impact area as well as the issues/concerns/possible impacts regarding the project and corresponding proposed mitigation/enhancement measures.

2.4.1 METHODOLOGY

Various methods were employed in gathering information on the socio-economic conditions of the impact area. These methods include:

Table 2-53. Methodologies used for People Module

METHODOLOGY USED	DATE	VENUE	REMARKS
Secondary Data Gathering	Legal and official documents from relevant Government Units and Agencies		
Site Visit/Ocular Inspection/Area Reconnaissance	14 November-03 December, 2018	Municipality of Pinamungajan 1. Barangay Duangan 2. Barangay Lut-od 3. Barangay Punod 4. Barangay Sibago 5. Barangay Guimbawian	--
Public Scoping	27 March 2019	Duangan Basketball Court, Barangay Duangan, Pinamungajan, Cebu	56 Participants
Perception Survey	22 November–30 November 2018	Municipality of Pinamungajan 1. Barangay Duangan 2. Barangay Lut-od 3. Barangay Punod 4. Barangay Sibago 5. Barangay Guimbawian	100 Participants (using Purposive Sampling)
Key Informant Interview	19 November 2018	Barangay Hall of Duangan	Respondents: Barangay Secretary
Focus Group Discussion (FGD)	15 November 2018 10 AM to 12 Noon	Barangay Hall of Duangan	Respondents: Barangay Officials (6 Participants)

2.4.1.1 SITE VISIT/RECONNAISSANCE

During the reconnaissance survey, the general condition of the Impact area and community was observed and noted. In this method, one can generalize the socio-economic and demographic conditions of the covered areas and communities. Brief random interviews of the residents within the area were also conducted to research on the general situation of the area and the communities and

help determine the perception of the respondents towards the project. The Site Visit/Ocular Inspection/ Area reconnaissance/ Preliminary Survey was conducted on November 14 – December 3, 2018.

2.4.1.2 PUBLIC SCOPING

There are 5 barangays covered by the project, Barangays Duangan, Lut-od, Punod, Sibago, and Guimbawian. The public scoping was conducted on March 27, 2019. Further details of the Public Scoping are shown in **Table 2-53**.

2.4.1.3 REVIEW OF SECONDARY DATA

Socio-demographic and economic data and information were procured from pertinent documents from respective government institutions such as from the provincial municipal LGU of Pinamungajan, as well as online sources for background information. All sources of such information were exhausted in this report.

2.4.1.4 PERCEPTION SURVEY

A Perception Survey was conducted in the Direct Impact Barangays of the proposed project namely: Barangays Duangan, Lut-od, Punod, Sibago, and Guimbawian of the Municipality of Pinamungajan in Cebu. This was conducted from 22 November– 30 November 2018. **Table 2-54** presents the summary of Perception Survey conducted for the proposed project. Further details and photo documentation are shown in the succeeding sections.

The methodology used for the perception survey conducted was purposive sampling. The respondents were selected based on the criteria of their present residency's, property's, lifestyle/cultural activities' and livelihood's distance and accessibility-in-relation to the project site. Also considered are factors such as those that may be most affected by the project's impacts, upon the Ocular Inspection/Site Visit/Area Reconnaissance of the Study Team and Specialists, thru their consultations, and in coordination with Key Agency/Office Authorities and Community Leaders, IP Elders and Stakeholder Representatives.

Table 2-54. Methods used for Perception Survey

METHOD	DATE OF SURVEY	LOCATION	NO. OF RESPONDENTS
Purposive Sampling	22 November– 30 November 2018	Municipality of Pinamungajan 1. Barangay Duangan 2. Barangay Lut-od 3. Barangay Punod 4. Barangay Sibago 5. Barangay Guimbawian	100

2.4.1.5 KEY INFORMANT INTERVIEW (KII)

Key Informant Interview (KII) was also conducted on 19 November 2018 to provide an in-depth discussion on the condition of the community and to determine the perceptions and interests of several groups in the host barangay. This was administered to the knowledgeable and influential people in the locale. Among those interviewed were residents and barangay officials in the Direct Impact Barangay. A questionnaire consisting of both closed and open-ended questions was prepared for the purpose.

2.4.1.6 FOCUS GROUP DISCUSSION

A Focus Group Discussion (FGD) was conducted on 15 November 2018 in the Barangay Hall of Duangan, with the officials of the direct impact barangays.

2.4.2 RESULTS

2.4.2.1 BASELINE SOCIO-ECONOMIC CONDITIONS

2.4.2.1.1 DEMOGRAPHIC PROFILE

2.4.2.1.1.1 POPULATION AND HOUSEHOLD PROFILE

The Municipality of Pinamungajan is a 2nd class municipality in the province of Cebu, Philippines. According to the 2015 census, it has a population of 65,955 people and the number of households are 13,874. This represented 2.24% of the total population of Cebu province, or 0.89% of the overall population of the Central Visayas region.

Table 2-55. Total population

BARANGAY	POPULATION (2015)	POPULATION PERCENTAGE (2015)
Anislag	1,597	2.42%
Anopog	3,797	5.76%
Binabag	2,142	3.25%
Buhingtubig	1,763	2.67%
Busay	1,117	1.69%
Butong	2,035	3.09%
Cabiangon	1,000	1.52%
Camugao	2,048	3.11%
Duangan	**1,400**	**2.12%**
Guimbawian	**1,894**	**2.87%**
Lamac	5,953	9.03%
Lut-od	**3,112**	**4.72%**
Mangoto	2,602	3.95%
Opao	503	0.76%
Pandacan	5,890	8.93%
Poblacion	6,754	10.24%
Punod	**1,781**	**2.70%**
Rizal	2,418	3.67%
Sacsac	1,533	2.32%
Sambagon	1,233	1.87%
Sibago	**2,261**	**3.43%**
Tajao	6,915	10.48%
Tangub	880	1.33%
Tanibag	2,002	3.04%
Tupas	864	1.31%

BARANGAY	POPULATION (2015)	POPULATION PERCENTAGE (2015)
Tutay	2,461	3.73%

Source: Philippine Statistics Authority (2015 census of population)

2.4.2.1.1.2 POPULATION DENSITY

The population density is computed at 604 inhabitants per square kilometer or 1,565 inhabitants per square mile.

2.4.2.1.1.3 POPULATION GROWTH

As shown on the table below, it can be observed that the municipality's population increases from 2010-2015. A sharp increase was noted in barangay Lut-od (impact barangay) with an increase of 6.71 percent. Another significant increase was observed in barangay Lamac with an increase of 5.61 percent.

Table 2-56. Population Growth, Municipality of Pinamungahan, Cebu (2010-2015)

BARANGAY	POPULATION (2010)	POPULATION (2015)	ANNUAL POPULATION GROWTH RATE (2010-2015)
Anislag	1,434	1,597	2.07%
Anopog	3,116	3,797	3.84%
Binabag	2,032	2,142	1.01%
Buhingtubig	1,691	1,763	0.80%
Busay	1,128	1,117	-0.19%
Butong	1,848	2,035	1.85%
Cabiangon	891	1,000	2.22%
Camugao	2,007	2,048	0.39%
Duangan	**1,264**	**1,400**	**1.96%**
Guimbawian	**1,698**	**1,894**	**2.10%**
Lamac	4,470	5,953	5.61%
Lut-od	**2,213**	**3,112**	**6.71%**
Mangoto	2,172	2,602	3.50%
Opao	511	503	-0.30%
Pandacan	5,291	5,890	2.06%
Poblacion	5,925	6,754	2.52%
Punod	**1,870**	**1,781**	**-0.92%**
Rizal	2,341	2,418	0.62%
Sacsac	1,415	1,533	1.54%
Sambagon	1,074	1,233	2.66%
Sibago	**1,830**	**2,261**	**4.11%**
Tajao	5,648	6,915	3.93%
Tangub	1,000	880	-2.40%
Tanibag	1,686	2,002	3.32%
Tupas	817	864	1.07%

BARANGAY	POPULATION (2010)	POPULATION (2015)	ANNUAL POPULATION GROWTH RATE (2010-2015)
Tutay	2,625	2,461	-1.22%
	57,997	65,955	2.48%

Source: PSA

2.4.2.1.1.4 GENDER AND AGE PROFILE

According to the 2015 Census, the age group with the highest population in Pinamungajan is *5 to 9*, with 8,160 individuals. Conversely, the age group with the lowest population is *80 and over*, with 590 individuals.

Table 2-57. Age Profile

Age group	Population (2015)
Under 1	1,572
1 to 4	6,267
5 to 9	8,160
10 to 14	7,529
15 to 19	6,684
20 to 24	5,976
25 to 29	5,127
30 to 34	4,264
35 to 39	3,893
40 to 44	3,361
45 to 49	2,993
50 to 54	2,711
55 to 59	2,239
60 to 64	1,767
65 to 69	1,211
70 to 74	980
75 to 79	631
80 and over	590
Total	65,955

Source: PhilAtlas (web)

2.4.2.1.2 CULTURE/LIFESTYLE

2.4.2.1.2.1 EXISTING CULTURE

The Pinamuohan Festival is one of the highlights of the annual fiesta celebration every May 4, in honor of Sta. Monica in Pinamungajan. The town festival is a celebration of bountiful harvests from land and sea, as well as the hardwork of its people. It was started in 2008 in line with the thrust of then governor and now Congresswoman Gwendolyn Garcia, who pushed for each Cebu town and city to hold a festival as part of local culture and heritage.

2.4.2.1.3 PUBLIC/SOCIAL SERVICES

2.4.2.1.3.1 WATER SUPPLY

The Pinamungajan Water District supplies safe and potable water to 15 covered barangays of Pinamungajan, Cebu. Water sources in the impact barangays are from water wells and spring water.

2.4.2.1.3.2 POWER SUPPLY

The supply of electricity in the municipality is operated by Cebu Electric Cooperative Inc. (CEBECO) serving ten (10) barangays.

2.4.2.1.3.3 COMMUNICATION

The post office, telephone, telex and telegraphic serve the communication needs of the municipality of Pinamungajan as shown in **Table 2-58**.

Table 2-58. Communication Facilities

TYPE OF SERVICES	NUMBER OF STATION/OFFICE
Post Office	1
Telephone station	1
Telex Services	1
Telegraphic station	1

Source: Municipal Government of Pinamungajan (web)

2.4.2.1.3.4 TRANSPORTATION

The available public vehicles in the municipality are buses, jeepneys, tricycle and trisikads as shown below:

Table 2-59. Transportation Facilities

TRANSPORTATION SERVICES	NUMBER OF VEHICLES
Buses	17
Jeepneys	47
Tricycles	49
Trisikads	61

Source: Official Website of Municipal Government of Pinamungajan

2.4.2.1.3.5 EDUCATIONAL FACILITIES

The Municipality of Pinamungajan has a complete educational level wherein there are 24 Elementary Schools; a private and a public school. There are also 6 secondary schools and 1 Tertiary School.

Aside from the existing schools in the municipality there are also 2 public libraries.

2.4.2.1.3.6 RECREATIONAL FACILITIES

The municipality is equipped with 20 courts/centers like gymnasium, athletic field, basketball, and volleyball courts. There are also 25 multi-purpose buildings in the municipality.

2.4.2.1.4 SOCIO-ECONOMIC

2.4.2.1.4.1 AGRICULTURE

Cultivating the land with various crops, and breeding of animals through livestock and poultry farms, are necessities to sustain life in a community. And these are things that remain visibly well maintained, promoted, and protected in Pinamungajan, even as other sources of living such as trading and

manufacturing have gained ground in the town. In fact, Pinamungajan is home to a few of the most advanced and modern farms of their kind.

Raw materials available within the area:

Types of Materials:

- Root Crops
- Corn
- Banana
- Legumes
- Rice
- Fish/Prawn farms
- Coco Midribs
- Vegetables
- Coconut
- Tikog
- Bamboo

Existing Commercial Farms within the area:

- Baricuatro Poultry
- Carvellida Poultry
- Malusay Poultry
- Tellidua Poultry
- Intong Poultry
- L. Alpas Poultry
- P. Gepitulan Poultry
- Cuaycong Poultry
- E. Yapha Livestock
- Tangarorang Livestock

2.4.2.1.4.2 COMMERCIAL ESTABLISHMENTS

Another source of the economy of the Municipality is the presence of the various commercial establishments in the area **Table 2-60**. These establishments provide the sources of income to the people in the area. Two hundred twelve (212) sari-sari stores are present in the area, followed by the 22 fresh fish and meat retailers and 20 restaurants and cafeterias within the municipality. Other types of commercial establishments in the Municipality are the bakeries, drugstores, shops, gasoline stations. Others could be further discerned in the table.

Table 2-60. Commercial Establishments

TYPE OF ESTABLISHMENT/S	NO. OF ESTABLISHMENTS
Sari-sari store	212
Restaurants & Cafeterias	20
Fresh Fish & Meat Retailers	22
General Merchandising	2
Service and Repair Shops	7
Tailoring & Dress Shops	4

TYPE OF ESTABLISHMENT/S	NO. OF ESTABLISHMENTS
Pawnshops & Lending Investments	1
Lumber and Hardwares	3
Pharmacies and Drug Stores	1
Marketing Firms(Appliances, furniture, etc.	1
Gasoline Station	2
Bakeries	5
Photo Shops & Beauty Parlors-	1

Source: Municipal Government of Pinamungajan (web)

2.4.2.1.4.3 BANKING AND FINANCIAL INSTITUTIONS

There is only one rural bank, 1 lending/financing institution and 16 cooperatives within the municipality of Pinamungajan.

2.4.2.2 PUBLIC SCOPING

The Public Scoping of the proposed Silica Sand Quarry Expansion Project was held at Duangan Basketball Court, Barangay Duangan, Pinamungajan, Cebu. The program started at 10:00 AM. In attendance were fifty-six (56) representatives in various sectors and/or organizations.

The issues and concerns raised during the Public Scoping is presented in the following table:

Table 2-61. Issues and Concerns raised during the Public Scoping

NAME - AGENCY/BRGY. and POSITION	ISSUES/CONCERNS	RESPONSE
Project Description		
Mr. Jaime Ponting – Farmer's Association President	How long will the quarry operations last? Will the quarry operations reach the households in Duangan?	Engr. Sombelon answered that MPSA has a lifespan of 25 years renewable once for another 25 years. This activity is a long process, very premature to specifically pinpoint which households are directly affected by mining activity. Nonetheless, by the time mining plans are in placed, SEDC will inform the residents through LGU, which of those households are affected and whose are not.
Mr. Felix Bagahansol – Punod Brgy. Captain	How will the SEDC mine the area in Punod if the elevation in the said barangay is already low?	Engr. Sombelon answered that SEDC has a survey team to conduct as built topographic survey of the area. Topographic map is a basic tool in the preparations and making of mining plans. A minimum of 5 meter difference in elevation from the elevation of rice field areas is usually established. In the making of mining plan, SEDC will consider the natural structures like gullies, creeks and rivers. SEDC will establish the recommended buffer zone to ensure that these water receiving bodies will not be disturbed once the mining activity commences. Engr. Campo also added that existing structures will definitely not be disturbed. However, there is also a program, if the farmers will allow it, that would convert rice fields into paddy fields since it will be considered as a flat area. But if the farmers won't allow, just like Engr. Joel said, a 5 meter difference in elevation will serve as a limit during the mining activity. As a conclusion, from time to time the company will ask and consider every landowner's decision as to what will be their final plan on their respective land areas.

NAME - AGENCY/BRGY. and POSITION	ISSUES/CONCERNS	RESPONSE
People		
Ms. Gina Gadiano - MSWDO	What are the benefits that vulnerable sectors may get from this project since they will be affected once the quarry operation commences?	Ms. Carin responded that as mandated by the Philippine Mining Act of 1995, mining companies, like SEDC, are required to establish a Social Development and Management Program. There are also specific programs under SDMP which need to be implemented like livelihood, access to health and health support, education programs and IEC. For the program to be sustainable, SEDC will consult with the affected sectors, main purpose of which, is to enhance the development of the host community. Since technical personnel are more needed in a mining company like SEDC, one of the programs SEDC has implemented is the Scholarship Program, main goal of which, is to eventually capacitate the said community. She further stated that SDMP should be community-driven and that is why SEDC consults and forges partnership with the host and neighboring communities.
	Can the residents of the affected barangays get a job once the project commences?	Engr. Campo added that one example of the benefits that the host community may get is the scholarship program from which they already started through their Community Development Program. Another benefit he mentioned is that SEDC will soon inquire to the senior citizens and persons with disabilities of the host community on what projects they want and SEDC will support and make a budget for it. He also added that for Safety and Health, SEDC already started the medical mission and will soon conduct a medical mission again to other affected barangays.
Mr. Ariel Bagahansol – Brgy. Punod	What are the safety measures for Brgy. Punod?	Engr. Sombelon answered that SEDC will not start the operation on target areas unless the mining plan is in placed already. The plan includes the area of extraction, and the haul roads. SEDC has a department whose in-charge of land acquisition, if there's a need to negotiate with the landowners for the affected or inside production areas to clear or free from hazards and

NAME - AGENCY/BRGY. and POSITION	ISSUES/CONCERNS	RESPONSE
		risks. But as of now, SEDC cannot still pinpoint the affected land and the structures in it.
Ms. Fructosa Maquiling - OSCA	Recommended that SEDC should go and visit the area and inform the people that a quarry operation will take place since showing the map won't be understood by the non-technical people.	Engr. Sombelon answered that from time to time, SEDC personnel will visit the area and inform the people whose area will be directly affected by the mining activity or not. This process is also part of the EIA activity.
Ms. Anette Navarro - Brgy. Capt. Duangan	She recounted that around 4-5 years ago, a team of technical experts from SEDC and TCPI thoroughly surveyed and studied the Duangan and Lut-od areas and suggested that the old Duangan Elementary School be transferred as the foundation of the school is not stable since it is composed of silica. They requested MGB to perform a geological survey of the area and MGB confirmed the recommendations of the Japanese experts that the school must be transferred to a more stable area. The school was immediately transferred with the help of SEDC and is now located beside the provincial road. The Barangay Captain added that people should listen to the recommendations of the experts in their respective fields so as to avoid damages.	Noted by facilitator.

2.4.2.3 PERCEPTION SURVEY

The perception survey was conducted with a total of 100 respondents from the impact barangays.

2.4.2.3.1 DEMOGRAPHIC DATA

The respondents were composed of 14% male and 86% female.

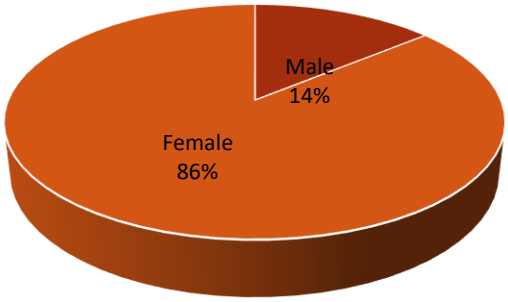


Figure 2-76. Gender of the respondents

Most of the respondents interviewed were in the 21-30 age group (36%); followed by the 31-40 age group (29%); 18% belonging to age group of 41-50 age group. Only 9% comprises the 51-50 age group; 4% for the 61-70 age group and 4% to less than 20 years old respondents.

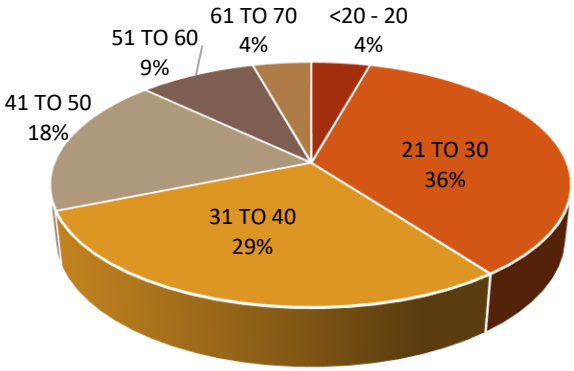


Figure 2-77. Age of the respondents

As observed in the following figure, 94% of the people interviewed were born in the barangay they lived in today while 4% are migrants from the same province and 2% from other parts of Visayas.

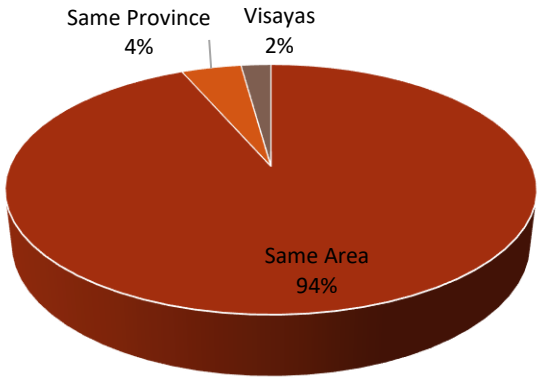


Figure 2-78. Place of Birth of the respondents

Majority of the respondents belong to a 1- to 2-member households.

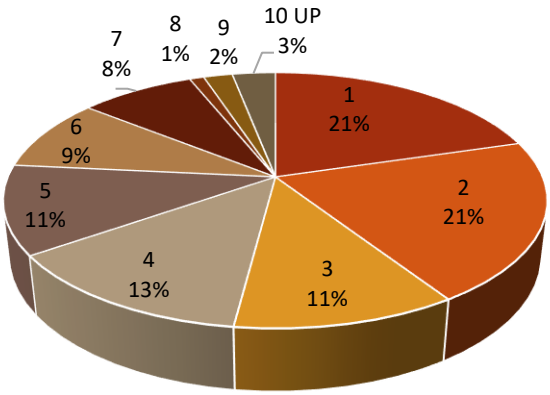


Figure 2-79. Number of Household Members

Ninety six percent (96%) of the total respondents interviewed are Roman Catholic practitioners while 4% are of Islam faith.

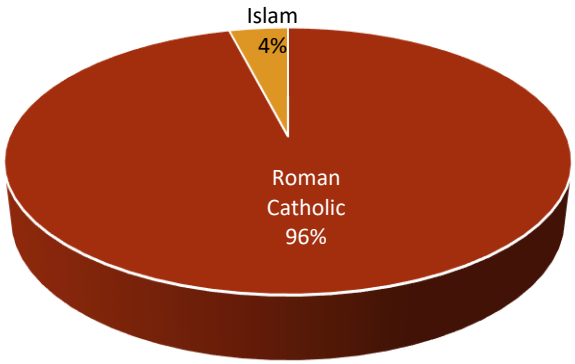


Figure 2-80. Religion of respondents

Ninety-two percent (92%) of the total respondents are Bisaya, 5% are Igorot, 2% are Ilocano, and 1% are Tagalog.

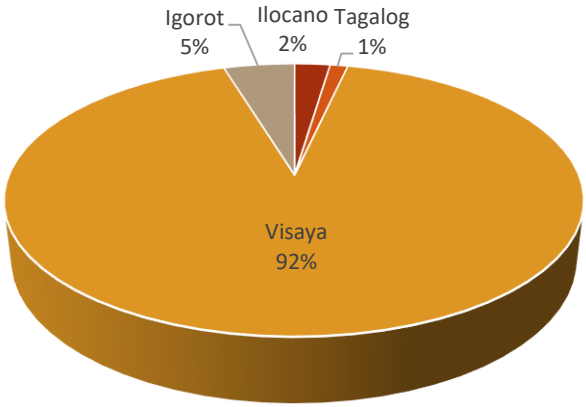


Figure 2-81. Ethnic Origin of the respondents

Thirty three percent (33%) of the total respondents have resided in the Barangay for 21-30 years already. Moreover, approximately 20% of the total respondents have been living in the barangay for 11-20 years.

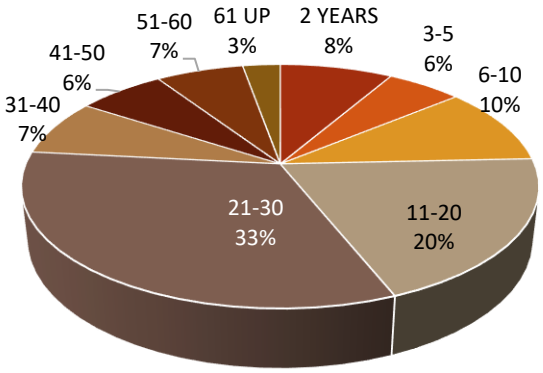


Figure 2-82. Years of residence

2.4.2.3.2 SOCIO-ECONOMIC PROFILE OF RESPONDENTS

The majority primary means of living is from being vendor (24%) and doing construction (24%), followed by selling with 10%. On the other hand, 55% of the respondents stated that the male head is the primary earner in the household while 10% has the female head as the primary earner.

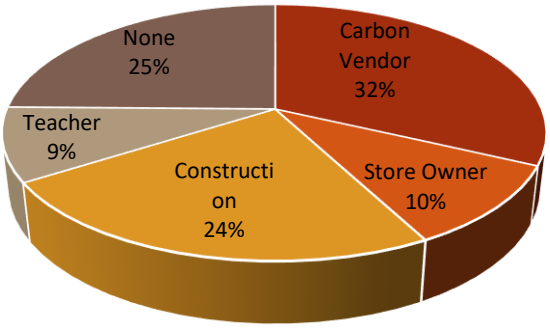


Figure 2-83. Source of income of respondents

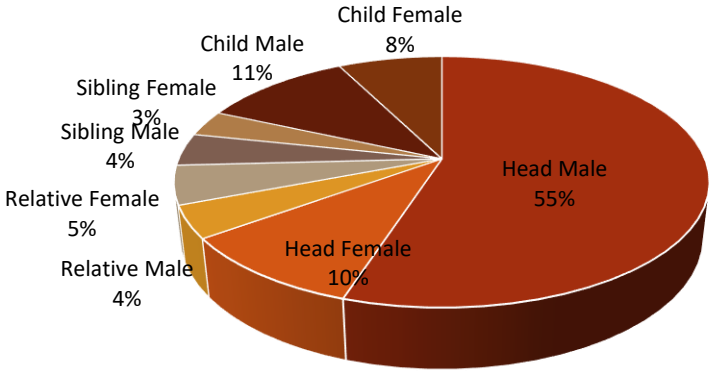


Figure 2-84. Breadwinner

The monthly poverty threshold for a family of five, according to NSO[5], is an average income of Php10,481 per month. This amount is enough to cover a single family's basic food and non-food needs. Poverty threshold refers to the minimum income a family or individual must earn in order to be considered "not poor".

In figure below, more than 14% of the respondents claim that they receive higher than the poverty threshold. Hence, about 86% of the interviewed respondents are classified as "poor".

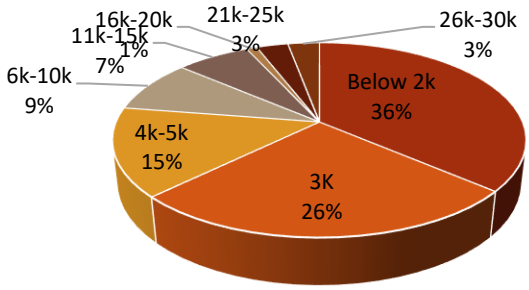


Figure 2-85. Monthly Income of the respondents

High School graduates comprise the largest percentage (23%) of the respondents followed by Highschool undergraduate (23%) and Elementary graduates (20%).

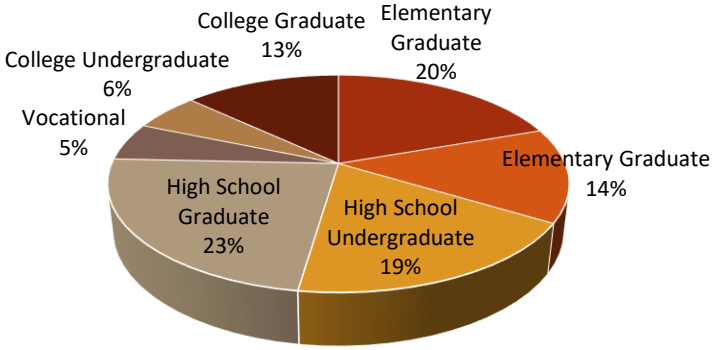


Figure 2-86. Educational Attainment

Fifty-three percent (53%) own their land, 40% are tenants only, and 7% are renting.

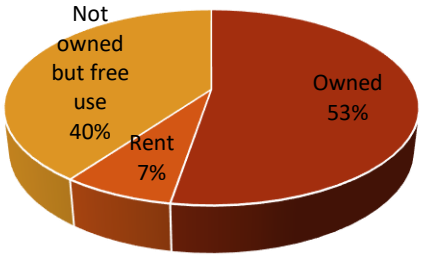


Figure 2-87. Tenurial Status of Residence

[5] NSO (2019). Food and Poverty Thresholds. Retrieved from https://psa.gov.ph/poverty-press-releases/nid/138411

For the previous year, 53% of the respondents have at least one of their household members who got ill. Fever (30%) and cough (30%) combined are the most prevalent in the area. Sixty nine percent (69%) of the respondents stated that the primary source of treatment for such illnesses in the household was in the community and 20% in the nearest hospital.

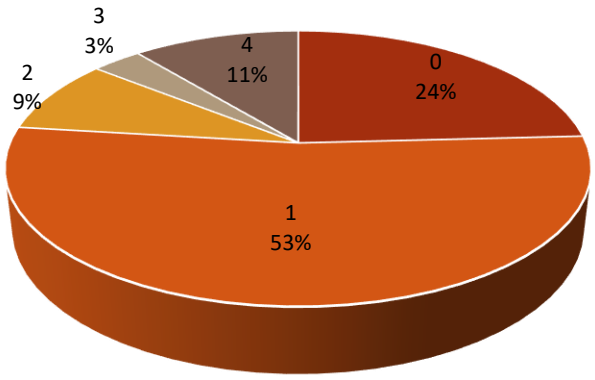


Figure 2-88. Number of Illness

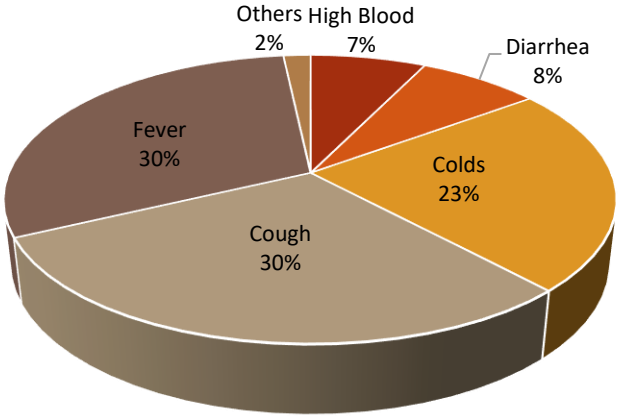


Figure 2-89. Type of Illness

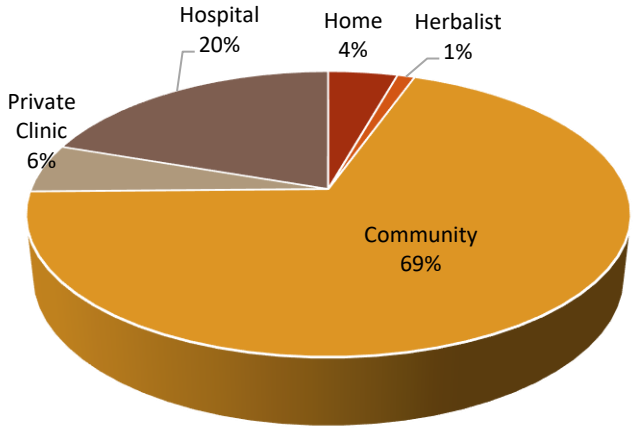


Figure 2-90. Source of Treatment

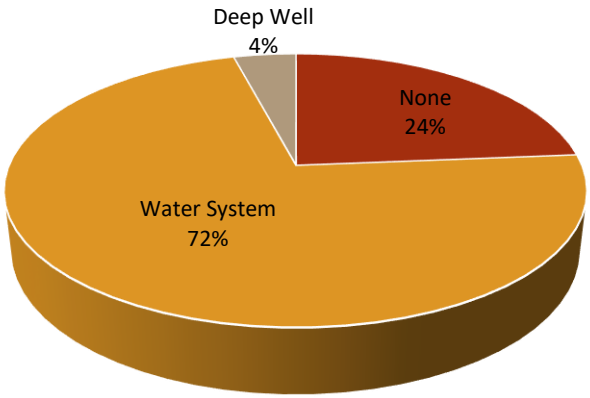


Figure 2-91. Water Source

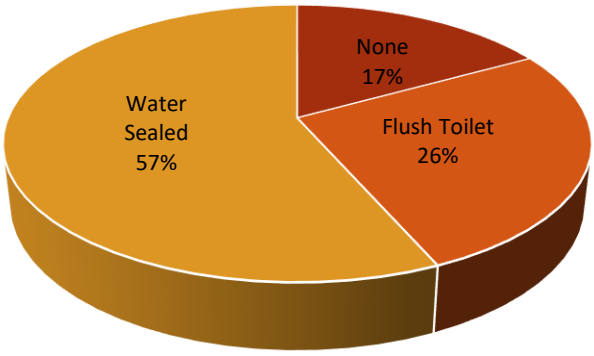


Figure 2-92. Toilet Facility

2.4.2.3.3 PERCEPTION ON THE PROJECT

2.4.2.3.3.1 PERCEIVED POSITIVE IMPACTS:

- Employment
- Barangay Income
- Improvement of Communications Network

2.4.2.3.3.2 PERCEIVED NEGATIVE IMPACTS:

- Damage to Road Network
- Landslide/Erosion
- Damage to nearby houses
- Noise Pollution

2.4.2.3.3.3 SUGGESTIONS WITH REGARDS TO THE PROPOSED EXPANSION:

- Take care of dangerous/accident prone/hazardous areas
- Avoid Landslides
- Signage in dangerous/accident prone/hazardous areas
- Tree planting as protection against landslides in other areas
- Provide access roads. Separate for the hauling, and for the community
- Relocation and housing to those affected
- Tree Replacement/Reforestation/Rehabilitation
- Concrete Slope Protection
- Petition for a flower garden in Lut-od

- In rehabilitation, create/gear towards tourist spot or eco-park
- Deepen/Strengthen the community relations

2.4.2.4 IMPACTS AND MITIGATION MEASURES

The proposed increase in annual production of 660,000 MT from 200,000 MT will not affect the current status socio-economic condition of the direct and indirect impact areas of the Project. The impacts and mitigations presented below are the impacts of the existing project and it is deemed that with the project modification, the Project will have the same impacts thus the implementation of the same mitigation measures currently being implemented.

2.4.2.4.1 EMPLOYMENT

The project provides direct and indirect employment and income to the host communities. The direct economic impact of construction to the local community will be significant and will provide employment opportunities to skilled and unskilled members of labor force. On the other hand, the impact of workers' consumer expenditures, which will be derived from their wages as employees, will generate indirect employment in other sectors of the local economy, the immediate sectors being agriculture and retail.

2.4.2.4.2 MIGRATION

The employment opportunities of the project bring in migrants, mostly job-seekers some of whom are accompanied by their families. This employment-driven migration would displace and push aside local jobseekers and even in the short-term, burden existing public services. The anonymous characters and varied backgrounds of migrants would diminish the community cohesion and social control.

Informal settling and non-conforming land uses may be established by migrant who cannot be accommodated by SEDC and who decide to settle while waiting for chances to be employed.

The proponent institutes a local first hiring policy to lessen the likelihood of massive migration to the project-affected communities, and thereby avoid the stress and competition on local resources, job opportunities, and public services because of newcomers.

2.4.2.4.3 HEALTH AND SAFETY

Various activities during the operational phase will generate nuisance that may expose and affect workers and even adjacent communities.

There could also be potential spread of microorganisms, infectious diseases, biologically contaminated waste materials due to indiscriminate and improper disposal of biological waste products or by-products potentially contaminated with microbes, and inadequate toilet facilities and access to safe water supply.

There will be potential ergonomic problem for workers because the operations of the quarry involve processes that entail transport and machinery operations. Ergonomic problem may arise from poor match between people and machines and other work situations that could cause poor productivity and adverse health conditions, e.g. repetitive strain injury, low back pain.

The project could also cause indirect health impacts, which may include economic dislocation, inadequacy or disruption of social services, community disintegration because of development caused by factors that include in-migration into the community because of availability of work, increasing

demand for limited community health resources and other services, increasing criminality and social problems like drugs, alcohol, gambling, and prostitution. These effects on health are indirect but pervasive since it affects all members of the community.

Compliance with EMP is being implemented by SEDC. Safety, Health, Environment Department (SHED) is tasked to oversee the implementation of other related programs.

2.4.2.4.4 TRAFFIC CONGESTION

The project will cause an increase in traffic given the number of haul trucks to be employed for the delivery of the quarry materials to the TCPI plant. This has the potential to add traffic congestion and affect sensitive receptors such as schools and community centers and may potentially cause road accidents. Heavy loads traversing infrastructure may also be over or near load bearing limits.

To mitigate traffic congestion and road safety concerns, a traffic management plan, in coordination with concerned LGUs and DPWH, will be prepared and implemented. IEC will also be conducted to communicate traffic impact and management plan to the community especially the host and neighboring barangays. Proper scheduling of delivery quarry materials will also be implemented to avoid peak hours/ traffic congestion and minimize the occurrence of accidents. Safety warnings and signages shall be installed.

2.4.2.4.5 GENERATION OF LOCAL BENEFITS FROM THE PROJECT

The operation of the project will somehow provide opportunities for the improvement of services on education and health. The education, health, as well as the social welfare services and public infrastructures will be enhanced due to the additional income opportunities of the LGUs from the taxes and fees to be collected from the proposed project as well as the mandatory assistance of the proponent through the Social Development and Management Program and Corporate Social Responsibility Program.

3 ENVIRONMENTAL MANAGEMENT PLAN

This chapter presents the appropriate mitigation and management measures implemented by SEDC to address the identified key impacts of the Silica Sand Quarry Expansion Project as discussed in Chapter 2- Assessment of Environmental Impacts.

Table 3-1. Impact Management Plan

PROJECT PHASE/ ENVIRONMENTAL ASPECT	ENVIRONMENTAL COMPONENT LIKELY TO BE AFFECTED	POTENTIAL IMPACT	OPTIONS FOR PREVENTION, MITIGATION OR ENHANCEMENT	RESPONSIBLE ENTITY	COST	GUARANTEE / FINANCIAL AGREEMENT
Operation Phase						
Quarry operations (bulldozing and materials handling, grading, hauling)	Air – Air quality	Degradation of air quality Dust generation	Planting of trees at the quarry/s periphery; Enhance buffer strip or tree buffer around and along the boundaries of the project site	SEDC	Part of EPEP cost	EPEP commitment
			Continue monitoring of wind speed and wind directions as part of the environmental management plan to lessen or minimize release of fugitive dusts	SEDC	Part of EPEP cost	EPEP commitment
			Regular watering of haul roads during dry condition; visual inspection of fugitive dust	SEDC	Part of EPEP cost	EPEP commitment
			Maintenance of quarry roads	SEDC	Part of EPEP cost	EPEP commitment
			Speed limits of vehicles (light and heavy) will be controlled to a maximum of 30 km/hr at the quarry site	SEDC / SEDC Contractor	None	SEDC Safety Protocol
			Regular maintenance of trucks to reduce or maintain tailpipe emissions	SEDC / SEDC Contractor	Incorporated in cost of contractor service	SEDC Safety Protocol
			Provide wheel washing facilities for vehicles leaving the quarry and project site. The wheel washing facility should be used to remove muds at the tires of trucks and heavy equipment	SEDC	Part of EPEP cost	EPEP commitment
			In case of very dry weather condition where wetting of dry surfaces would be effective for short duration, consider re-routing of vehicles away from area sensitive receptors (households or residences)	SEDC	Part of operating expenses	SEDC Work Program
			Dampen lose soil or cover loose soil pile	SEDC	Part of EPEP cost	EPEP commitment

PROJECT PHASE/ ENVIRONMENTAL ASPECT	ENVIRONMENTAL COMPONENT LIKELY TO BE AFFECTED	POTENTIAL IMPACT	OPTIONS FOR PREVENTION, MITIGATION OR ENHANCEMENT	RESPONSIBLE ENTITY	COST	GUARANTEE / FINANCIAL AGREEMENT
	Air / People	Increase in ambient noise level	Install effective mufflers on all heavy equipment and other equipment using internal combustion engines	SEDC / SEDC Contractor	Incorporated in cost of contractor service	SEDC Work Program
			Impose speed limits at quarry and along access roads (30 kph)	SEDC	None	SEDC Safety Protocol
			Daytime quarry operation; Restrict use of equipment at nighttime especially equipment that emits high noise levels	SEDC	None	SEDC Work Program
			Construct temporary noise barriers between households and quarry, when necessary	SEDC	Part of EPEP cost	EPEP commitment
			Progressive planting in mined-out areas and planting of trees at the buffer zone; Enhance buffer strips or tree buffers around and along project boundaries	SEDC	Part of EPEP cost	EPEP commitment
Generation and stockpiling of loose materials	Water – Water Quality	Siltation / degradation of surface water quality	Construction of settling ponds and silt traps	SEDC	Part of EPEP cost	EPEP commitment
			Desilting of settling ponds or as needed. Sediments will be used for road surfacing within quarry areas or to Barangays in need.	SEDC	Part of EPEP cost	EPEP commitment
			Mobile heavy equipment and vehicles shall have a designated holding area for removal of excess silt and mud from the tires and underbellies. The holding area shall have adequate drainage and traps to contain the washed sediments.	SEDC	Part of EPEP cost	EPEP commitment
Excavation, digging and stockpiling of raw materials	Land – Geology / Soil	Soil erosion	Provision of storm drainage canals to prevent rain water from eroding the quarry area.	SEDC	Part of EPEP cost	EPEP commitment
			Maintenance of quarry waste dump site	SEDC	Part of EPEP cost	EPEP commitment

PROJECT PHASE/ ENVIRONMENTAL ASPECT	ENVIRONMENTAL COMPONENT LIKELY TO BE AFFECTED	POTENTIAL IMPACT	OPTIONS FOR PREVENTION, MITIGATION OR ENHANCEMENT	RESPONSIBLE ENTITY	COST	GUARANTEE / FINANCIAL AGREEMENT
			Topsoil stockpile slope shall not exceed its angle of repose.			
			Progressive resoiling or revegetation will be implemented to maintain a limited stock of loose waste material.	SEDC	Part of EPEP cost	EPEP commitment
Use of heavy equipment	Land – Geology / Soil	Soil compaction	Compacted mined out portions will be ripped before resoiling to allow infiltration.	SEDC	Part of EPEP cost	EPEP commitment
Quarrying	Land – Geology / Soil	Alteration of topography / natural drainage	Resoiling / rehabilitation through implementation of reforestation program.	SEDC	Part of EPEP cost	EPEP commitment
			Establishment of SEDC nursery.			
			The company shall also practice community-based reforestation on areas outside the mined-out areas.			
			Maintenance of the existing drainage system consisting of drainage canals Regular desilting of settling ponds	SEDC	Part of EPEP cost	EPEP commitment
			Lowest level of the quarry operation shall be maintained at +35 masl	SEDC	None	SEDC Work Program
		Change in land use	Quarrying operations can be considered as temporary land use. Progressive rehabilitation of the mined-out areas, through reforestation, shall be implemented	SEDC	Part of EPEP cost	EPEP/FMRDP commitment
Removal of vegetation cover	Land – Flora & Fauna	Vegetation removal and loss of habitat	Limit the quarrying activities within direct impact area only to avoid vegetation removal of adjacent areas	SEDC	Part of EPEP cost	EPEP commitment
			Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations is recommended			

PROJECT PHASE/ ENVIRONMENTAL ASPECT	ENVIRONMENTAL COMPONENT LIKELY TO BE AFFECTED	POTENTIAL IMPACT	OPTIONS FOR PREVENTION, MITIGATION OR ENHANCEMENT	RESPONSIBLE ENTITY	COST	GUARANTEE / FINANCIAL AGREEMENT
		Threat to existence and/or loss of important local species	Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations is recommended			
			Monitor replacement planting to ensure growth and survival			
		Threat to abundance, frequency and distribution of important species	Continuous seedling production, regular tree planting, replanting, donations of seedlings and partnership with private, NGO and government organizations are recommended			
			Monitor replacement planting to ensure growth and survival			
			Continuous allocation of annual budget for these activities is likewise recommended to allow sustainability of the mitigation activity			
		Proliferation of invasive species	Immediate revegetation with preference to indigenous plant species within the cleared and opened areas should be conducted			
			Generate list of invasive species and avoid its reintroduction on site			
Abandonment Phase						
Mine closure / abandonment	People – Livelihood	Loss of livelihood of local workforce	Provide psycho-social services to project-affected families	SEDC	Part of SDMP cost	SDMP commitment
		Reduction/loss of company support for some services	Re-training and enhancement of alternative livelihood programs for workers in the affected areas	SEDC	Part of SDMP cost	SDMP commitment

PROJECT PHASE/ ENVIRONMENTAL ASPECT	ENVIRONMENTAL COMPONENT LIKELY TO BE AFFECTED	POTENTIAL IMPACT	OPTIONS FOR PREVENTION, MITIGATION OR ENHANCEMENT	RESPONSIBLE ENTITY	COST	GUARANTEE / FINANCIAL AGREEMENT
		Decrease in economic activity in the area (i.e. reduced business profits due to project closure therefore reduced market consumers)				
Disposal of scrap materials	People – Safety	Threat to public safety	IEC implementation to the community	SEDC	Part of SDMP cost	SDMP commitment
		Injury or fatality of local community due to unauthorized access to site	Proper implementation of the abandonment/ decommissioning plan	SEDC	Part of FMRDP cost	FMRDP commitment
Clearing / removal of support facilities	Land / Water / People	Removal of structures may result to accidental spillage of toxic and hazardous wastes	Proper implementation of the approved rehabilitation and abandonment plan Use of DENR-accredited haulers/TSD companies for hazardous wastes	SEDC	Part of FMRDP cost	FMRDP commitment
Abandonment	Land	Proliferation of invasive species on opened areas	Rehabilitation of disturbed areas through revegetation (i.e., indigenous tree planting, cover crops planting) Avoid use and deliberate introduction of invasive species	SEDC	Part of FMRDP cost	FMRDP commitment

4 ENVIRONMENTAL RISK ASSESSMENT (ERA) & EMERGENCY RESPONSE POLICY AND GUIDELINES

This Environmental Risk Assessment (ERA) was conducted for the Silica Sand Quarry Expansion Project with reference to the prescribed methodology outlined in Annex 2-7e of the Revised Procedural Manual of DAO 2003-30, DMC 2010-14, and the Technical Screening Checklist for the Project. The Revised Procedural Manual (RPM) of DENR Administrative Order (DAO) 2003–30 defines the Environmental Risk Assessment (ERA) as a process of analyzing and describing the risks associated with a project or activity to the ecosystems, human health and welfare.

During the risk assessment, hazards are evaluated in terms of the likelihood that a problem may occur and the damage it would cause if such an event did occur. Adequate safety and emergency preparedness require considering all the possible hazards that could be encountered. Some hazards, however, are more likely to cause problems than others at a given time and some would result in greater damage than others. For mining and mineral processing operations, an agreement on how to recognize the various types of risks encountered and the management practices to address these risks is vital for the sustainability of mining activities.

4.1 RISK ASSESSMENT

The ERA conducted for the project applies the generic framework of Australia and New Zealand (AS/NZS 4360:2004) for establishing the context, identifying, analyzing, evaluating, treating, monitoring, and communicating risk. Specifically, this ERA makes use of the Qualitative Method which is a quick and relatively easy to use method. Broad consequences and likelihoods can be identified. The qualitative risk assessment can provide a general understanding of comparative risk between risk events, and the risk matrix can be used to separate risk events into risk classes (ratings). Qualitative methods use descriptive terms to identify and record consequences and likelihoods of events and resultant risk.

Figure 4-1 outlines the AS/NZS 4360:2004 Risk Management Standard process for identifying, analyzing and managing risks, including technical risk. It also emphasizes the importance of stakeholder engagement, risk communication and community consultation processes at each stage. The objective of risk analysis is to produce outputs that can be used to evaluate the nature and distribution of risk, and to develop appropriate strategies to manage the risk.

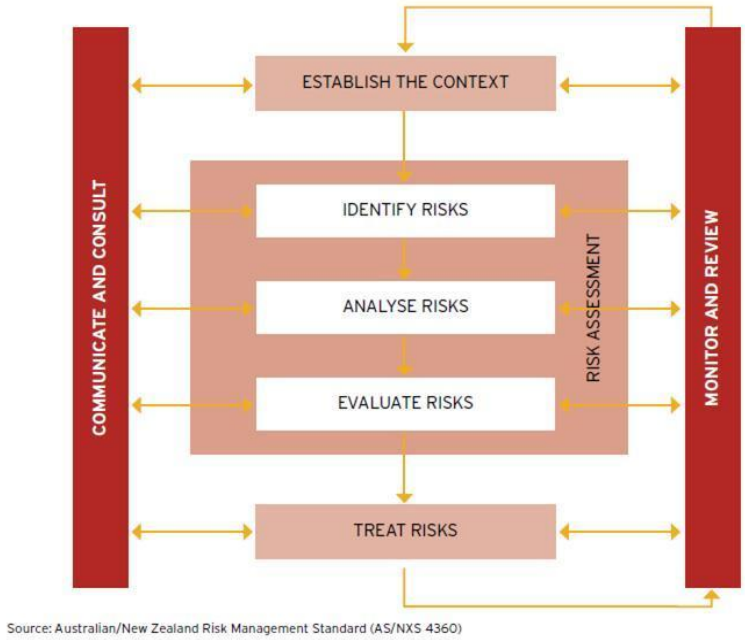


Figure 4-1. AS/NZS 4360:2004 Risk management steps

4.1.1 CONSEQUENCE RATING

Qualitative measures of **"Consequence"** or impact (based on AS/NZS 4360:1999).

LEVEL	DESCRIPTOR	CONSEQUENCE
1	Insignificant	Minimal, if any impact for some workers, communities. Potentially some impact for a small number of (<10) individuals. Denoting an insignificant or trivial effect as a result of an event occurring
2	Minor	Low level impact for some workers, communities, or high impact for a small number (<10) of individuals. Denoting small effects following the occurrence of an event or series of events
3	Moderate	High level impact for some workers, communities, or moderate impact for communities (Barangay level) Defined as noticeable event or a series of events that can be rectified in the long term
4	Major	High level of impact for workers, communities (Barangay level) Describing key events leading to fatalities, breakdown of social order, loss of abundance and/or loss of species, and widespread contamination resulting to reduction of air and water qualities
5	Catastrophic	High level of impact (Municipal level)

LEVEL	DESCRIPTOR	CONSEQUENCE
		Describing disastrous events that would lead to multiple fatalities, complete breakdown of social order, local extinction of population and widespread contamination that cannot be immediately remediated

4.1.2 LIKELIHOOD RATING

Qualitative measures of **"Likelihood"**

LEVEL	DESCRIPTOR	DESCRIPTION
A	Almost certain	Is expected to occur in most circumstances (80 - < 100%)
B	Likely	Will probably occur in most circumstances (60 - < 80%)
C	Possible	Might occur at some time (40 - < 60%)
D	Unlikely	Could occur at some time (20 - < 40%)
E	Rare	May occur only in exceptional circumstances (< 20%)

4.1.3 QUALITATIVE RISK MATRIX

		Consequence level				
		1	2	3	4	5
Likelihood level	Descriptor	Insignificant	Minor	Moderate	Major	Catastrophic
A	Almost certain	A1	A2	A3	A4	A5
B	Likely	B1	B2	B3	B4	B5
C	Possible	C1	C2	C3	C4	C5
D	Unlikely	D1	D2	D3	D4	D5
E	Rare	E1	E2	E3	E4	E5

Risk rating
Extreme
High
Moderate
Low

Source: Bowden, Lane and Martin (2001)

Extreme Risk	**Immediate action required.**
High Risk	**Management measures must be employed.**
Moderate Risk	**Management measures must be identified.**
Low Risk	**Manage by routine procedures.**

4.1.4 RESULTS OF RISK ASSESSMENT

Table 4-1. Sources of Risks and Corresponding Management Measures

Potential Hazard	Cause / Triggers	Impact / Possible consequences	What / Who will be affected	Without Controls			Proposed / Existing Controls	With Controls		
				CR*	LR*	Risk Level		CR*	LR*	Risk Level
High wall / bench slope	Heavy rains Earthquake	Landslides Soil erosion	Safety Workers Nearby community	3	C	C3 (High)	Strict enforcement of benching design	3	E	E3 (Moderate)
Falls from benches	Non-observance of safety precautions; unsafe acts/ conditions	Body injury or death	Safety Workers	5	D	D5 (Extreme)	Strict implementation of safety guidelines Conduct relevant safety trainings and seminars regularly Daily safety briefing (pep talks)	5	E	E5 (High)
Vehicular accidents	Reckless driving, Poor maintenance of vehicle lack of safety warning devices	Body injury or death	Safety Workers	5	D	D5 (Extreme)	Strict implementation speed limits Install safety signage Conduct relevant safety trainings and seminars regularly Daily safety briefing (pep talks)	5	E	E5 (High)
Noise	Equipment operation	Health problem	Health Workers Nearby community	1	D	D1 (Low)	Limit operation during daytime Use mufflers Provide PPEs to workers Regular maintenance of vehicles/ equipment	1	E	E1 (Low)

Potential Hazard	Cause / Triggers	Impact / Possible consequences	What / Who will be affected	Without Controls			Proposed / Existing Controls	With Controls		
				CR*	LR*	Risk Level		CR*	LR*	Risk Level
Silt / Sediments from stockpiles and waste dumps	Heavy rains	Siltation	Environment Luknay Creek Coastal area of San Fernando	2	C	C2 (Moderate)	Construct drainage canals leading to settling ponds with adequate capacities Regular maintenance/ desilting of drainage canals and settling ponds Maintain vegetative buffers Waste Management	2	E	E2 (Low)
Flooding	Heavy rains Site clearing and development/ deforestation	Damage to properties	Safety/ Environment Low-lying areas near the coast	2	D	D2 (Low)	Limit disturbed areas Progressive rehabilitation of the quarry area and enhancement planting of the surrounding areas Regular cleaning of natural drainage channels – Luknay Creek and Sabang River Climate Change Mitigation and Adaptation (National Greening Program)	2	E	E2 (Low)
Fire / Explosion *the	Unsafe acts Interaction of chemicals Faulty electrical	Damage to properties Body injury or death	Safety Workers Nearby community (at the port)	4	D	C4	Implementation of planned or scheduled preventive maintenance of	4	E	E4

Potential Hazard	Cause / Triggers	Impact / Possible consequences	What / Who will be affected	Without Controls			Proposed / Existing Controls	With Controls		
				CR*	LR*	Risk Level		CR*	LR*	Risk Level
operations quarry will not implement blasting (no explosives)	wiring Mechanical fire due to excessive stress / overuse						equipment Provide proper ventilation for equipment to avoid overheating Construction of facilities following the guidelines stipulated in Fire Code of the Philippines Implementation of Emergency Preparedness and Response Plan Conduct fire emergency drills regularly Regular inspection of Fire Alarm System, emergency equipment such as fire extinguishers, fire hose and other firefighting equipment			
Exhaust from equipment	Running time of equipment Lack of proper equipment maintenance	Pollution Health problems	Health/ Environment Air quality Workers Community	1	D	D1 (Low)	Limit movement of equipment only as required Provide PPEs to workers Preventive maintenance of	1	E	E1 (Low)

Potential Hazard	Cause / Triggers	Impact / Possible consequences	What / Who will be affected	Without Controls			Proposed / Existing Controls	With Controls		
				CR*	LR*	Risk Level		CR*	LR*	Risk Level
							vehicles/ equipment			
Fugitive dust	Hauling operations	Air pollution Health problem Smothering of vegetation	Health/ Environment Workers Community	2	B	B2 (High)	Set speed limits Periodic road watering Cover haul trucks Provide PPEs to workers	2	D	D2 (Low)
Natural hazards (calamities)	catastrophic events like typhoon, earthquake, etc.	Stoppage of operation	Socio-economic Workers Operations	3	D	D3 (Moderate)	Implement Emergency Response Plan Implement disaster risk reduction programs	2	D	D2 (Low)
Issuance of a Ceased and Desist Order (CDO)	Stoppage of project due to noncompliance with regulatory requirements.	Stoppage of project operation. Penalties. Filing of court cases Loss of income	Socio-economic Workers Operations	5	D	D5 (Extreme)	Continuous implementation of the approved IMP and compliance to government regulations. Regular training of PCOs Conduct IEC programs for workers regarding environmental compliance	5	E	E5 (High)
Increase in anti-project sentiments, strained relationship with the LGU	Unpopularity of the project implementation due to poor Project-LGU relationship	Delays in project implementation Loss of income Protests/ rallies	Socio-economic Workers Operations	3	C	C3 (High)	Implementation of the SDMP during operations. Harmonized relationship with the host community through regular IEC	3	E	E3 (Moderate)

Potential Hazard	Cause / Triggers	Impact / Possible consequences	What / Who will be affected	Without Controls			Proposed / Existing Controls	With Controls		
				CR*	LR*	Risk Level		CR*	LR*	Risk Level
							Campaign Implement EPEP commitments			

*Note: CR - Consequence Rating; LR – Likelihood Rating

4.2 Risk Management

SEDC will implement the following Risk Action Plan to manage the risks related to the Project.

Table 4-2. Risk Management - Safety

RISK ASSESSMENT	MITIGATING MEASURE	REMARKS
• Equipment falling at the edge of the benches • Siltation and dust associated to operations (loading and hauling) • Workers being struck/ entrapped/ pinned by moving vehicles • Slope/ face instability giving rise to rock falls or slides • Moving vehicle pose hazards to workers. The risk of entrapping/ pinning/ striking workers would greatly increase if operators of moving vehicles are not skilled or qualified operators • Face instability will cause rock falls and/or slides. It can happen due to adverse geologic condition or inappropriate work methods. Those at greatest risks are the workers exposed or near these slopes.	• Provision of signages, or safety cordon, or provision of safety berm • Provision of storm water drainage to manage silted waters during heavy rainfall. • Provision of safety signage on areas where risks are present such as high wall edges, areas below high wall and areas where there is possibility of falling rocks. • Brief the workers to follow company procedures. Violators will be dealt accordingly to avoid repeat of similar violations. • Only qualified operators will be allowed. Proper coordination of vehicle movement in the work area. • Regular inspection of the benches for signs of instability. • Implementation of Mining Program benches design.	The effectively of the measures will be determined through: • Daily monitoring of hazard areas • Analysis of safety accident reports • Review and revisions of Mining methodology

Table 4-3. Risk Management - Environment

RISK ASSESSMENT	MITIGATING MEASURE	REMARKS
• Slumping/landslide of slopes in the quarry	• Vegetation of areas where there is high water runoff	The effectively of the measures will be determined

RISK ASSESSMENT	MITIGATING MEASURE	REMARKS
● Ineffective drainage system in the quarry area ● Failure of pollution control facilities (Silt ponds)	● Construction of silt traps and drainage canals to divert excess runoff ● Maintain drainage system and ensure that its design serve its purpose ● Regular cleaning and desilting of drainage canals and silt traps ● Progressive rehabilitation of affected areas	through: ● Daily monitoring of hazard areas ● Analysis of environmental monitoring reports

Table 4-4. Risk Management - Social

RISK ASSESSMENT	MITIGATING MEASURE	REMARKS
● Premature closure of company ● Negative sentiments to mining of some sectors ● Strained relationship with the LGU caused by unpopularity of the project implementation due to poor Project-LGU relationship	● Monitor/ implement SDMP ● Conduct regular IEC for the stakeholders to fully understand the project ● Help the stakeholders with their need, coordinate with LGU and NGO for the implementation of the project and assist the community with their social and economic development that will directly minimize if not eliminate their negative outlook to mining.	The effectively of the measures will be determined through: ● Monitoring and analysis of the progress of the project

4.3 SAFETY PERFORMANCE

Since the project has not been implemented, no safety performance is available. However, it is SEDC's commitment, through its Health and Safety Policy, to manage a safe and responsible mining operations by providing safe and healthy working conditions to its employees and outsource process/service providers and adhering to safety and health standards. Incident prevention is the corporate goal of the Safety and Health Program. It aims to eliminate/minimize potential pre-determined hazards and risks associated in each stage of SEDC operations through established operational controls and strategies for continual improvement. SEDC initiates efforts to cooperate

with the government, public and private sectors in seeking solutions to safety and health problems and related community issues.

Adhering to its Health and Safety Policy, SEDC was awarded with the ***Safest Quarry Operation Award*** by the Philippine Mine Safety and Environment Association and the Department of Environment and Natural Resources - Mines and Geosciences Bureau for three consecutive years from 2014 to 2016. Below is the list of awards given to SEDC for its safe mining operations.

- Zero Lost Time Accident Award (PMSEA)
  - Fiscal Year 2004-2005
  - Fiscal Year 2006-2007
  - Fiscal Year 2008-2009
  - Fiscal Year 2009-2010
- Zero Lost Time Awardee, Region VII (Quarry Operations Category)
  - Fiscal Year 2013-2014 by DENR-MGB VII
- 2014 Safest Mines Award (Quarry Operations Category) by DENR-MGB VII
- Safest Quarry Operations Award by PMSEA
  - November 14, 2014
  - November 20, 2015
  - November 18, 2016
- Safest Mining Operation: Non-Metallic Category by PMSEA
  - November 18, 2016
- SEDC's 5-year Safety Statistics

4.4 EMERGENCY PREPAREDNESS AND RESPONSE GUIDELINES

The purpose of the Emergency Preparedness and Response procedure of SEDC is to maintain a system for carrying out emergency preparedness and response actions within the premises of the company and areas of its operations, with the aim of minimizing the impacts of emergency situations towards the environment including risks and injuries to employees, outsourced process/ service providers and other interested parties.

This procedure is applicable to all emergency situations which can have significant impacts to the environment, including occupational health and safety risks to employees and other personnel working for or in behalf of Solid Earth Development Corporation in conformance to the requirements of ISO 14001:2015 Environmental Management System.

4.4.1 REFERENCE DOCUMENTS

- Annual Safety and Health Program
- Oil Spill Contingency Plan
- Incident Reporting and Investigation

4.4.2 RESPONSIBILITIES AND AUTHORITIES

4.4.2.1 TOP MANAGEMENT

The top management is responsible for providing resources related to the effective implementation of the company's Emergency Response Preparedness Plan (ERPP).

4.4.2.2 Safety, Health and Environment Department Manager and Safety, Health and Environment Officer

The Safety, Health and Environment (SHE) Department Manager and SHE Officer are responsible for ensuring that this procedure is implemented consistently and effectively throughout the company and other personnel working for or in behalf of Solid Earth Development Corporation.

4.4.2.3 Emergency Response Team

- Emergency Response Coordinator is responsible for handling and managing the Emergency Response Team (ERT) and implementing emergency response procedures.
    - Directs the overall execution of the ERPP.
    - Provides regular updates to Management on the development and progress taking place on site.
    - Coordinates and maintain efficient communication with the TCPI-ESD Manager/Staff for immediate assistance.
    - Overall in-charge of information relay and coordination with stakeholders as well as documentation and reporting.
    - Clear all outgoing communications and acts as spoke-person of the company.
    - Submits Final Report to Management which is essential for claims (including costs and lessons learned).
- Alternate/Co-Alternate ERC
    - Assist the ERC in the execution of the plan.
    - Advise the ERC on matters pertaining to Safety, Health and Environment Management to ensure that health and safety of the response teams is not compromised during the activity.
    - Act as ERC in his absence.
- Team Leader
    - Evaluate and determine extend and severity of the situation.
    - Assume command over all emergency response teams at the site to carry out actions as per ERPP.
    - Liaise and update the ERC of the actions carried out on site.
    - Ensures that heavy equipment are readily available for whatever aggravating situation that needs special attention.
    - Supervise the teams under him.
- Members of the Emergency Response Team (ERT) On-Duty
    - Responsible for ensuring proper implementation of the company's emergency response plans.
    - Execute the plan safely as directed by the Team Leader.
    - Coordinates and maintain efficient communication with the Team Leader.
- Herstal Security Head Guard On-Duty
    - Receives instructions and relays information to concerned parties as directed by the ERC.
    - Guides the Local Disaster Coordinating Council (LDCC) as directed by the ERC.
    - Advise the ERC on matters pertaining to Security.
    - Ensures that unauthorized personnel are kept out from the site.

4.4.3 GUIDELINES

4.4.3.1 EMERGENCY SCENARIO IDENTIFICATION

- The Safety, Health and Environment Officer, in coordination with other department heads, shall identify all potential emergency situations or scenarios arising from the risk assessment associated with the company's activities, operations and processes including the means to eliminate, control and minimize the hazards and risk associated with it.
- All identified emergency scenarios shall be developed, registered and maintained specifying the activities, operations and processes including the hazards, risks and appropriate controls.

4.4.3.2 EMERGENCY RESPONSE TEAM

- An Emergency Response Team (ERT) shall be formed and maintained to ensure the company's readiness in the event of incidents and other emergency situations affecting the environment and health & safety of art personnel as well as company properties.
- The ERT shall be headed by an assigned "Emergency Response Coordinator" and shall be organized in accordance with "Emergency Response Team Structure", which identifies the key emergency responders in the overall Emergency Response Preparedness Plan (ERPP).
- Members of the ERT shall be qualified and trained in matters related to emergency preparedness & response actions to mitigate severe impacts to the environment and its associated risk in the event of its occurrence. Emergency trainings shall be planned and coordinated by the Safety, Health and Environment Manager with qualified trainers.

4.4.3.3 EMERGENCY CLASSIFICATION AND NOTIFICATION

- All emergency situations will be assessed by the Emergency Response Coordinator, Safety, Health and Department Manager and Safety, Health and Environment Officer who shall determine the level of emergency according to the classification specified in "Emergency Classification".
- Appropriate communications shall be performed by the Safety, Health and Department Manager and Safety, Health and Environment Officer with all relevant authorities depending on the classification level of emergency.
- For Level 2 & Level 3, refer to Action Flow of Communication and Response indicated in the Annual Safety and Health Program.

Table 4-5. Classification of emergency scenarios

LEVEL OF EMERGENCY	DESCRIPTION
LEVEL 1	An emergency has occurred and can be controlled by the company's ERT.
LEVEL 2	An emergency has occurred. However, the situation is not under control but is confined within facility premised. The emergency is confined to a small area or to a fixed site and does not posed a threat of spreading to a larger area or off-site. The company's ERT shall take the necessary response for controlling the situation.
LEVEL 3	An emergency has occurred where the situation is not under control and protective action may be necessary to protect the surrounding or offsite area. A site area emergency involves events in process or which have occurred that result in actual or likely major failures of safety functions.

LEVEL OF EMERGENCY	DESCRIPTION
	The company's ERT together with other relevant agencies shall take the necessary response for controlling the situation.

4.4.3.4 COMMUNICATIONS AND EMERGENCY INFORMATION FLOW

- Communication lines through radios, telephones and mobile phones shall be accessible, readily usable and maintained to facilitate proper communication with relevant authorities.
- In addition, emergency contact numbers of key personnel, including ambulance, police and fire departments shall be posted for quick reference.
- All occurrences of environmental and OH&S emergency situations and incidents shall be communicated immediately to the Safety, Health and Environment Department, Environmental Management Representative and/ or Technical Adviser/ Director.

4.4.3.5 EMERGENCY DRILLS

- The Safety, Health and Environment Manager, in coordination with the Environmental Management Representative and Top Management, including all other departments in the organization, shall plan and conduct a company-wide emergency drills at least once every 6 months.
- Emergency drills and trainings shall cover all but not limited to different types of emergencies as follows:
    - Evacuation;
    - Firefighting;
    - Oil Spill;
    - Earthquake;
    - First Aid;
    - Bomb threat;
- Designated fire exits and evacuation areas (or "assembly points") within or near the company premises shall be clearly marked and made clear to all personnel. Selected and assigned personnel (referred to as "fire wardens") shall supervise the evacuation, including headcount.
- Where appropriate, an evacuation plan and vicinity map or site layout shall be posted in strategic locations of the company premises for the general awareness of everyone. The maps should show evacuation routes, recovery routes, closest exits, fire protection equipment location and whatever is applicable. All employees should follow these instructions and be familiar with the evacuation map.
- If planned results are not achieved, appropriate corrective actions shall be planned and earned out.
- The Safety, Health and Environment Department shall prepare and maintain records of "Emergency Drill Report" duly signed by the EMR and/or Technical Adviser.

4.4.3.6 EMERGENCY EQUIPMENT MONITORING AND INSPECTION

The Safety, Health and Environment Manager shall ensure that appropriate emergency equipment is provided, deployed and easily accessible in strategic areas of the company premises where a potential environmental emergency and associated risks could potentially occur.

Emergency equipment shall cover all but not limited to the following:

- Fire Extinguishers
- Fire Alarms (system is dependent with TCPI)
- Fire Hose (system is dependent with TCPI) -check MOA
- Emergency lights
- Spill kits (in the event of chemical/oil spills)
- First Aid Kit
- Fire Fighting Equipment

The Safety, Health and Environment Manager and/or its assigned officer shall periodically check and monitor all emergency equipment using the "Emergency Equipment Monitoring Sheet" (Portable Fire Extinguisher, Oil Spin Response Equipment, Fire Fighting, First Aid Kit. Frequency of inspection and maintenance shall be specified in the list.

It shall be the responsibility of the Safety, Health and Environment Manager and his designated officer to ensure that all emergency equipment is in good operational condition and easily accessible in the event of an incident and other emergency situation.

4.4.3.7 EMERGENCY RESPONSE

- At the sound of an Emergency Evacuation Alarm, all personnel shall stop working except those with designated duties in this PLAN and shall proceed in an orderly movement towards the designated EVACUATION AREAS.
- An announcement by the TCPI Emergency Response Coordinator (ERC) will be affected right after the emergency alarm is sounded to disseminate information and instructions for proper guidance. The highest-ranking personnel should conduct headcount at once and report it to the SEDC Emergency Response Coordinator (ERC) to ascertain accountability of personnel.

4.4.3.8 AFTERMATH CLEAN-UP PROCEDURES

It is important that after any eventuality, full concern for the protection of public health, safety and the environment are immediately taken cared-of as corrective measures.

The following guidelines are formulated to meet adherence to this intent:

- **Area Inspection** – An Inspection Team composed of technical personnel as directed by the Technical Director shall immediately conduct thorough inspection to determine the extent of damage and other related data in relation to the stability of structures, prevailing and impending environmental aspects-impacts, safety and conclusively recommends whatever normalization measures are to be undertaken.
- **Cleaning/ Demolition** – A Composite Team shall then be tasked to undertake these cleaning/ demolition activities.
- **Waste Disposal** – Waste generated from the demolition and cleaning shall conform to the established procedure in Waste Management.

4.4.3.9 REPORTING AND MEETING

- The EMR, Safety, Health and Environment Manager and other relevant personnel shall review and discuss any reported incident and shall plan corrective measures to avoid recurrence of the same environmental and OH&S emergency and incident.
- Emergency procedures shall be reviewed and revised as necessary to reflect continual improvement on the company's EPRP

- All matters discussed shall be communicated to all interested parties such as employees, outsourced process/ service providers, government offices and other persons working for or in behalf of the company through meetings and bulletin boards for general awareness.

5 SOCIAL DEVELOPMENT PLAN/FRAMEWORK (SDP) AND IEC FRAMEWORK

5.1 SOCIAL DEVELOPMENT PLAN

5.1.1 INDICATIVE SOCIAL DEVELOPMENT PLAN

Indicative social development planning is necessary in formulating programs and strategies that would mitigate the major impacts of the project. This would guide the proponent in preventing/mitigating and/or enhancing a project's adverse and positive impacts on people's livelihood, health and environment.

Social Development Plan (SDP) aims to assess and identify the basic needs of the communities which will be affected by the project. SDP should be patterned in the Municipal and Barangay Development Plans of the host communities and in accordance with the mandated Corporate Social Responsibility. It aims to establish a strong relationship between the Project Proponent, community institutions, and stakeholders towards the goal of achieving an improved quality of life of the residents of the host localities.

The issues garnered from the perception survey conducted on November 14 – December 3, 2018 were considered and addressed in the formulation of the SDP. These are the following:

- Employment
- Barangay Income
- Improvement of Communications Network
- Damage to Road Network
- Landslide/Erosion
- Damage to nearby houses
- Noise Pollution
- Take care of dangerous/accident prone/hazardous areas
- Avoid Landslides
- Signage in dangerous/accident prone/hazardous areas
- Tree planting as protection against landslides in other areas
- Provide access roads. Separate for the hauling, and for the community
- Relocation and housing to those affected
- Tree Replacement/Reforestation/Rehabilitation
- Concrete Slope Protection
- Petition for a flower garden in Lut-od
- In rehabilitation, create/gear towards tourist spot or eco-park
- Deepen/Strengthen the community relations

The Indicative Social Development Plan (SDP) presenting the major programs and activities is presented in **Table 5-1**. As mandated under DENR Administrative Order No. 2000-99, a Comprehensive Social Development and Management Program (SDMP) will be formulated and implemented in partnership and discussion with various stakeholders. While the SDMP and SDP may be similar in efforts for the company to realize its corporate social responsibility, it must be emphasized that the SDP is impact-based as a result of the EIA. This SDP therefore is rationalized within the purview of the

PEISS addressing all the possible socio-economic impacts that may arise during and after the operation of the mine as a result of significantly technical impacts. The company through its experienced Community Development or Social Work Officer will implement the SDP in coordination with all stakeholders. A periodic monitoring and evaluation of SDP projects and activities will be carried out in partnership with other stakeholders. Moreover, coordination with the Project-affected barangays and the Municipal LGU of San Fernando will also be carried out to ensure conformity of activities and projects to the development thrust of the local government. The SDP as a framework plan shall be an indicative set of programs that will:

- Identify the key concerns to be addressed (including those of the second level scoping issues and concerns);
- Recommend and design measures in response to these concerns;
- Indicate the responsible agency or organization with respect to these measures; and
- Plan broad timelines to make these measures happen.

Table 5-1. Indicative Social Development Plan/Framework

CONCERN	PROGRAM ACTIONS	LEAD ORGANIZATION	RESPONSIBLE COMMUNITY MEMBER/BENEFICIARY	INDICATIVE TIMELINE	SOURCE OF FUND
1. Economic empowerment	● Set-up barangay public employment/business services offices ● Seminar and educational tour on sustainable agriculture, agroforestry, and organic farming: - Pro-poor Livelihood programs - Program for the elderly - Technical skills for women ● Livelihood project and enterprise development projects for women, elderly and out of school youth - Piggery and poultry - Handicraft training/seminar - Backyard gardening	SEDC, DA, TESDA, MSWD	● Barangay Committees ● Communities within impact barangay ● POs and NGOs of impact barangays	Pre-construction Construction Operation	SEDC
2. Health	● Set-up community health program at project affected areas; regular monitoring and consultation on medical services ● IEC on sanitation and distribution of toilet construction materials to residents without toilets ● Quarterly Health Education and Sanitation Program ● Health & Safety Training for employees ● Maternal Care and Child Health Care: Prenatal, Intranatal, Postnatal, Child birth in health centers or hospitals ● Nutrition Program: Supplemental feeding and In-school Supplemental Feeding Program ● Health Care prioritizing non-employees of the company in health centers or hospitals	SEDC, DOH, DepEd, Municipal Health Officer	● Barangay Committee on Health, Barangay Health Workers ● Residents affected by the project ● POs and NGOs of impact barangay ● Employees of the project ● Barangay Nutrition scholars and Health ● Workers; Women and children of the affected barangays	Pre-construction Construction Operation	SEDC
3. Hazards and disaster preparedness	● Disaster Risk Management Plan ● IEC on Disaster Risk Management ● Seminars/training for communities and mining workers on Disaster Risk Preparedness and Mitigation	SEDC in partnership with local authorities and community	● Communities of impact barangays ● SEDC Employees	Pre-construction Construction	

CONCERN	PROGRAM ACTIONS	LEAD ORGANIZATION	RESPONSIBLE COMMUNITY MEMBER/BENEFICIARY	INDICATIVE TIMELINE	SOURCE OF FUND
	• Provision of equipment and aid in response and recovery of affected communities • IEC and consultation on community	organizations		Operation Abandonment	
4. Transportation	• Improvement of roads • Constant and frequent water sprinkling along unpaved roads	SEDC in partnership with local authorities and community organizations	• Barangay Committees • Communities within impact barangay • POs and NGOs of impact barangay	Pre-construction Construction Operation	
5. Water supply	• Assistance for the development of water sources for the community;	SEDC in partnership with local authorities and community organizations	• Barangay Committees • Communities within impact barangay • POs and NGOs of impact barangay	Pre-construction Construction Operation	
6. Peace and Order	• Provision of seminars and workshops • Provision of equipment and facilities as aid in keeping order in the community	SEDC, PNP, Barangay LGU - Tanod	• Barangay Committees • Communities within impact barangay • POs and NGOs of impact barangay	Pre-construction Construction Operation	SEDC
7. Mining closure	• Psycho-social services to Project-affected families • Re-training and enhancement of alternative livelihood programs for workers in the affected areas	SEDC, DTI	• Employees of the company	Abandonment	

5.1.2 Implemented Social Development Programs

As per latest CMR has not yet implemented since the status of the existing project is under DMPF.

5.1.3 SDMP Cost

The table below shows the Social Development and Management Program (SDMP) Cost per category project or program actions:

PROGRAM / PROJECT	YEAR 1	YEAR 2	YEAR 3	TOTAL
1. Livelihood Project (15%)	615,000	630,000	660,000	3,300,000
2. Infrastructure Project (15%)	615,000	630,000	660,000	3,300,000
3. Health Program (15%)	615,000	630,000	660,000	3,300,000
4. Education Program (20%)	820,000	840,000	880,000	4,400,000
5. Community Support (10%)	410,000	420,000	440,000	2,200,000
5. Development of Mining Technology (10%)	410,000	420,000	440,000	2,200,000
5. IEC Program (15%)	615,000	630,000	660,000	3,300,000
TOTAL BUDGET	**4,100,000**	**4,200,000**	**4,400,000**	**22,000,000**
Parameters:				
Annual Production	660,000	660,000	660,000	3,300,000
Operating Cost	406	422	439	439
Minimum Requirement (1.5%)	4,019,400	4,177,800	4,346,100	21,760,200

5.2 Information, Education and Communication (IEC) Framework

A comprehensive and intensive Information Education and Communication (IEC) Campaign is designed for the better information and education of the communities and the general public pertaining the objectives, necessity and benefits of the project, and the processes involved with the construction and operation of the proposed project. These shall be done through the distribution and posting of written materials such as brochures, newsletters, media statements and articles, bulletins and posters, comics, and online presence. Moreover, non-written types such as fora, symposia, conferences, workshops, community discussions and hearings, interpersonal focus discussions, house-to-house and purok-to-purok information drives, information desk/center, community seminars, mine visits audio visual presentations, radio and TV programs and/or guestings, etc., can also be used for the campaign. The IEC materials and activities will also serve as a venue for continuous dialogue, feedback and check and balance mechanism for the parties involved. Table 5-2 presents the proposed IEC Plan for the Project.

SEDC has its Complaints Management Guideline to ensure that complaints from any of the interested parties (i.e. stakeholders, employees, customer, community, government agencies/offices and other related entities who wish to express their dissatisfaction pertaining to the effects of the company's operations) are properly communicated and addressed. Below is a summary of the Complaints Management Guideline of SEDC.

5.2.1.1 Responsibilities and Authorities

Legal Assistant - is responsible in recording complaints received such as complainant's information, complaint's details, source, date and time raised in the complaints blotter (logbook). It is his/ her responsibility to initially assess, notify the concerned department, follow through actions taken, and monitor its effectiveness. Thereafter, closing of complaints once settled and safekeeping of records.

Grievance Committee - is a team of Division/ Department Managers and Legal Assistant who is responsible to respond, investigate and validate complaints.

Concerned Department (Process Owner) - is responsible to initiate and implement immediate/ corrective actions and ensures consistency of actions deployed.

5.2.1.2 RECEIVING A COMPLAINT

Complaints are received verbally or in writing at any of the following:

- at any SEDC Office
- via any of SEDC's contact numbers
- via any of SEDC's advertised email address and fax numbers
- via SEDC's website or official page

Personal information is collected, stored, used and disclosed. Any information transferred outside the company without the consent of the complainant may be a breach of information privacy.

Privacy Statement:

"Solid Earth Development Corporation is collecting your personal details for the purpose of responding to your complaint. Your information will not be disclosed to a third party without your consent unless required or authorized to do so by law."

5.2.1.3 RECORDING OF A COMPLAINT

Recordkeeping is the responsibility of the Legal Assistant. All complaints received shall be recorded in the Complaints Blotter. They are retained and destroyed under an approved retention and disposal schedule. Records/ files with confidential, sensitive and/ or personal information must be saved within the recordkeeping system with appropriate security classifications and security access controls.

5.2.1.4 ASSESSING A COMPLAINT

After receiving a complaint, it is assessed to determine:

- if it will be managed under this procedure;
- if it will be accepted;
- how, where and by whom it should be managed.

The issues raised, the relevant information provided, the actions undertaken so far and the outcome requested must be considered to understand the complaint based on the complainant's perspective.

In addition, to be able to determine how to manage the complaint, factors such as the significance of the issues, the reasoning for any decisions or actions made so far, any relevant legislative, policy or process requirements, the likely outcome or remedy and any potential corrective actions or improvement must be considered.

To ensure that complaints are managed consistently and appropriately, the nature and implication of the issues raised must be reviewed to determine the best classification of the complaint. Below are the classification levels of complaints:

Typical Complaint – assessed as having a low level of risk and/or minimal level of detriment to the complainant or to the company. These complaints normally involve minimal investigation.

Intermediate Complaint – assessed as having a medium level of risk and/or moderate level of detriment to the complainant or to the company. These complaints may involve detailed investigation and may require referral to the senior/executive management.

Complex Complaint – assessed as being serious or significant, with a high or extreme level of detriment to the complainant or to the company. These complaints may involve extensive investigation and require immediate attention of the senior/executive management.

5.2.1.5 INVESTIGATING A COMPLAINT

The key steps of the investigation process are the following:

- Identify the key issues;
- Assess if there is conflict of interest;
- Plan the investigation;
- Gather and evaluate evidences; and
- Make a decision.

5.2.1.6 RESPONDING TO AND REPORTING A COMPLAINT

Following an investigation, a timely and meaningful feedback must be provided to the complainant and any relevant staff or business areas involved and/ or that might be affected by any findings or corrective actions.

Complaints are consistently and systematically categorized and reported to the top management.

Table 5-2. IEC Plan/Framework for the Project

TARGET SECTOR IDENTIFIED AS NEEDING PROJECT IEC	MAJOR TOPIC/S OF CONCERN IN RELATION TO PROJECT	IEC SCHEME/ STRATEGY/ METHODS	INFORMATION MEDIUM	INDICATIVE TIMELINES AND FREQUENCY	INDICATIVE COST
Communities of impact barangay; SEDC employees, LGUs, POs, NGOs	Project details/ background; • Proponent • Scope of the project • Schedule of activities • Project development • Benefits from the Project	• Conduct of Seminars, • Mine tours/visits, conference, forum and workshops, meetings with LGUs, Local newspaper, press releases, Leaflets, Billboards; • Distribution of info materials • Maintenance of Information desk and center	Print Media, Posters, brochures, Comics Multi-media press releases, broadcast, TV spots and social media	Pre-construction	15% of the SDMP Fund as mandated under the DAO 2010-13
Communities of impact barangay; LGUs, POs, NGOs, Contractors	EIA Results • Compliance with the DENR requirements • Environmental Management Plan • Environmental Compliance and Monitoring • Environmental laws and related regulations on EPEP, FMRDP, MMT, MRFC, ECC, etc • Clean-Air Act, Clean Water Act, Ecological Solid Waste	• Public Meetings • Purok-to-purok information drive • Distribution of info materials • Maintenance of Information desk and center	Print Media, Posters, brochures, Comics Multi-media press releases, broadcast, TV spots and social media	Pre-construction Construction Operation Abandonment	15% of the SDMP Fund as mandated under the DAO 2010-13

TARGET SECTOR IDENTIFIED AS NEEDING PROJECT IEC	MAJOR TOPIC/S OF CONCERN IN RELATION TO PROJECT	IEC SCHEME/ STRATEGY/ METHODS	INFORMATION MEDIUM	INDICATIVE TIMELINES AND FREQUENCY	INDICATIVE COST
	Management Act and other laws and regulations.				
Communities of impact barangay; LGUs, POs, NGOs; Employees of SEDC, school children	The program of implementing the Social Development and Management Program such as: • Environmental Health and Sanitation • Environmental Conservation, Protection and Management • Disaster Risk Preparedness • Solid Waste Management on Schools and Households	• Information dissemination during meetings of organized and assisted POs and sector; • House-to-house and schools information dissemination; • School workshops • Community seminar/ trainings • Purok-to-purok information drive. • Distribution of info materials • Maintenance of Information desk and center	Print Media, Posters, brochures, Comics Multi-media press releases, broadcast, TV spots and social media	Pre-construction Construction Operation Abandonment	15% of the SDMP Fund as mandated under the DAO 2010-13

6 ENVIRONMENTAL COMPLIANCE MONITORING

6.1 ENVIRONMENTAL PERFORMANCE

SEDC continuously implements the mitigating measures committed in the EMP and the ECC Conditions are well monitored and complied. Based on the submitted monitoring reports, the project is still in the developmental stage particularly in the acquisition of the Project Declaration of Mining Project Feasibility (DMPF) so they can proceed with the project operational stage.

6.1.1 PROJECT ENVIRONMENTAL PERFORMANCE

Although the ECC for the existing project was awarded in 2016, there was no major development in the two MPSAs covered by the ECC. The project has an on-going DMPF application. Thus, monitoring data available were limited for comparison and trend analysis. The succeeding sections discuss the comparison of available data (baseline in 2014-2015).

6.1.1.1 TERRESTRIAL ECOLOGY

6.1.1.1.1 BIODIVERSITY PERFORMANCE

6.1.1.1.1.1 FLORA

A decrease in number of species as compared to March 2016 EIS was recorded based on the results of 2019 flora assessment. The number of recorded endemic species and threatened species also decreased. This can be attributed to the method employed, level of effort, season and location of sampling activities and disturbances occurred in the area.

Dominant species in 2017 and 2019 flora sampling were both agroforestry species suggesting that the project area maintained the land cover with dominantly production area or agro-ecosystem.

No monitoring data of terrestrial ecology was available during the small-scale mining operations of the project.

6.1.1.1.1.2 FAUNA

A total of 52 fauna species was recorded in 2016 while only 41 species was recorded on the 2019 study. The difference in species richness can be attributed to different transects surveyed for each sampling period, drier conditions in rivers/streams in the 2019 study which limited the record of herpetofauna, and observer bias. Nevertheless, species composition in the 2016 study is almost similar with the 2019 study. Endemic and threatened species remain present on site despite the operation of the project indicating insignificant impact of the project to fauna assemblage on site.

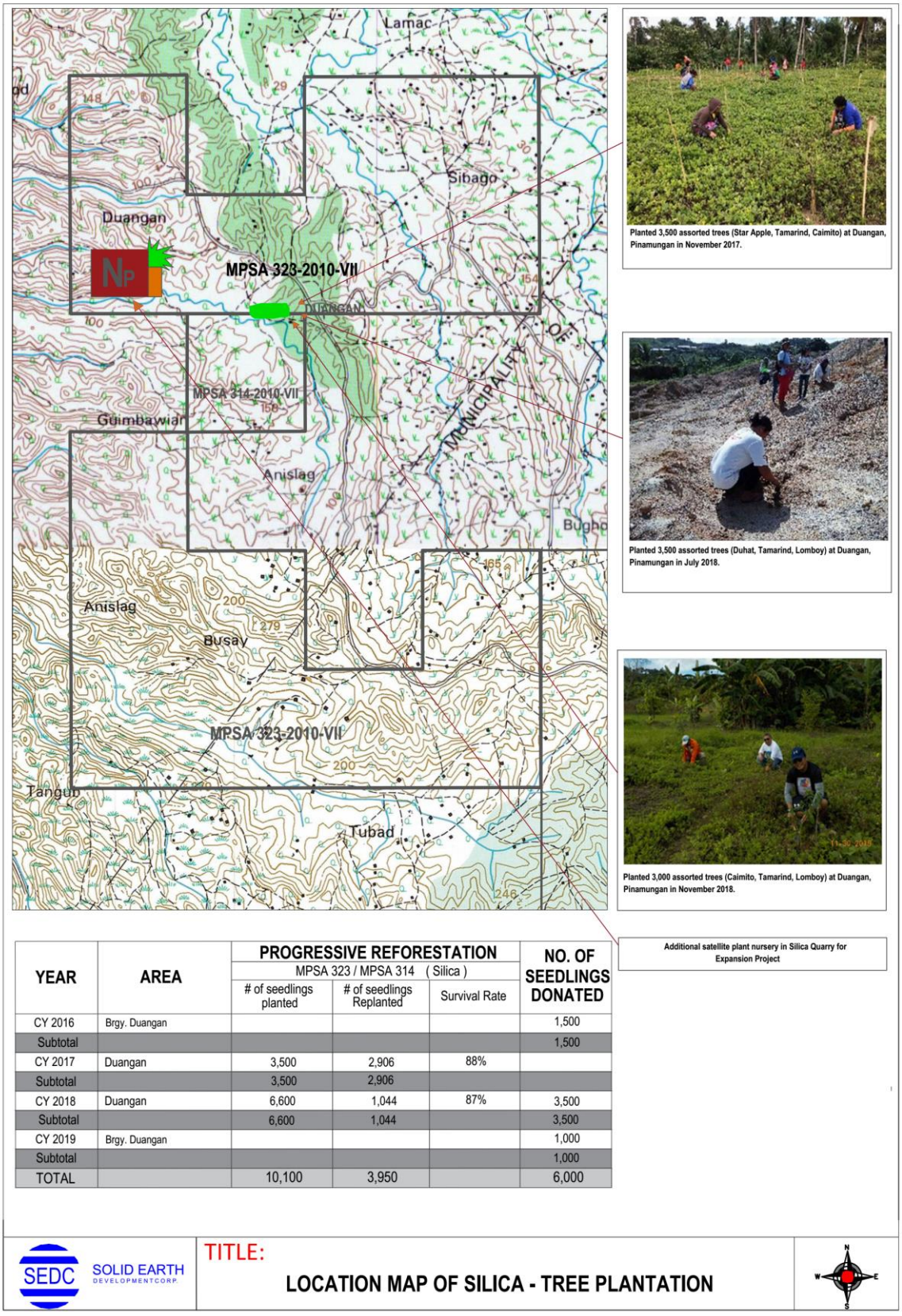
In terms of diversity, birds recorded in the 2016 study was highly diverse with an index value of 3.05 while a moderate diversity was recorded in the 2019 study with an index value of 2.94. Difference in diversity indices can be due to the abundance of several species, which outnumbers other birds during the 2019 study. In other words, bird populations are more evenly distributed during the 2016 study and/or a result of observer bias.

6.1.1.1.2 PROGRESSIVE REHABILITATION

As of November 2017, SEDC has planted 3,500 assorted trees (Star Apple, Tamarind, Caimito) at Duangan, Pinamungahan. On the other hand, 3,500 assorted trees (Duhat, Tamarind, Lomboy) were planted at Duangan, Pinamungan in July 2018 and 3,000 assorted trees (Caimito, Tamarind, Lomboy) at Duangan, Pinamungan in November 2018. Thus, since 2016, a total of 10,100 seedlings were planted by the company and 3,950 were replanted.

A total of 6,000 seedlings were donated by SEDC from 2016-2019 as part of its rehabilitation program.

A satellite nursery was established in Duangan Area that supplies the seedlings for the rehabilitation.



YEAR	AREA	PROGRESSIVE REFORESTATION MPSA 323 / MPSA 314 (Silica)			NO. OF SEEDLINGS DONATED
		# of seedlings planted	# of seedlings Replanted	Survival Rate	
CY 2016	Brgy. Duangan				1,500
Subtotal					1,500
CY 2017	Duangan	3,500	2,906	88%	
Subtotal		3,500	2,906		
CY 2018	Duangan	6,600	1,044	87%	3,500
Subtotal		6,600	1,044		3,500
CY 2019	Brgy. Duangan				1,000
Subtotal					1,000
TOTAL		10,100	3,950		6,000

SEDC SOLID EARTH DEVELOPMENT CORP.

TITLE:

LOCATION MAP OF SILICA - TREE PLANTATION

Figure 6-1. Progressive Rehabilitation conducted by SEDC 2016-2019

6.1.1.2 WATER QUALITY

6.1.1.3 GHG EMISSIONS OF THE PROJECT

The estimated GHG emissions for the current and proposed productions (quarry equipment) are 3,277.371 and 3,707.199 tons per year of CO_2e, respectively. The proposed production is projected to increase CO_2e emissions by about 11.6%.

The proponent is yet to establish a comprehensive program on GHG accounting and reduction, although there are practices that are noted to reduce GHG emissions. The proposed mitigating measures were discussed in **Section 2.3.1.5**.

6.1.1.4 AIR QUALITY

6.1.1.5 NOISE QUALITY

6.1.2 COMPLIANCE TO ECC CONDITIONS AND EMP COMMITMENT

Table 6-1. Summary Status of Project Compliance

REQUIREMENT	STATUS OF COMPLIANCE
Project coverage/limits The certificate shall cover the quarry operation with an annual production rate of 200,000 DMT of silica sand for a total of 229.5 hectares / production area. The quarry operation shall be done in surface mining and shall not include blasting.	COMPLIED - At present, the proponent's MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.
Components The project shall have the following components: quarry area, access roads, top soil stockpile area, waste material stockpile area, quarry drainage system and settling ponds.	COMPLIED - At present, the proponent's MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.
All the commitments appropriate mitigating/ enhancement measures and monitoring requirements contained in the EPRMP particularly in the EMoP shall be fully instituted to minimize any adverse impact of the project.	COMPLIED - Safety, Health and Environment Department is tasked to oversee the implementation and monitoring of all the necessary environmental and other related programs formed as based in the EMoP.
Undertake an effective and continuing Information, Education and Communication (IEC) Program to inform to all stakeholders regarding the projects' operations, EMP for greater awareness, understanding and sustained acceptance of the project.	COMPLIED - The proponent in coordination with the Brgy. officials conducts a semi - annual general assembly which is solely participated by the community.
No other activities shall be undertaken other than what was stipulated in the EPRMP document. Should	Complied - No other activities were conducted. Same as planned.

REQUIREMENT	STATUS OF COMPLIANCE
there be an expansion or modification of the Project beyond the project description or any change in the activity shall be made subject to a new EIA study.	
Transfer of ownership of this project carries the same conditions and restrictions.	No transfer of ownership took place.

Table 6-2. Summary Status of Project Compliance to ECC Conditions

REQUIREMENT	STATUS OF COMPLIANCE
All commitments, appropriate mitigating/enhancement measures and monitoring requirements contained in the EPRMP, particularly in the Environmental Management and Monitoring Plan (EMMoP), as approved by the EMB, shall be fully implemented to minimize any adverse impact of the entire project including its components, to the environment, which shall include the following: 1. The proponent shall observe appropriate mining and vegetative restoration practices, land use, soil and water management, which shall include among others: a. Proper stockpiling and disposal of materials generated from the quarry site, silt materials scooped-out from the settling ponds, and other solid nonhazardous waste in permanent, stabilized areas away from any water body and drainage systems, as well as maintained is a safe and non-polluting condition; b. Strictly effect stabilization and erosion control of all side slopes of the mining sites, settling ponds, roads and nearby gullies, creeks and rivers within the project site; c. Use the recovered topsoil for re-soiling or as soil cover on waste dumps and other disturbed areas for rehabilitation and revegetation. Temporary stockpiles shall be maintained and managed below the angle of repose; d. Provision of necessary catchment, storm drainage and diversion canals, concrete culverts, and other flood control measures to adequately receive and channel the silt-laden runoff away from natural receiving bodies of water especially during heavy	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.

REQUIREMENT	STATUS OF COMPLIANCE
rainfall	
Establish appropriate measures and buffer zones of fifteen (15) meters along the entire periphery of the project site with appropriate Species/dense vegetation cover to serve as noise, vibration and dust buffers;	The proponent recently conducted a tree growing activity at Magsico Eco – Park last June 19, 2019. A total of 2,500 seedlings were planted.
The proponent shall implement climate change initiatives including the initial reforestation of 250 hectares in 25 years to offset greenhouse gas (GHG) emissions of the Project in line with the DENR's thrust for GHG emission reduction programs, in coordination with EMB Region VII, DENR Provincial Environment and Natural Resources Office (PENRO) and/or Community Environment and Natural Resources Office (CENRO) concerned. The program shall be submitted within six (6) months from receipt hereof to EMB Central Office for approval, and implementation shall proceed one (1) month from the start of operation;	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.
Undertake effective and continuing Information, Education and Communication (IEC) Program to inform all stakeholders, especially the local residents regarding the projects' operation, Environmental Management Plan (EMP) for greater awareness, understanding and sustained acceptance of the project. The proponent shall formulate and implement a detailed IEC program within six (6) months from receipt hereof in coordination with the Mines and Geoscience Bureau Regional Office (MGB Region VII) and EMB Region VII. The program shall be submitted to EMB Central Office on an annual IEC within thirty (30) days from the start of every years' operation;	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application. However, the proponent continuously conduct an IEC annually with stakeholders and other local residents.
The proponent shall protect the natural springs that are being utilized as sources of potable and domestic water by the community. The proponent shall secure clearance from CENRO and or NWRB prior to	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.

REQUIREMENT	STATUS OF COMPLIANCE
implementation of development activities in natural springs, creeks and waterways;	
Construction of the settling ponds and other siltation control measures/facilities shall be in accordance with appropriate geotechnical engineering works	Construction of settling ponds were provided within the MPSA. Regular monitoring is conducted through SHED. Desilting of pond will be coordinated to outsource service provider.
The entire operations shall conform with the provisions of RA No. 6969 (Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990), RA No. 8749 (Philippine Clean Air Act of 1999), RA No. 9003 (Ecological Solid Waste Management Program Act of 2000), and RA No. 9275 (Philippine Clean Water Act of 2OO4)	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.
The proponent shall comply with the environmental management and protection requirements of the Philippine Mining Act of 1995 (RA No. 7942) and its Implementing Rules and Regulations (DAO 2OIO-21), and Harmonization of the Implementation of the Philippine Environmental Impact Statement System and the Philippine Mining Act of 1995 (DAO 2OI5-O21,such as, but not limited to, the following: a. Submission to the MGB Central Office for approval the Environmental Protection and Enhancement Program (EPEP),with the Final Mine Rehabilitation and/or Decommissioning Plan (FMRDP); b. Establishment of the Multipartite Monitoring Team (MMT) with representatives from the concerned Local Government Units (LGUs), NonGovernment Organization (NGOs), People's Organizations (POs) among others as members. c. Establishment of Contingent Liability and Rehabilitation Fund (CLRF) and Environmental Trust Fund (ETF) with in sixty (60) days from receipt of this Certificate. The EMB Central Office shall be furnished proof of compliance within fifteen (15) days from establishment thereof; d. Submission of a Comprehensive Social Development and Management Program (SDMP) covering the entire project within thirty (30) days from receipt of this Certificate to the MGB Central Office for approval, copy furnished the EMB Central Office and EMB Region VII; e. Creation of a Mine	The existing Multipartite Monitoring Team (MMT) for the SEDC Limestone Project includes the inspection of the Silica Sand Mining Project during the quarterly monitoring by the MMT members.

REQUIREMENT	STATUS OF COMPLIANCE
Environmental Protection and Enhancement office (MEPEO) within thirty (30) days from receipt hereof, which shall competently handle all environment-related aspects of the project. In addition to the compliance monitoring requirements as specified in the EMMoP, the MEPEO shall also monitor the actual project impacts vis-avis the predicted impacts and management measures stated in the EPRMP and submit Compliance Monitoring Reports (CMR)to EMB Central Office among others in accordance with the format prescribed under the Implementing Rules and Regulations(IRR)of the Philippine Environmental Impact Statement System(PEISS);	
The proponent shall ensure that its contractors and sub-contractors strictly comply with the relevant conditions of this Certificate;	Representative from each contractors and sub-contractor are members of SEDC Central Safety, Health and Environment Committee Meeting.
The quarry operation shall be done by surface mining and shall not include blasting	No blasting activity shall be conducted as part of the mining operations.
Secure endorsement approval of concerned Sanggunian prior to project implementation pursuant to the provisions of Section 27 of the Local Government Code. Proof of which shall be submitted to EMB Central Office within sixty (60) days after issuance thereof by said the concerned Sanggunian.	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application.
No other activities shall be undertaken other than what was stipulated in the EPRMP document. Should there be an expansion or modification of the Project beyond the project description or any change in the activity shall be made subject to a new EIA study; and	MPSA 314-2010-VII and MPSA 323-2010-VII is under Pre-development stage. On-going DMPF application. The proposed expansion is being covered by this ECC amendment application.
Transfer of ownership of this project carries the same conditions and restrictions, for which, written notification shall be made by herein grantee to EMB within fifteen (15) days from such transfer.	No transfer of ownership.

6.2 ENVIRONMENTAL MONITORING PLAN

Table 6-2. Environmental Monitoring Plan of SEDC Silica Sand Quarry Expansion Project

Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
								EPQL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Operation Phase													
Extraction	Land	Landform and soil management	Site inspection	Quarterly	Quarry area	PCO	10,000	Quarry land form as per approved plan			Deviation from approved plan needs to be justified		
	Deterioration of Surface Water	TSS O&G	Grab sampling	Quarterly	WQ1 WQ2	PCO	35,000	72 mg/L for TSS 4 mg/L for O&G 71 mg/L for TSS 4 mg/L for O&G (rainy season values, or +40mg/L over non-impact waterways)	81 mg/L for TSS mg/L for 0& 80 mg/L for TSS mg/L for 0& (rainy season values, or +560mg/L over nonimpact waterways)	90mg/L for TSS 5 mg/L for O&G 89mg/L for TSS 5 mg/L for O&G (rainy season values, or +60mg/L over non-impact waterways)	Identification of sources of sediments/ silt and other pollutants such as O&G; Check if cross-drains are installed and adequate for peak storm Institute O&G audit and waste management monitoring	Reconfigure drainage to ensure runoff drains toward settling ponds Provide cutoff channel if necessary, as bypass for Background run-off; Only quarry equipment will be maintained at quarry site	Increase dimensions of contour canals, drainage canals and settling ponds. Install gabion check dams
	Flooding and water ponding	Location of, and construction of silt ponds cum storm water detention and water reservoir ponds	Site inspection	Quarterly	Quarry site	PCO	10,000	Ponding area is >40m wide	Ponding area has depth >1m or >45 m2	Ponding area has depth >1m or >50m2	Backfill depressed area	Properly size contour canals to contribute to storm water detention; Provide contour canals with stone heaps d also decelerate storm drain velocity.	Provide drainage course toward settling pond, add to capacity of rain harvesting / water detention basins
	Safety record and accident occurrence	Safety record, Accident/ fatality	Record keeping	Daily	quarry site	Safety Officer	10,000	Lost time due to minor injury	Occurrence of major injury due to	Occurrence of fatality due to accident	Conduct regular safety briefing and	Conduct daily inspection of construction	Construction stoppage and conduct

Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
								EPQL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		incidence/ occurrence							accident		orientation to laborers and workers Installation of safety signage along accident prone areas within the construction site	area Conduct daily briefing on safety program	of investigation
	Increase noise level	Noise level (dBA)	Noise Meter	Monthly	At populated area along roadside near quarry	PCO	20,000	55 dBA morning and daytime	Limit work between 7am to 6pm	40 dBA nighttime	Strictly impose noise standard if work needs to extend to night time	Equipment maintenance, adjustment, installation of noise reduction apparatus such as sound deadening sheets on noise source engines, engines or	No night time operations
Extraction and Hauling	Air pollution	Total Suspended Particulates (TSP) and PM10	1-hour and 24-hours Ambient air quality sampling	Quarterly	At Locations to be identified by MMT, expected to progressively change according to location of active quarry areas.	PCO	400,000	260µg/Ncm TSP, (lhr sampling) 200µg/Ncm TSP 130 µg/Ncm PM10 (24hr sampling)	280µg/Ncm TSP (lhr sampling) 210µg/I\lcm TSP 130 µg/Ncm PM10 (24hr sampling)	300 µ/Ncm TSP 230 µg/Ncm TSP 150 µg/Ncm PM10 from 24hr sampling 90 µg/Ncm TSP 60 µg/Ncm PMio 1 yr. average	Seed siltation ponds with algae to develop microbiotic filaments in water for spraying, for soil crusting. Monitor road watering is done daily in dry season Mandatory maintenance of all equipment engines - check unrestricted airflow, engine	Water the dusty areas until dust resuspension is controlled as per visual observation. Measure water usage per m2 road area and count daily frequency of road watering until dust is controlled	Apply flocculants for dust suppression

Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling & Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
								EPQL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
											injection timing, injection timing, reduce flow of exhaust gas recirculation devices, check performance of fuel oxidation catalyst, check engine compression pressures and if necessary calibrate injection pumps.		
	Air Quality	Carbon sequestration- Number of trees planted Number of trees maintained Number of trees surviving	GPS tagging of plantation, regular site inspection, Record keeping by photograph per block basis	Quarterly	Inspection in buffer zone	PCO	10,000	10% less than target trees surviving	15% less than target trees surviving	20% less than target trees surviving	Review seedling propagation and nursery maintenance procedure for correct practices and adequate water supply	If nursery operations are acceptable, increase nursery and tree planting activities to factor-in mortality rate and result to target # trees surviving and thriving	Conduct reforestation program audit
	Social Development Projects	Progress against plan, learnings, resolution of issues	Document review, participatory Project Benefit Monitoring and Evaluation	Annual	With leaders from partner barangays	MEPEO	100,000	100% on target disbursement, 30% below target social satisfaction rating	100% on target disbursement, 40% below target social satisfaction rating	100% on target disbursement, 50% below target social satisfaction rating	Conduct community consultation for program improvement	Review internal SDMP disbursement and utilization guidelines, and actual implementation experience	Conduct SDMP audit

6.3 MULTI-SECTORAL MONITORING FRAMEWORK

As provided in DAO 2003-30, a Multipartite Monitoring Team (MMT) will be organized to regularly monitor the activities stipulated in the approved EMP and conditions set in the ECC. The MMT for this project shall be composed of the different stakeholders to include but not limited to the following:

- Representative from the MGB Regional Office No. VII
- Representative from the DENR Regional Office No. VII
- Representative from the Proponent
- Representative from the affected communities (Barangay and Municipal LGU)
- Representative from the concerned NGOs operating in the area

MMT Member	MMT Role	Responsibilities / Activities
MGB Regional Office No. VII	Chairman	• Team leadership to monitor the Proponent's compliance with the EPEP. • Strengthening of monitoring, analytical, and reporting capabilities of the Team. • Resolution of any conflicts and issues within the Team. • Management of the Monitoring Trust Fund. • Reporting of MMT activities and accomplishments to the MRF Committee
DENR Regional Office No. VII	Member	• Ensure compliances to environmental laws, rules, and regulations • Provides information necessary for compliances with environmental requirements and commitments • Preparation and review of MMT reports
SEDC	Member	• Provision of monitoring budget to the MMT • Provides information necessary for compliances with environmental requirements and commitments • Coordination with MMT members • Preparation and review of MMT reports
Municipal ENRO	Member	• Participation in actual monitoring activities • Provision of information to the MMT about the environmental and socio-economic conditions as well as issues, problems, and suggestions of the stakeholders • Preparation and review of MMT reports
Barangay Local Government	Member	• Participation in actual monitoring activities • Provision of information to the MMT about the environmental and socio-economic conditions as well as issues, problems, and suggestions of the stakeholders • Preparation and review of MMT reports
Representative of People's Organization (POs)	Member	• Participation in actual monitoring activities • Provision of information on policies, plans, and programs of the POs particularly to affected areas of the Project • Advice to MMT of any complaints, issues, and recommendations concerning the project • Preparation and review of MMT reports

6.4 Environmental Guarantee and Monitoring Fund Commitments

The Philippine Mining Act (1995 and its IRR) requires for the establishment of the Contingent Liability and Rehabilitation Fund (CLRF) which is the financial mechanism for the multi-partite monitoring, progressive mine rehabilitation and compensation for claims and damages. The CLRF ensures just and timely compensation for damages and progressive and sustainable rehabilitation for any adverse effect a mining operation or related activity may cause. The CLRF is broken-down in three (3) forms such as the Mine Rehabilitation Fund (MRF), Mine Wastes and Tailings Fund (MWTF), and Final Mine Rehabilitation and Decommissioning Plan (FMRDP).

The MRF is established and maintained by each operating mine as sufficient environmental deposit to ensure the availability of funds for the satisfactory compliance and implementation of its Environmental Protection and Enhancement Program (EPEP). The MRF is utilized for the regular monitoring of mining operations, physical rehabilitation of mining affected areas and research on the technical and preventive aspects of rehabilitation. The MRF is further broken down into:

- Monitoring Trust Fund (MTF) - This fund shall be exclusively used in the monitoring program approved by the MRF Committee. It shall be in cash and in an amount to be determined by the MRF Committee, which shall not be less than the amount of ONE HUNDRED FIFTY THOUSAND PESOS (Php 150,000.00). Replenishment of this amount shall be done quarterly to correspond to the expenses incurred by the monitoring team for the quarter.
- Rehabilitation Cash Fund (RCF) - This fund shall be set up for a designated amount to ensure compliance with the approved rehabilitation activities and schedules for specific mining project phase including research programs as defined in the EPEP/AEPEP. The RCF shall be equivalent to percent (10%) of the approved total amount needed to implement EPEP. In the event of withdrawals from the RCF, the SEDC shall annually replenish the RCF so as to maintain the minimum required amount thereof.
- Mine Waste Fees (MWF) – The company shall diligently comply with the remittance to the MGB of its Mine Waste Fees (MWF) based on its sworn semiannual report on the amount of waste it produces, disposed, contained, and/or utilized. The amount of MWF collected shall accrue to the Mine Waste and Tailings (MWT) Reserve Fund to be used for payment for compensation for damages caused by mining pollution.
- Environmental Trust Fund (ETF) – The company shall put up an ETF in the form of Insurance Policy amounting to Php 500,000.00 and in cash amounting to Php 100,000.00 to ensure payment of compensable damages, as may be adjudicated by the CLRF Steering Committee to be not compensable under the MWT Reserve Fund.

The FMRDF is established by each operating mining company to ensure the implementation of the approved Final Mine Rehabilitation and Decommissioning Plan. The FMRDF is accrued before the end of the operating life of the mine and is deposited in a Government depository bank for the sole purpose of FMR/DP implementation.

7 ABANDONMENT AND DECOMMISSIONING / REHABILITATION POLICY

The environmental conditions that the Proponent intends to achieve in the quarry area upon abandonment of quarry operations and quarry decommissioning stage include but not limited to the following:

1. Stable contoured, terraced and benched slopes, with low or almost no land slide potential Slope faces will be planted with appropriate vegetation for slope stability
2. Area will have proper drainage design that prevents area flooding, ponding or inundation
3. With properly situated storm run-off detention basins to prevent flashfloods in downstream areas. These may serve local irrigation purposes as needed in the locality.
4. Top slopes that may have value as storm wind breaker will not be lowered or altered, but densely planted with trees to serve ambient micro atmospheric temperature buffer
5. Where possible such in the surrounding benched and terraced slopes at the perimeter of the flat final pit, agroforestry activities may be promoted with the cooperation of the local community, for local food production and tree maintenance. Tree species are expected to have economic value to be cared-for into perpetuity by local partner communities.

The Final Mine Rehabilitation and Decommissioning Plan (FMRDP) is already prepared but still under consultation; and shall take guidance from the policies that will be given in the project ECC. The subsequent sections shall compose the FMRDP of the Silica Sand Quarry Expansion Project.

7.1 SITE MANAGEMENT PLAN

The management of the site refers to the management of the rehabilitated area. The management will be done by the management of Solid Earth Development Corp. or its assignee. There shall be an office in the field which will be called Mine Environmental Rehabilitation Office or MERO which will be headed by a Mine Environmental Rehabilitation Officer (MERO). The primary function of the MERO is to see to it that all plans and programs related to the approved FMRDP will be implemented efficiently and effectively.

Under the MERO will be three staff with the following functions:

1. IEC / COMREL Officer;
2. MEPEO / Monitoring Section; and
3. SAFETY Officer

Depending upon the scope, magnitude and necessity of the works, each section shall have at most three pick up laborer.

In the Management of the site, the MERO will also be responsible for the following:

- Ensure the success of the reforestation;
- See to it that no illegal cutting be done in the rehabilitated area;
- Make sure that illegal entry is avoided; and
- Recommend to the SEDC Top Management (or its assignee) any activities that will improve the rehabilitation and management of the site.

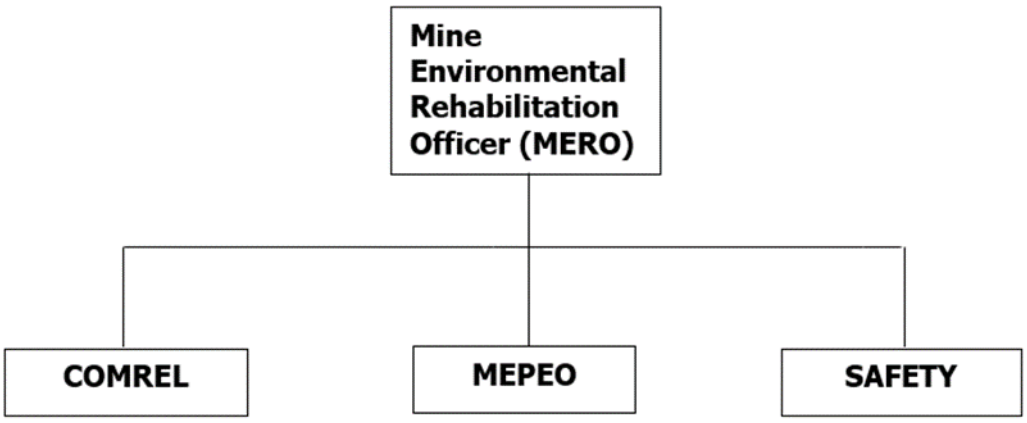


Figure 7-1. Organizational Arrangement of MERO

The table below details the responsibilities of the Mine Environmental Rehabilitation Office:

Table 7-1. Roles and Responsibilities of MERO

Department	Roles and Responsibilities
MERO	• Will act as the over-all overseer or manager of the mine rehabilitation activities. • He should see to it that the planned and approved programs are implemented effectively. • Harmonize the functions of the three (3) sections under him; the IEC/COMREL, Tree Planting and Maintenance Crew; and the Safety and Monitoring • Report to the Board of Directors of SEDC regarding the progress of the Rehabilitation. • Act as the representative of SEDC in transacting with different government agencies. • Request for amendment of the approved plans if he finds of any approved activity irrelevant. • See to it that the funds are appropriately disbursed.
COMREL	• This section will be responsible for informing the public on what is happening in the rehabilitation activities. • This section will also see to it that the community's concerns are addressed properly. • Report to the MERO of any suggestions, complaints or observations made by the neighbors and other relevant stakeholders. • Constantly conduct stakeholders' analysis (as the need arises) • In the absence of the MERO the COMREL may represent the company especially in representation to the LGU and NGO.
MEPEO	• This is responsible of the tree planting component of the rehabilitation.

Department	Roles and Responsibilities
	• Conduct regular inspection of the planted trees and immediately do re planting if necessary. • Recommend to the MERO appropriate interventions to ensure the high survival of the tree plantation
Safety	• This will be responsible for monitoring of the working crew and ensure the safety of every worker. • Recommend policy or directives to the MERO for issuance of a memorandum so that the workers will be protected and safe. • Monitor all areas and report to the maintenance crew any hazardous condition.

7.2 Final Land Use of Site and for Each Identified Mine Concept

The final land use of the site and each identified Mine Component is to convert the mined-out area into an agroforestry and crop plantation. The Mine Components that will be replanting and subject for agro forestry and crop plantation include the following:

- Quarry Loading Area
- Waste Dump Area
- Hauling Roads
- Silt Ponds
- Quarry Field Office
- Quarry Periphery
- Benches
- Creeks and natural water ways

This intended final land use suits well to the physical characteristics of the affected land. For the tree planting, a planting hole will be made and filled which mounded up to the root collar with a soil media (a mixture of 50% topsoil, 30% sand and 20% organic fertilizer).

The proponent will turn-over the use of the properties to the lot owners for their agricultural projects or for whatever plans of the local government relating to farming or agriculture. To this end and prior to said turn-over, the proponent shall prepare the area suitable and conducive to such agricultural purposes or use by the lot owners, or community later.

7.3 Mine Closure Criteria and Performance Standards

The mine closure criteria presented are specific to the project component being rehabilitated or closed. These criteria are a set rehabilitation indicator which, upon being met, will demonstrate successful rehabilitation of a site. The re-vegetation of the forty (40) hectares mined out quarry project area will be the final criteria. The survival rate of the plants used for plantation will dictate the performance standards. Rehabilitation Indicators provides a basis for monitoring and reviewing the effectiveness of the system. It also helps identify activities that need corrective action and improvement. Typical Indicators are the following:

1. **Surface and Groundwater Indicators:**

Typically, criteria or standards are applied to surface and groundwater quality whereby water being discharged, or at some compliance point within the receiving rivers, must be of a quality equal to or better than a defined chemistry. Such standards are threshold indicators in a scalar value of concentrations. Because of total assimilative load limitations for receiving rivers, the permissible discharges are sometimes specified as loads and not as concentrations. Other indicators include seep coloration, odor and taste.

2. Stability and Erosion Indicators

Indicators and criteria are also typically applied to ensure the integrity and long-term stability of structures. Typically, civil engineering safety standards (such as a factor of safety of 1.5 for slope stability) will be applied during the operating life of the mine. Durability of structure is dependent on the durability of the materials the structure relies upon for stability. Structures are under the continual attack of both perpetual forces such as weathering and corrosion, erosion by wing and water, sedimentation, biotic action by roots and burrowing animals and frost action.

3. Land Use and Socio-economic Indicators

The post mining land use and socio-economic impacts are extremely important issues for consideration in closure planning. Mine site development is often responsible for significant changes in the local social and economic conditions in an area. To the extent reasonably achievable, mine closure must address the facilities and conditions that should be maintained post mining, to sustain the social and economic benefits generated during mining. While it is not possible to select closure criteria for all these issues, comparative assessments using indicators such as maintenance of access and power and on-going protection of health and safety should be completed.

7.4 Details of the Decommissioning Plan

7.4.1 List of Areas and Equipment that Require Decommissioning

Only heavy equipment and quarry machineries including the equipment repair shop are due for decommissioning after the life of MPSA. Other mine components will be retained and maintained like Silt Ponds and Field Office. However, the decommissioning of heavy equipment is at the expense of the Quarry Contractor and at no cost to SEDC.

Below is the list of equipment that requires decommissioning:

Name of Equipment	No. of Units
Backhoe	2
Payloader	1
Dump Truck	10
Road Grader	1
Water Truck	1

7.4.2 Decommissioning Strategy

The following will be the decommissioning strategy:

A. Inventory of all equipment and facilities for decommissioning;
   The MEPEO together with the personnel of the quarry will do the actual inventory or simple counting of the equipment and facilities.
B. Assessment of the conditions of equipment and facilities;

The assessment of all the equipment and facilities present in the quarry area will involve checking the conditions of the engine and major parts of the equipment. The equipment that is in good condition may immediately be removed from the site. Those that are not in running condition will be further evaluated and planning for the removal of such will be done, perhaps with the use of trailers.

C. Planning and review of decommissioning procedure vis-à-vis the standard operating procedures. Coordination with equipment/ facilities supplier. Consultation with stakeholders thru the MRFC; This is an office activity just to make sure that safety is always adhered to in conducting the demolition of building (if there will be any). If there is a need to move dilapidated vehicle or equipment, proper procedure should be reviewed. The output of this activity will be a memorandum to be issued by the resident manager outlining the safety procedure of demolition. As of the moment, it is difficult to draft the memorandum because this will be dependent on the result of the assessment.

D. Identification of personnel requirement and qualification required to implement the decommissioning. Cross matching with company employees and qualified residents within the host community; This is also the job of the human resources department or personnel. The existing employees (during the final year of the operation) will be evaluated according to their expertise. Those that will qualify for the jobs during the rehabilitation and demolition will be retained while those that will not will have to avail the retrenchment package.

E. Briefing and training (when necessary) of the selected personnel;

After the HRD had chosen the personnel to be retained, the safety department will be conducting the safety training of these employees. The training will involve proper handling of materials and equipment, proper positioning when lifting, use of right PPE at the right time, place and activity, use of fire extinguishers, first aid, proper lifting of patient, and many more.

F. Decommissioning of equipment and facilities under the supervision of the MEPEO. Among the activities involved are the removal of non-essential fixed equipment and facilities, demolishing and non-essential facilities, etc.; After the personnel had undergone training and the necessary protocol or plan for the decommissioning had taken place, the next activity will be the implementation of the decommissioning. Decommissioning of the fixed structures will require close supervision of the safety men/officer. All safety rules and regulation applicable to the kind of activity during that time will be implemented.

G. Post assessment of the decommissioned equipment, facilities and areas;

After the fixed facilities, mobile equipment and every improvement in the quarry had been removed/decommissioned, the next activity will be the final evaluation by the top management of the final scenario. This will involve actual inspection and decision on the commencement of the rehabilitation. If there are things that need to be done prior to the actual rehabilitation or tree planting, then the top management will formulate the procedure to fully attain the condition of the area that will be suitable for rehabilitation.

H. Issuance of clearance for rehabilitation of the areas affected by the decommissioned equipment/facility by the MEPEO. This is the result of the evaluation mentioned above. This is the final declaration that the area is safe for rehabilitation. A memorandum signed by the top management will serve as go signal of the rehabilitation.

Table 7-2. Summary Matrix of Decommissioning Strategy

ACTIVITY	Environmental IMPACTS	MITIGATING MEASURES	INSTITUTIONAL ARRANGEMENT
1. Inventory	None	None	This will be purely ocular inspection
2. Assessment of equipment & Structures in the quarry	None	None	This is purely ocular inspection.
3. Review and formulation of applicable procedures	None	None	This is purely office work
4.Personnel Selection	None	None	This is purely office work.
5. Training	None	None	The training will be held in the office.
6. Actual Decommissioning	Generation of Wastes	-Proper collection of wastes materials.	The activity should conform to the formulated safety protocol/procedures.
7. Post-decommissioning assessment	none	None	This is an ocular verification/inspection of the site.
8. Issuance of Clearance	none	None	This is purely paperwork.

Demobilization safety will be implemented such as:

A. Trucks will be used to haul or transport equipment and quarry machineries from the Quarry to the Plant.
B. Heavy items will be loaded by Backhoe and will be tightened by binders for them not to move while traveling. Unloading will be done by a crane at plant site.
C. In case of very heavy load (like Backhoe), service vehicle will be provided ahead of the truck, equipped with two-way radio in order to warn the driver about the situation ahead; and
D. Safety Rules and Regulations will be implemented specially Chapter XX, Section 72 of DENR DAO No. 2000-98 and all the safety measures during the duration of mobilization.

The Mine Components subject for Decommissioning are the following:

1. Quarry Benches: Quarry Benches are narrow, strip of land cut into the side of an open-cut mine. These step-like zones are created along the walls for access and mining. During decommissioning, the quarry bottom will be stabilized and re-contour the slope outside or below final bench floor to avoid erosion or soil movement to ensure public safety and environmentally stable condition compatible with surrounding environment.
2. Silting Ponds: Silting Ponds are earthen structure using sedimentation to remove settleable matter and turbidity from wastewater. The basins are used to control water pollution. During decommissioning, the silt ponds will be filled with topsoil in preparation for reforestation.
3. Equipment and Machineries: Majority of heavy equipment involved in quarrying are mobile equipment such as backhoe, payloader, bulldozer, dump trucks, grader and water trucks.

During decommissioning, this equipment will be demobilized and transport them to the motor pool.

7.4.3 Decommissioning and Rehabilitation of Quarry Areas

A. Objectives
- To stabilize quarry bottom
- To re-contour slope outside or below final bench floor to avoid erosion or soil movement and siltation;
- To ensure public health and safety; and
- To ensure environmentally stable condition compatible with surrounding environment.

B. Decommissioning and Rehabilitation Strategy
- Reinforcement of Quarry area edges;
- Re-vegetation and tree planting along the mined out quarry area;
- Application of Geotechnical reinforcement technique if needed or required;
- Planting of Leguminous shrubs species to further enhance the slopes;
- Monitoring and maintenance of planted trees.

C. Active / Passive Care
- Continuous tree planting/ mortality replacement activities;
- Constant monitoring and inspection of protective fences;
- Monitoring of high wall for any movement or irregularities.
- Discouraging firewood gatherers and illegal settlers; and
- Employing local personnel to maintain, monitor and guard the area.

D. Criteria for Measuring Objectives
- Photo-documentation starting from the implementation period and yearly comparison, taken from a fixed point;
- Survival rate of planted trees; and
- Incidence of erosion along floor slopes.

7.4.4 Decommissioning of Various Heavy Equipment, Quarry Machineries, and Structures

Majority of heavy equipment involved in Quarrying are mobile equipment such as backhoe, payloader, bulldozer, dump trucks, grader and water trucks. Structures were also constructed like satellite field office and guard house. These structures have no electrical installations.

A. Objective of Decommissioning
- To ensure that the area is free from machineries and equipment;
- To clear the area from unwanted tools, equipment and waste materials

B. Decommissioning and rehabilitation Strategy
- Demobilize equipment, machineries and waste materials by loading them into trucks and transport them to the plant;
- Remove all unwanted tools, equipment and waste materials by loading these into trucks and transport them to the plant; and
- Rehabilitate the area as planned.

C. Active / Passive Care

- Re-vegetate the area previously erected with structures;
- Continued maintenance of planted trees to ensure high survival rate, and replacement of some, if needed; and
- Maintain personnel to monitor, care and guard the area

D. Criteria for Measuring Against Objective

- Pictures from a fixed point taken before and after demobilization;
- Survival of planted species

7.5 DETAIL OF FINAL MINE REHABILITATION

The Final Mine Rehabilitation Plan identifies the activities and research required to address on-going rehabilitation and include strategies to address long-term stability and sustainability and timeframes for the assessment of rehabilitation activities. The activities to be undertaken during rehabilitation are divided into three phases, namely;

I. Pre-implementation Phase:

a. Surface preparation through site clearing, leveling and stabilizing the mined-out areas.

b. Planting hole excavation and spreading of soil mix media (a mixture of 50% topsoil, 30% sand, and 20% fertilizer) at the mining floor for grass plantation and tree planting.

c. Road network provisions with drainage system.

II. Implementation Phase:

a. Tree and Fruit Plantation by random planting

i. Madre de Cacao – 5m x 5m spacing

ii. Mahogany – 4m x 4m spacing

iii. Narra – 5m x 5m spacing

iv. Jackfruit – 5m x 5m spacing

v. Mango – 10m x 10m spacing

b. Shrubs

i. Banana – 5m x 5m spacing

c. Grass and Vines Plantation by random planting

i. Bamboo – 10m x 10m spacing

d. Employing local personnel to maintain, monitor and guard the area.

III. Evaluation Phase:

a. Continuous planting/mortality replacement activities

b. Constant monitoring and inspection of re-vegetated area.

c. Monitoring of high wall for any movement or irregularities.

7.5.1 REHABILITATION STRATEGY, SCHEDULE AND TECHNIQUES

To ensure the success of rehabilitation, the area will be cleared of loose rocks, structures and non-biodegradable materials detrimental to plant growth. The final land configuration will incorporate road network to make as many areas accessible as possible with provisions for drainage system. Below are the other activities to be undertaken:

- Continuous planting/ mortality replacement activities;
- Constant monitoring and inspection of re-vegetated area;
- Monitoring of high wall for any movement or irregularities;
- Discouraging firewood gatherers and illegal, settlers; and
- Employing local personnel to maintain monitor and guard the area.

7.5.1.1 CRITERIA FOR MEASURING OBJECTIVES

Below are the criteria for measuring the objectives:

- Photo-documentation starting from the implementation period and yearly comparison, taken from a fixed point;
- Survival rate of plants ; and
- Incident of erosion along floor slopes.

7.5.1.2 DETAILS OF MATERIALS, OPERATIONAL, AND FINANCIAL RESOURCES REQUIRED

7.5.1.2.1 BACKFILLING MATERIALS

The materials to be used for backfilling will be sourced from the top soil stripped during mining operations and stockpiled at designated areas. The total volume of topsoil needed for reforestation is computed below:

1. Tree Holes backfilling: For the tree plantation, a hole will be excavated and backfilled which will be mounded up the root collar with a mixture of 50% topsoil, 30% sand and 20% organic fertilizer.
    a. 14,650 holes x 0.10 cu.m. x 0.50 = 732 cu.m.

7.5.1.2.2 SAND

Sand will be sourced from the desilted materials at Silting Ponds. The total requirement is computed below:

a. 14,650 holes x 0.10 cu.m. x 0.30 = 440 cu.m.

7.5.1.2.3 ORGANIC FERTILIZER

The organic fertilizer will be sourced from the poultry farm in San Fernando, Cebu. The application of organic fertilizer will be done at every plant at a ratio of 20% per hole or equivalent to 293 cu.m.

7.5.1.2.4 SEEDLINGS

The seedlings to be used for progressive rehabilitation will be sourced from the plant nursery to be constructed in Duangan, Pinamungajan, Cebu about two (2) km away from the siliceous sand quarry. However, since the tree planting will start as soon as the quarry operation started and the nursery plant is not yet available, then all seedlings will be taken first from the company-owned plant nursery situated in Magsico, San Fernando, Cebu twenty one (21) km away from the project.

Size of Nursery : 20m x 30m = 600 sq. m.
Capacity : 50,000 seedlings
Infrastructure : Nursery Building and Water Reservoir

Below, are the tabulated species for tree planting with corresponding planting design, plantation area, and number of seedlings to be planted:

Table 7-3. Seedlings used for Progressive Rehabilitation

Species	Spacing (m)	Plantation area (has.)	No. of Seedlings
Endemic Trees			
Madre de Cacao	5 x 5	3	1,200
Timber Trees			
Mahogany	4 x 4	5	3,125
Narra	5 x 5	5	2,000
Fruit Trees			
Jackfruit	5 x 5	10	4,000
Mango	10 x 10	10	1,000
Shrubs			
Banana	4 x 4	5	3,125
Grasses			
Bamboo	10 x 10	2	200
TOTAL		**40**	**14,650**

7.5.1.2.5 MANPOWER

The tree planting activities will be participated by the local residents including the barangay officials of the direct impact barangays particularly barangay Duangan of the Municipality of Pinamungajan.

7.5.1.2.6 EQUIPMENT

The equipment used during quarrying like off road dump truck, dozers, loaders will be utilized for rehabilitation.

7.5.1.2.7 FINANCIAL

The financial requirements of the rehabilitation will be provided by the company through the Final Mine Rehabilitation and Decommissioning Fund.

7.5.1.2.8 DETAILS OF MONITORING PROGRAM

The Mine Rehabilitation Fund Committee (MRFC) through the Multi-partite Monitoring Team (MMT) shall monitor the implementation of the FMR/DP. The contingent Liability Rehabilitation Fund Steering Committee and/or the Mines and Geosciences Bureau (MGB) will audit the implementation of the FMR/DP. An in-house monitoring headed by the MEPEO will be likewise implemented. Significant Impacts to be monitored are the following:

a. Area disturbed by Quarrying Operations
b. Drainage System
c. Water Quality
d. Area Rehabilitated by Reforestation

Table 7-4 presents the parameters to be monitored, methodology, frequency and who will monitor the mine components and impacts during the rehabilitation and decommissioning stage of the project:

Table 7-4. Environmental Impacts to be Monitored

MINE COMPONENTS	PARAMETERS TO BE MONITORED	METHODOLOGY	FREQUENCY	MONITORED BY:
Quarry Benches	Bench slope, Bench height, Bench width	Measured using survey instruments and working map.	Monthly/ Quarterly	MEPEO/ MMT
Canals & Silting Ponds	Silt level	Ocular Inspection	Monthly/ Quarterly	MEPEO/ MMT
Effluent	pH, TSS, Oil & Grease	Water samples will be taken on the point of discharge as agreed by MMT.	Monthly/ Quarterly	MEPEO/ MMT
Growth of Trees	Height of Trees	Actual measurement using meter stick	Monthly/ Quarterly	MEPEO/ MMT

The sampling point will be at the silt pond discharge leading to the river. TSS, pH, Oil and Grease are also included in water analysis.

7.6 After Closure Social Plan

Typically, mine closure means a drop in the standard of living for the local community, and the nearby localities. Thus, it is important to plan prior to the mine closure. The positive social legacies that are left behind by the company include the skills development and training programs. The company's social plan is focused mainly on its employees and the host communities. Part of the company's social responsibility is to promote information, education and communication (IEC) to the residents of the eight (8) impact barangays and proper information will be given to the affected contracted service provider. One year, prior to the mine closure, SEDC will start implementing the activities stipulated in this social plan.

The company's 5-Year Social Development Management Program (which is renewable for every five years) is also being considered as the preparatory move towards the betterment of the community and in preparation to the future closure of the mining company, particularly, for the affected communities. Programs like, scholarship grants (better education would help decrease poverty in the area), infrastructures, livelihood programs – goat-raising, loom-weaving, fishing, etc.

Table 7-5. Summary Matrix of the Social Plan before Closure

Month	Description of activity	Objective	Responsibility	Expected Output
1st Mo.	1. Presentation of IEC Program to SEDC Management 2. Consultation / Meeting with the Barangay	1. To inform the Management of the IEC Program and seek their approval.	1. Anchor Group 2. Company's Representative, MEPEO/ CRO and	1. Approved Plan and Budget of the Program 2. The Barangay Heads will have a clear understanding for the

Month	Description of activity	Objective	Responsibility	Expected Output
	Chairpersons of the affected Barangays 3. General Assembly/Forum with the employees 4. Assessment and counseling with the employees 5. Inform the Contractor who provide services to SEDC. 6. Communicate with the Government Agencies concerned, thru personal visit or by sending a formal letter.	2. To properly inform the Heads of the impact barangays in relation to the mine closure. 3. To inform well the employees of the company's mine closure and to have an effective discussion between the company's management and its employees. 4. To include discussion pertaining to the Retirement Plan and the Retrenchment package. 5. To let the Contractor aware of SEDC's plan for the stoppage of its operation. 6. To inform the Government Agencies concerned with mining activities, e.g. DENR, Local government units, DOLE, etc.	the Barangay Chairpersons 3. Company's Top Management and all employees 4. Top management, HRD and all employees 5. Company's Representative / MEPEO / CRO 6. Company's Representative / MEPEO / CRO	company's mine closure. 3. Company's employees are made aware of the mine closure, and the Top management is aware of the needs of its employees. Discussion by both parties is effective, in a win-win situation. 4. Employees have a clear understanding on the company's Retirement Plan and the Retrenchment package. 5. Contractor would be ready for the mine closure of SEDC. 6. Company management has a clear understanding on the statutory and regulatory laws and policies, for effective implementation.
2nd Mo.	Consultation/ Forum with the Barangay Council	To be able to determine, synthesize and	Company's Representatives, MEPEO / CRO,	Barangay Council Members and BCO's are made aware of the

Month	Description of activity	Objective	Responsibility	Expected Output
	Members and the Barangay Community Officers	formulate possible recommendations on the issues that will be raised by the group.	Barangay Council Members and Barangay Community Officers	mine closure, and recommendations on the issues raised are formulated.
3rd, 4th and 5th months	1. Conduct survey using structured questions that are derived from the workshop with the Barangay Officials 2. Implement skills development programs to employees, thru trainings, that would be beneficial to the employees and would create a re-employment or livelihood	1. To gather information from the residents within the affected barangays 2. To train the employees in preparation to the closure of mine. To teach / train employees for any possible livelihood programs	MEPEO / CRO TESDA, Training Institution, MEPEO/ CRO	Factual information is gathered. Employees are prepared and would have diversities in earning for a living. Employees will either find a new job, or start to implement its livelihood projects.
6th Mo.	1. Analysis of the survey results 2. Continue implementing the Training / skills devt. Programs	1. To analyze the results of surveys 2. To continuously implement the learning process.	MEPEO and CRO TESDA, Training Institution, MEPEO/ CRO	Accurate information is being gathered and effective solutions will be formulated Preparedness of the employees prior to the mine closure
7th, 8th, 9th and 10th months	Implementation of the mitigating measures. These measures are unpredictable as of to-date. Evaluation of the training conducted.	To start the implementation of the identified measures, without unjustifiable delay. To evaluate the effectiveness of the training conducted.	MEPEO and CRO TESDA, Training Institution, Company HRD and	Full understanding between the company and the affected communities, regarding the stoppage of the operation. Qualifications of the trained employees are upgraded.

Month	Description of activity	Objective	Responsibility	Expected Output
			the Department heads	Employees can easily find a job.
11th	Review on the results of the implemented measures	To thoroughly evaluate the effectiveness of the measures being implemented.	MEPEO and CRO	The degree of acceptance is being determined.
12th	Farewell meeting with the Barangay Heads, the Contractor Company and SEDC Top Officials and its members Farewell meeting / party with the company employees	To formally thank the leaders of the host barangays and the Contractor company and say goodbye to them. To formally say goodbye to the company's employees.	Barangay Heads of the impact barangays, Contractor Company and SEDC Top Officials and its members. Top management, company's employees	Better relationship between SEDC and the affected Barangays would still be in place, even if the company will soon stop its operation. Better relationship between top management and its employees would still be present, even if the company will stop its operation.

7.6.1 RETRENCHMENT PACKAGES AND RETIREMENT PLANS

The company will notify the employees and the Department of Labor and Employment for the company closure, by serving a written notice, at least one (1) month before the intended date thereof. The separation pay due to company closure that will be given to each employee shall be equivalent to his / her one month pay or to at least one-half (1/2) month pay for every year of service, whichever is higher. A fraction of at least six (6) months shall be considered one (1) whole year. In addition, the company gives what is due to the employees as mandated by Labor law such as:

- 5 days incentive leave per year of services;
- 5 days per year of services for monthly employees;
- 13 days per year of service for daily employees;
- 13 month pay;
- Withholding pay;
- Unused sick leave and vacation leave ; and
- Prorated sick leave and vacation leave

The company will also established a retirement fund to provide for the payment of benefits of its employees when they are retired, disabled, or separated from service, or in the event of death, the

payment of definite amounts to their beneficiaries subject to the conditions and limitations set forth in the retirement plan rules and regulations. (Please see Annex "11.6" for the Retirement Plan)

The following are the benefits provided in the plan:

1. **Retirement** - Upon retirement, a Member shall be entitled to a retirement benefit in an amount equivalent to 100% of his Final Monthly Basic Salary times the number of years of his Credited Service.
2. **Death and Disability** -
    a. In the event of death of a Member while still in active service, his Beneficiary shall be entitled to a benefit computed in the plan. Any payment to the Beneficiary shall be made in accordance with and pursuant to the procedure presently prescribed in Article 105 (b) of the Labor Code.
    b. A member who is separated from employment on account of permanent total disability shall be entitled to a benefit computed in accordance with the retirement benefit formula.
    c. Should the death or disability of a Member arise on account of self-inflicted injuries, suicide, or any criminal act attributable to him, no death or disability benefits shall be paid under the Plan.
3. **Resignation Benefit** - Any Member who voluntarily and unconditionally resigns from the service of the company upon completion of at least ten (10) years of service, shall be entitled to a benefit computed in accordance with the schedule stated in the plan.
4. **Involuntary Separation** - Any Member who is involuntarily separated from the service by the Company for any reason or cause not due to his own fault, wrongdoing, misconduct, negligence, fraud, malfeasance or nonfeasance shall be entitled to a benefit calculated in accordance with the retirement benefit formula of the Labor Code, whichever is higher.

Although there is no scheduled termination date for the Plan, it may be amended suspended or terminated at any time by the Company (in its sole and absolute discretion) on account of (a) business necessity or adverse economic conditions, or any other factors beyond its control or (b) if at any time during the existence of the Plan, any new amendatory legislation or statue shall grant to Employees pension, annuities, retirement gratuities or similar government – sponsored benefits (to which the Company contributes a material amount, or is required to participate and to so contribute), and such benefits (and the company's contributions thereto) are substantial, or, are equal, or almost equal to the benefits given to the participants, or the contributions of the Company under the Plan, but no such action of the Company shall operate to permit any part of the assets of the Fund to be used for, or diverted to, purposes other than for the exclusive benefit of the Members or their Beneficiaries. Neither shall it be applied retroactively so as to adversely affect or reduce in any way the benefit that may have accrued to any Member on account of service prior to the date such amendment, suspension or termination. In no event shall any part of the assets of the fund revert to the Company before all liabilities of the Plan have been satisfied.

7.6.2 LABOR SUPPORT POLICIES AND PROGRAMS

The company believes that every employee is one of its assets and a partner in the business. The company will develop a training plan and program for its employees, one (1) year prior to the

expiration of the company's MPSA. The training plan and program shall focus on skills development and livelihood aspects and shall be coordinated with TESDA or with other training institution.

Employees of Solid Earth Development Corporation as well as the impacted communities of Pinamungajan, Cebu, where the company is located, will be greatly affected by the mine closure. In order to lessen the impacts of mine closure such as loss on employment, loss on revenues and loss on social services, mitigating measures that will add value to the human capital will be adopted by the company. These are to help workers and the impacted communities manage themselves socially and economically when the mine finally closes. These involve providing retraining skills and creating opportunities for employees of Solid Earth Development Corporation and providing community employment and economic opportunities. Retraining skills or education programs that will be given to employees will involve skills on mechanical trade, construction and administration. Concepts on business enterprise or entrepreneurship will also be introduced for employees to consider self-employment as an alternative to finding a replacement job. Various skills training and workshops about farming, welding, electricity and fishing will also be provided to the impacted communities to give them other means of making a living once the mine closes. Hiring of local residents to undertake the mine closure activities such as planting trees, site security, establishing drainage system and reclamation of mine site will also be undertaken by the company to help address the concern on loss of revenues. And finally, counseling activities will be provided to employees for them to be mentally prepared on the mine closure and will therefore focus on money related matters and property management.

7.6.3 Transfer of Social Assets

One of the socio-economic impacts of mine closure is the loss of social services. And, as a socially responsible company, Solid Earth Development Corporation as part of its mine closure plan will be donating various equipment and facilities to local government units and schools in Pinamungajan, Cebu. The mine facilities/structure/equipment that will be turned over to the community are the following: (1) Field Office, (2) Computers and Printers, (3) Office Tables and Chairs. Mine facilities that will be turned over to the community like computers and printers, will be provided with a Memorandum of Agreement (MOA) and assist in the formulation of a Management and Sustainability Plan for continuous operations of the said facilities. On the general welfare of the community, it will now be the responsibility of the local government of Pinamungajan to maintain the local infrastructure and to provide the services previously provided by the company. Solid Earth Development Corporation will also consider transferring the mine farm to the government. Such transfer of asset will be very beneficial for the government's agricultural livelihood projects for mountain barangays.

7.7 Maintenance and Monitoring Plans

This plan covers the period when the reforestation is already completed. The following maintenance activities will be undertaken:

- Replanting where seedling failed to survive;
- Pest and weed control ;
- Watering of plants in drier areas;
- application of fertilizers

Objective:

To determine the level of success and compliance by the company with the planned tree planting and area stabilization of the disturbed area.

Components of the success criteria could include:

- Physical;
- Biological; and
- Water quality of the nearby creek.

Monitoring Procedure:

Monitoring will cover the entire projected mined out area that is subject of rehabilitation: This is fifty (50) hectares.

Table 7-6. Matrix Rehabilitation Parameters to be Monitored

Components to be monitored	Parameters to be Monitored	Method of Monitoring	Frequency	To be monitored by:
Stability of the Final Bench slopes	Bench slope, Bench height, Bench width	Measured using survey instruments and working map.	Monthly/ Quarterly	MEPEO/ MMT
Conditions of the drainage	Silt level	Ocular Inspection	Monthly/ Quarterly	MEPEO/ MMT
Quality of the water flowing in the Mangoto River, Cabiangon River, Banban River	pH, TSS, Oil & Grease	Water samples will be taken on the point of discharge as agreed by MMT.	Monthly/ Quarterly	MEPEO/ MMT
Growth of the trees	Height of Trees	Actual measurement using meterstick	Monthly/ Quarterly	MEPEO/ MMT

7.7.1 Maintenance and Monitoring Program and Procedures

7.7.1.1 Monitoring

Monitoring shall include:

- Safety of the site;
- Growth rate and the density of the plants including the return of non-sown desirable species and weeds;
- Return of native flora and fauna;
- Evidence of erosion or land degradation;
- Water quality;
- Structural condition of surrounding land;
- Social Plan;

- Air quality

7.7.1.2 MAINTENANCE

Maintenance activities other than re-working rehabilitated areas that failed would include:

- Provision of fences and signages to discourage entry to the area;
- Watering the seedlings to ensure their survival and sustained growth;
- Control pest and weed accumulation;
- Fertilize as needed; and
- Conduct annual or semi-annual inventory of planted species on every plantation area.

8 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

The Environmental Management Bureau Region VII (EMB VII) Office is the instrumentality of the Department of Environment and Natural Resources (DENR) that exercise jurisdiction over environmental management matters in the Province of Cebu. This office is coordinating with the Mines and Geo-Sciences Bureau Region VII (MGB VII) Office that regulates the mining industry in the Region which covers quarry operations including the Proposed Silica Sand Quarry Expansion Project. MGB VII has already approved the MPSA 314-2010-VII and MPSA 323-2010-VII covering the proposed production area of the quarry site. DENR R7 has under its organization the CENRO Toledo City, which conducts regular monitoring of natural resources and environment matters at the city/municipal level including the Municipality of Pinamungajan where the project is located.

The proponent, SEDC has its Environmental Management Unit (EMU) that is responsible for all environmental concerns of the company. The EMU is imbedded in the Mine Environmental and Enhancement Office (MEPEO). The MEPEO unit handles the environmental compliance concerns of SEDC and of the sister company, TCPI. It is manned by key personnel and is responsible for ensuring that the Company meets environmental requirements for smooth project operation. The MEPEO assigns respective staff interfaces with the Mine Rehabilitation Fund Committee (MRFC) and the Multipartite Monitoring Team (MMT), prepare the periodic Self-Monitoring Reports and take charge of the counterpart secretariat work for the MRFC and the MMT. The existing MMT that monitors the existing project of SEDC and TCPI will accommodate the monitoring of this project. **Figure 8-1** contains the organizational structure of the MEPEO.

The quarry and hauling activities will mostly be implemented through Contractors and Subcontractors. The Proponent will do well to include in its operating Contracts specific provisions to comply with the environmental management measures committed in the Environmental Performance Report and Management Plan. `

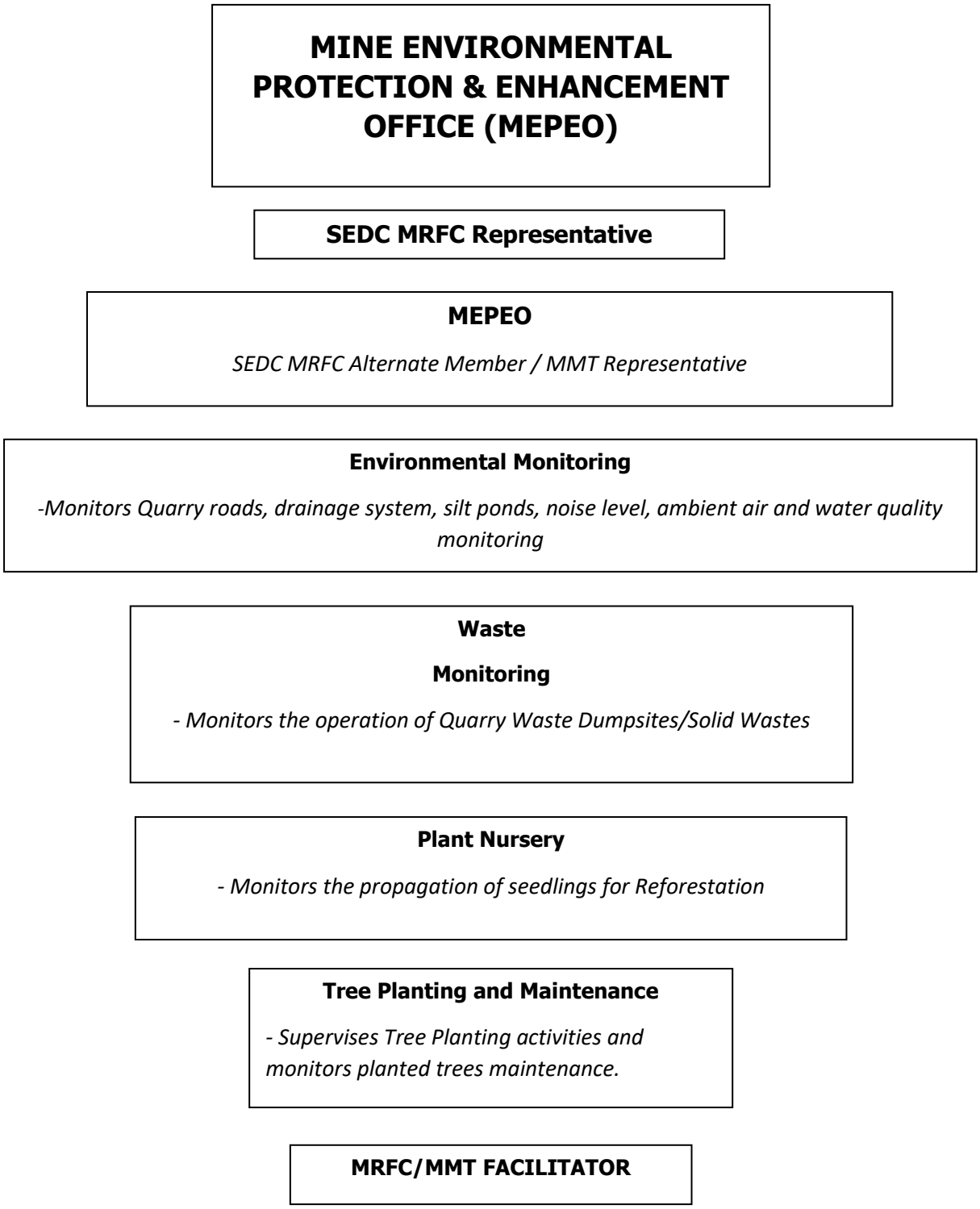


Figure 8-1. Organizational Structure of the SEDC MEPEO