ENVIRONMENTAL IMPACT ASSESSMENT

PROPOSED QVPI CEBU MARBLE AND AGGREGATES PROJECT

MUNICIPALITY OF PINAMUNGAHAN, CITY OF NAGA, AND CITY OF TOLEDO, CEBU

MAIN REPORT

QUARRY VENTURES PHILIPPINES, INC.

117 Shaw Boulevard, Pasig City, 1600

February 2019

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EXECUTIVE SUMMARY

Project Fact Sheet:

Name of Project	**QVPI Cebu Marble and Aggregates Quarry Project**
Location	Parcel 1: Barangay Tagjaguimit, City of Naga and Barangay Lamac, Municipality of Pinamungahan. Parcel 2: Barangay Tagjaguimit, City of Naga. Parcel 3: Barangays Media Once, Bulongan, and Poog, City of Toledo Parcel 5: Barangay Cogon, City of Naga
MPSA No.	111-98-VII Total MPSA Area: 607.50 hectares Date granted: May 26, 1998 Validity: May 25, 2023
ECC	**07-07-07-27-0263-303A**
Nature of Project	Resource Extractive Industry
Size	**Existing ECC:** Production Capacity: 3,000 m^3/y Area: 14.02 hectares **Proposed Operation:** Production Capacity: 21,000MT/Yr of Marble, 973,900 MT/Yr of Limestone Aggregates, and 924,000MT/Yr of Basalt, for **4 parcels** **Parcel 1: 6,000 cubic meter/yr (Marble Blocks)** Parcel 2: 16,200 MT/Yr (Marble Blocks) Parcel 3: 990,000 MT/Yr, broken down as follow: 16,100 MT/yr Marble Blocks 973,900 MT/yr Aggregates Parcel 5: 1,937,000 MT/Yr (Basalt) Area: A total of 567 hectares, over **4 parcels**. Parcel 1: 81 hectares (mine area = 2.8has.) Parcel 2: 81 hectares (mine area = 2.5has.) Parcel 3: 324 hectares (mine area = 22.9has.) Parcel 5: 81 hectares (mine area = 18.7has.)
Commodity	**Existing:** Marble Blocks and Boulders **Proposed:** Limestone and basalt which will be processed into marble and aggregate products.
Mining Method	Surface Mining Method (Quarrying) - unchanged

Proponent Profile

Proponent Name	**Quarry Ventures Philippines, Inc.**
Address	117 Shaw Boulevard, Pasig City, 1600
Contact Person	**Engr. Ser Allain Pleyto**
Contact Number	0917-5907233

Project Preparer

AXceltechs, Inc.

Office Address:	Unit 10C, Lansbergh Place 170 Tomas Morato, Quezon City
Authorized Representative/ Contact Person (s):	**Engr. Paulo Noni T. Tidalgo** Managing Director
Contact Number	(02) 376-0043

Comparative Matrix of Existing and Proposed Project Components

Project Components		**Existing**	**Planned**
Quarry	Parcel 1	- Covered by MPSA No. 111-98-VII - 14.2 hectares	- Same MPSA - 81 hectares
	Parcel 2		- Covered by MPSA No. 111-98-VII - 81 hectares
	Parcel 3		- Covered by MPSA No. 111-98-VII - 324 hectares
	Parcel 5		- Covered by MPSA No. 111-98-VII - 81 hectares
	Quarry Facilities	- Stockpile - Admin building, staff house, laboratory, motor pool and nursery - Waste dump	- Stockpile Parcel 1: 0.5 hectares Parcel 2: 0.5 hectares Parcel 3: 1 hectare Parcel 5: 1 hectare - Admin building, staff house, laboratory, motor pool and nursery Parcel 1: 3,100m2 Parcel 2: 1,100m2 Parcel 3: 6,000m2 Parcel 5: 4,100m2 - 2 Crushers (Parcel 3 and 5) 960,000 MT/yr. 250MT/hr - Parcel 3 Road Network: 500m
	Extraction Method	Surface Mining – Quarrying	
	Extraction Rate	- Parcel 1: 3,000 m^3/y	- Parcel 1: 3,000 cubic meter/yr (Marble Blocks) - Parcel 2: 16,200 MT/Yr (Marble Blocks) - Parcel 3: 990,000 MT/Yr, broken down as follows: 16,200 MT/yr Marble Blocks 973,800 MT/yr Aggregates - Parcel 5: 1,937,000 MT/Yr (Basalt)
	Total Project Area		567 hectares

Project Components		Existing	Planned
	Commodity	Marble Blocks and Boulders	Limestone and basalt which will be processed into marble and aggregate products.
Waste Management	Quarry Pollution Control Structures	-	- Drainage systems - settling ponds Parcel 1: 1 Parcel 2: 1 Parcel 3: 2 Parcel 5: 1 - Silt collector sump Parcel 1: 2 Parcel 2: 2 Parcel 3: 9 Parcel 5: 5
	Domestic Wastewater Treatment	Septic tanks	
	Solid and Hazardous waste	- waste segregation - Materials Recovery Facility - storage area (laydown): hazardous - haulage and treatment/disposal of hazardous wastes by the EMB accredited treaters	

Process Documentation of the Conduct of Environmental Impact Assessment

The terms of reference used for this Environmental Impact Assessment (EIA) was consistent with that stipulated in the Revised Procedural Manual (RMP) for Department of Environment and Natural Resources (DENR) Administrative Order (DAO) NO. 2003-30, Implementing Rules and Regulations of Presidential Decree No. 1586 *"Establishing the Philippine Environmental Impact Statement System."*

The Environmental Impact Assessment (EIA) Team is comprised of multi-disciplinary specialists/experts who have extensive training and experience on their respective fields and in the conduct of EIA for various industry sectors.

EPRMP Team

This study is a conglomeration and integration of the various technical, environmental, institutional/legal and social inputs and findings of the following specialists/experts:

EPRMP Team Member	Field of Expertise/Module	Preparer Registration No.
Paulo Noni T. Tidalgo, EM, RN	Environment, Mining and Geology	IPCO-103
Bernardo V. Valmonte, Jr., EM	Mining and Geology	IPCO-073
Wilfredo Sanidad, PhD.	Water Quality	IPCO-139
Czarina May M. Olores	Environmental Management	IPCO-075
Gilbert Hernandez	Social Expert	

EPRMP Team Member	Field of Expertise/Module	Preparer Registration No.
Maribel Agoo, PhD	Terrestrial Ecology	
Einre Jinji Elcid Quiambao	Project Coordinator	IPCO-154

EIA Study Schedule and Area

The scope of the study was discussed during the Technical Scoping Meeting held on 25 April, 2016 at the EIA Conference Room, 2nd Floor EMB Building, DENR Compound, Visayas Avenue, Diliman, Quezon City. The meeting was facilitated by the EMB Case handlers and was attended by the Environmental Management Bureau (EMB) Review Committee Members, representatives from QVPI and Axceltechs.

Below is the EIA study schedule.

Activities	Date
IEC and Public Scoping	February 9-11, 2016
Technical Scoping	April 25, 2016
Baseline Sampling	June 23-27, 2016
Gathering of secondary data	June 23, 2016 – November 30, 2017

The area subjected to the EIA was based on the perceived direct and indirect impact areas of the proposed project. As stipulated in DAO 2017-15, known as the "*Guidelines on Public Participation under the Philippine Environmental Impact Statement System*," direct impact area shall be delineated based on the result of the assessment of the project's impact on air, water, land, and people.

Aspect	Direct Impact Area
Land	- Area within the MPSA and the periphery of the mining area
Water	- Receiving bodies of water near the project site - Underlying aquifer
Air	- Area within the MPSA, and the community
People	- Brgy. Tagjaguimit and Cogon, City of Naga - Brgy. Lamac, Municipality of Pinamungahan - Brgy. Bulongan, Media Once, and Poog, City of Toledo

On the other hand, areas not directly subjected to any activities/construction and those outside the project area but are within the jurisdiction of the Municipality of Pinamungajan, City of Toledo, and City of Naga are considered as indirect impact areas. For social impacts, the study focused on six (6) direct impact barangays, consistent with the provision of DAO 2017-15.

EIA Methodology

Primary and secondary data were utilized for the assessment of the project impacts. Primary data were obtained from conducted on-site investigation and field sampling/surveys while secondary data were acquired from the proponent and government agencies/institutions. Relevant and previously conducted studies were also considered. The following are the sampling/assessment methodologies employed by the EIA team for the study:

Module		***Methodology***
Land	Land Use	Gathering and review of secondary data
	Geology and Geomorphology	Gathering and review of secondary data
	Natural Hazards	Gathering and review of secondary data
	Pedology	Soil sampling and laboratory analysis
Water	Hydrology and Hydrogeology	Gathering and review of secondary data
	Water Quality	In-situ measurements; grab sampling and laboratory analysis
Air and Noise	Meteorology	Gathering and review of secondary data
	Air and Noise Quality	High volume sampler (TSP and metals) Colorimetric-Pararosaline Greiss-Saltzman Atomic Absorption Spectrophotometry Sound level meter for noise
People	Socio-economic Profile	Gathering and review of secondary data Perception survey

Public Participation

Stakeholders' participation in the conduct of EIA study includes participation in the following:

- Information, Education and Communication (IEC) and Public Scoping activities on February 9-11, 2016. Among the attendees of the first IEC were Barangay officials including the Chairman, Purok Leaders, Home Owners Association Leaders, representatives of nearby industries while the latter was participated by stakeholders from the government agencies.;
- Perception surveys in 11 barangays on September 19 – October 10, 2016 where a total of 300 individuals were surveyed.

Project Alternative

Since mining projects are site specific because mineral extraction can only be undertaken where economic deposits occur, the proponent has not considered any alternative project site. Initial feasibility conducted, drilling/geologic results and environmental considerations reveal that extraction of resource in the area is best suitably done through surface mining method. See Section 1.5 for the details on the Project Alternatives

Summary of Environmental Risk Assessment

Hazards associated with the marble and aggregates quarry are mass movement of soil/rocks from the quarry sites; mass release of sediments from settling ponds; flooding; occupational safety hazards; fire/explosion hazards from storage liquid fuel (diesel), exposure to dusts; siltation and contamination of surface water bodies; soil erosion and loss of soil fertility; and natural calamities, especially during extreme climate events; and exposure to high intensity noise.

Occupational safety hazards may occur at the various operation units from the quarry site. Outcome of occupational safety hazards include deaths and injuries resulting from ground/structure failure, fall from heights, being struck or crushed by equipment parts or falling rocks/debris, vehicular/equipment accidents, and others. Mass movement of soil and rocks may occur quarry sites and in disturbed elevated areas. Mass release of sediments and flooding may arise mainly due to breach of containing walls of impoundment and dikes especially at settling ponds. Such incidents may be triggered by natural events such as extreme climate events (torrential rains, strong typhoons, storm surges, etc.) earthquakes and subsidence; faulty engineering design; inadequate maintenance of structures; and sabotage. Water contamination could result from the release mining overburden and wastes to water bodies. The surface water bodies could also become heavily silted. Fire/explosion hazards may arise from the storage and utilization of coal and liquid fuel (diesel).

Major Project Impact

EIA Study Module	Impact	Mitigation	Residual Effect
Land	Removal of topsoil and Vegetation cover Alteration of topography; lowering of landform elevation	Mining in blocks; Progressive revegetation of mined-out blocks	Revegetated quarry area
Water	Increase TSS and turbidity of water	Erosion control structures such as appropriate drainage, catch basins and sediment settling ponds; quarrying to be done in stages	Small soil particles suspended in the pond may flowout, regular monitoring and maintenance of the pond shall strictly implememted.
Air	Local increase in TSP and noise levels Air pollution due quarry operation	Proper and regular maintenance of equipment Water spraying; mining activities to be confined during daytime as much as possible IEC on proper scheduling of hauler trucks to avoid busy and late hours	Dust will be generated during blasting, movements of mobile equipments and quarrying operation. Controlled blasting will be implemented by the company. Water sprinkling will be done to alleviate excessive dust generation.
People	Local government generation of revenues from taxes, permits and LGU share in the quarrying activities Payment of local taxes and fees to Municipal and Barangay Local Government Units Generation of employment Generation of livelihood opportunities by putting-up food stalls, variety stores and other services near the quarry area which	Implementation of community development programs through Social Development Management Plan equivalent to 1.5% of Operating cost based on the identified needs of the communities Total taxes paid to the national government will exceed >Excise Tax: 60% goes to the national government; 40%, to the local government– -20% for host Provinces -45% for host Municipalities	Enhancement socio-economic welfare of the community

EIA Study Module	Impact	Mitigation	Residual Effect
	might cause problems of congestion, peace and order and security breaches	-35% for host Barangays Occupation Fees and Real Property Tax to province and municipalities IEC on nature of jobs the proponents require and qualification Consultation on job requirements and qualification Skills training to upgrade local skills of residents that can be hired by the project Implementation livelihood development programs through the SDMP Coordination with the Barangay LGUs to monitor issuance of business permits in small- to medium- scale commercial establishments to ensure proper zoning of business areas, peace and order, solid waste management	

1 PROJECT DESCRIPTION

1.1 Project Background

In 1986, Teresa Marble Corporation (TMC), sister company of Quarry Ventures Phils. Inc. (QVPI), acquired a small-scale mining permit for an area in Sitio Gaway-gaway, Barangay Uling, Naga; also known as the Rosatta Quarry. For said operation, TMC hired six (6) skilled quarry men from Antipolo, Rizal ans started producing marble blocks using air compressor and jack hammers.

Come 1994, TMC turned over its mining rights to QVPI. The latter then applied for a Mineral Production Sharing Agreement (MPSA) in 1998; and in 1999, QVPI modernized the operations by using wiresaw, hydraulic jack, rotary drill and bigger backhoe. The company also bought the processing plant of Phoenix Marble in Brgy. Uling, Naga.

In 2006, QVPI started operating 5 hectares in Barangay Tagjaguimit Uling under a small-scale quarry permit.

QVPI applied for an Environmental Compliance Certificate for its quarry operation in Parcel 1. The ECC for such was eventually issued in 2008 denominated as 07-07-07-27-0263-303A (**Annex 3**). The Declaration of Mining Feasibility was also approved for Parcel 1 (14 hec.) in 2009.

1.2 Project Location

The proposed Project of QVPI is located in the Municipalities of Pinamungahan, Naga City and Toledo City, all in the Province of Cebu. It has a total area of 567 hectares divided into four (4) parcels covered by MPSA No. III – 98 – VII. The geographical coordinates and specific location per parcel is shown below:

Parcel 1 is located in Barangay Tagjaguimit, City of Naga and Barangay Lamac in the Municipality of Pinamungahan.

Table 1-1: Parcel 1 Coordinate Points

Corner	Latitude	Longitude
1	10°15’30”N	123°40’00”E
2	10°16’00”N	123°40’00”E
3	10°16’00”N	123°40’30”E
4	10°15’30”N	123°40’30”E
Total Area	**81 hectares**	

Parcel 2 is located in Barangay Lamac, Municipality of Pinamungahan.

Table 1-2: Parcel 2 Coordinate Points

Corner	Latitude	Longitude
1	10°16’30”N	123°40’00”E
2	10°17’00”N	123°40’00”E
3	10°17’00”N	123°40’30”E
4	10°16’30”N	123°40’30”E
Total Area	**81 hectares**	

Parcel 3 is located in Barangays Media Once, Bulungan, and Poog, all in the City of Toledo.

Table 1-3: Parcel 3 Coordinate Points

Corner	Latitude	Longitude
1	10°18’00”N	123°39’30”E
2	10°19’00”N	123°39’30”E
3	10°19’00”N	123°40’00”E
4	10°19’30”N	123°40’00”E
5	10°19’30”N	123°40’30”E
6	10°18’30”N	123°40’30”E
7	10°18’30”N	123°40’00”E
8	10°18’00”N	123°40’00”E
Total Area	**324 hectares**	

Parcel 5 is located in Barangay Cogon, City of Naga

Table 1-4: Parcel 5 Coordinate Points

Corner	Latitude	Longitude
1	10°17’00”N	123°44’00”E
2	10°17’30”N	123°44’00”E
3	10°17’30”N	123°44’30”E
4	10°17’00”N	123°44’30”E
Total Area	**81 hectares**	

Parcel 4 of MPSA No. III – 98 – VII is already coverd with ECC no. 9107-028-302A. It is currently non-operational and is not covered in this study. It is currently non-operational. All quarry activities are focused on Parcel 1, covered by ECC no. 07-07-07-27-0263-303A. It is this project’s objective to cover Parcels 1, 2, 3, and 5 with a single ECC. Parcel 4 shall remain separate and non-operational.

Figure 1-1: Project Location Map

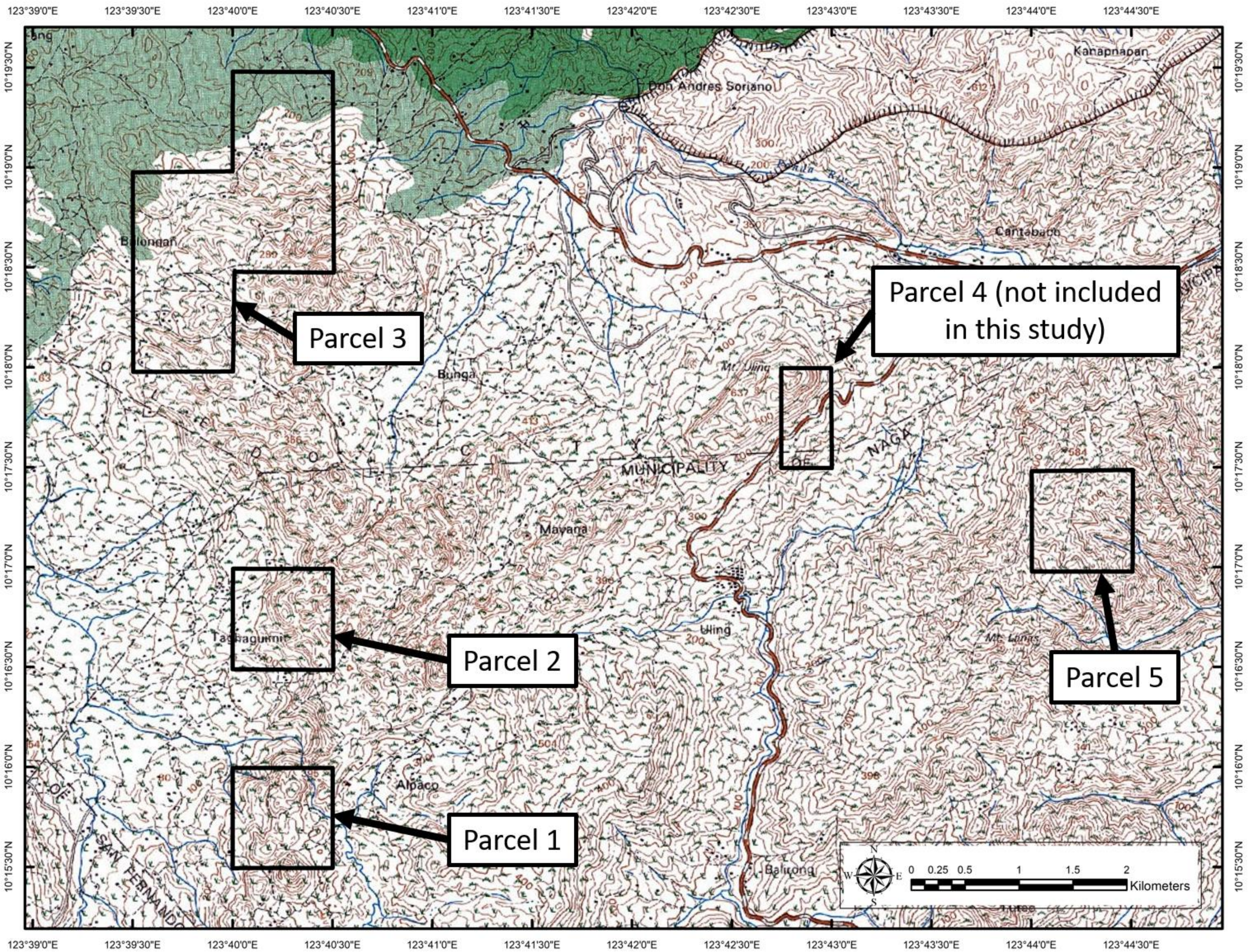


Figure 1-2: Project Location Map by Parcel

Figure 1-3: Drone Shot of Parcel 1

Figure 1-4: Drone Shot of Parcel 2

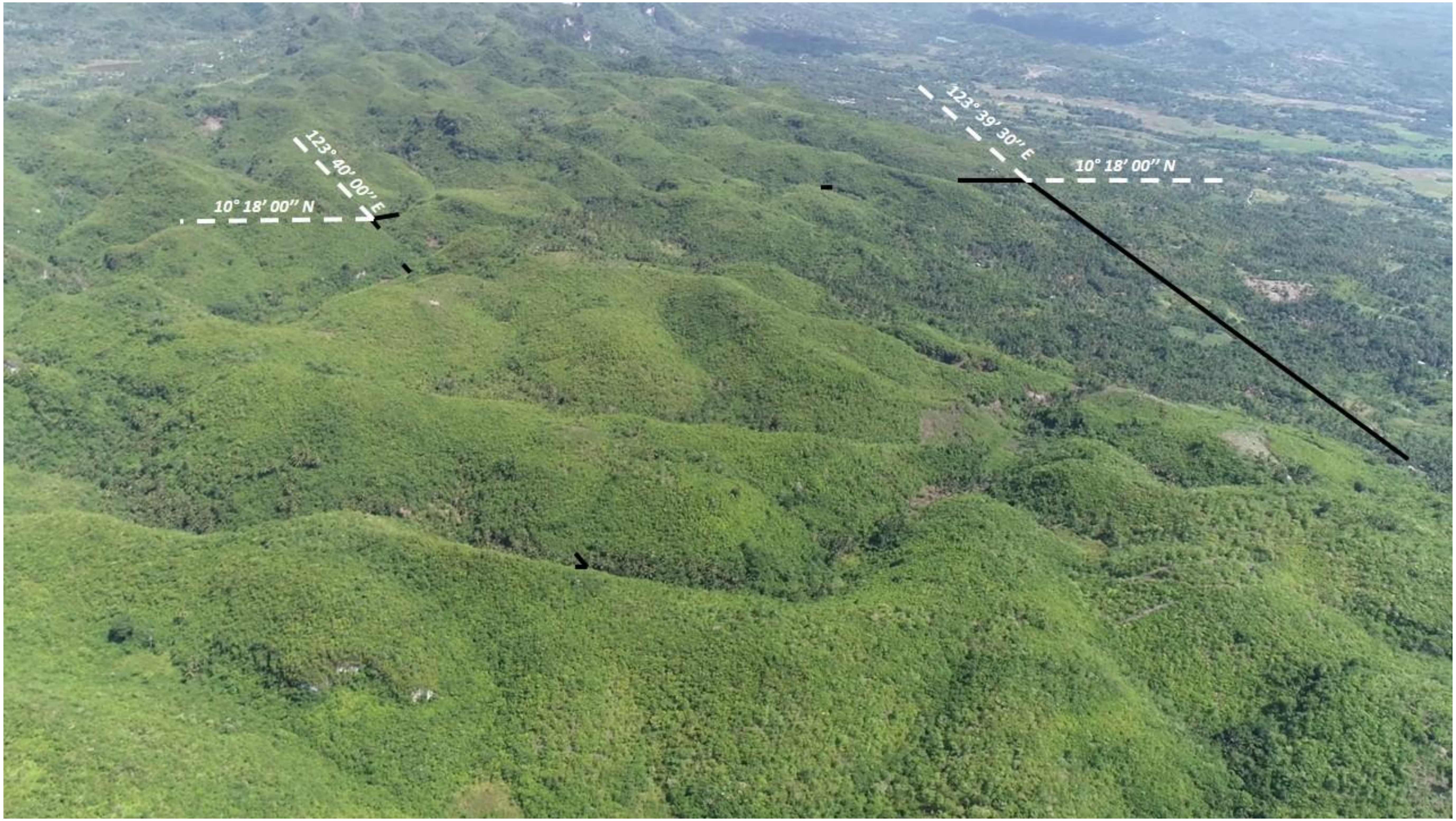


Figure 1-5: Drone Shot of Parcel 3

Figure 1-6: Drone Shot of Parcel 5

1.3 Project Accessibility

Cebu Island can be reached by daily commercial airline flights from Manila to Cebu City or by commercial ferries also from Manila and from other central Visayan localities. The City of Naga is approximately 25 km south of Cebu City, the capital of the province of Cebu. While Toledo City is situated 47 km away from Cebu City.

Parcel 1 can be reached from Cebu City to Naga City thru the South Reclamation Project Highway, thence to Barangay Tajaguimit by a barangay road.

Parcels 2 and 3 can be access from Cebu City to Naga City through the South Reclamation Project Highway, thence to Brgy. Media Once or Poog (Toledo City) via the Hega-Uling Road and finally by barangay roads to the project area. The said areas can also be reached via the Manipis Road from Tabunoc town to Toledo City.

Parcel 5 can be reached from Cebu City to Naga City thru the South Reclamation Project Highway, thence to Brgy. Lanas, Naga via the Cebu Trans-Central Highway, and then by a barangay road to the western edge of the Parcel 5 claim block.

1.4 Project Rationale

The proponent engaged the project, not just for profit, but for the development of the community. The sites were a good source of marble and aggregates, and the actual project site is not fit for agriculture. The National Government and the LGU will benefit from the project through taxes, fees, and duties it would garner. The project would also promote employment to the local community, and provisions of community development projects. The project will have significant impact in local and national economy. The key beneficiaries will include the local workforce and businesses allied to the mining operations. Education and development of new enterprises in the host communities will create employment and new skills.

Substantial earnings could be derived from direct employment while potential additional earning could be derived from entrepreneurship. Health and sanitation would be improved as support from the company in form of available medical team could be relied upon. Improvement of infrastructure will provide better services to the community. This will develop them into future better students and hopefully obtain good employment.

Skills acquired as a result of employment and technology transfer is useful for other opportunities that might come along. Revenues in form of taxes and other valuable monetary support from SDMP, EPEP and FMRDP could also be realized.

1.5 Project Alternatives

1.5.1 Alternative Project Location

Since mining projects are site specific because mineral extraction can only be undertaken where economic deposits occur, the proponent has not considered any alternative project site. Initial feasibility conducted, drilling/geologic results and environmental considerations reveal that extraction of resource in the area is best suitably done through surface mining method.

1.5.2 Mining Method Selection

Marble and aggregates are extracted through physical removal of the quarry, which involves cutting and blasting. Considering the target minerals, these would be the best methods available for extraction. These methods, however, would induce dust generation so proper mitigating measures would be implemented all throughout the operation.

Safety of the community and employees would also be considered due to the nature of the mining method. Proper measures, like wearing of PPE’s and informing the community of blast schedules, will be observed.

1.5.3 Power

Power to the site will be supplied by the Visayan Electric Company (VECO). Generators will be installed on standby, in case of power failures, that could generate 120 KW of power.

1.5.4 Environmental Impact

The major environmental impact that will be brought about by the project modification considering all the above mentioned alternatives is dust generation.

1.5.5 Consequences of not proceeding with the Project

Left untouched, the parcels 1, 2, and 5 are hilly areas and wouldn't be suitable for agriculture without proper slope stabilization. Terracing may be employed, but since the hills are rich in marble and aggregates, the soil may prove to be too hard for crops.

1.6 Project Components

1.6.1 Status of the Current Operation

Parcel I of MPSA III-98-VII was partially declared last 2007. It started as a commercial production last 2009. Out of 14 hectares that was partially declared, only 4 hectares was disturbed. Production area is approximately 1 hectare; 3 hectares were used as stockpile area of marble block by-products, wasted and haul access road.

Average production is around 1,700 m^3 per year. Marble quarry operation is using wire saws/diamond beads. Power is supplied by 220 KVA, 440 Volt Generator Set. Water is required to cool off diamond beads and consumes around 50m3 of water for wire saws and drilling machines.

Waste/Marble Block by-products are stock piled along the slope and will be subjected to size reduction by hydraulic breaker to be used or sold as reclamation materials, armor rock, quarry run rock (QRR) and /filling materials. There is no crushing plant facility in the quarry at present.

Since there are no Mined-Out areas, tree planting was done along the quarry road and was also done on private private/public land with memorandum of agreement. The total area planted as of 2018 is around 20.16 hectares equivalent to 68,050 assorted trees.

Quarry drainage/Run-off Water is through drainage canals from top-most portion of quarry bench passing through series of silt traps and finally settled to silt collector sumps below the quarry road. The length of the quarry access road is around 500 meters leading to Barangay road.

Support facilities are Quarry Field Office, Pantry areas, Motorpool/Washing Area with Water-Oil Separator, Holding Area for chemical, oil and waste materials, Electrical Motorpool and 10-Footer container van serving as storage/tool room.

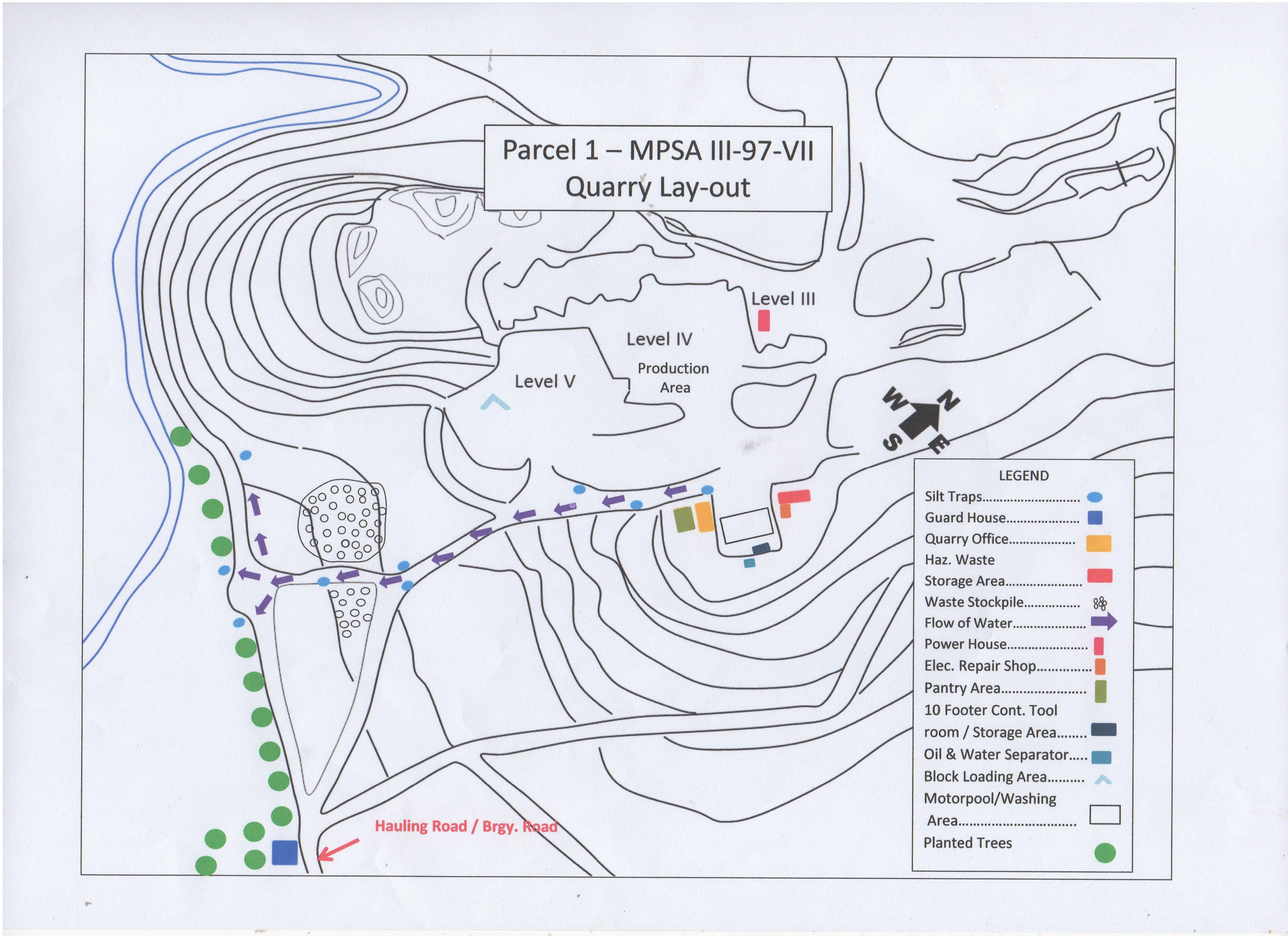


Figure 1-7: Parcel 1 Operation - Project Layout

1.6.2 Major Components

A `summary of the major components of the project is given in **Table 1-5**.

Table 1-5: Summary of Major Components

Project Components		Existing	Planned
Quarry	Parcel 1	- Covered by MPSA No. 111-98-VII - 14.2 hectares	- Same MPSA - 81 hectares
	Parcel 2		- Covered by MPSA No. 111-98-VII - 81 hectares
	Parcel 3		- Covered by MPSA No. 111-98-VII - 324 hectares
	Parcel 5		- Covered by MPSA No. 111-98-VII - 81 hectares
	Quarry Facilities	- Stockpile - Admin building, staff house, laboratory, motor pool and nursery - Waste dump	- Stockpile Parcel 1: 0.5 hectares Parcel 2: 0.5 hectares Parcel 3: 1 hectare Parcel 5: 1 hectare - Admin building, staff house, laboratory, motor pool and nursery Parcel 1: 3,100m2 Parcel 2: 1,100m2 Parcel 3: 6,000m2 Parcel 5: 4,100m2 - 2 Crushers (Parcel 3 and 5) 960,000 MT/yr. 250MT/hr - Parcel 3 Road Network: 500m
	Extraction Method	Surface Mining – Quarrying	
	Extraction Rate	- Parcel 1: 3,000 m^3/y	- Parcel 1: 3,000 cubic meter/yr (Marble Blocks) - Parcel 2: 16,200 MT/Yr (Marble Blocks) - Parcel 3: 990,000 MT/Yr, broken down as follows: 16,200 MT/yr Marble Blocks 973,800 MT/yr Aggregates - Parcel 5: 1,937,000 MT/Yr (Basalt)
	Total Project Area		567 hectares
	Commodity	Marble Blocks and Boulders	Limestone and basalt which will be processed into marble and aggregate products.
Waste Management	Quarry Pollution Control Structures	-	- Drainage systems - settling ponds Parcel 1: 1 Parcel 2: 1 Parcel 3: 2 Parcel 5: 1 - Silt collector sump

Project Components		Existing	Planned
			Parcel 1: 2 Parcel 2: 2 Parcel 3: 9 Parcel 5: 5
	Domestic Wastewater Treatment	Septic tanks	
	Solid and Hazardous waste	- waste segregation - Materials Recovery Facility - storage area (laydown): hazardous - haulage and treatment/disposal of hazardous wastes by the EMB accredited treaters	

A detailed description of the project components is provided in the succeeding discussions.

1.6.2.1 Mining Method (Current Operation)

Marble Block Operation

After 2 working benches have been developed, the first step in the process is topping and or facing. Topping is the removal of the cracky portion and irregular surface wherein cutting is done horizontally. Facing on the other hand, is the removal of the cracky portion and undesired color/surface using wiresaw and cutting is done vertically. It will then be the bench height. Once planar surface is exposed, the quarry block is evaluated for color, solidity and its amenability to be cut into slabs or tiles. The bad and unsuitable marble quarry block is removed to access the inner and more likely good quality blocks.

The good quality deposit/block is the prepared for production through wire sawing. This entails drilling of intersecting holes. Vertical and horizontal holes are drilled using rotary drills, MPH-100. The intersected drill holes are where the diamond cable of the wiresaw is made to pass prior to actual cutting of the Quarry block. Cutting is both Vertical and Horizontal planes.

The quarry block is then cut into bancatta using diamond wire and wiresaw machines. First step is the horizontal cut, followed by vertical side cut to separate the quarry block from the solid mass. After cutting the horizontal and side channel, cutting of vertical cut is made from the nearest free face (Bancatta Cutting) once the bancatta is cut and or separated vertically and horizontally, it is then toppled by the use of either hydraulic jack (titano jack), air bags or hydro bags. Quarry waste materials consisting of clay, soil and small fragments are placed in front of bancatta to serve as cushion when bancatta is toppled down in order to prevent breaking of bancatta. The toppled bancatta then inspected and laid out to give the best block that can be produced with regards to soundness, color and tone. The end product of the marble block is also considered during the lay-out. Marble block sizes range around 1.5m (W) x 1.3m (H) x 2.0m to 3.0m (L). Marble blocks are separated from bancatta using wiresaw especially designated to cut smaller sizes and or by line drilling using jack hammers and splitted by wedging using steel plug and feathers.

When blocks are separated, it is then classified as to size, color tone and overall quality. Blocks are then marked with identification and coded. Each block produced has its own index card for references. Blocks are then loaded into a Reo 5 tonner truck for delivery to plant site together with each index card.

Limestone Boulders Operation

By product of marble blocks are scraps and boulders. Scrap blocks are processed in the plant to produce marble strips, normally 300mm x random or 400mm by random. Boulders normally head size and below are being sold locally which are being used as backfilling materials and together with small sizes, clay etc are used for reclamation purposes.

1.6.2.2 Mining Method (Proposed Operation)

Surface Mining Method, particularly, quarrying will be employed for the whole project operation. The quarry operation will be divided into two stages; the quarry development and the production stage.

Development phase is the stage in quarry where preparation for full blasts operation will be carried out. It will involve removal and grubbing of vegetative covers, stripping of overburden and establishment of production benches, drainage canals, settling ponds and access roads to the deposit.

The extraction or production stage is the actual removal of the deposit from the developed (cleared) benches. The major activities in this stage are drilling for quality control and simply ripping and dozing on soft and medium ground while drilling, cutting, and blasting for hard rock area followed by loading and hauling of quarry materials.

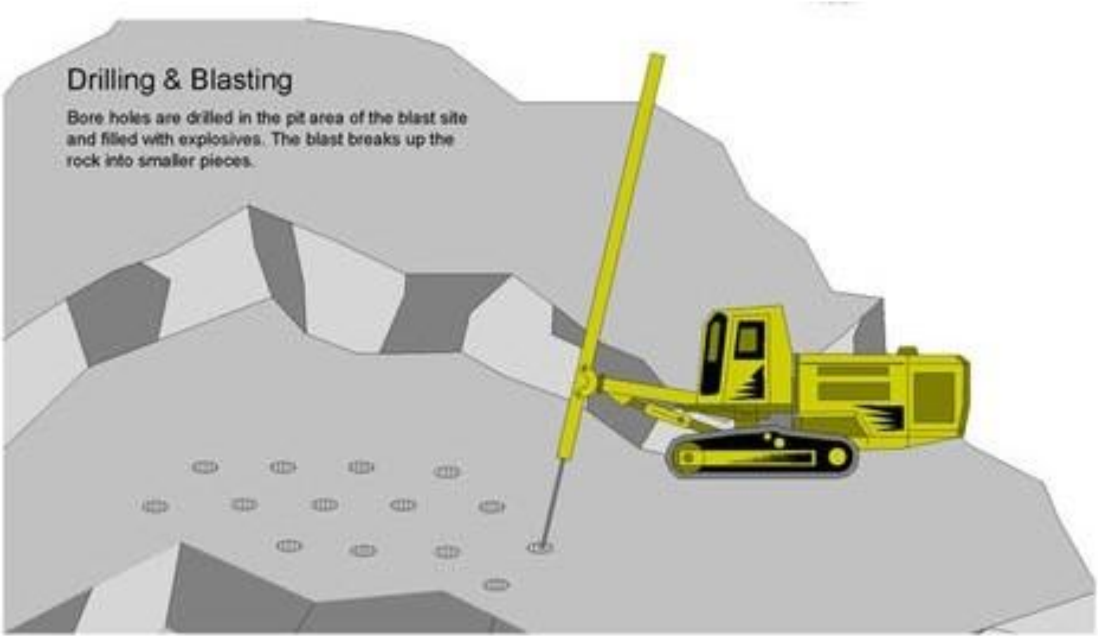


Figure 1-8: Drilling and Blasting Diagram

The marble extraction will utilize the use of diamond wiresaw complimented by rock drilling. When the blocks are already separated from the big mass or bancatta, it will undergo quality checking as to size, color, tone, and overall quality. The blocks that pass the quality checking will be mark with identification numbers and client codes prior to delivery to the processing plant.

Loosened/Blasted limestone and basalt materials from the bench will be loaded by either a wheel loader or backhoe (excavator) shovel into a 25-ton truck and will be transported to the crusher or nearby area. By the time the loosened materials are fully hauled out, a new loading area will be available. The cycle of drilling for quality control, blasting, excavation, loading and hauling continues until all programmed benches have been subjected for production and resource exhaustion.

1.6.2.3 Blasting Operation

For soft ores, rippers and the excavator will be used to extract and load the limestone to the dump trucks. For hard ores, blasting will be employed. Only government authorized blasting contractors will be engaged in the blasting. Controlled blasting using delays will be used to minimize ground vibrations, fly rocks and misfires. Desired boulder size is less than 1m. The following blasting parameters will be used:

When blasting is needed, the quarry will be prepared for a conventional drill and blast operation with a bench height of 10 meters. Blasting and explosive materials will be provided by the blasting contractor.

Two drilling patterns will be used for the production blast: staggered pattern and square pattern. Timing system used is the hole by hole blasting with blast design composed of the following. The blasting nomenclature are shown in **Figure 1-9**.

Free End Blast;

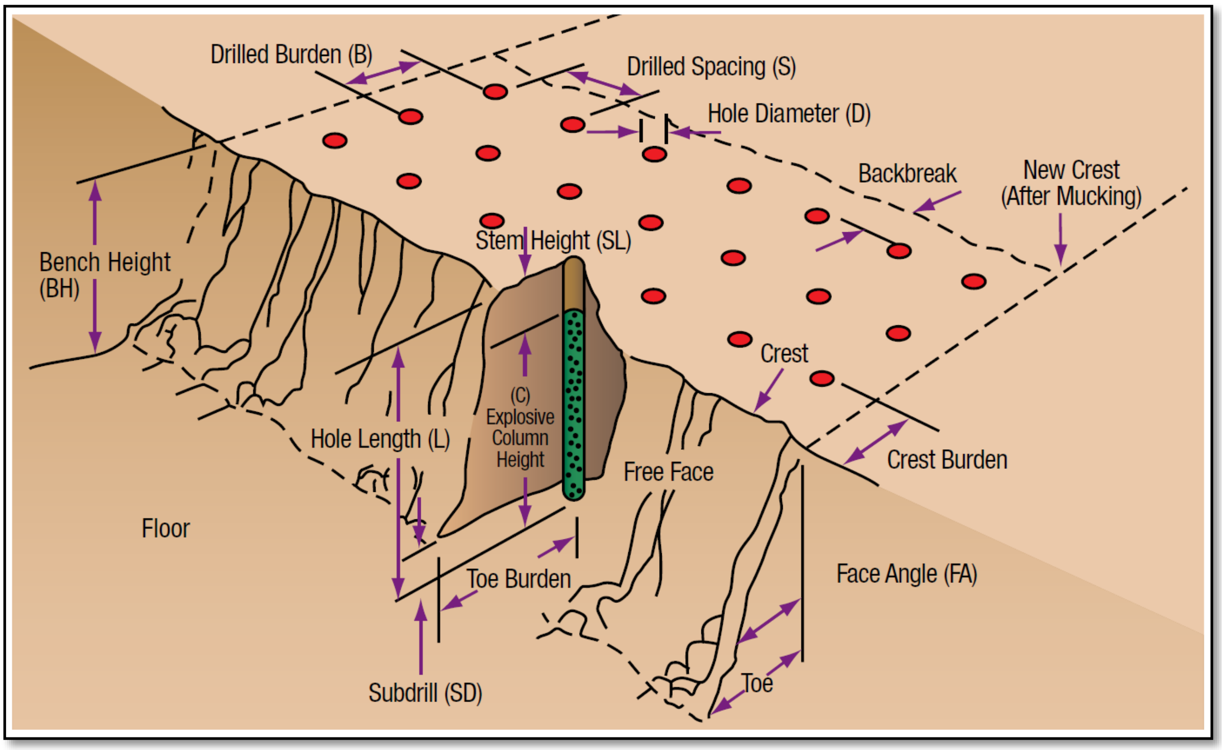
- Forward Echelon;
- Reversed Echelon; and
- “V” Blast.

Blast Geometry/Parameter:

- Drill Hole Diameter - 89 to 102mm
- Bench Height - 10 m
- Sub-drill - 1.00 m
- Burden - 3.00 m
- Spacing - 3.50 m

Typical loading of 10m hole:

- Explosive Column - 7.60 m
- Stemming height - 2.40 m
- Kilograms (kgs) of Explosive/hole - 38 kgs



Source: Blasting and Explosives Quick Reference Guide, Dyno Nobel Asia Pacific, Pty Limited 2011

Figure 1-9: Blasting Nomenclature

1.6.2.4 Crushing of Aggregates

The Project is expected to produce a total of 973,800 MTPY of limestone aggregates and 924,000 MTPY of basalt aggregates covering two (2) 500 TPH crushing plants in Parcels 3 and 5 respectively.

The blasted materials will undergo crushing, screening and classifying processes with the introduction of water spray to eliminate dust, silt and other materials that are not part of the final product. The run-of-mine-ore will undergo three stages: (1) crushing, (2) screening and (3) classifying:

Below are the discussions on each stage of processing:

a. Blasted materials from the quarry are fed into the feeding hopper to the reciprocating feeder and to the grizzly bars.
b. The undersize from the grizzly bars will go to the primary crusher with a jaw opening of 3-inch.

c. The crushed products from the primary jaw crusher is conveyed to the triple deck vibrating screen with an opening of 1 ½ inch, ¾ inch and 3/8 inch respectively.
d. The oversize from the 11/2 inch opening is then fed into the secondary cone crusher for further grinding and then returned to the triple deck vibrating screen.
e. The undersize passing through the ¾ inch opening will be conveyed to the stockpile area designated as G-1, which is estimated to comprise about 35% of the total product ratio.
f. The materials passing through the ¾ inch screen opening and retained at the 3/8 inch screen opening is conveyed to the stockpile area designated as G-3/4. This product is estimated to make up 31% of the total production.
g. The materials passing through the 3/8 inch screen materials comprises the slimes and the G-3/8 product that is estimated to be about 18% of the total product. These materials are conveyed to the stockpile area for G-3/8.
h. The slimes and silt goes to the sand classifier to separate the sand materials from the silt. The washed sand materials are transported through a conveyor to the S-1 stockpile while the waste water goes to the settling pond where it will undergo a series of settling process. Clear water sorted at the last pond is being recycled to the crusher. The settling ponds are regularly dredged to maintain its capacity and the collected silt materials are dried up at the adjacent drying beds. Silt materials are hauled to the base coarse stockpile for mixing.

The crushing schematic diagram is shown in **Figure 1-10** below.

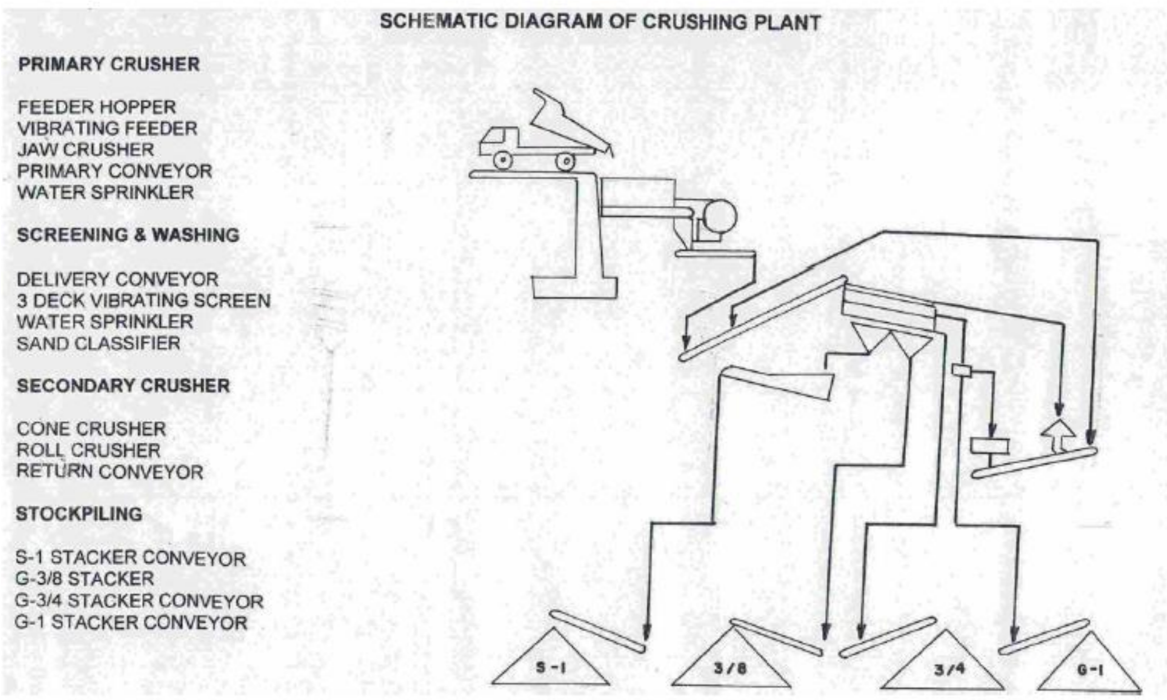


Figure 1-10: Schematic Diagram of Crushing Plant

1.6.2.5 Haul Road and Access Road

Quarry haul and access roads will be developed in the project area. The said facilities will be constructed following the topographic surface contour and shall have a maximum gradient of 8% to ensure safety and efficiency. Haul road and access road shall be ballasted with waste rock extracted from the quarry area to provide stability.

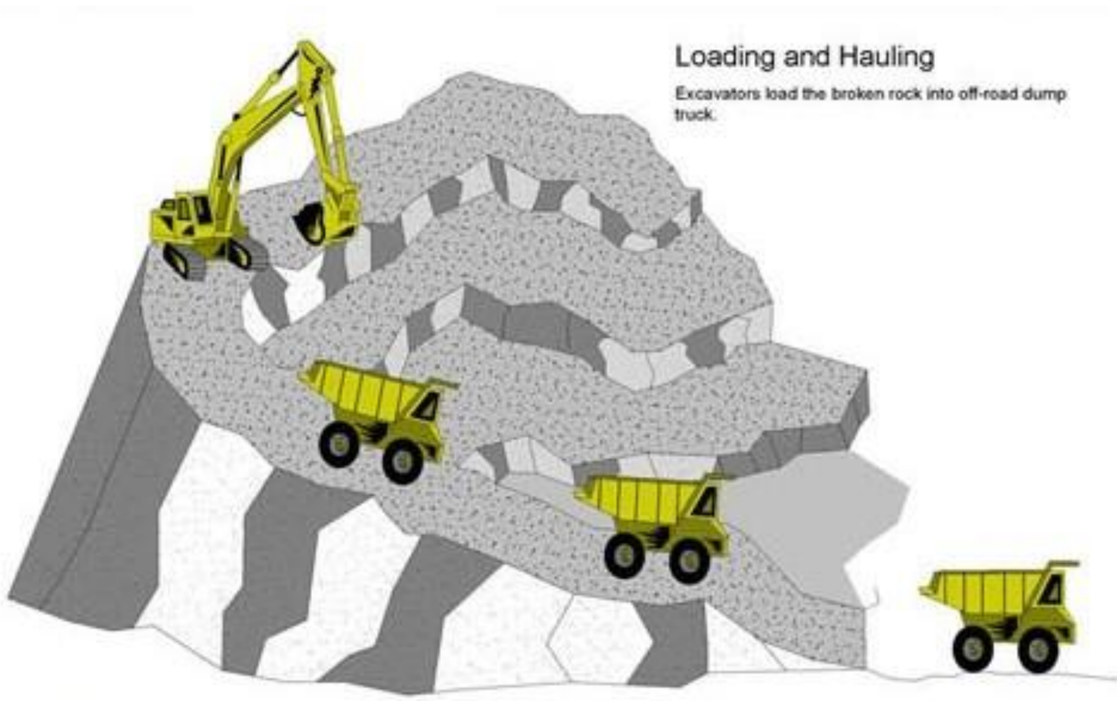


Figure 1-11: Loading and Hauling Diagram

1.6.2.6 Stockpile and Dumps

For the expansion, stockpile and waste dumps will still be established within the quarry site. All good materials will be hauled from the quarry site to the stockpile area. Moreover, all quarry wastes specifically topsoil and boulders will be stockpiled in the waste dump area and will be utilized as a backfilling materials during progressive rehabilitation.

Stockpile slope will be kept at low angle and height to minimize slumping. The proposed height of the stockpile will depend on the angle-of-repose of the material. This is to ensure that the maximum volume of materials will be stockpiled without sacrificing safety.

The stockpile and dumps to be constructed will have the following area:

Parcel	Covered Area
Parcel 1	0.5 hectare
Parcel 2	0.5 hectare
Parcel 3	1 hectare
Parcel 5	1 hectare

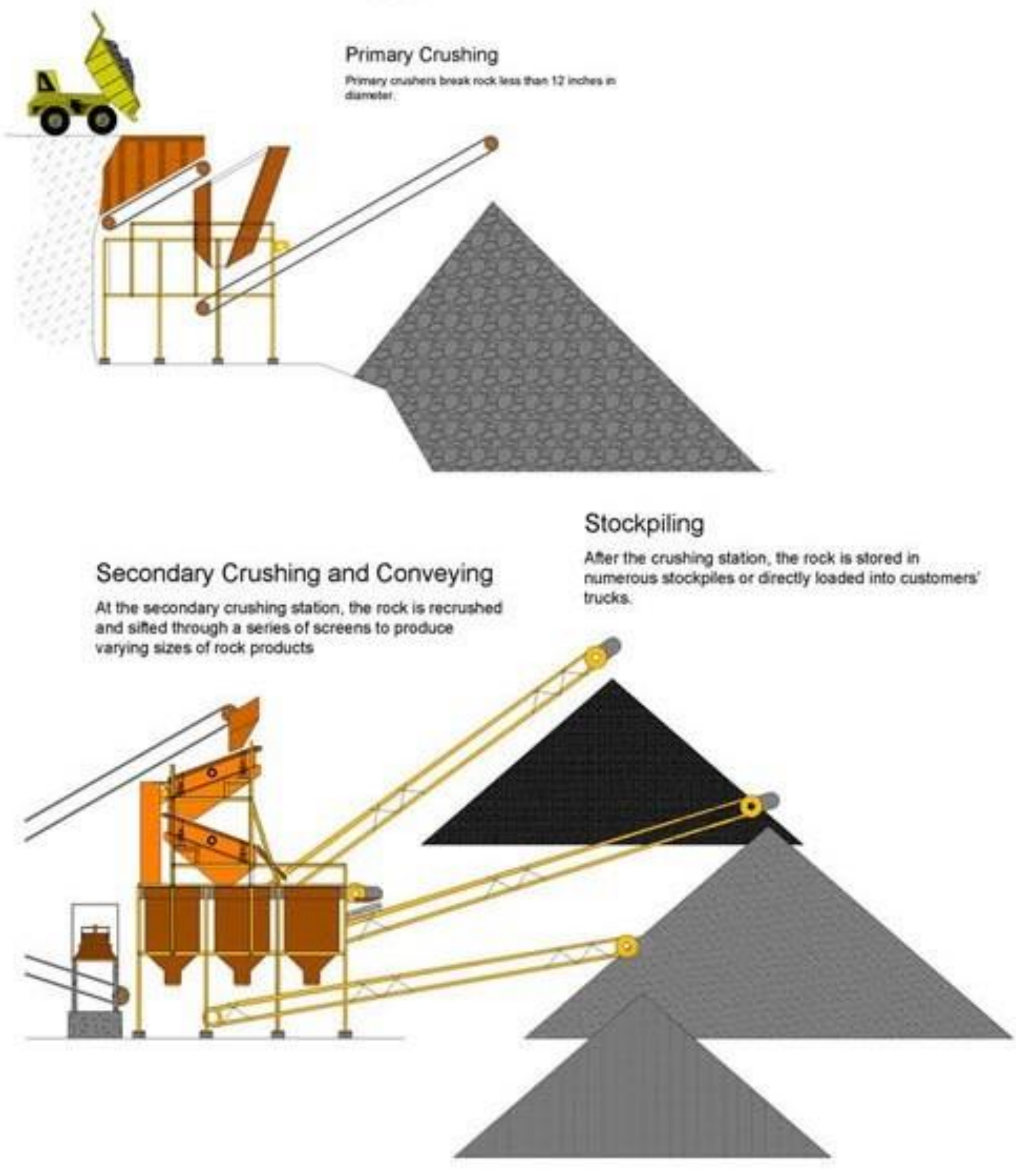


Figure 1-12: Crushing, Conveying, and Stockpiling Diagram

1.6.3 Support Facilities

The following facilities will be constructed within the MPSA area to support the proposed project operation:

Table 1-6: Proposed Support Facilities

Facility	Description	Covered Area			
		Parcel 1	*Parcel 2*	*Parcel 3*	*Parcel 5*
Admin Office Complex	The Office Building shall be the headquarters of the Project managers. It will hold the offices of the Resident Manager, Mine Planning, MEPEO, CRO, Safety and Health, clinic, survey and geology, administrative, and finance personnel.	2,000 m^2		2,000 m^2	2,000 m^2
Motorpool Area	The motorpool area shall be established for the care and maintenance of all the necessary equipment in relation to the project operation.	1,000 m^2	1,000 m^2	2,000 m^2	2,000 m^2
Nursery	A nursery area will be establish to serve as the main source of seedlings for the quarry project.			2,000 m^2	
Seedling Bank	A seedling bank shall be constructed to support the revegetation and rehabilitation activities of the project.	100 m^2	100 m^2		100 m^2

1.6.4 Pollution Control Devices/Facilities

1.6.4.1 Siltation Pond/Settling Ponds

Sedimentation/settling ponds shall be constructed to trap the sediments coming from the project operation. This facility shall be made of compacted materials and shall be strategically located adjacent to the quarry and stockpile areas. The purpose of the sediment/settling ponds is to block the water runoff with silt and impound/trap the water to allow the silt to settle.

Settling ponds will be constructed in series. Sediments shall be impounded from the first to the third pond in succession. While, the second pond is utilized, the first pond shall be drained and allowed to dry and desilted. Recovered silt materials will be used to backfill mined out areas. The third pond shall act a buffer for the first two ponds and shall be the source of water for the road sprinkling.

Silt traps will also be constructed along the main drainage canals to initially trap sediments carried by heavy rain before going to main settling ponds.

1.6.4.2 Quarry Drainage

Quarry drainage to be constructed will have a sufficient depth to handle volume of storm runoff and will be laid along the bench toe. Berms will be provided on the unprotected crest side to ensure safety.

1.6.5 Utilities

1.6.5.1 Water Requirement

Minimal water requirement will be needed by the project. The water requirement is estimated to be 10-15 m^3/day. Domestic water requirement for mine offices and other facilities will be sourced from deepwell/groundwater available on site. Mine water diverted through canals and collected in settling ponds can be recycled for road spraying and truck/equipment washing.

1.6.5.2 Power Requirement

The power requirement for each parcel are the following. The power is supplied by by the Visayan Electric Company (VECO) which draws their supply from National Power Corporation (NPC) and generators.

Table 1-7: Estimated Power Requirements per Parcel

Parcel	Power Requirement (KW)	Source
Parcel 1	120	Generator or VECO
Parcel 2	120	Generator or VECO
Parcel 3	120	Generator or VECO
Parcel 5	120	Generator or VECO

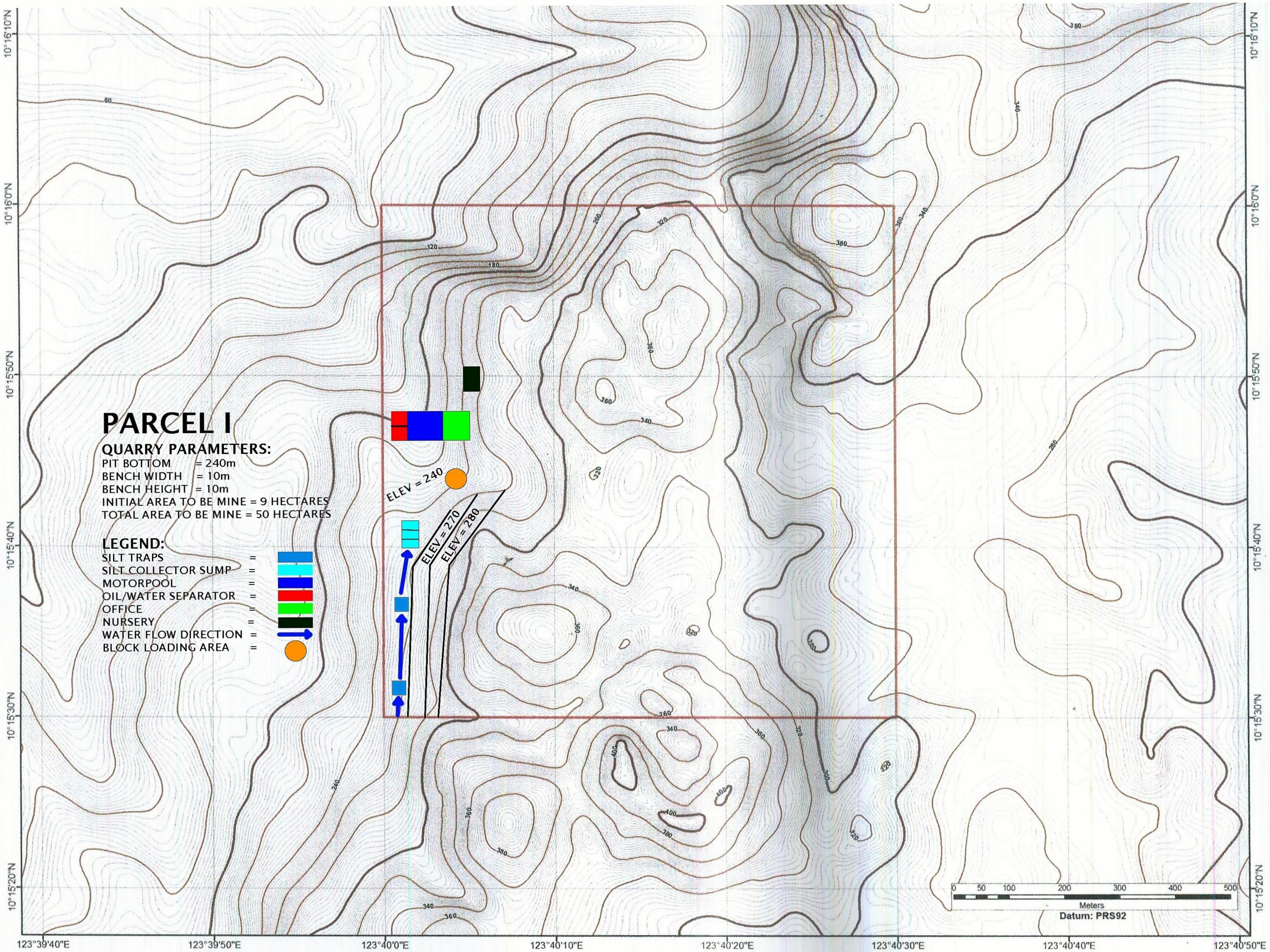


Figure 1-13: Site Development Plan for Parcel 1

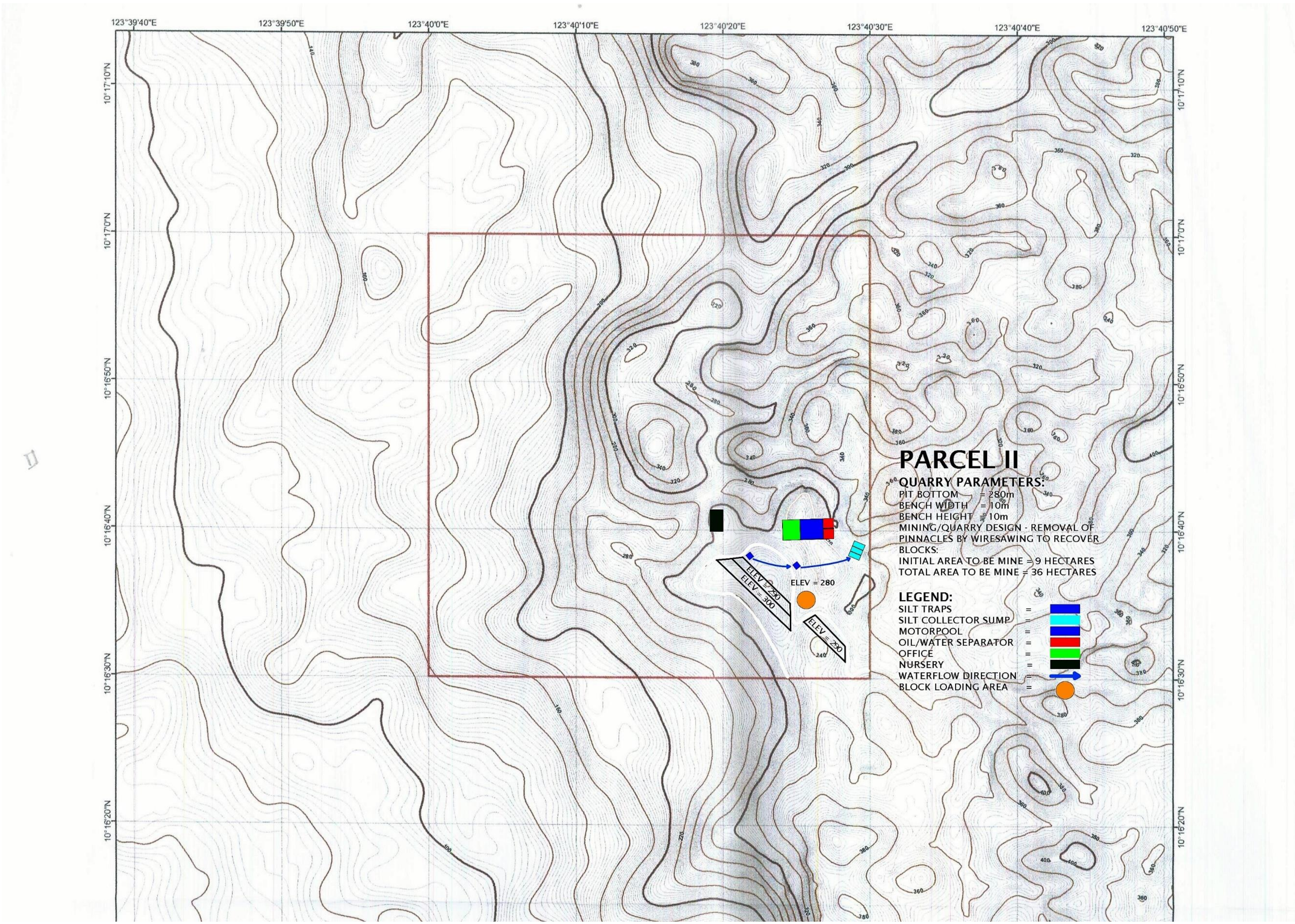


Figure 1-14: Site Development Plan for Parcel 2

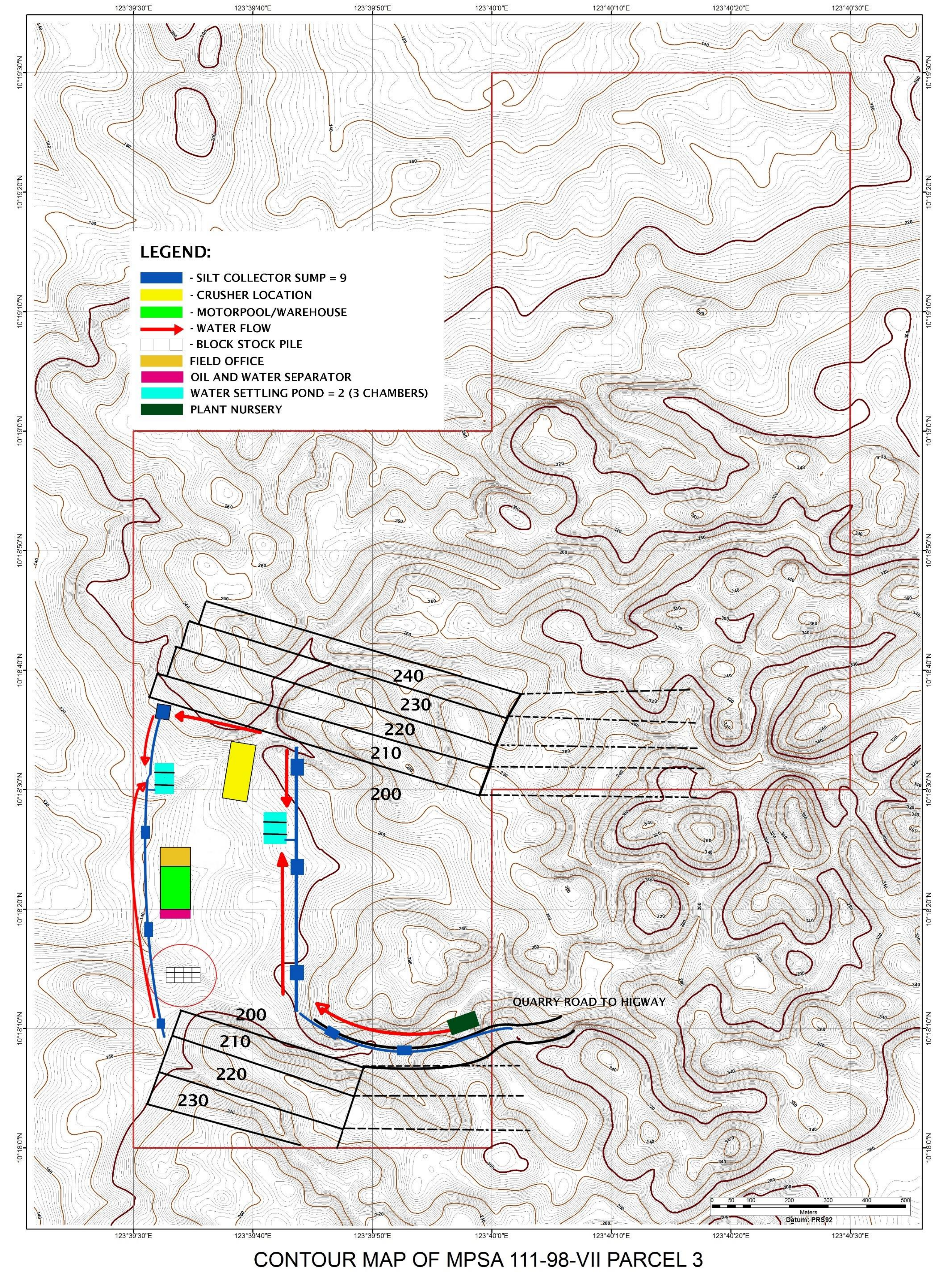


Figure 1-15: Site Development Plan for Parcel 3

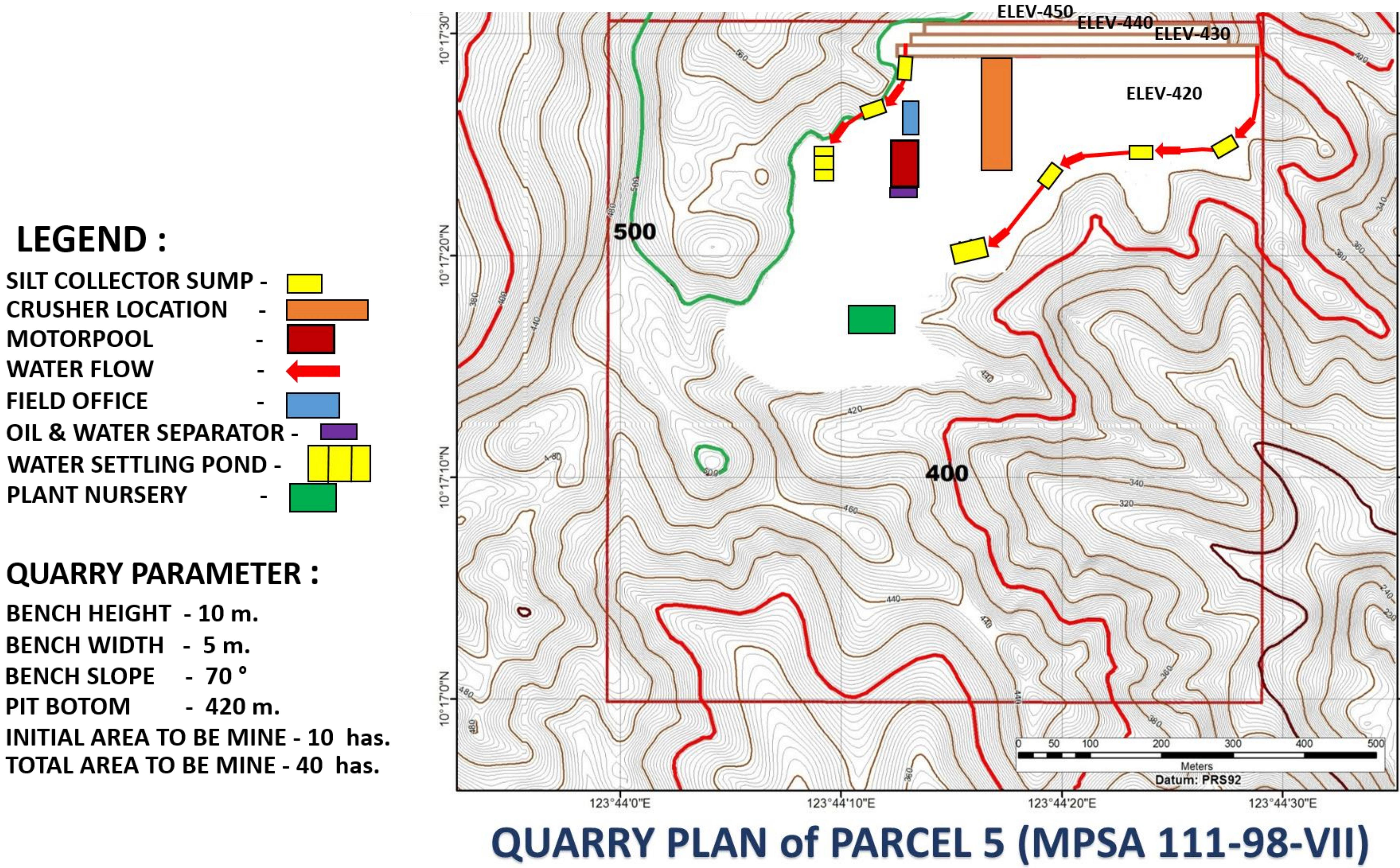


Figure 1-16: Site Development Plan for Parcel 5

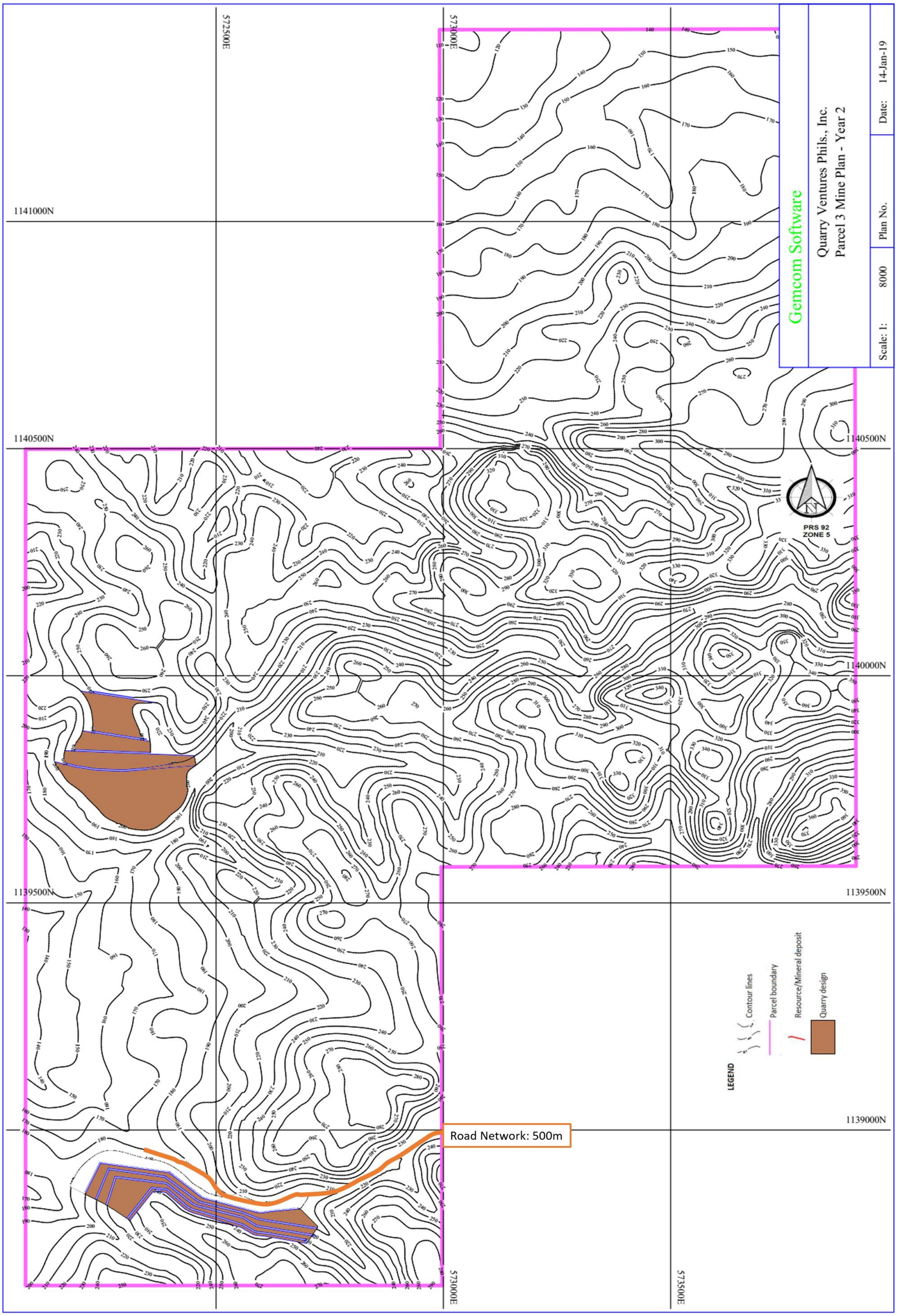


Figure 1-17: Proposed Acces Road for Parcel 3

1.7 Process / Technology

There is already an existing marble quarrying operation being conducted by QVPI in Parcel 1 covering 14.999 hectares of the 81 hectares alloted in the ECC. This operation will continue to be implemented in Parcel 1 and will be introduced to Parcel 2 and part of Parcel 3. The marble quarrying operation will utilize the use of diamond wiresaw complimented by rock drilling. This method is a three-step block cutting.

First, a quarry rock area to be put into production will be qualify by means of color, structural discontinuities. From the defined quarry block, each bancatta will be laid out, normally with a width of 2.6 meters. Each quarry block will have three to four (3-4) bancattas that will measure for around 10m x 7m x 2.6m.

After the two (2) working benches have been developed, topping or facing will be conducted. This is done to remove the blocks with cracks, weathered and irregular outer layer of the mineable marble block using the wiresaw. Once the planar surface is exposed, the quarry block will be evaluated for color, solidity and its amenability to be cut into slabs and tiles. The unsuitable marble quarry block will be removed to access the inner part to expose the high-quality marble.

The high-quality marble will then be prepared for wiresaw cutting. This will entail the drilling of intersecting holes (25-32 mm) by a rock drill equipment. Vertical and horizontal holes will be drilled on the edges of the defined quarry block to be mined using rotary drill (MPH-100 drill). On the intersected drill holes the diamond cable of wiresaw will be made to pass, prior to actual cutting of the marble block. Cutting will be done in horizontal and vertical motion.

Figure 1-18: Laying out of Wiresaw to cut the Marble into Blocks

The marble block will be cut again into bancattas using wiresaw after drilling the required holes intersecting horizontally and vertically. Once the bancatta has been cut (10m x 8m x 2.6m) and or separated from the mass, it will then be toppled by the use of hydraulic jack, air jack or hydro bag or combination of any of the three. Quarry waste materials comprising of clay, soil and small marble fragments will be placed in front of the bancatta to serve as cushion during the toppling process. The toppled bancatta will be inspected and laid out to give the best block that can be produced with regards to soundness, color and tone. These will be done either by drilling with jackhammers and will be spilled by wedging or cut by small wiresaw designed for block trimming.

Figure 1-19: Toppling Bancatta Using Titano Jack

Figure 1-20: Toppling Bancatta Using Hydro Bag

Figure 1-21: Toppling Bancatta Using Airpillow

For Parcels 5 and part of Parcel 3 method of mining to be utilized by the project is quarrying using conventional heavy equipment.

The limestone/basalt will have production benches of five to ten (5 - 10) meters high (depending on the reach of the loading unit to be utilized) with a 70° bench slope during development and production stage. Development work will generally start from the uppermost portion of the permit area and progresses downward. A portion of the area will be develop until a production bench with a slope of about 70° and a loading area of 30 meters, will be formed enough to sustain the safe movement of quarry equipment. Once a bench is formed, a new working level below (5 – 10 m downward) will be worked out to form another set of bench. Should safety and economy warrant, the cycle of creating a new working level (benches) at lower elevation will continue until desired target is reached. Incidental production is generally common in the development stage. Limestone and basalt materials may be extracted while access and benches are being established. Generally, the working parameters of the limestone quarry will be the following:

Table 1-8: Limestone Quarry Details

Parameters	Devt / Prod'n stage	Final Pit
Bench slope	70° - 75°	60-70°
Bench height	5 - 10 m	5m
Bench width	30 m (min.)	10m
Pit slope	60-70° (max.)	60-70°

Table 1-9: Pit Bottom

	Year 1	Year 2	Year 3	Year 4	Year 5
Parcel 1 marble	Construction and Development	260	260	260	260
Parcel 2 marble	Construction and Development	280	280	280	280
Parcel 3 marble	Construction and Development	200	200	200	200
Parcel 3 aggregates	Construction and Development	200	200	200	200
Parcel 5 aggregates	370	330	310	310	310

Table 1-10: Mining Area to be Disturbed per Year

	Year 1	Year 2	Year 3	Year 4	Year 5
Parcel 1 marble	Construction and Development	1	1.9	2.4	2.8
Parcel 2 marble	Construction and Development	1.45	1.93	2.3	2.5
Parcel 3 marble	Construction and Development	1.15	2.26	2.8	3.1
Parcel 3 aggregates	Construction and Development	2.61	5.96	13.56	19.8
Parcel 5 aggregates	4.51	7.37	10.67	14.92	18.7

Table 1-11: Coordinates and Mine Life Capacity of Parcel 1

Year	Latitude	Longitude	Capacity
Year 5	10°15'30"N	123°40'00"E	300,000MT

Year	Latitude	Longitude	Capacity
Year 5	10°15’40”N	123°40’00”E	
Year 5	10°15’44”N	123°40’08”E	
Year 5	10°15’40”N	123°40’05”E	
Year 5	10°15’30”N	123°40’05”E	
Year 25	10°15’40”N	123°40’15”E	1.8MMT
Year 25	10°15’30”N	123°40’15”E	

Table 1-12: Coordinates and Mine Life Capacity of Parcel 2

Year	Latitude	Longitude	Capacity
Year 5	10°16’35”N	123°40’15”E	300,000MT
Year 5	10°16’40”N	123°40’15”E	
Year 5	10°16’30”N	123°40’28”E	
Year 5	10°16’30”N	123°40’20”E	
Year 25	10°16’40”N	123°40’20”E	2MMT
Year 25	10°16’55”N	123°40’30”E	
Year 25	10°16’30”N	123°40’30”E	

Table 1-13: Coordinates and Mine Life Capacity of Parcel 3

Year	Latitude	Longitude	Capacity
Year 5	10°18’00”N	123°39’35”E	400,000MT
Year 5	10°18’10”N	123°39’35”E	
Year 5	10°18’10”N	123°39’55”E	
Year 5	10°18’00”N	123°39’55”E	
Year 5	10°18’35”N	123°39’30”E	7MMT
Year 5	10°18’50”N	123°39’30”E	
Year 5	10°18’45”N	123°39’45”E	
Year 5	10°18’45”N	123°40’00”E	
Year 5	10°18’30”N	123°40’00”E	
Year 5	10°18’30”N	123°39’45”E	
Year 25	10°18’10”N	123°39’45”E	1.5MMT
Year 25	10°18’20”N	123°39’45”E	
Year 25	10°18’20”N	123°40’00”E	
Year 25	10°19’05”N	123°40’00”E	35MMT
Year 25	10°19’05”N	123°40’30”E	

Table 1-14: Coordinates and Mine Life Capacity of Parcel 5

Year	Latitude	Longitude	Capacity
Year 5	10°17’00”N	123°44’15”E	60MMT
Year 5	10°17’12”N	123°44’15”E	
Year 5	10°17’12”N	123°44’20”E	
Year 5	10°17’18”N	123°44’20”E	
Year 5	10°17’18”N	123°44’15”E	
Year 5	10°17’22”N	123°44’15”E	
Year 5	10°17’22”N	123°44’30”E	
Year 5	10°17’26”N	123°44’30”E	

Year	Latitude	Longitude	Capacity
Year 5	10°17’26”N	123°44’15”E	
Year 5	10°17’26”N	123°44’15”E	

The mine plans for all the parcels and the details are given in **Figure 1-22** to **Figure 1-43**.

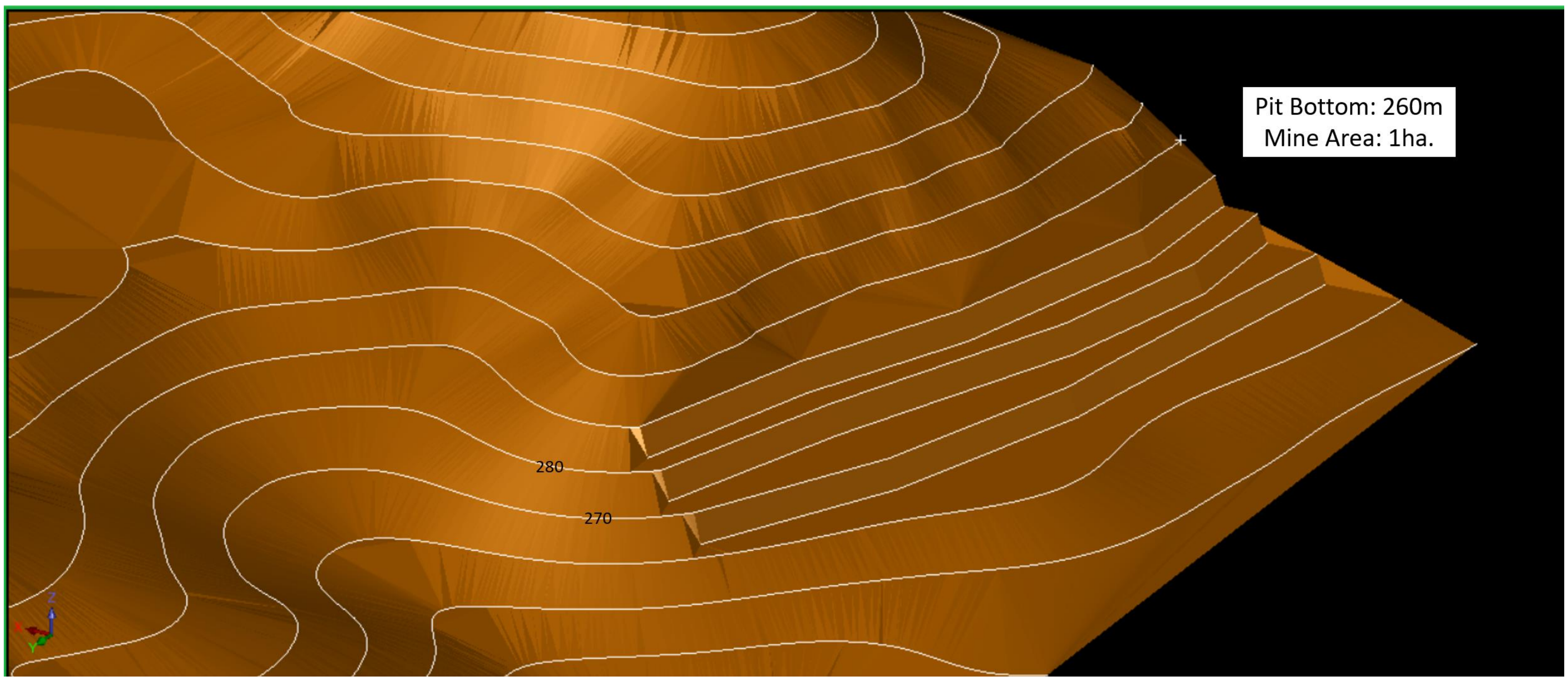


Figure 1-22: Mining Plan - Parcel 1 Year 2

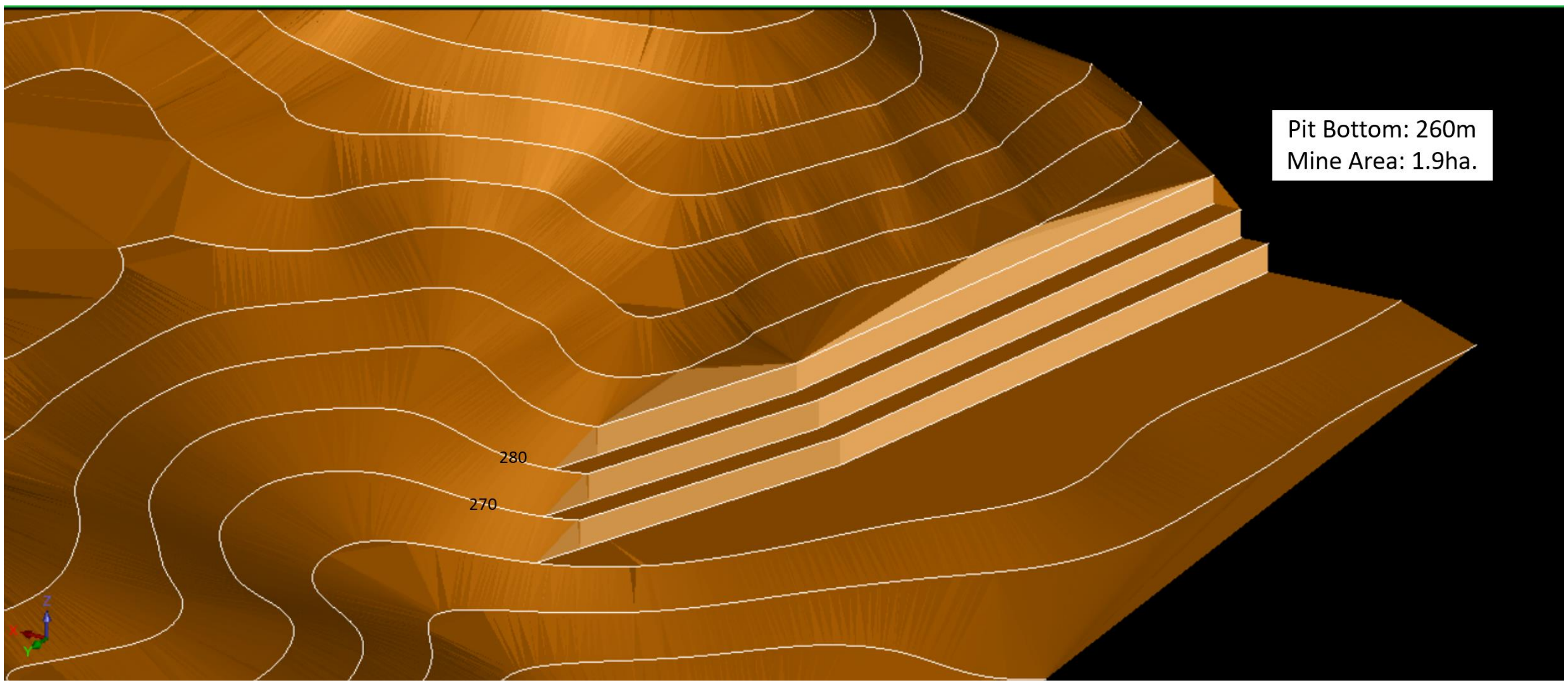


Figure 1-23: Mining Plan - Parcel 1 Year 3

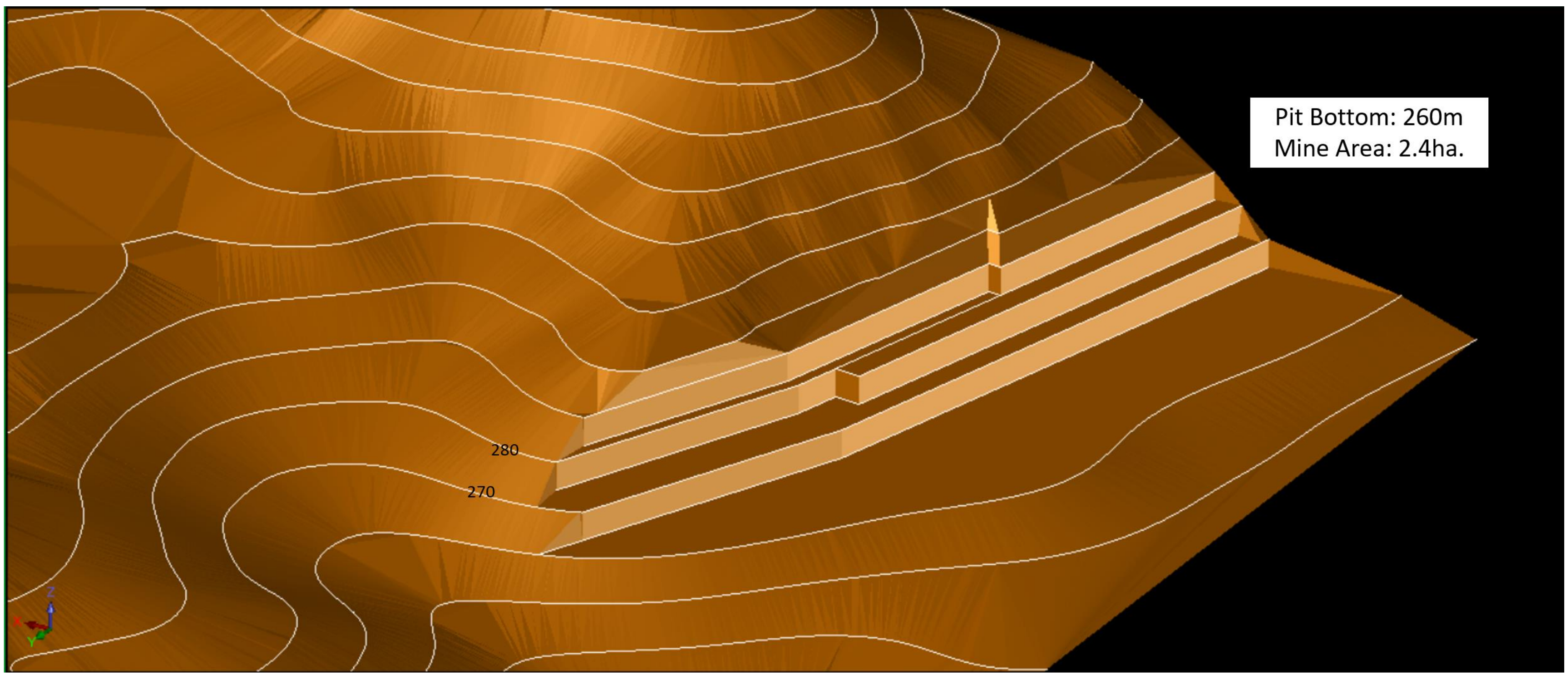


Figure 1-24: Mining Plan - Parcel 1 Year 4

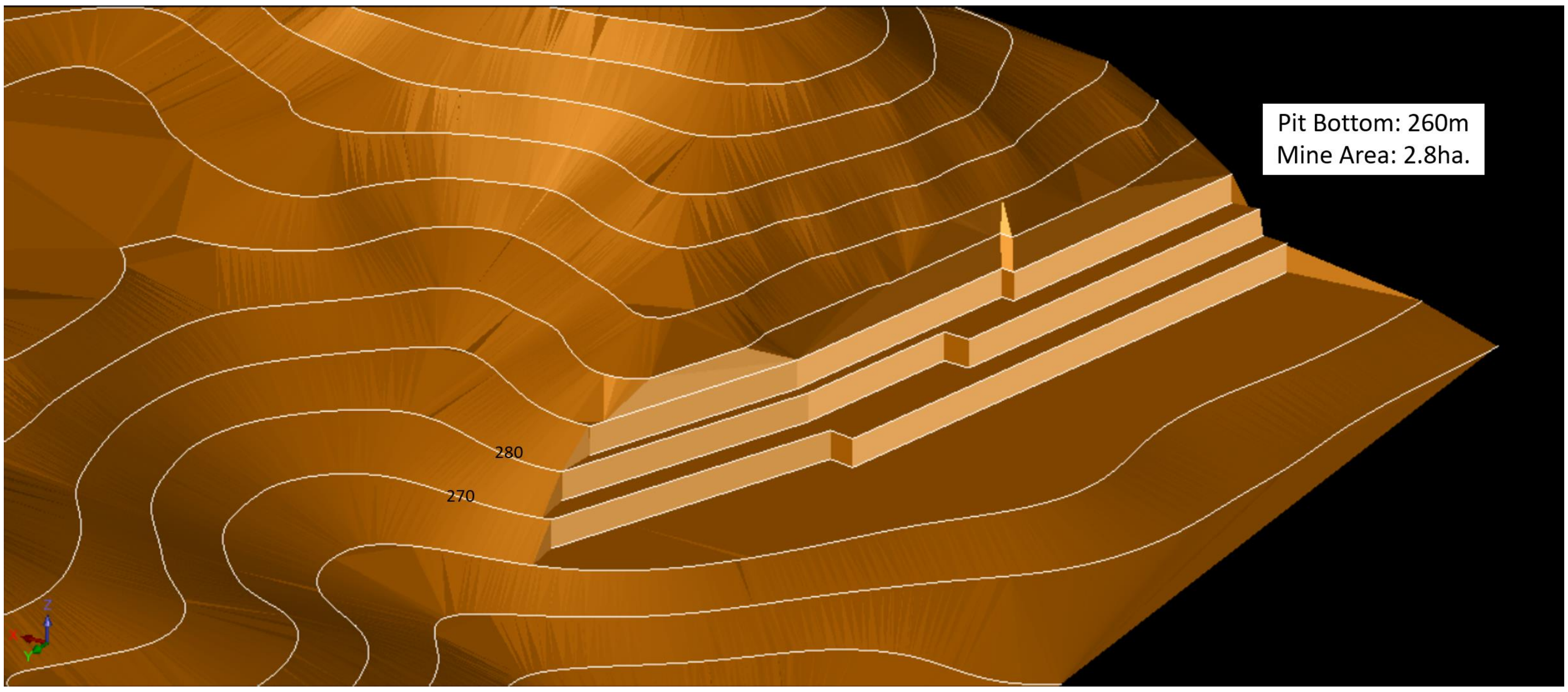


Figure 1-25: Mining Plan - Parcel 1 Year 5

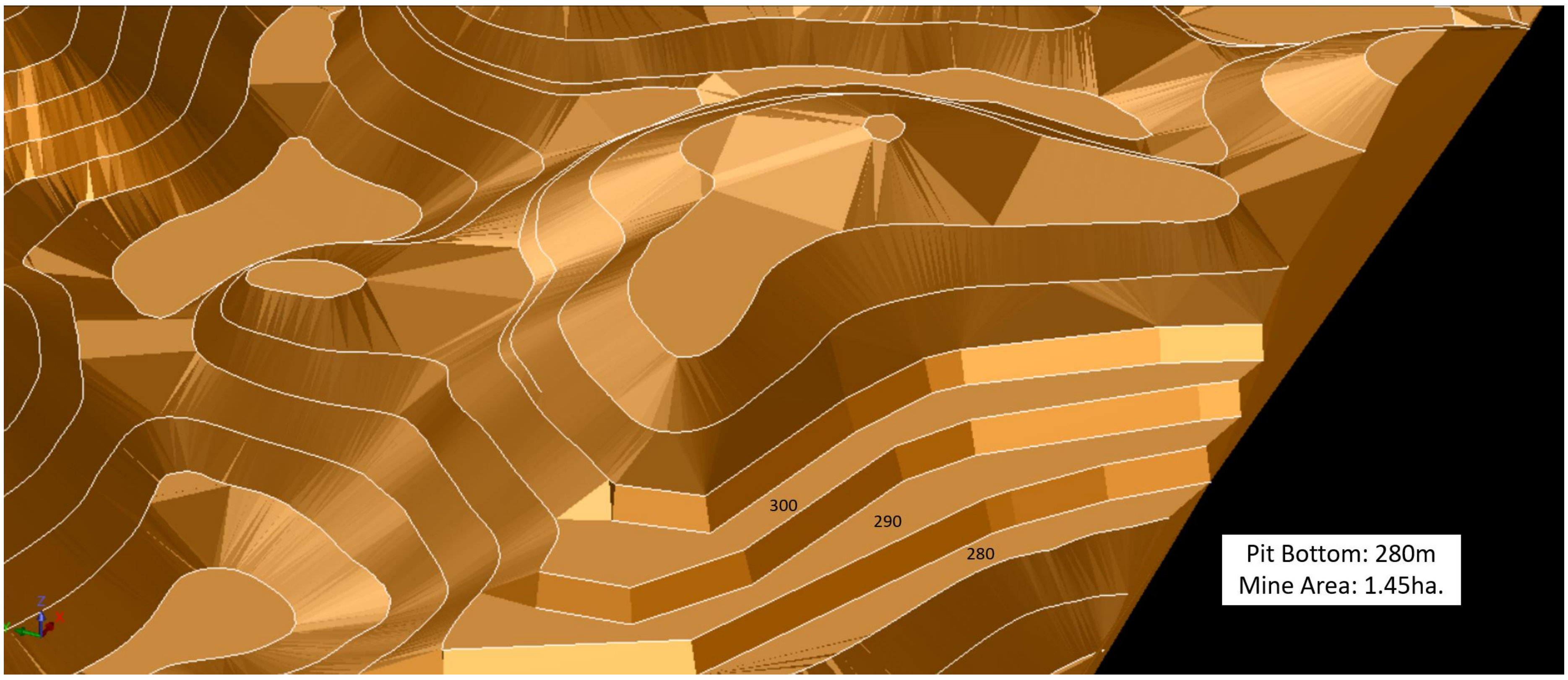


Figure 1-26: Mining Plan - Parcel 2 Year 2

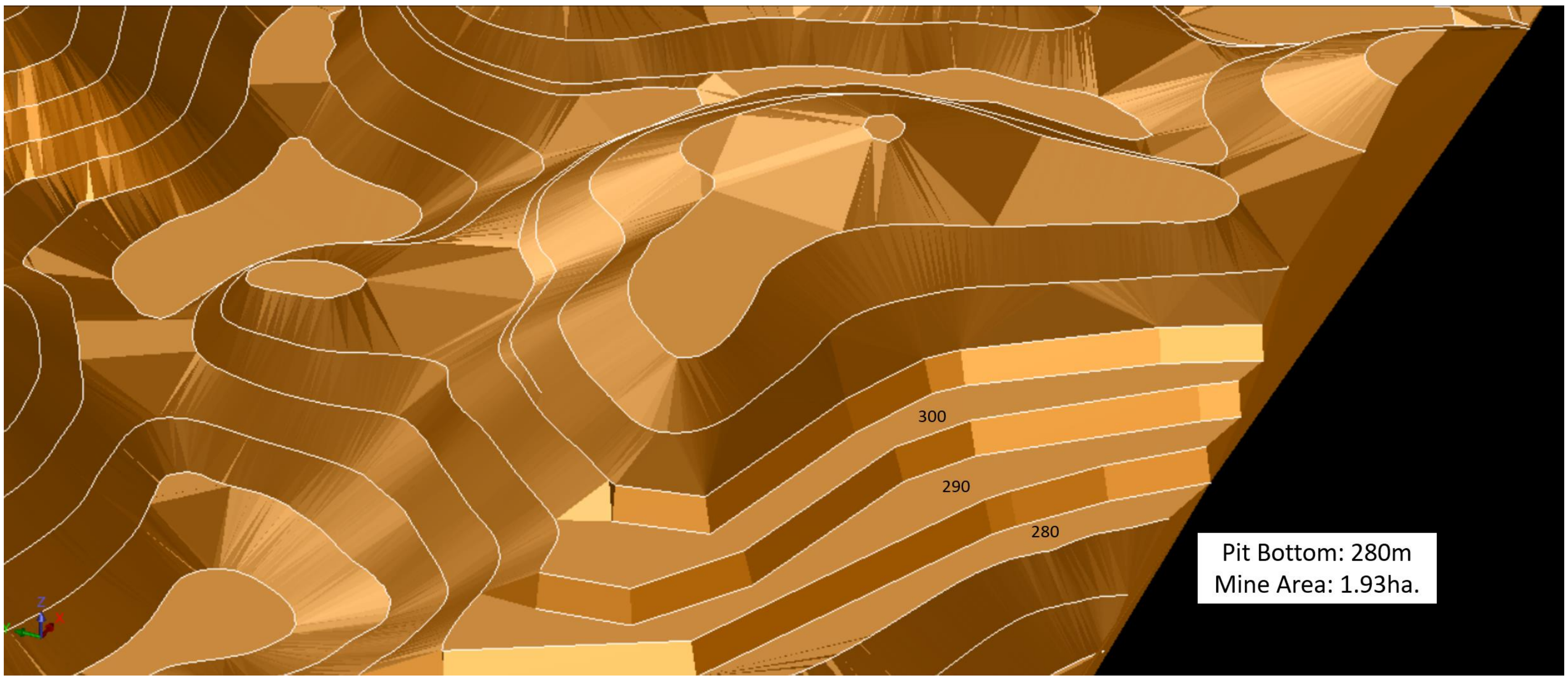


Figure 1-27: Mining Plan - Parcel 2 Year 3

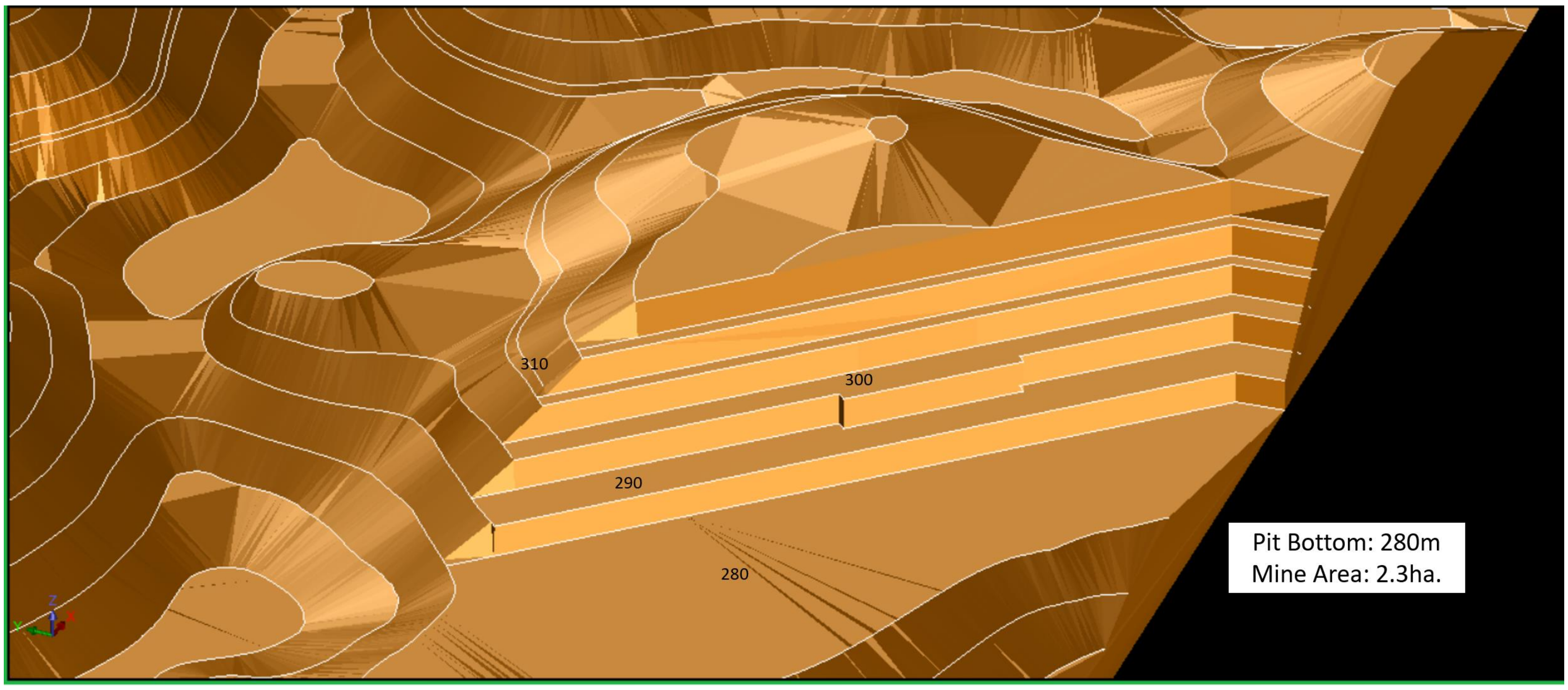


Figure 1-28: Mining Plan - Parcel 2 Year 4

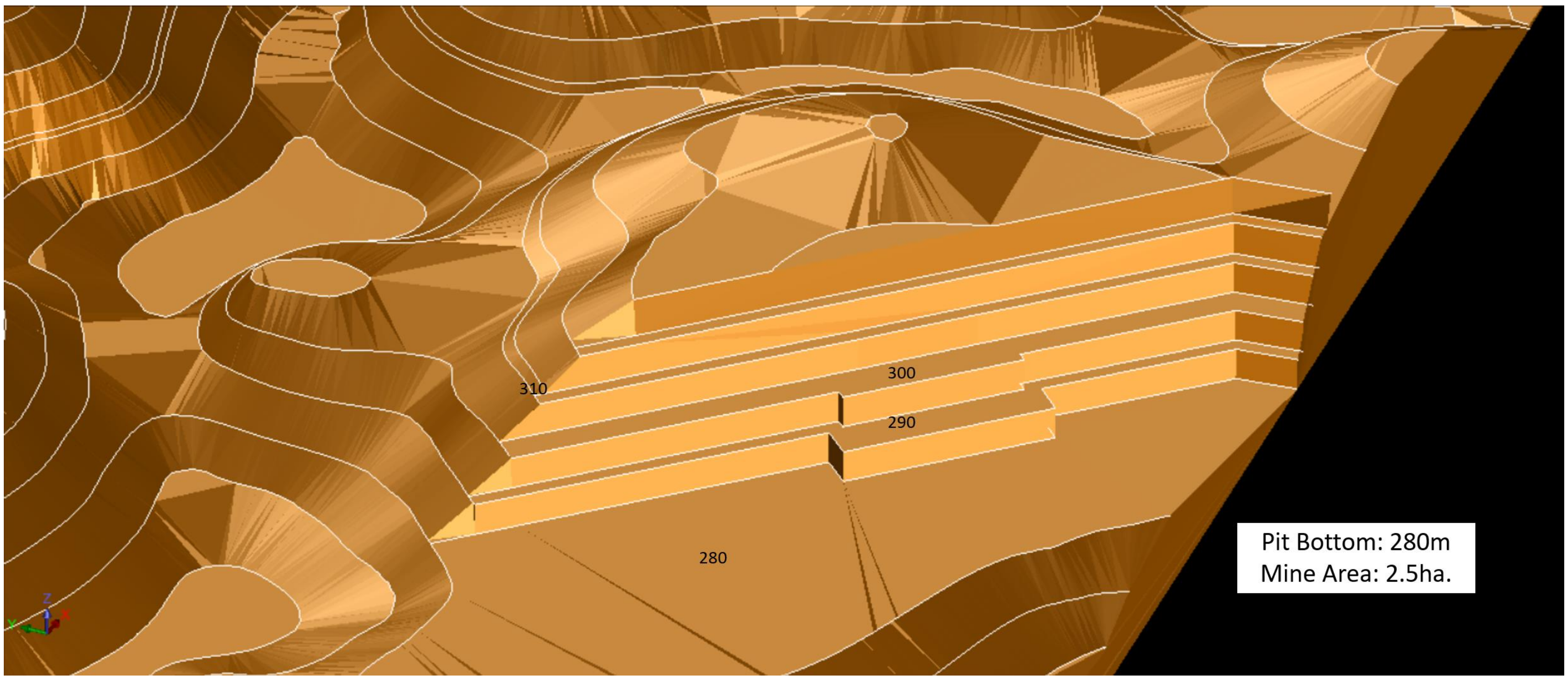


Figure 1-29: Mining Plan - Parcel 2 Year 5

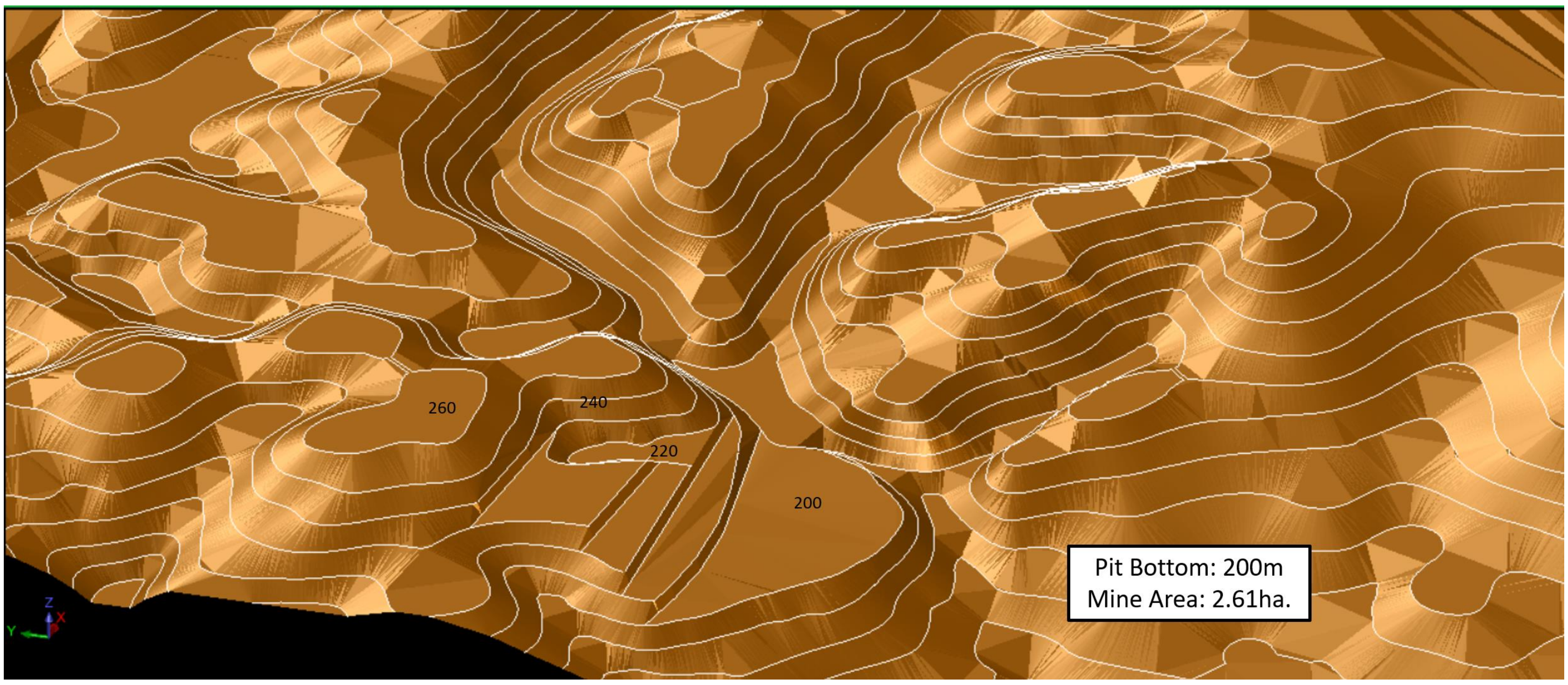


Figure 1-30: Mining Plan - Parcel 3 Aggregates Year 2

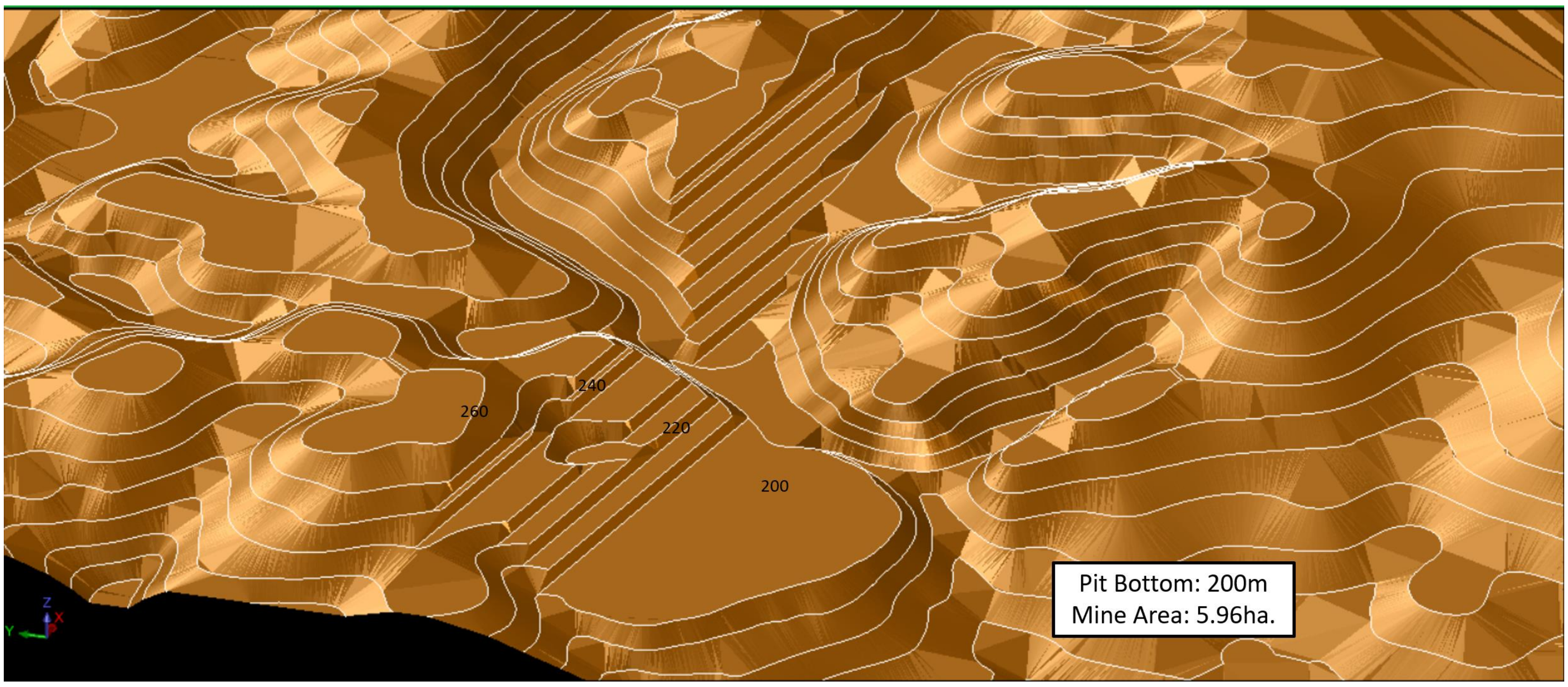


Figure 1-31: Mining Plan - Parcel 3 Aggregates Year 3

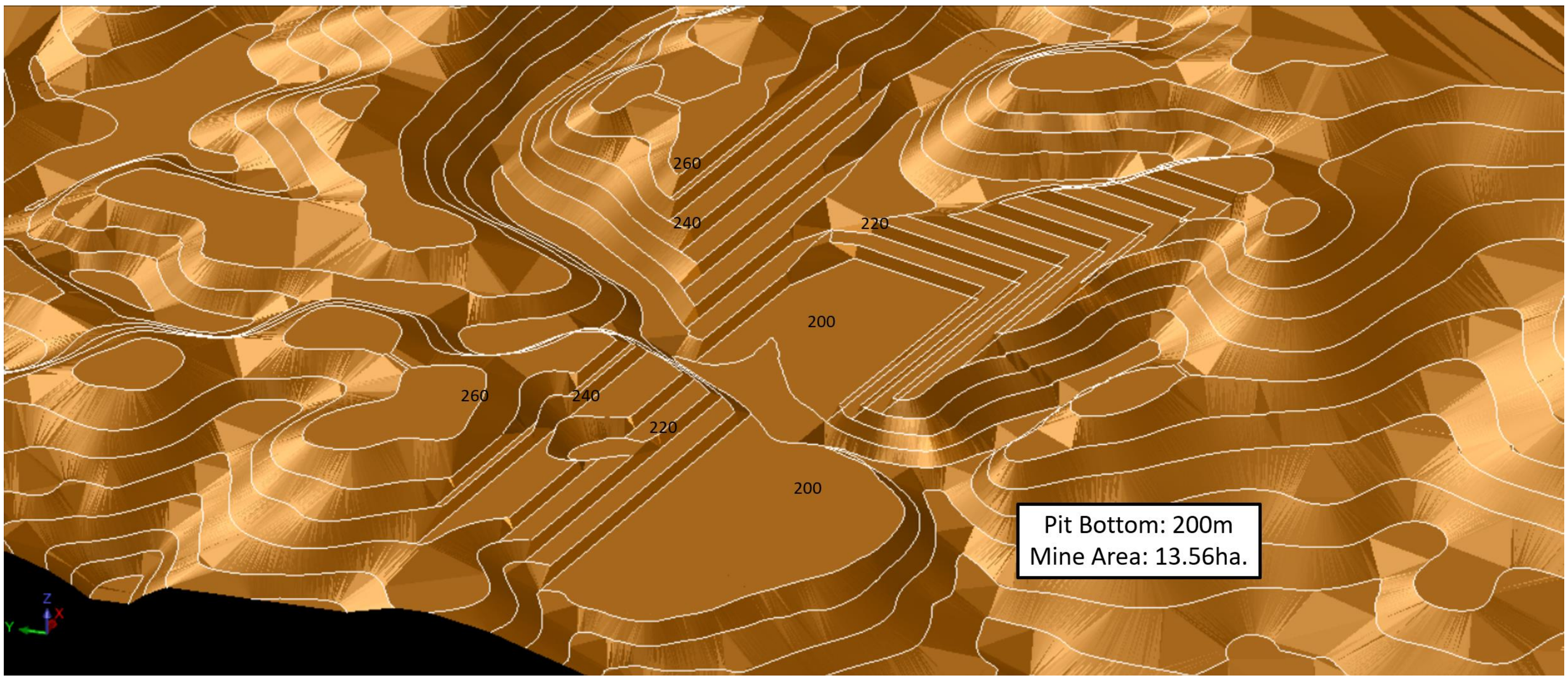


Figure 1-32: Mining Plan - Parcel 3 Aggregates Year 4

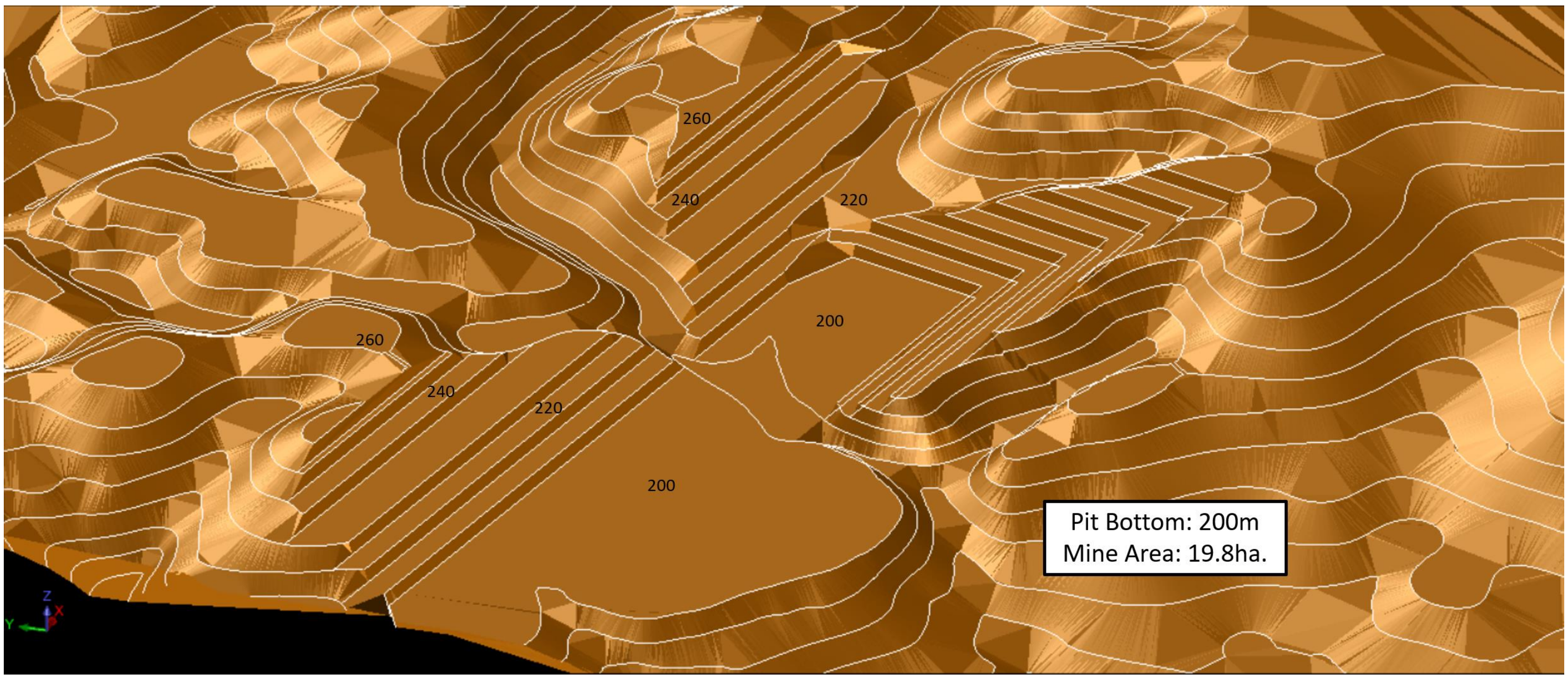


Figure 1-33: Mining Plan - Parcel 3 Aggregates Year 5

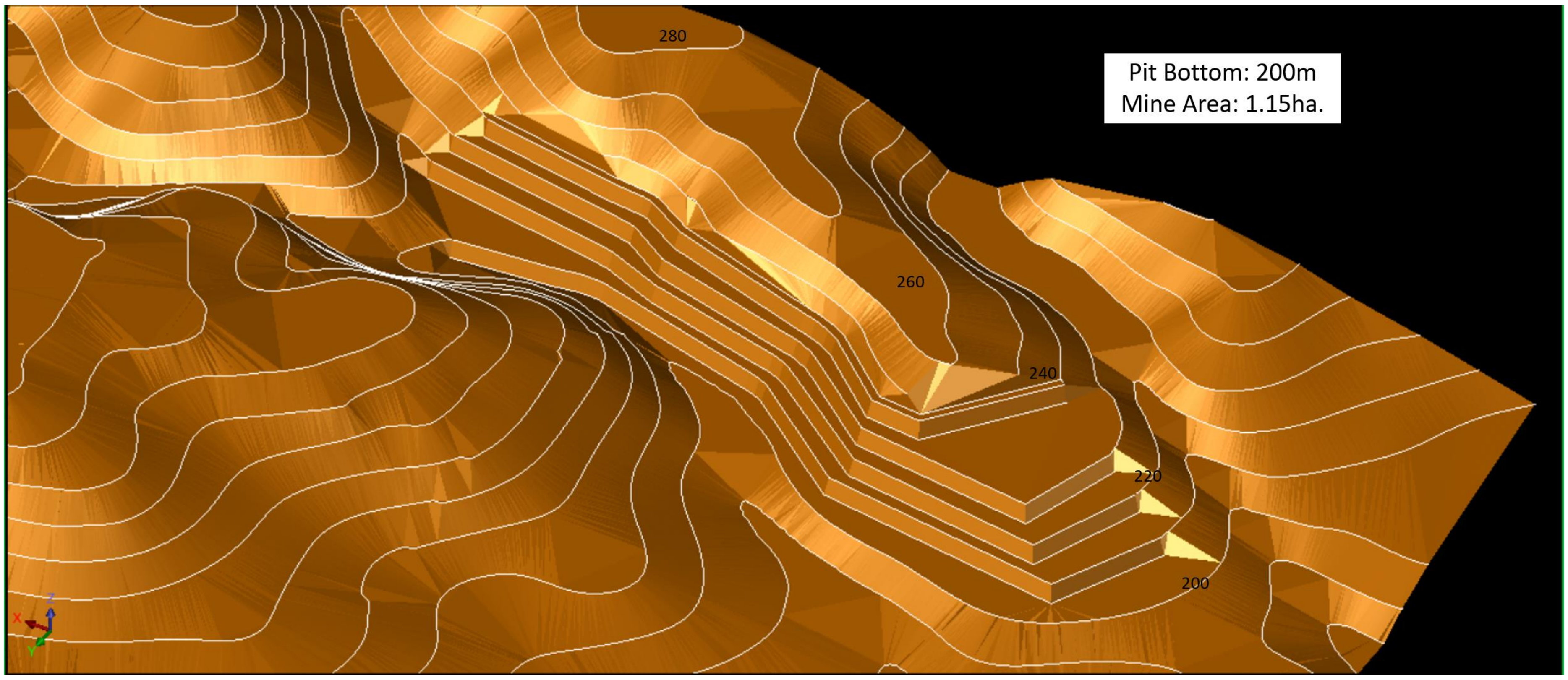


Figure 1-34: Mining Plan - Parcel 3 Marble Year 2

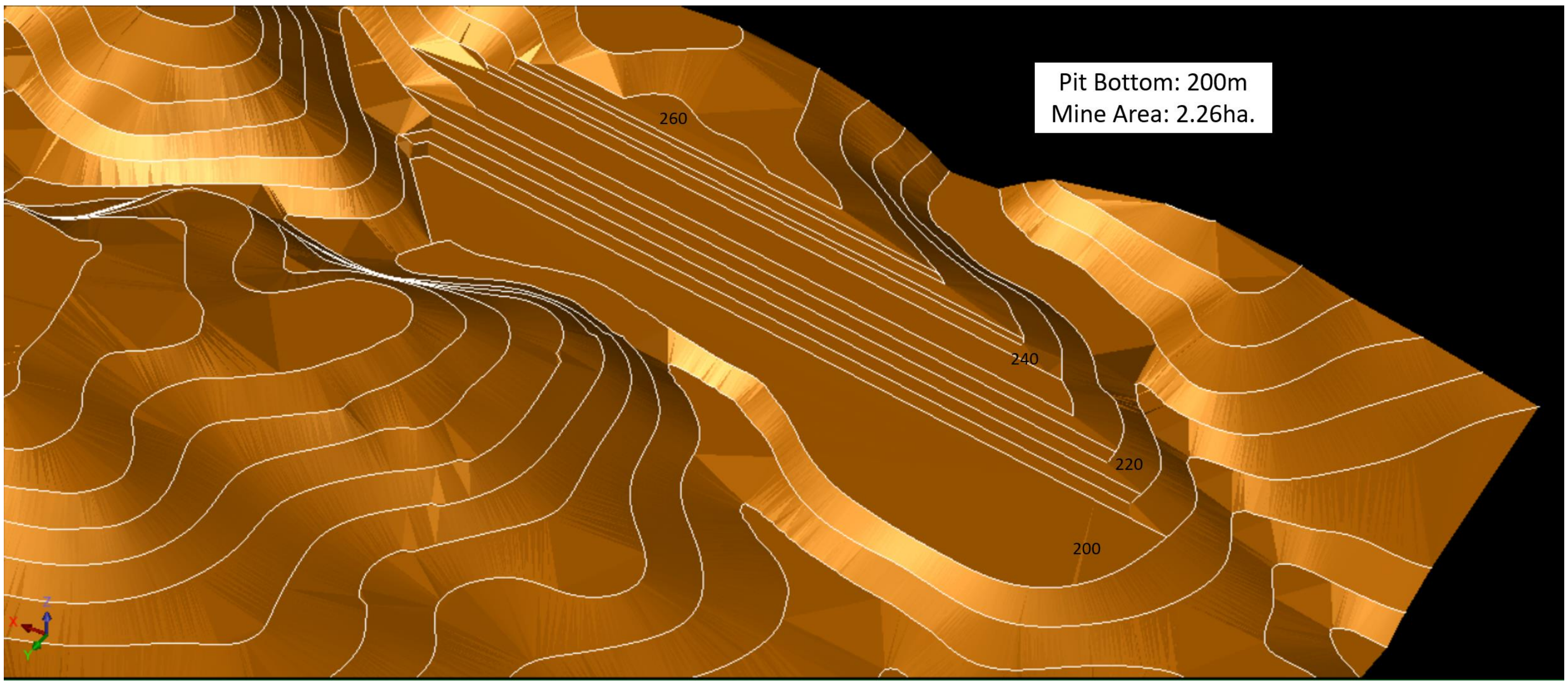


Figure 1-35: Mining Plan - Parcel 3 Marble Year 3

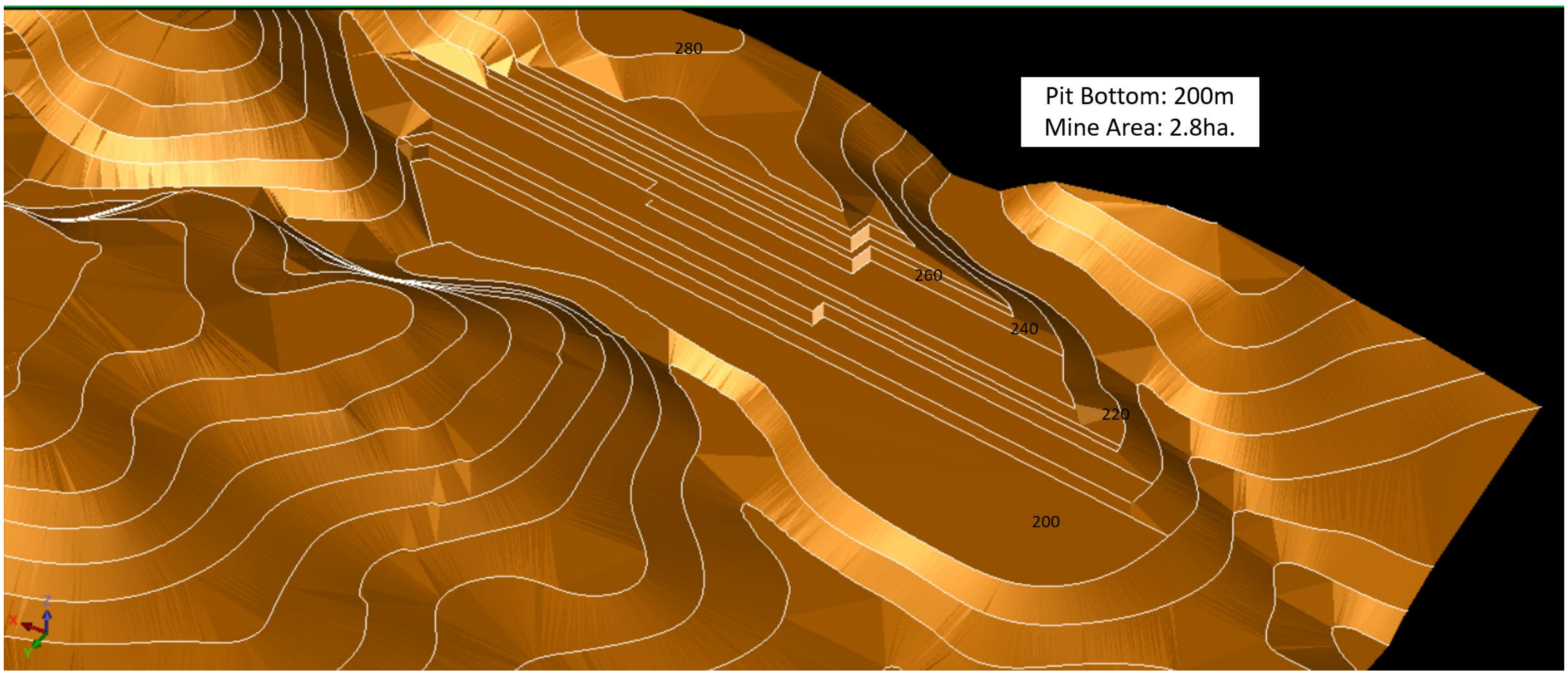


Figure 1-36: Mining Plan - Parcel 3 Marble Year 4

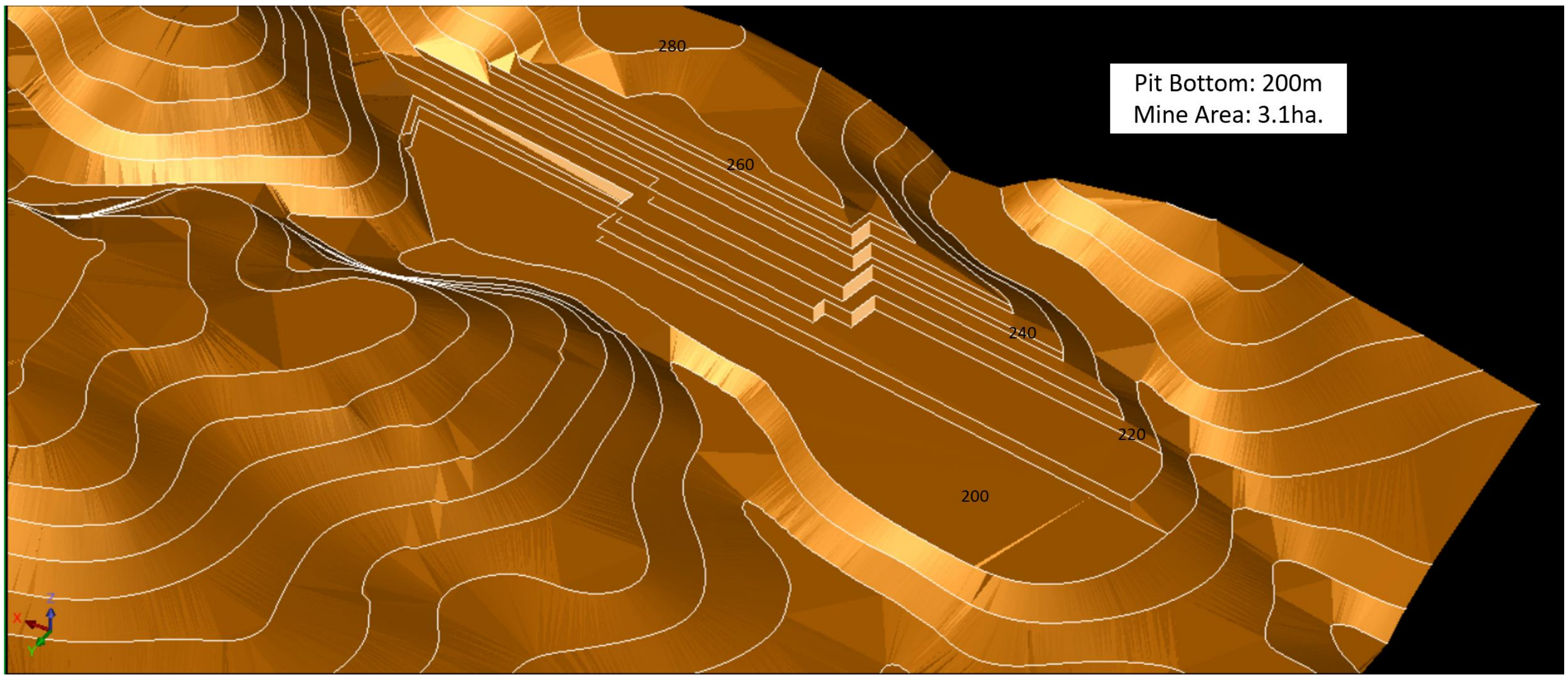


Figure 1-37: Mining Plan - Parcel 3 Marble Year 5

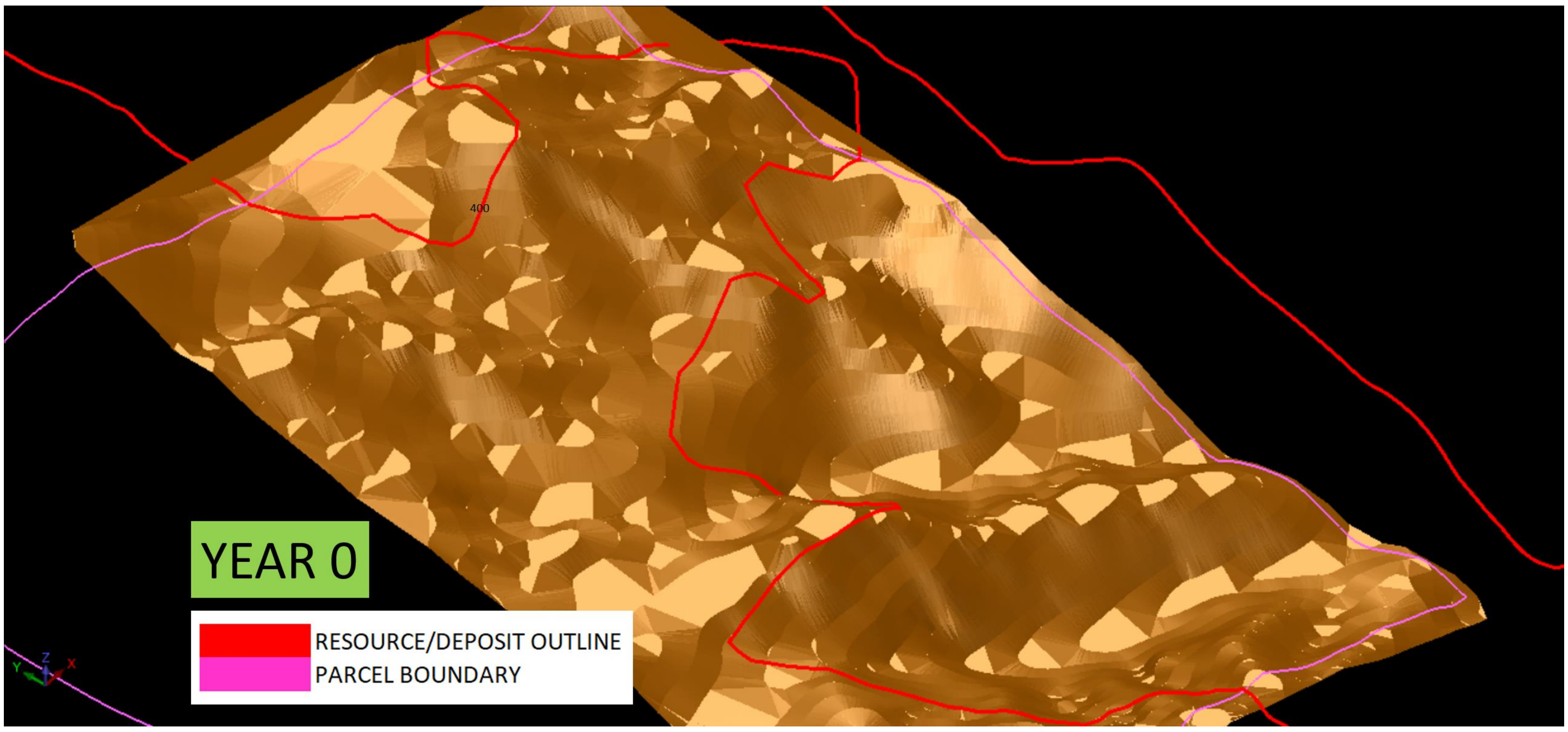


Figure 1-38: Mining Plan - Parcel 5 Year 0

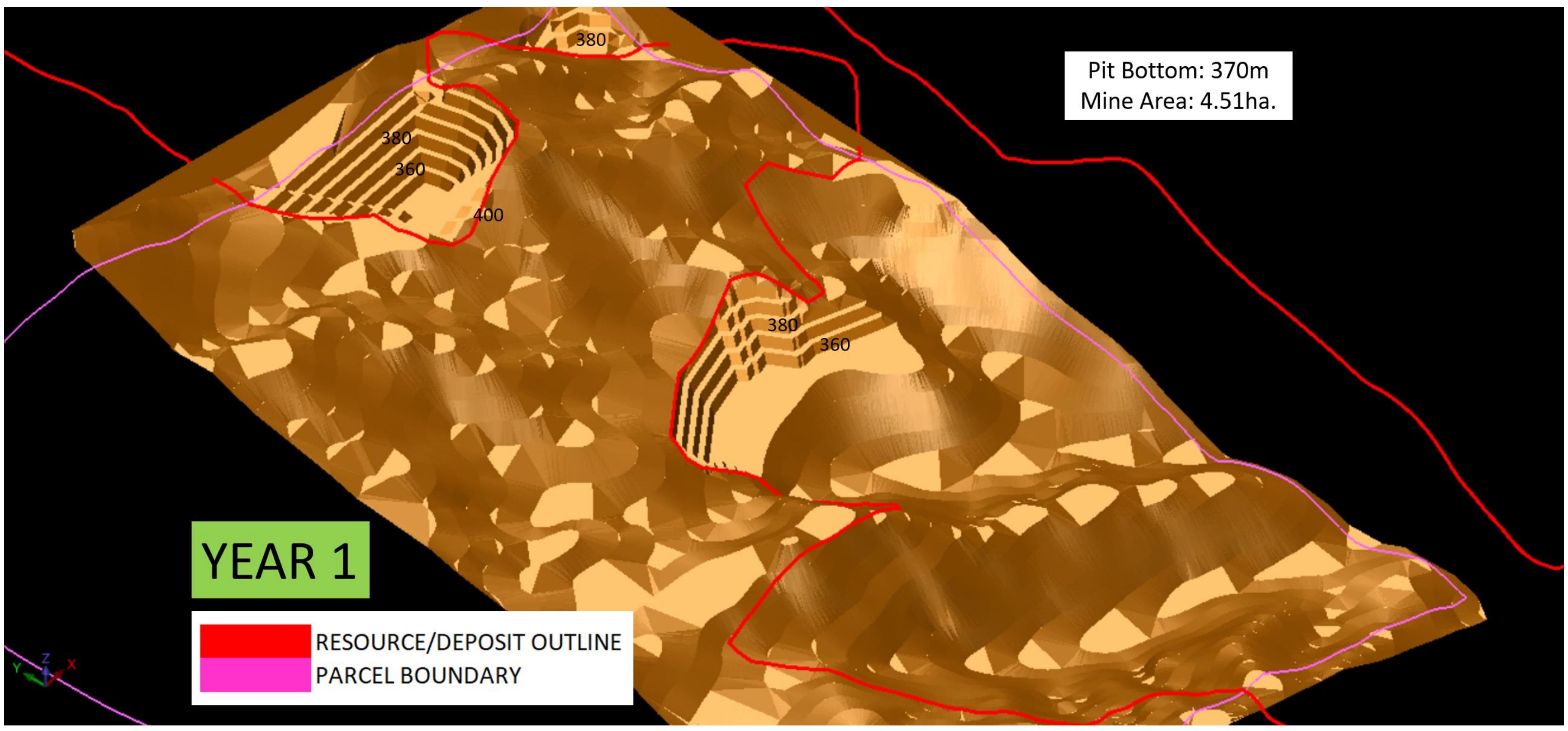


Figure 1-39: Mining Plan - Parcel 5 Year 1

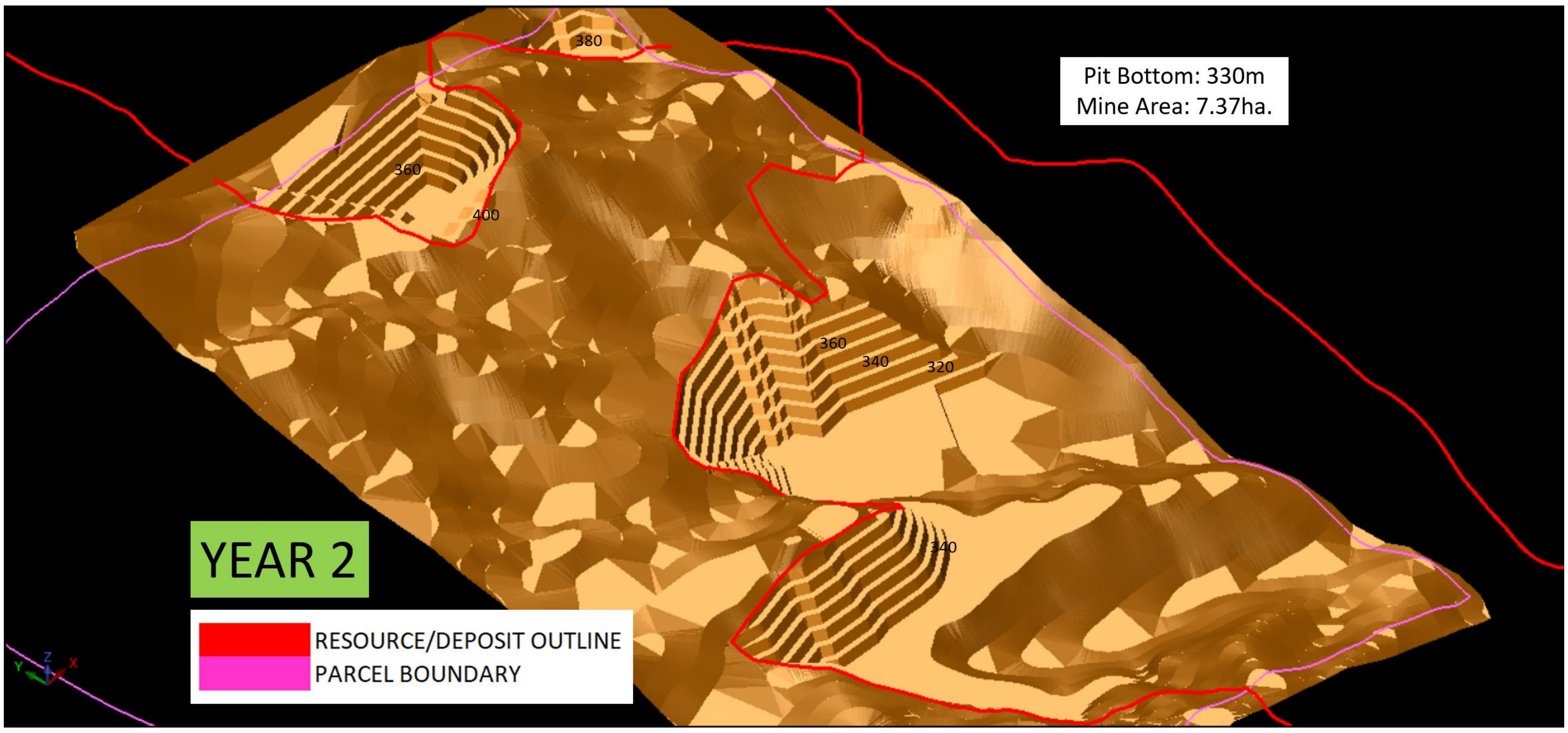


Figure 1-40: Mining Plan - Parcel 5 Year 2

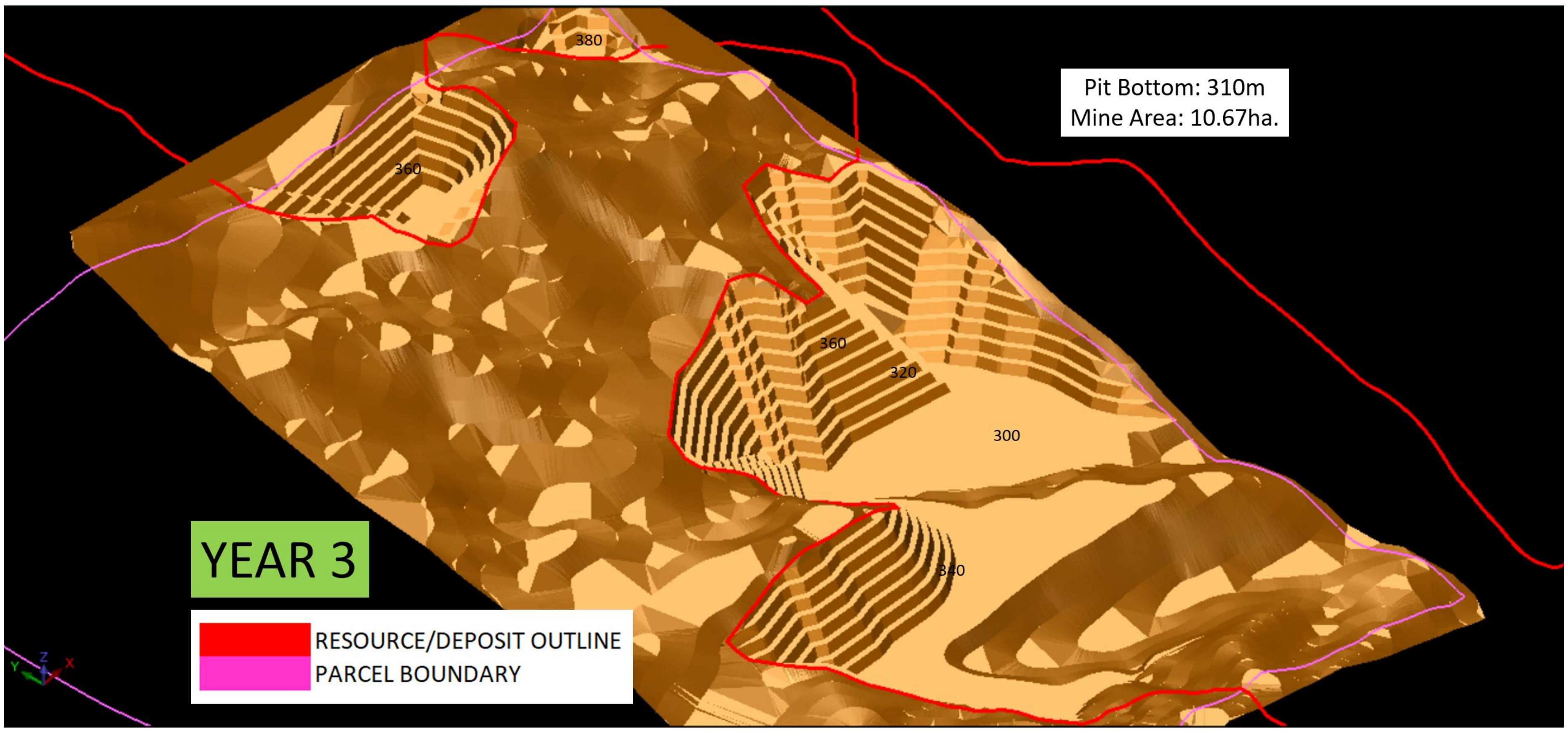


Figure 1-41: Mining Plan - Parcel 5 Year 3

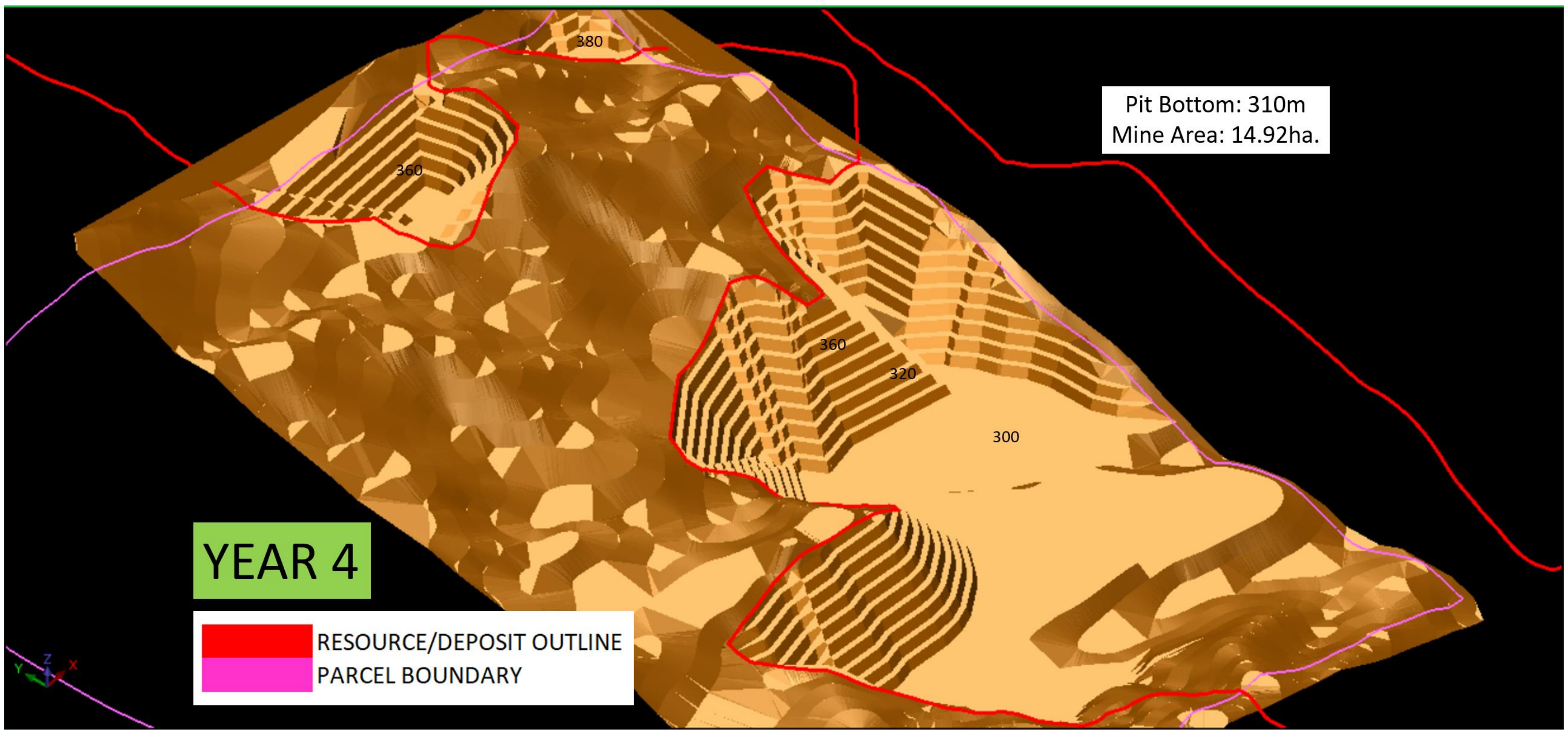


Figure 1-42: Mining Plan - Parcel 5 Year 4

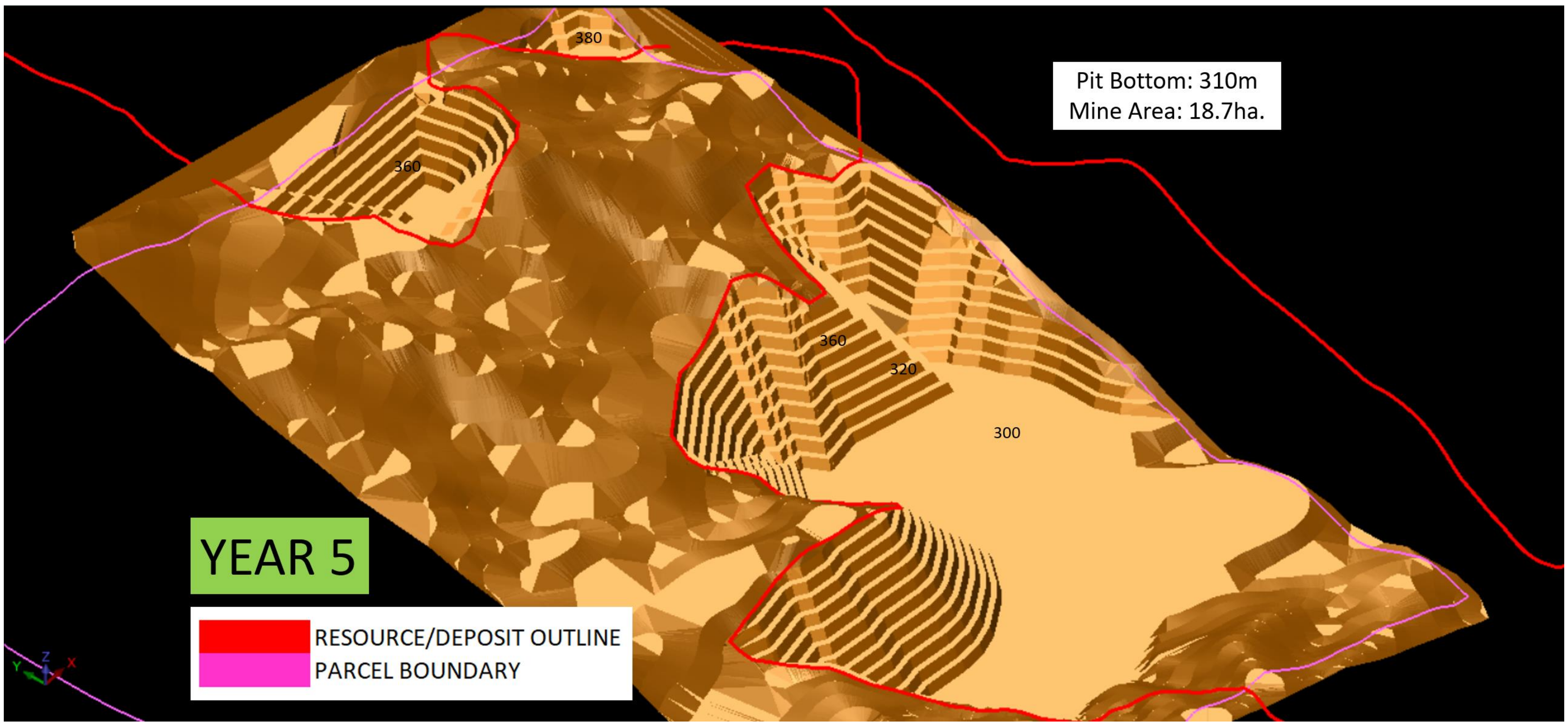


Figure 1-43: Mining Plan - Parcel 5 Year 5

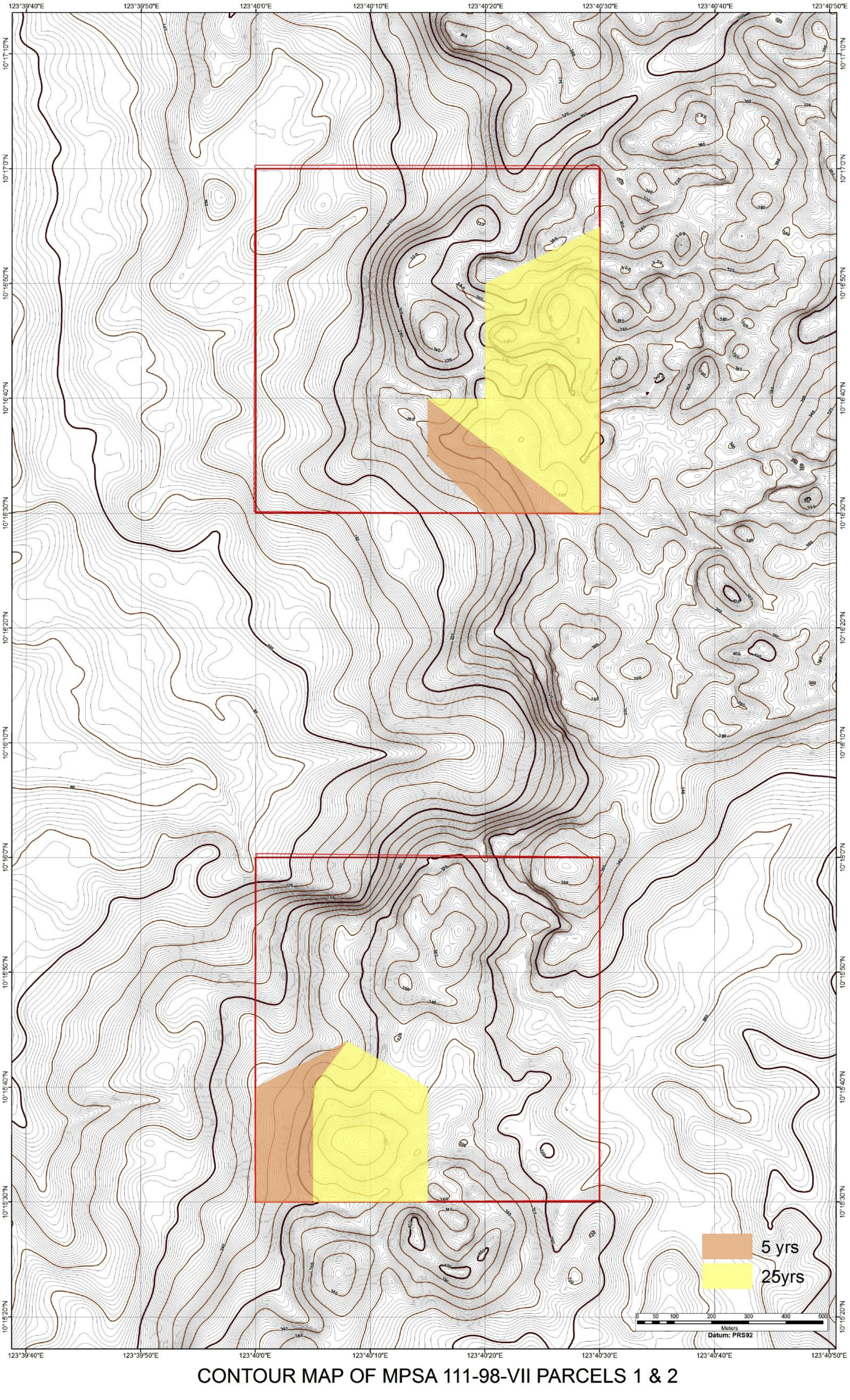


Figure 1-44: Estimated 5-Year and 25-Year Mine Area for Parcel 1 and 2

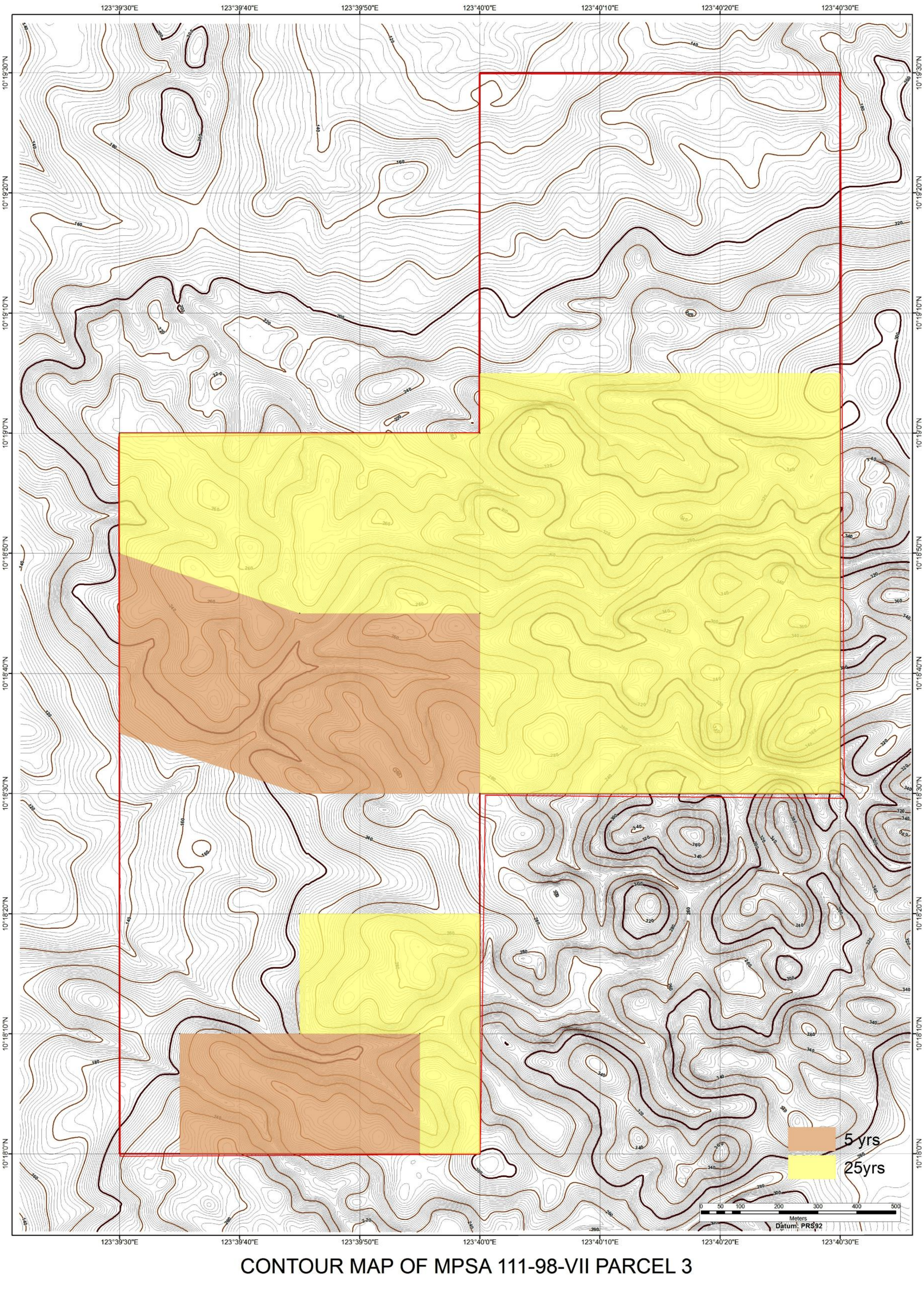
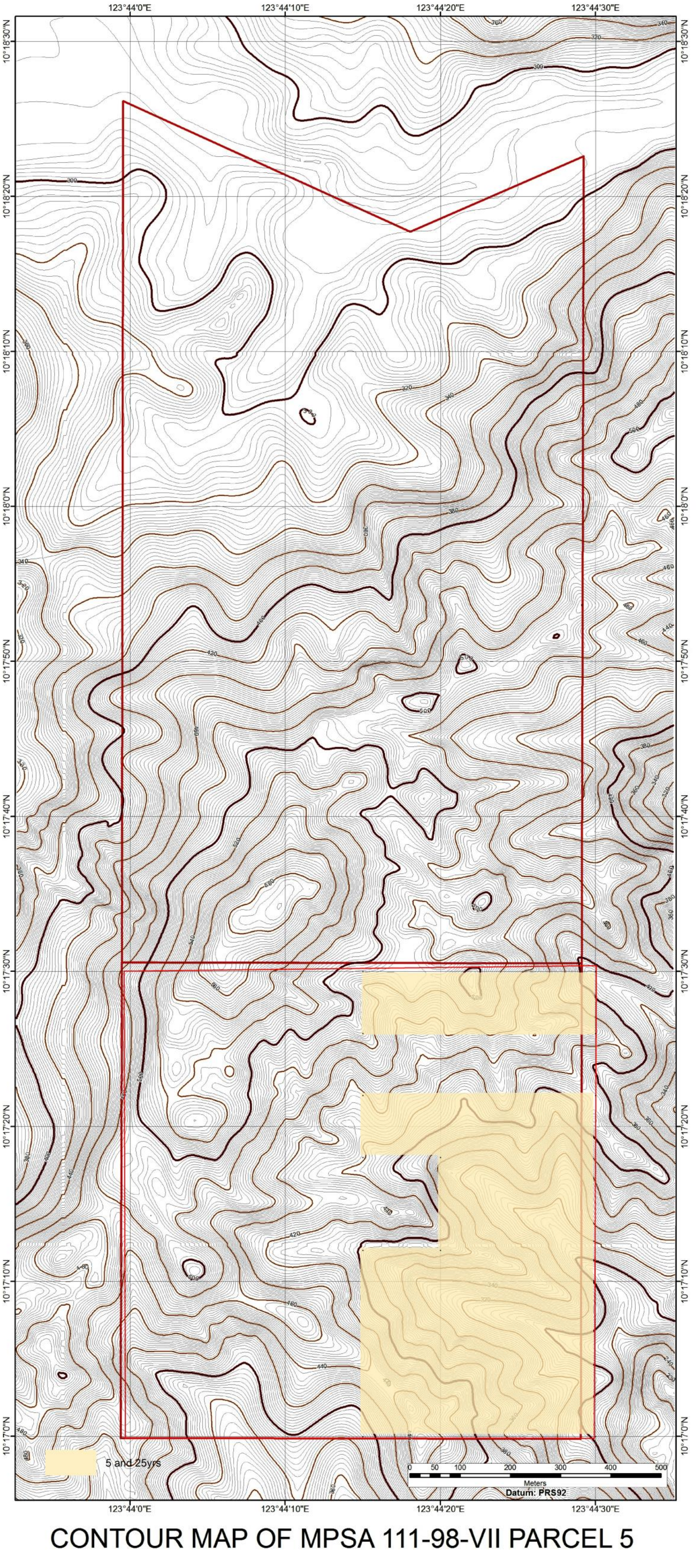


Figure 1-45: Estimated 5-Year and 25-Year Mine Area for Parcel 3



CONTOUR MAP OF MPSA 111-98-VII PARCEL 5

Figure 1-46: Estimated 5-Year and 25-Year Mine Area for Parcel 5

1.8 Project Size

1.8.1 Availability of Raw Materials

The estimated basalt deposit in Parcel 5 hosted by the Cansi Basalt are 82. 33 million cubic meters of indicated resources and 45.94 million cubic meters of inferred resources. The limestone/marble deposits within the Uling Limestone in Parcel 2 have an indicated resource of 61.22 million cubic meters and 29.8 million cubic meters of inferred resources. In Parcel 3, the indicated resource is 262.60 million cubic meters and the inferred resource is 37.9 million cubic meters. These were based on the Geologic Exploration and Resource Assessment Report prepared by Competent Person Geologist Rolando Pena in 2015.

1.8.2 Production Capacity and Area

Currently, QVPI have an allowable production capacity of 3,000 m^3/y of marble blocks and boulders covering a total area of 14.02 hectares as per the approved ECC. The proposed project expansion will cover a total area of 567 hectares having an annual production rate of 37,100 MT/yr of Marble, 973,900 MT/yr of Limestone Aggregates and 1,937,000 MT/yr of Basalt.

Table 1-15: Estimated Production Capacity per Parcel

Parcel	Area (current)	Area (expansion)	**Production Capacity (current)**	**Production Capacity**
Parcel 1	14.02 hectares	81 hectares	3,000 m^3 or 4,800 MT marble blocks/year	6,000 m^3 or 9,600 MT marble blocks/year
Parcel 2		81 hectares		16,200 MT marble blocks/year
Parcel 3		324 hectares		16, 100 MT marble blocks/year 973, 900 MT limestone aggregates per year
Parcel 5		81 hectares		1,937,000 MT basalt/year

1.8.3 Mine Life

Marble Quarry

Parcel	Proposed Extraction Capacity	Mineral Reserve Capacity	Estimated Mine Life
Parcel 1	3,000 m^3/yr	274,510 m^3	92 years
Parcel 2	6,750 m^3/yr	61,230,00 m^3	9,071 years
Parcel 3	6,750 m^3/yr	262,600,000 m^3	38,904 years

Aggregates Quarry

Parcel	Proposed Extraction Capacity	Mineral Reserve Capacity	Estimated Mine Life
Parcel 3	990,000 MT/yr	709,020,000 MT	716
Parcel 5	1,937,400 MT/yr	230,440,000 MT	119

Based on the calculation of the proposed extraction capacity, and the mineral reserve capacity, the mine life for the project area is estimated to last for 38,000 years for marble and 700 years for the aggregates. However, the proponent only plans to operate on the project site up to the MPSA validity of 5 years, subject to renewal, if necessary.

1.9 Project Phases

1.9.1 Pre-Construction Phase

This phase involves the hiring of skilled local employees in preparation for project development. During this phase all permits mandated by the government shall be acquired by the company prior to the construction phase.

The Information Education and Communication (IEC) campaign shall be continuously implemented to update the stakeholders on the current and future development of the project.

1.9.2 Construction Phase

This phase will require hiring of additional manpower to support the construction activities of the project. Local hiring of skilled individual will be prioritized/implemented by the company.

Construction of haul road and access road shall be the first activity during this phase. The construction of these facilities shall be conducted in a manner wherein minimal disturbance will be created. All roads shall follow the topographic contour of the area and shall be equipped with road drainage for further environmental measures.

Temporary settling ponds shall be developed within the construction area to cater the mitigation of possible siltation and water contamination. If the constructed ponds will no longer be usable during the operation phase, such facility shall be dewatered, backfilled and revegetated.

The construction of horizontal buildings shall conform to the Building Code of the Philippines to ensure safety and stability. Clearing, grubbing and compaction will be done at the region wherein construction will be conducted. The said activity shall be limited to the area wherein the facilities will be erected to minimize the expanse of disturbance.

A series of settling ponds will be established within the quarry area with the use of backhoe to facilitate the excavation of soil. All waste materials will be stockpiled at the waste dump and shall be utilized as a backfilling medium for progressive rehabilitation.

1.9.3 Operation Phase

Upon the completion of all the support facilities and other project components, operation phase will initiate. Surface mining method will be utilized by the project operation. Quarry operation will be started from clearing and grubbing of the identified quarry area, stripping of overburden materials, followed by the development of the production benches, bench sampling, actual quarrying and hauling of limestone (marble and aggregates) and basalt.

The topsoil or overburden will be transported to waste dump area or in a previously excavated/mined-out areas and/or designated topsoil stockpile area to be used in the progressive rehabilitation activity.

Water impounded in the settling pond shall be utilized as the source of water for the sprinkling of haul roads and access roads. Environmental management and monitoring shall be regularly implemented during this phase to alleviate further environmental contamination.

1.9.4 Abandonment Phase

Consistent with the basic policy of the State to assure the availability, sustainability and equitable distribution of the country's natural resources, the Philippine Government adopts the policy that mining activities shall be managed in a technically, financially, socially, culturally and environmentally responsible manner to promote the general welfare of the country. One of objectives of this policy is the establishment of a functional post-disturbance land use capability. Moreover, remediation and rehabilitation of abandoned mines shall be accorded top priority to address the negative impacts of past mining activities. This is through protection and conservation of environment by identification of appropriate rehabilitation and mitigating measures per project component to inhibit and/or prevent any possible risks or adverse impacts that could endanger human and its environment.

Listed below are the major objectives of Final Mine Rehabilitation Plan:

- Rehabilitate/re-vegetate all the disturbed areas within the MPSA affected by quarry operations by reshaping/re-contouring affected areas prior to re-vegetation;
- Progressively rehabilitate the area to a condition agreed/suggested by the community during the stakeholder consultation;
- Minimize long term visual impacts due to the inactivity of the mine site by employing effective mitigation and measures creating landforms with vegetation compatible with the surrounding thus establishing a functional post-disturbance land use capability;
- Eliminate safety and health risks of the inactive mine site to the surrounding communities;
- Remove all unnecessary mine facilities and equipment used in operations and rehabilitate the areas prior to abandonment; and
- Provide the estimated cost that will be incurred from the implementation of the identified rehabilitation and/or decommissioning strategies and the consequent final land use.

1.9.4.1 Proposed Final Land Use for each Component

The proposed final land use for the project will be a stable and revegetated mined-out area that is sustainable and promotes the recolonization of the pre-project flora and fauna.

Table 1-16: Proposed Final Land Use

Mine Component	Final Land Use
Quarry area	Revegetated area. This will entail backfilling using the materials from the waste dump, soil conditioning, planting with endemic species and maintenance works.
Crusher	To be dismantled and utilize in other mining project owned by the company.
Admin building, staff house, laboratory, motor pool and nursery	Facilities/structures that are usable maybe donated to the community. This however will depend on the FMRDP consultation to be conducted upon the issuance of the ECC and/or during the preparation of the FMRDP report.
Siltation Ponds	Revegetated area. All siltation ponds in the quarry area will be maintained until full rehabilitation of the mined-out parcels. As rehabilitation is progressive, settling ponds that are no longer required will be decommissioned and rehabilitated. The excavated materials may, in the future have economic value; otherwise, these will be used for backfill, grading or removed from the site.
Haul roads and access roads	If considered useful by the community, internal haul road can be left. If not required, these will be re-planted; water diversion measures will be installed for runoff interception and to enhance re-vegetation. Signs, guardrails and barriers will be removed or retained depending upon the consultation with the stakeholders.
Stockpile/Stockyard Area	Revegetated area This will entail backfilling using the materials from the waste dump, soil conditioning, planting with endemic species and maintenance works.

A Final Mine Rehabilitation and Decommissioning Plan (FMRDP) will be prepared and submitted to the Mines and Geosciences Bureau for review and approval. Among the plans to be considered are appropriate rehabilitation and decommissioning plans that will best benefit the community.

1.10 Project Manpower

An additional of 80 manpower will be needed to facilitate the project operation. Parcel 1 and 2 is run with 53 personnel, and the same number of Plant/Maintenance Repair and Quarry Operation personnel will be needed for Parcel 3 and Parcel 5 each. The breakdown of the manpower requirement is given below.

Table 1-17: Manpower for Existing Operation and Expansion

Position	Current Personnel for Parcel 1 and 2	Additional for Parcel 3 and 5
Quarry Manager	1	
PCO	1	
CRO	1	
SHE	1	
MEPEO	1	
Tenement	1	
Admin	5	
Accounting / Finance	5	
Plant/Maintenance Repair	18	40 – 20
Quarry Operation	19	40
Total	153	

1.11 Project Cost

The indicative project cost to put-up the project is PHP150 Million.

2 ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

2.1 Land

2.1.1 Land Use and Classification

General Description of the Province of Cebu

The Province of Cebu is one of the most densely populated areas in the Philippines. To sustain such a great number of inhabitants, extensive cultivation of the land for the production of foodstuffs has to be done. The people being primarily corn consumers clear every available spot of their land to plant this cereal crop, whether the land is suitable or not for such cultivation. Since Cebu is typically a hilly province, the planting of any clean-cultured-crop, like corn, would inevitably accelerate soil erosion. This is the main cause that besets the present agriculture of Cebu Province. Low production and crop failure mean individual poverty and finally low government revenue. The province of Cebu to date is one of the severely eroded areas in the Philippines.

The Province of Cebu lies centrally in the Visayan Islands and is approximately between 9°25’ and 11°21’ North latitude and between 123°18’ and 124°40’ East latitude. The mainland Cebu is a long and narrow island measuring nearly 220 kilometers long and 36 kilometers wide measured at its widest portion (Asturias - Danao City). The total land area is 486,850 hectares representing Cebu Island and number of smaller islands on the North, East and West of the mainland. These are Bantayan, Camotes, Badian and Mactan Islands.
Present Land Use

Agricultural crops include coconut, sugarcane, corn, vegetables, irrigated and non-irrigated paddy rice and root crops. Extensive areas of grasses and shrubs together with small area of forest make up most of the remaining area. Development of land use can be accomplished by:

1. Total change of crops grown
2. Retention of the present cropping system by instituting modern farm practices
3. Introduction of crop diversification (e. g. intercropping).

There are six (6) major land use categories identified in the Province of Cebu namely: agricultural, grassland, shrub-land, woodland, wetland (Brackish water) and special land use. Each of these categories was determined on the percentage of the dominant/associated land use over the area.

Land Use and Extent

Agricultural land use covers about 216,493 hectares or 45% of the province area. Grasses dominate the non-agricultural area covering about 237,471 hectares or 49%. Forest area (Natural planted and planted area) is about 8,016 hectares or 2%.

Agricultural Land Use

There are about 216,493 hectares or 45% of the province is devoted to the production of agricultural crops. Among the agricultural crops, coconut is the most dominant covering an average of 42,590 hectares. Banana is the second widely cultivated crops and covers an average of 9,172 hectares. This is followed by sugarcane (6,127 has.), mango (5,609.33 has.), cassava (2,749 has.), camote (2,095 has.), and mongo (1,213 has.). **Table 2-1** shows the distribution of land use in Cebu, and **Table 2-2** shows the area coverage of major crops in Cebu from 2006 to 2008.

Table 2-1: Distribution of Land Uses in Cebu (2007)

Land Use	Area (has.)	%
Agricultural	216,493	45%
Grassland/Shrubland Areas	237,471	49%
Woodland/Forest Areas	8,016	2%
Wetland Areas	9,463	2%
Miscellaneous Areas	9,307	2%
Total (in hectares)	480,750	100%

Table 2-2: Area Coverage (in has.) of Selected Crops in Cebu (2006-2008)

Crops	2006	2007	2008	Average
Abaca	162	162	170	164.67
Banana	9,177	9,177	9,162	9,172.00
Cabbage	566	592	598	585.33
Calamansi	120	120	122	120.67
Camote	2,280	1,830	2,175	2,095.00
Cassava	3,195	2,520	2,532	2,749.00
Coconut	42,590	42,590	42,590	42,590.00
Coffee	12	8	11	10.33
Eggplant	980	920	937	945.67
Garlic	3	1	-	2.00
Mango	5,605	5,605	5,618	5,609.33
Mongo	1,340	1,150	1,149	1,213.00
Onion	2	-	-	2.00
Peanut	525	510	509	514.67
Pineapple	7	7	7	7.00
Sugarcane	5,551	4,467	8,363	6,127.00
Tobacco	110	110	40	86.67
Tomato	860	695	690	748.33

Grassland and Shrubland

Grassland and shrubland widely covers the entire province of 237,539 hectares or 35% of the entire province. It covers most of the undulating terrain, volcanic and limestone hills and mountains.

Woodland

Woodland covers about 8,016 hectares or 2% of the entire province. These areas consist mainly of forest, mostly found in major karst, volcanic and limestone hills. Ipil-ipil is common in all municipalities. They are being used as shade trees, wind breaks, firewood, herbage for livestock and vegetative terrace.

Wetland (Brackish water)

Wetland areas of the province of Cebu, covers about 9,463 hectares or 2%. This category includes low-lying areas mostly coastal swamp otherwise known as active tidal flats, covered mainly with mangrove trees and nipa palms. Also included in this category are areas extending inland along rivers or creeks which during high tides are subject to brackish water inundations. Mangrove tree type is extensively grown in the province. Fishpond is mainly concentrated in the municipalities of Talisay, Carcar, Argao, Badian, Moalboal, Ronda Dumanjug, Pinamungahan, Toledo City, Tubuelan, San Remedios, Medellin, Daanbantayan, Bogo, Danao City, Lilo-an, Consolacion, Mandaue City, Lapulapu City, and Cordova. Salt beds exist in the municipalities of Bogo, Medellien, Danao City and Mandaue City.

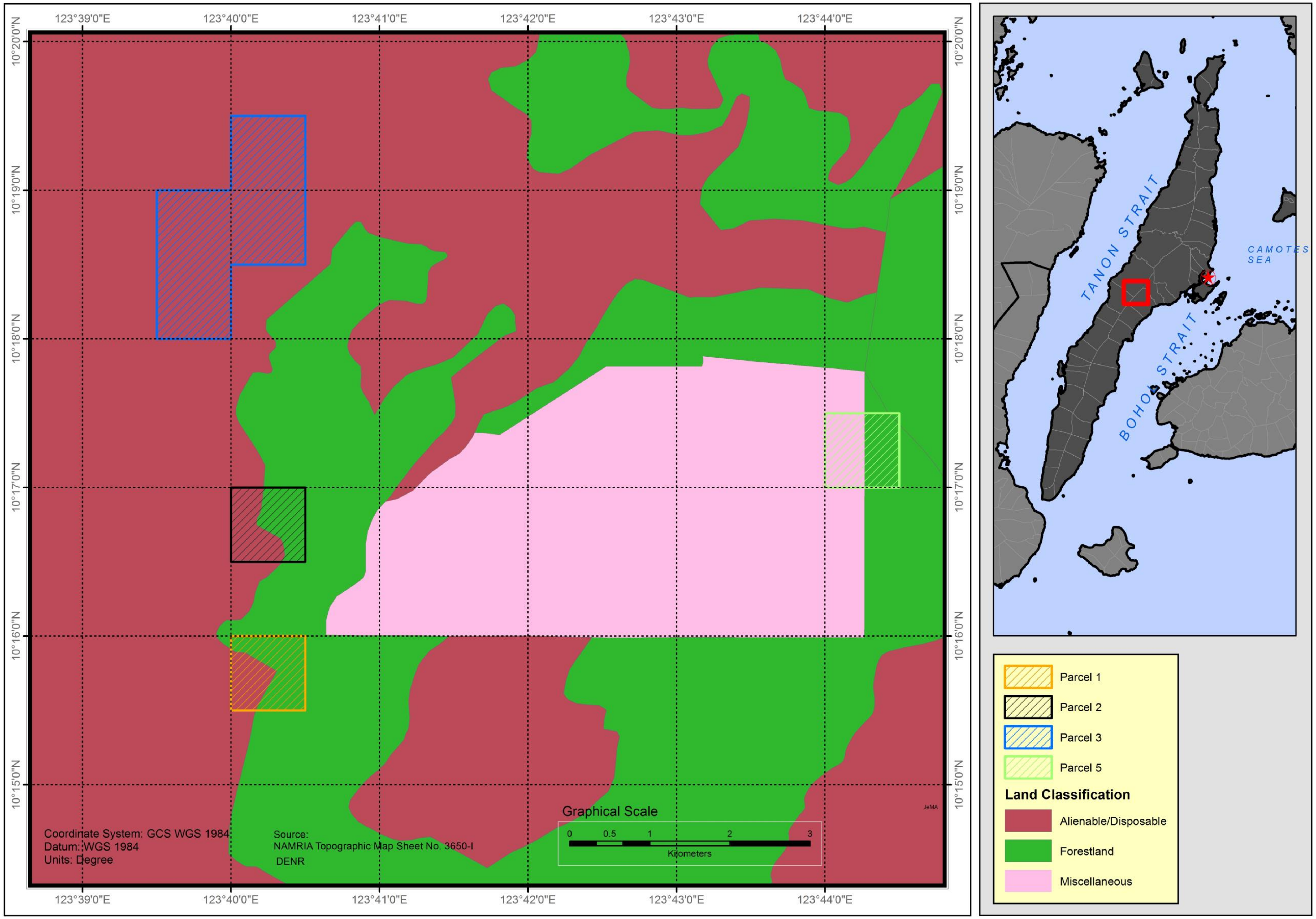


Figure 2-1: Land Classification Map of the Project Site

Special land Uses

This type of Land use is composed of the Mine areas pit/Quarry, Airport, River wash areas, Bodies of Water (e.g. Lakes and rivers) and Water Dams or 4% of the total land area of the province.

Pinamungahan Municipality Land Use

The municipality of Pinamungahan covers a total of 11,725.27 hectares. Large extent of the existing general land use is allotted for agricultural use. However, based on the Municipal Agriculture Officer, the productive area only covers 3,902.75 hectares.

Table 2-3: Municipality of Pinamungahan Land Distribution

Land Use Categories	Land Area (hectares	
	Existing	Proposed
Agricultural	5,884.77	3,939.00
Grassland	5,028.50	-
Forest/Timberland		
- Production		3,242.77
- Protection		3,124.70
Built-up area	265.00	365.00
Industrial	-	431.00
Tourism	-	15.94
Quarry Area	-	75.3
Mangroves	41.50	150.00
Fishponds	506.00	397.50
Total	**11,725.27**	**11,725.27**

Source: Comprehensive Land Use Book of Pinamungahan (1995-2005)

Naga City Land Use

The City of Naga Cebu is currently undertaking their CLUP updating, and was not able to provide any copies of it. They, however, were able to provide a copy of the current Zoning Map, which shows Parcel 5 of the QVPI quarry area, and a copy of their 1996-2005 CLUP. Naga City has a total land area of 9,298.45 hectares, with 28 barangays. The zoning map of Naga city is presented in Figure 2-2.

Table 2-4: Naga City Land Distribution

Land Use Categories	Land Area (hectares	
	Existing	Proposed
Agricultural	1,875.00	1,687.50
Grassland	5.911.73	0

Land Use Categories	Land Area (hectares	
	Existing	Proposed
Forest/Timberland		
- Production	0	2,148.98
- Protection	9.80	2.321.02
Built-up area	681.61	1,265.06
Special Eco. Zone	0	764.90
Industrial	273.00	424.80
Mangrove	6.00	6.00
Tourism	28.60	8.00
Utility (Dumping Site, Abbatoir)	0.50	4.50
Mineral Lands	512.00	0.00
Planned Unit for Development (PUD)	0	611.00
Reclamation	0	1,000.00
Fishponds	0	56.48
Total	**9,298.24**	**10,298.24**

Source: Naga City CLUP (1996-2005)

Toledo City Land Use

The latest copy of of the CLUP that Toledo Cuty was able to provide was from 2006. Toledo City has a total land area of 21,627.70 has. It has 38 barangays and 292.88 has. for Urban Land Use. The existing land use map of Toledo City is presented in **Figure 2-3**.

Table 2-5: Toledo City Land Distribution

Land Use Categories	Area (has.)	Percentage Distribution
Agricultural Land	8,355.00	38.63%
Forest Land	5,333.00	24.66%
Mining/Industrial Area	4,717.50	21.81%
Idle/Vacant Land	2,380.00	11.00%
Built-Up Area	727.20	3.36%
Swamp/Mangrobe/Fishponds	115.00	0.53%
Total	21,627.70	100.00%

Source: Toledo City Comprehensive Land Use Plan (2006-2015)

Table 2-6: Toledo City Existing Urban Land Use

Land Use Categories	Area (has.)	Percentage Distribution
Residential	141.42	48.29%
Industrial	88.96	30.37%
Commercial	23.71	8.10%
Parks/Open Space	20.85	7.12%
Institutional	13.64	4.66%

Cemete ry	4.3	1.47%
Total	292.88	100.00%

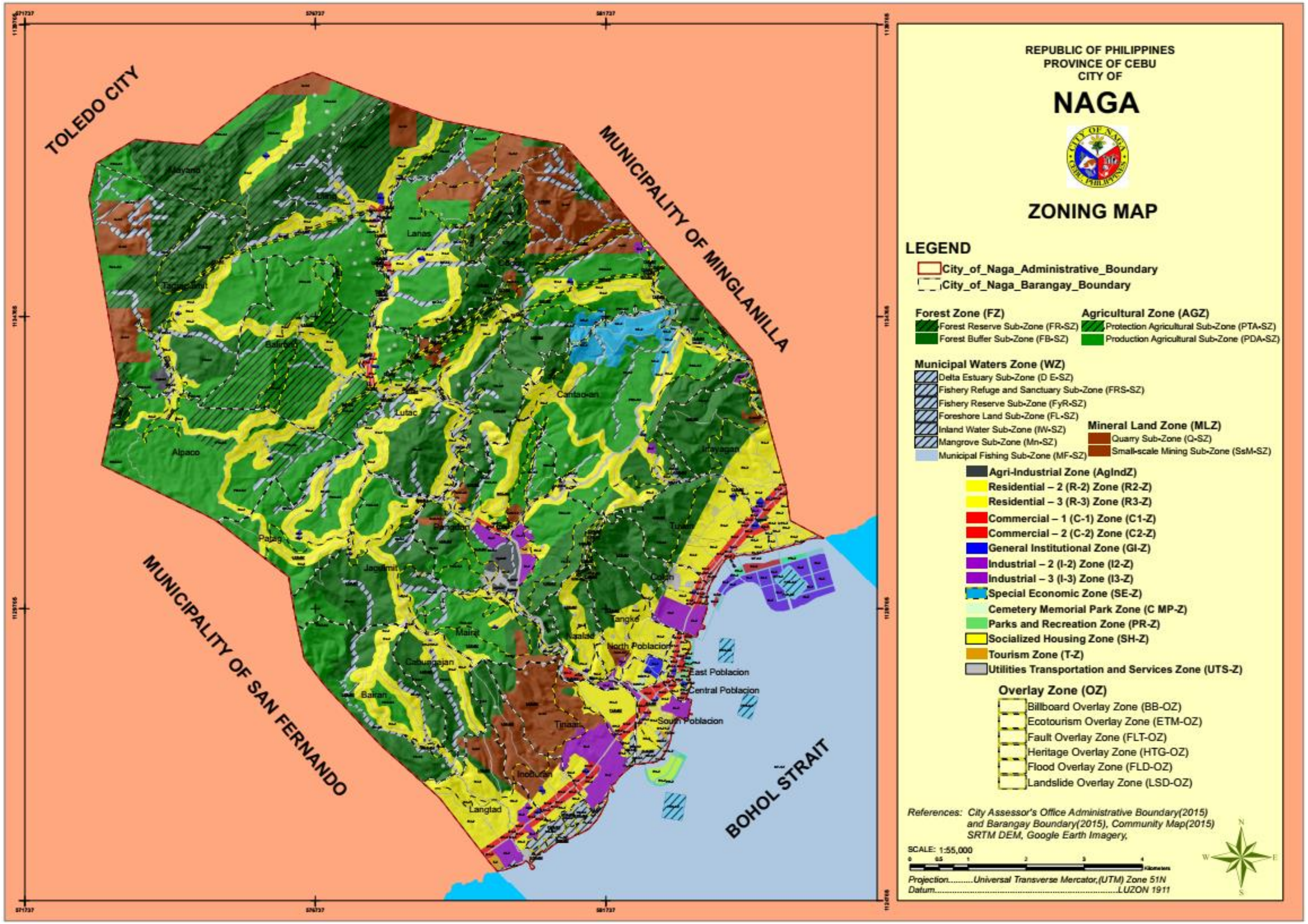


Figure 2-2: Naga City Zoning Map (2018)

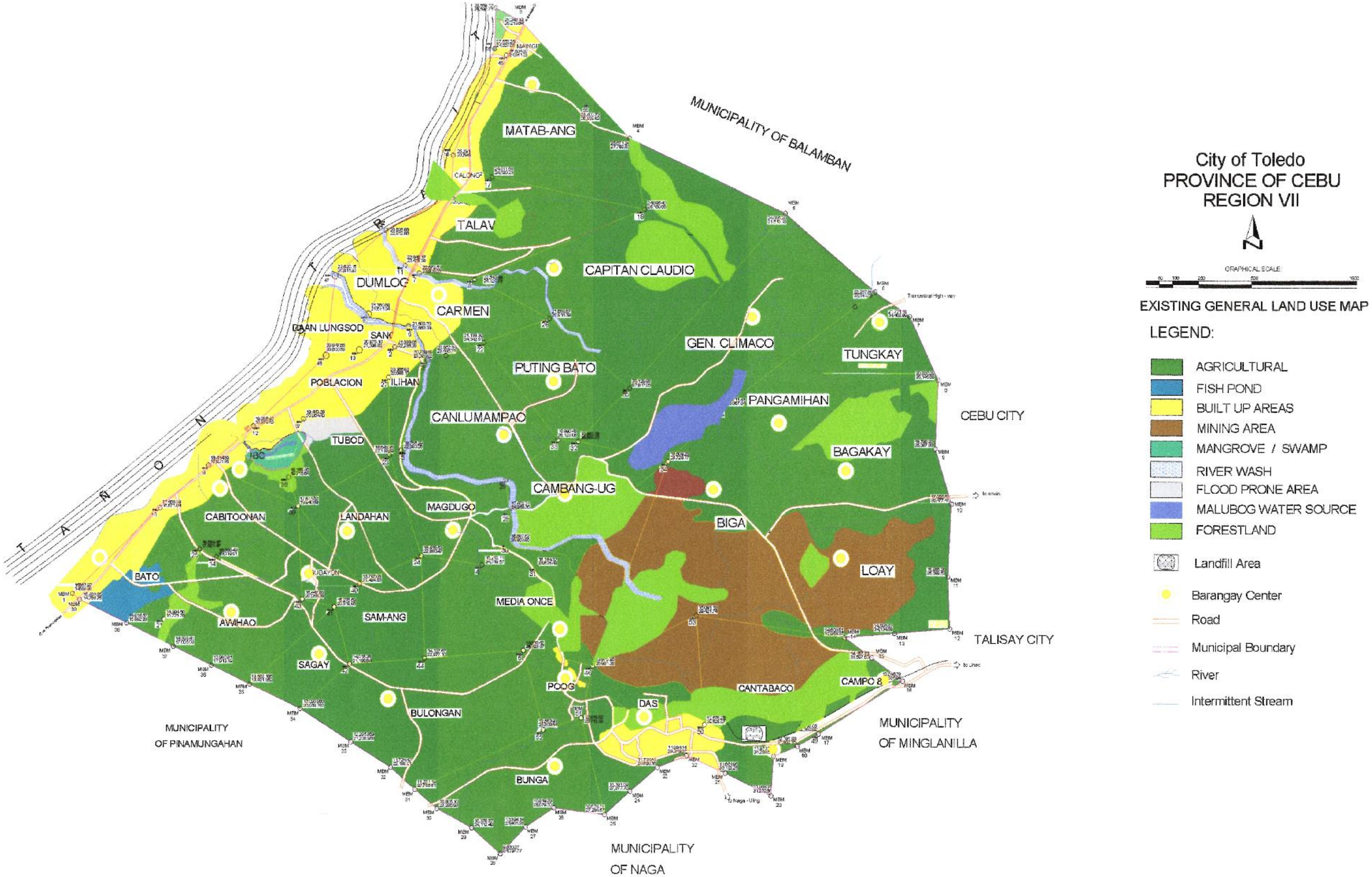


Figure 2-3: Toledo CityExisting Land Use Map (2006)

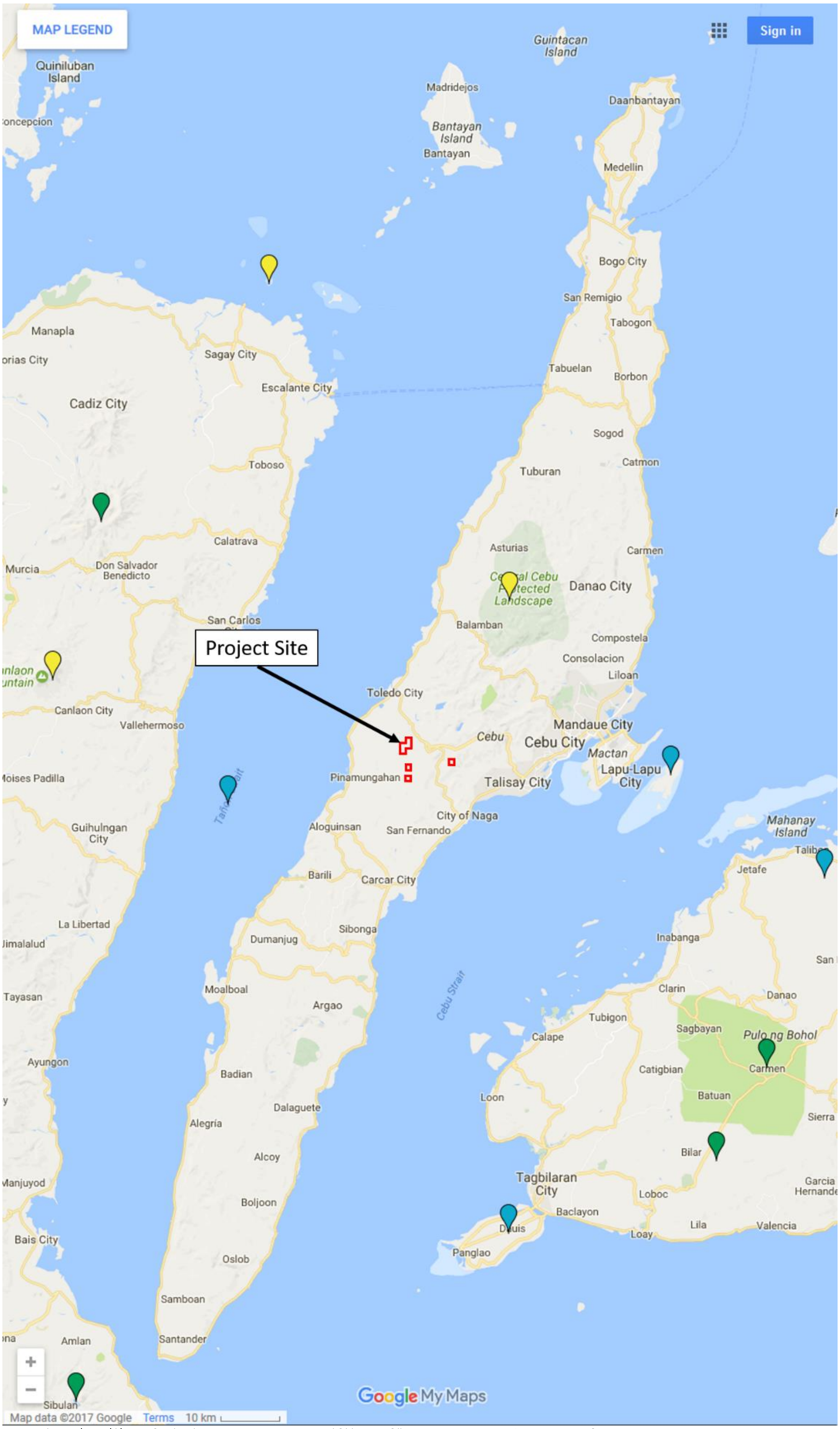
2.1.1.1 Impact in terms of compatibility with existing land use

The actual land use near the project sites are mainly agricultural. Most of the parcels have small rice farms on the low areas surrounding it. The proponent would stay within the boundaries of their MPSA, and would observe an adequate buffer area along its borders, to minimize any negative effects the project may have to the adjacent areas. The proponent would also employ proper rehabilitation processes to ensure that the mined out will be backfilled so it could be used for agriculture, or other purposes deemed necessary by the LGU and the nearby communities.

2.1.1.2 Impact on compatibility with classification as an Environmentally Critical Area (ECA)

The nearest protected area to the project is the Central Cebu Protected Landscape and the Central Cebu River Basin. The Central Cebu Protected Landscape is found about 20km north east of the project site, while the Central Cebu River Basin is 10km to the east. The protected area is home to a number of endemic and indigenous flora and fauna. Due to the distance of the project site, extraction activities would not disrupt ecological activities, nor affect the Central Cebu Protected Landscape.

The marble and aggregate extraction involves extensive ground movement, and could cause disturbances to nearby tributaries and streams going towards the river basin. Necessary measures will be taken to avoid this, like concentrating activities away from water sources, and providing proper drainage during heavy rains. **Figure 2-4** shows the location of the project site relative to the nearest protected area, and **Figure 2-5** shows its location relative to the nearest river basin.



Source: https://www.google.com/maps/d/viewer?mid=1YbuJg66imB9oiwYyZI7FNXX6E8k&hl=en_US&ll=10.519207900000007%2C123.8187977&z=9

Figure 2-4: Project Site's Proximity to Nearby Protected Area

Source: https://www.google.com/maps/d/viewer?mid=1tWPz0l4Cu9021ny2h-5wFtp2cs8&hl=en_US&ll=10.372044860731421%2C123.89720950000003&z=12

Figure 2-5: Project Site's Proximity to Nearby Watershed

2.1.1.3 Impact in existing land tenure issues

CARP-related Issues

There are no known CARP areas/CARP-related issues within the project area.

2.1.1.4 Impairment of visual aesthetics

Marble and aggregates extraction require an open pit method of mining which could be unsightly to most people, due to exposure and excavation of the soil. In order to minimize the aesthetic impairment, the management will maintain the project site's buffer areas which would provide a vegetated border. The mined-out areas would also be rehabilitated and re-vegetated following the conditions agreed/suggested by the host communities.

2.1.1.5 Devaluation of land value as a result of improper solid waste management and other related impacts

Extraction of marble and aggregates only require physical removal of the desired material. There would be no chemical treatment, nor processing, within the project site. Due to this method, the main source of solid waste would only come from anthropological activities such as office wastes, equipment maintenance spillages, and kitchen wastes from the canteens. The expected solid waste generated will be handled by a waste management plan, which would involve proper collection, treatment, and disposal of wastes. Recyclables and biodegradable waste may be sent to nearby Material Recovery Facilities for further use, or in the case of biodegradables, be broken down to compost.

Equipment and vehicle maintenance will also be supervised by trained mechanics/personnel to ensure good running conditions. Storage depots for fuel and oils will be constructed avoid soil and water contamination of oil and other chemicals. Generator sets will also be contained in a special room to avoid contamination from accidental spillages.

2.1.2 Geology and Geomorphology

Cebu Island is located in the central Visayan group of Isalnds. It is bounded to the west by Negros Island and to the east by Leyte and Bohol Islands. West of Negros is the Negros Trench where subduction is currently active. To the east, the active Philippine Fault traverses the whole length of Leyte.

Cebu is within the Visayan Sea Basin that encompasses the whole island of Cebu and portions of Negros, Bohol, and Leyte. The principalstructural grain in this region is north-south to NNE-SSW. The island of Cebu itself is elongated along a NNE-SSW direction and major tectonic elements on the island conform to this direction. The style of deformation in the Visayan region is strongly influenced by the 3 major tectonic elements, namely the Negros Trench, the Philippine Trench, and the Philippine Fault.

2.1.2.1 Change in surface landform/geomorphology/topography/terrain/slope

The Tunlob Schist is considered as the oldest formation in Cebu, possibly of the Jurassic age. It consists of strongly foliated, faulted, and folded chloriticorthoschist and micaceous paraschist. The Tunlob is presumed to constitute the basement of the stratigraphic package in Cebu. Succeeding the Tunlob is the Mananga Group, a sequence of Formations at Mananga Valley, consisting of Tuburan Limestone, Cansi Basalt, and Pandan Formation. These units have intertonguing, gradational, or conformable relations with each other. The Cansi Basalt consists of pillow lavas, flow breccias, and agglomerates which apparently has an intertonguing relation with the Tuburan Limestone. The Cansi ranges in composition from typical basalt to pyroxene andesite. The Tuburan Limestone is an orbitolina-bearing carbonate formation which was observed to lie on top of the Cansi but elsewhere also shows up as clasts in the volcaniclastics of the Cansi. In northeastern Maypay area, it was observed to rest on the Tunlob Schist. The orbitolinid assemblage and rudistsin the Tuburan, indicate an Early Cretaceous age for the formation. The Pandan Formation is a thick sequence of highly folded, steeply dipping limestone, shale, and conglomerate lying uncomfortably over the Cansi Basalt. Fossils belonging to *Globotuncana* species in the limestone and clastic rocks of the Pandacan indicate a Late Cretaceous age. The formation has an estimated thickness of 2,000m.

The Bantoon Serpentinite are lenticular bodies of serpentinized peridotite occupying major fault zones in Central Cebu. The Serpentinites intrude Tunlob Schist, Cansi basalt, and Pandan Formation and could have been emplaced during the Late Cretaceous time.

Also intruding the Cretaceous volcanic and sedimentary rocks in the central highlands of Cebu are elongated stocks and dikes of diorite, quartz diorite, andesite, and dacite designated collectively as Lutopan Diorite. Radiometric dating of diorite samples range in age from Early Eocene (50.7 Ma) to late Early Cretaceous (108 Ma) suggesting multiple phases of intrusion by these diorite bodies.

Suceeding the Lutopan Diorite is the Baye Limestone, which rests above the formations of the Mananga Group. The Baye is a 20-m thick Nummulite-bearing formation with an indicated age of

Middle – Late Eocene. Stratigraphically above the Baye Limestone is the Lutak Limestone, an 80-m thick fossiliferous carbonate formation confined around Lutak area in the central part of Pandan Valley in Central Cebu. The Lutak Limestone unconformably overlies siltstones of the Pandan Formation. Fossils in the limestone span NP 23 – NP 24 zones, equivalent to Early – Late Oligocene.

These 2 limestone formations are succeeded by the Naga Group, consisting of the Cebu Formation and Malubog Formation. These are intertonguing formations that represent the start of basin formation in Cebu. The Cebu Formation is subdivided into 2 members, namely, Lower Coal Measures and Ilag Limestone. Comprising the Lower Coal Measures are basal conglomerate grading to sandstone, siltstone, and mudstone occasionally with interbeds of coal and conglomerates. They lie uncomfortably above the Lutak Limestone is an orbitoid-rich limestone which alsi contains other foraminifers and molluscan fragments. It is thinly to thickly bedded, occasionally marly, with thin interbeds of sandstone and shale. The Ilag conformably overlies, and in places, intertongues with the Coal Measures. Like the Lower Coal Measures, the thickness of the limestone varies to a large degree but rarely exceeds 60m. Conformably overlying the Cebu Formation is the Malubog Formation, consisting of mudstone, shale, and limestone with subordinate sandstone, conglomerate and coal stringers. The Formation is subdivided into 2 members, namely, a lower Cantabaco Mudstone Member and an upper Alpaco Member. The Cantabaco consists dominantly of mudstone and shale with local lenticular limestone at the base and thin sandstone interbeds and coastal stringers towards its top. The Alpaco is composed of limestones and carbonaceous clastic rocks with associated coal seams. Fossils in the Malubog Formation indicate an age of Late Oligocene to Early Miocene for the formation. The lower Malubog is around 460m in the Naga-Toldeo City area but the whole formation could reach up to 1,200m near Uling.

Resting conformably above the Malubog Formation is the Uling Limestone. It is a coralline limestone unti with admixed algae and benthic foraminifera. The limestone is assigned a Middle Miocene age and has an estimated thickness of 200-250m. Unconformably overlying the Malubog Formation is the Luka Formation, exposed in the Luka area, northeast of Balamban. It consists of alternating beds of sandstone, conglomerate, and mudstone with lenses of limestone. It is also considered Middle Miocene in age.

Late Middle Miocene plutonic intrusions represented by small stocks of diorite and quartz monzonite in the western part of central eastern Talambanwere designated by MMAJ-JICA (1990) as Talamban Diorite. Other diorite bodies were reported in Maypay, Malugan, Mangilamon, and Sibakan. Radiometric K-Ar dating (10.2Ma – 12.5Ma) indicates a late Middle Miocene age for the intrusives. Andesite flows and pyroclastic rocks of probable Middle to Late Miocene age in the southwestern range of Central Cebu were named Bulacao Andesite. Exposures of massive volcanic flows and pyroclastic rocks also occur in the central highlands.

Middle Miocene to early Late Miocene clastic rocks and limestone in central Cebu were lumped into the Talavera Group, composed of Toledo Formation and Maingit Formation. An angular conformity separates the Toledo Formation from the underlying Malubog Formation. The Toledo Formation consists of shale and sandstone with occasional beds of calcarenite and conglomeratic limestone. It lies conformably over the Uling Formation, with some intertonguing relationships between Uling and Toldeo and thus consider the Uling as the shallow water equivalent of the Toledo. Large foraminifera in the Toledo Formation indicate a Middle Miocene age. Its thickness ranges from 620m to 1,860m. The Maingit Formation may be divided into 3 memebrs, namely, a lower limestone member, a middle conglomerate member, and an upper sandstone-shale sequence. The lower member is a lenticular coralline unit which is only around 30m thick. The middle member is a conglomerate with pebble to boulder size clasts of basement rocks and limestone. The upper sandstone-shale sequence has occasional stringers of coal and thin beds of limestone. The formation has an aggregate thickness of 1,175m, with the middle member accounting for 575m and the upper member constituting 550m. Foraminifera and nannofossils from the Maingit indicate an age of late Middle Miocene to early Late Miocene.

Unconformably overlying the Maingit and Toledo formations is the Barili Formation, which is subdivided into a lower limestone member, and an upper Bolok-bolok member. The lower limestone member is composed of a basal conglomerate and a 200-350m thick section of coralline limestone with abundant fossils dated Late Miocene. The upper Bolok-bolok member consists chiefly of calcareous fossiliferous mudstone with subordinate interbeds of siltstone, sandstone, and on places, basal carbonaceous shale or poorly bedded lenticular sandstone and conglomerate. The Bolok-bolok has an age of Late Miocene to early Pliocene and attain a thickness of 500m. It was probably deposited in a deep basinal environment.

Above the Barili Formation and older rock units is the Carcar Limestone, a coralline carbonate unti that fringes the coastal areas of Cebu except a narrow strip between Ginatilan and Malabuyoc in the south. The Carcar is separated from the underlying Barili Formation by an angular unconformity. It is porous, coralline, massive to bedded, fossiliferous and in places, dolomitic. In places, it is intercalated with marl and grades into rubbly to conglomeratic limestone. Foraminifera and nannoplankton inidicate a Pleistocene age but may extend down to Late Pleistocene. The Carcar has an average thickness of around 300m, with a maximum of 375m.
The stratigraphic package in Southern Cebu is widely different from that of northern – Central Cebu discussed above. This is represented by a sequence of sedimentary rocks spanning Late Oligocene to Early Miocene time, composed of Calagasan Formation, Butong Limestone, and

Linut-od Formation, comprising the Argao Group. The Late Oligocene Calagasan Formation is the oldest sedimentary unit mapped in southern Cebu. It consists of thick sequence of conglomerate, sandstone, mudstone, and carbonaceous shale with interbeds of limestone and coal. The measured thickness of the formation ranges from 720m to 1,300m. The Butong Limestone is a lenticular body which ranges in thickness from less than 36m to a maximum of 388m. It conformably overlies or intertongues with the Calagasan and likewise dated Late Oligocene based on foraminifera. The Linut-of Formation which overlies the Butong Limestone, consists of a succession of conglomerate, sandstone, mudstone, and shale with coal interbeds. Compared to Calagasan, the mudstones are more dominant. It is Early Miocene in age and has a thickness ranging from 325m to 1,300m.

The stratigraphy of Cebu is given in **Figure 2-6**.

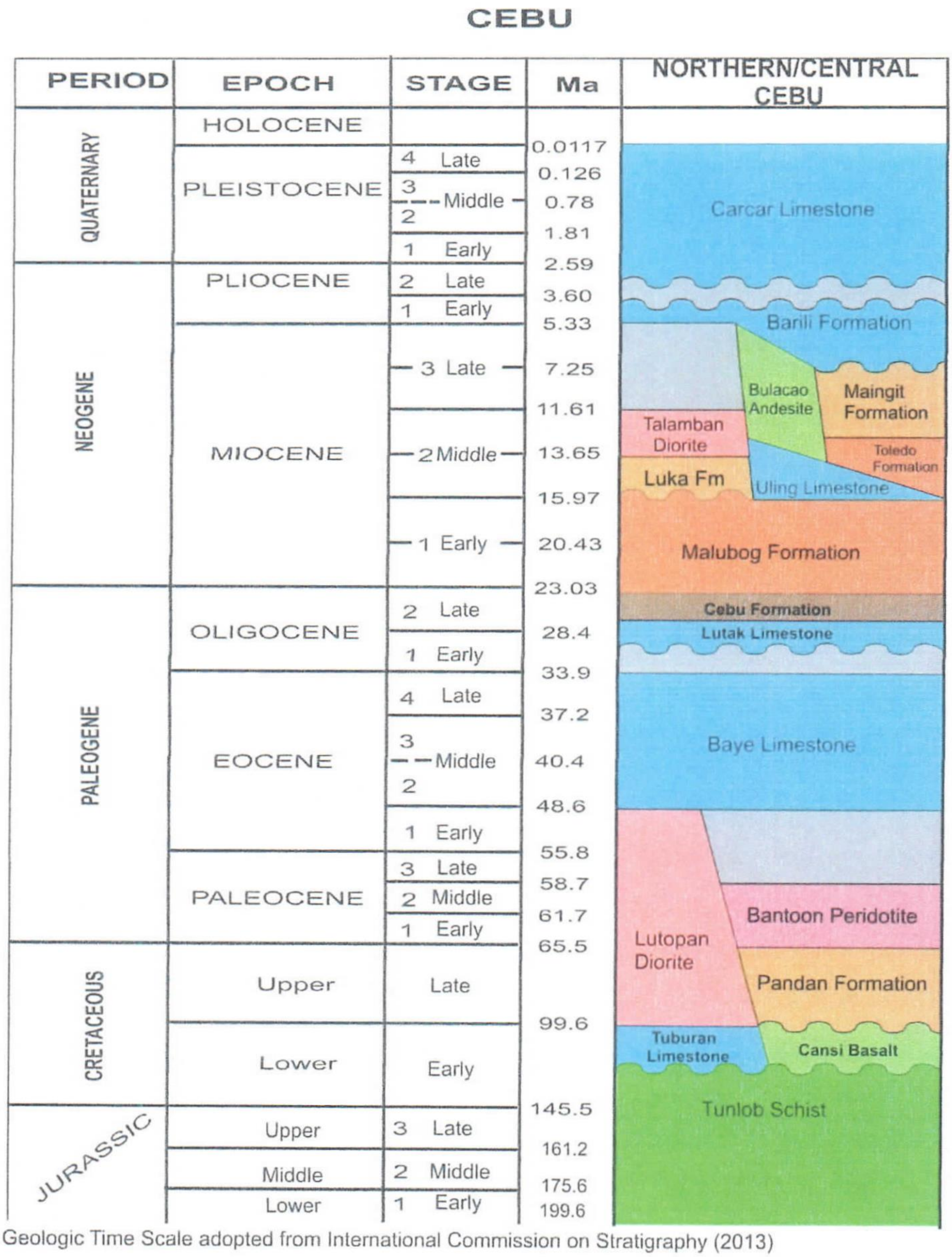


Figure 2-6: Stratigraphy of Cebu

Geologic Structures

The major tectonic elements of Cebu are aligned mainly along a NNE-SSW direction, which conforms to the orientation of its elongation (**Figure 2-7**). The Cebu Arch, a major structural feature of the island that stretches for 200km is essentially a doubly plunging northeast-trending anticlinorium in which the basement has been exposed at its central part and many stratigraphic units are generally aligned in a northeast direction. It is bounded on the west by the Tañon Strait (actually sub-basin and part trough) and on the east by the Cebu Strait Sub-basin and NW Leyte thrust belt.

On the north and south of the island, the dominant fault sets trend N-S to NNE but those in central Cebu trend NE Thrust faults and fold sets trending NNE are consistent with an echelon dextral wrench faults that could be rejuvenated pre-existing normal faults which controlled down-warping during the Late Oligocene to Middle Miocene. Sedimentary beds in the south generally strike NNE and dip to the NW and SE. In the north, folding of the sedimentary formations is more open compared to those in the south.

Local Geology

The area coverd by the parcels of MPSA 111 is underlain by the Mananga Group (MG), Lutopan Diorite (LD), Cebu Formation (CF), Malubog Formation (MbF), Uling Limestone (UL), and Toldeo Formation (TF). The project involves physical extraction of marble and aggregate deposits from the terrain. This would mean leveling off natural landforms. Slope management is essential to protect both the workers on the site, and the nearby communities. Landforms may be reduced to ground level after extraction. This would expose soil for agricultural use, or further infrastructure development for the communities.

Parcel 1, 2, and 3

The Middle Miocene UL largely occupies these 3 parcels. An arm of the limestone extends northwest, partly covering Parcel 4 to the west. The Early Miocene MbF partly encompasses the UL and underlies portions of Parcels 4 and 5. The MG, consisting mostly of volcanic and pyroclastic rocks of Cansi Basalt largely underlies the eastern portion of the area covered by MPSA 111, including a large chunk of Parcel 5. Other stratigraphic units in the area cover less space, such as LD, CF, and TF. Faults traversing the area are generally oriented northeast.

Parcel 5

The MG consisting mostly of volcanic and pyroclastic rocks of Cansi Basalt largely underlies the eastern portion of the area covered by MPSA 111, including Parcel 5. Parcel 5 is entirely underlain by the Cretaceous MG, consisting of Cansi Basalt, Tuburan Limestone, and Pandan Formation. The Early Miocene MbF partly encompasses the UL and underlies portions of Parcels 4 and 5.

Four main rock types were identified in Parcel 5 during the semi-detailed geological exploration survey covering the QVPI basalt aggregate project area, namely:

1. Basalt – andesite flows with minor andesite dikes (Cansi Basalt)
2. Basaltic pyroclastics and agglomerates (Cansi Basalt)
3. Interbedded sandstone – siltstone – conglomerate with minor limestone (Pandan Formation)
4. Calcareous mudstone – siltstone (MbF)

The basalt–andesite flows have limited exposures mainly along the lower creek level in Parcel 5, while the intercalated abasltic pyroclastics and agglomerates, have a more widespread distribution along the eastern flank of the claim block, and appear to be more dominant up-section above the basalt-andesite flows.

The basaltic pyroclastics mapped in the survey area probably represent the upper sections of the Cansi Volcanics from elevations 230 to almost 500masl. Towars the southeast where structural deformation (due to earlier thrust faulting) is evident, the basaltic pyroclastics are metamorphosed to some degree (as metavolcanics) and are cut by andesite dikes.

The interbedded sandstone-siltstone-conglomerate-limestone sedimentary units of the Pandan Formation outcrop along the southern portion of Parcel 5 and to a limited extent, along the northern-central portion of the QVPI area. These partly deformed and slightly metamorphosed units appear as erosional windows (300 – 500masl elevation) below the overlying mudstone – siltstone beds of the MbF. However, the sediments appearing as erosional windows may also be interpreted as slices of the Pandan Formation thrusted into the older Cansi Volcanics during earlier tectonic events.

A prominent north-south trending ridge – Mt. Cabalauan – which occupies the northwestern segment of Parcel 5 area, is underlain by the fine calcareous sedimentary rocks of the MbF. This sedimentary ridge (380 – 584masl elevation) is part of the Mt. Lanas – Mt. Cabalauan Range and serves as younger unconformable capping over the much older rock types in the survey area older rock types in the survey area.

The Local Geologic Map of the MPSA is presented in **Figure 2-8,** and the Slope Map is presented in **Figure 2-9**.

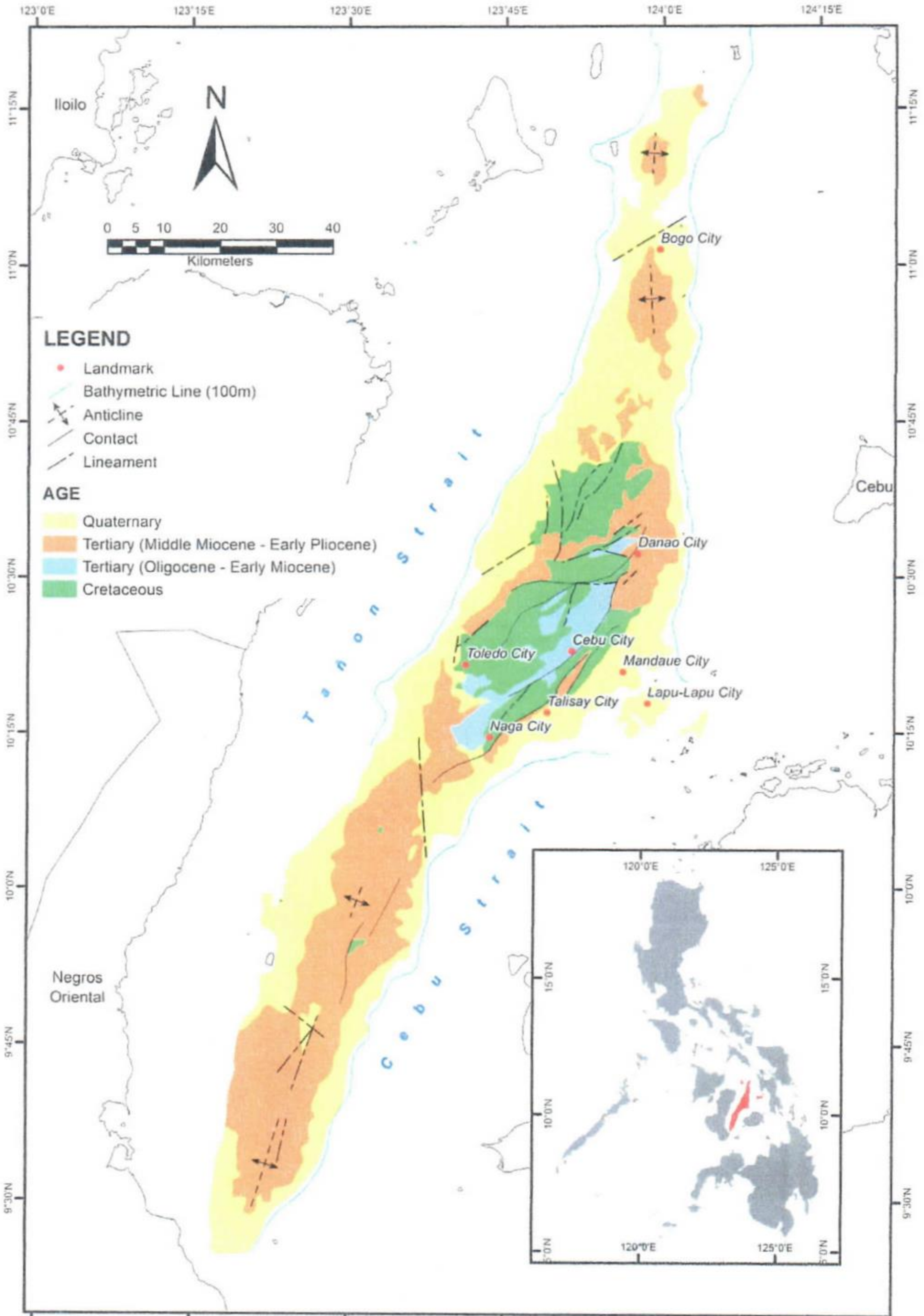


Figure 2-7: Geologic Map of Cebu

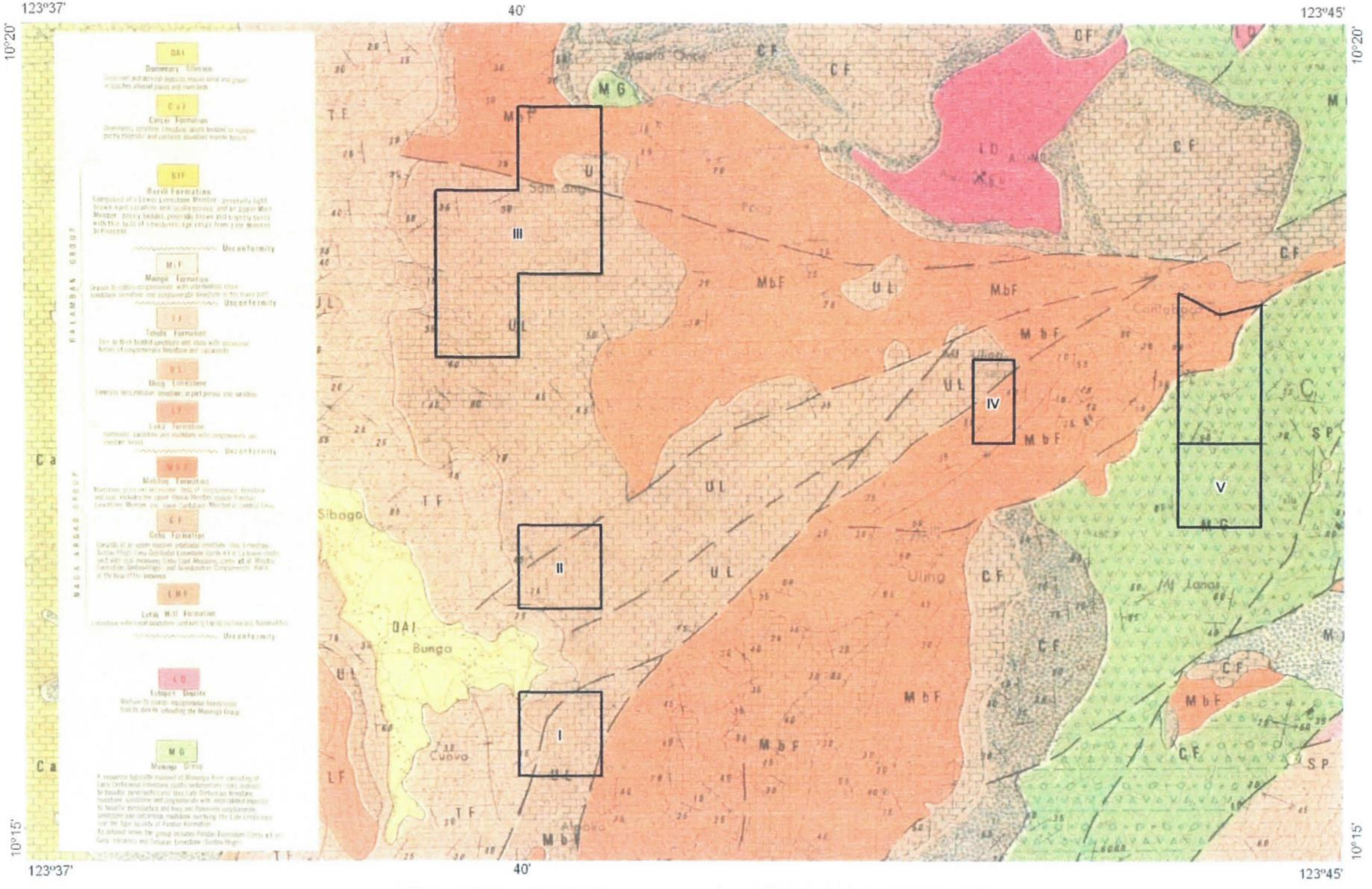


Figure 2-8: Geologic Map of MPSA

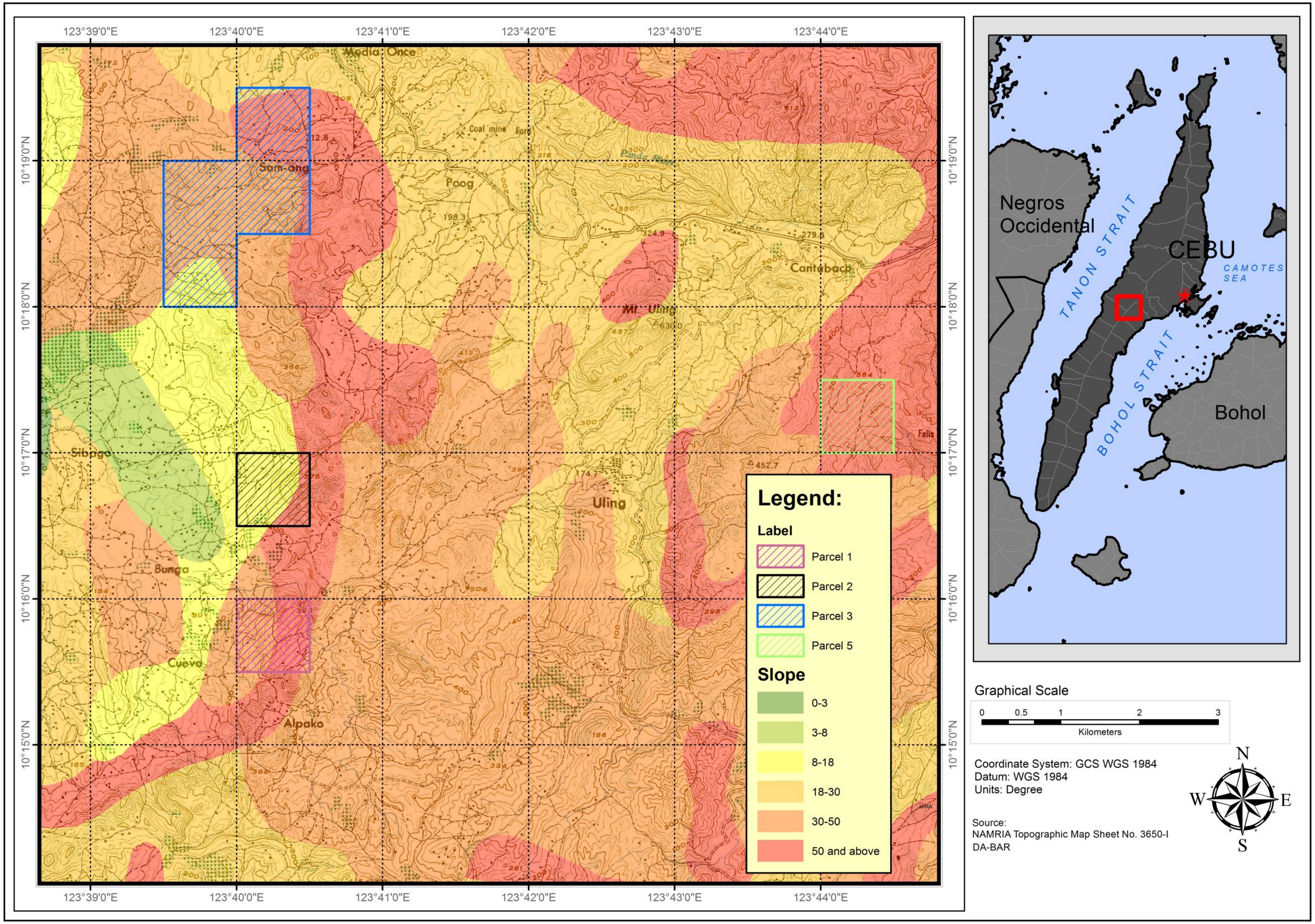


Figure 2-9: Slope Map of the MPSA

2.1.2.2 Change in sub-surface geology/underground conditions

The underground conditions for marble and aggregates extraction would not be severely affected. After removing the quarry materials, left over soil, and mineral specimens that did not meet quality requirements will be used as backfill. Most marble deposits are only above ground so the quarry would stop once ground level is reached. Aggregate quarry would follow the same process as marble but it involves blasting to physically loosen rocks. The primary effect of this would be intense vibrations during the blasting. To avoid complications, like landslides, explosive materials will be strategically placed to avoid damages outside the area, and scheduled to minimize vibration only at the desired time.

2.1.2.3 Inducement of subsidence, liquefaction, landslides, mud/debris flow

Earthquake Hazards (Seismic Hazards)

Regional seismicity suggests vulnerability of the area to earthquake hazards. Intense ground shaking is the main hazard associated with earthquakes, with ground rupture/fissuring, liquefaction and landslides as collateral hazards. The degree and extent by which the area is affected by these seismic hazards will be dependent on the magnitude of the earthquake, proximity to the earthquake source (epicenter), and site ground condition.

The potential earthquake generators that may affect the project area as shown in **Figure 2-10** include the East Bohol Fault, Central Leyte Fault, and Central Negros Fault. Recent recorded earthquakes from 2013 and 2016 indicates that the faults are still active.

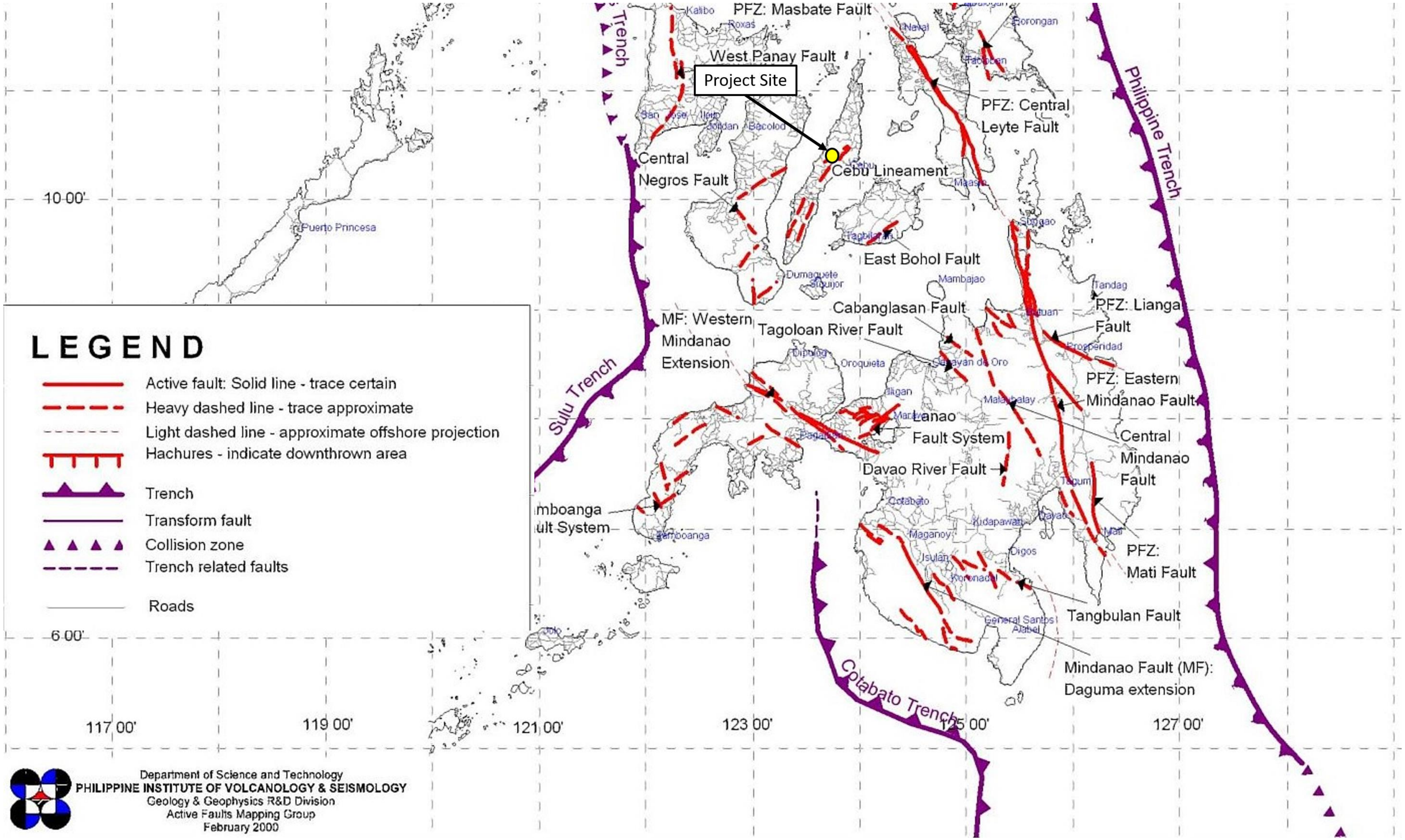


Figure 2-10: Distribution of Active Faults and Trenches

Landslides and Flooding Hazards

The sites are primarily in areas with high susceptibility to landslides. This due to the outcrops rich in marble deposits and mineral deposits for aggregates. During the quarry operation, these outcrops will be stabilized by benching to minimize landslide to the community and the site workers. Extraction of materials will also be strategically planned to maintain stability of the structures, and to avoid falling debris. Once the quarry has reached it decommissioning and abandonment phase, the stabilized and leveled site could be further developed.

There are several tributaries near or passing through the project sites, though it is not highly susceptible to flooding. In order to maintain this, settling ponds will be constructed to minimize sedimentation, and also to hold some of the precipitation before it flows through the tributaries. Trees and plants will also be planted along the buffer areas on the borders of the project sites to improve water retention in the soil.

Figure 2-11 shows the landslide and flooding susceptibility of the areas near the project site.

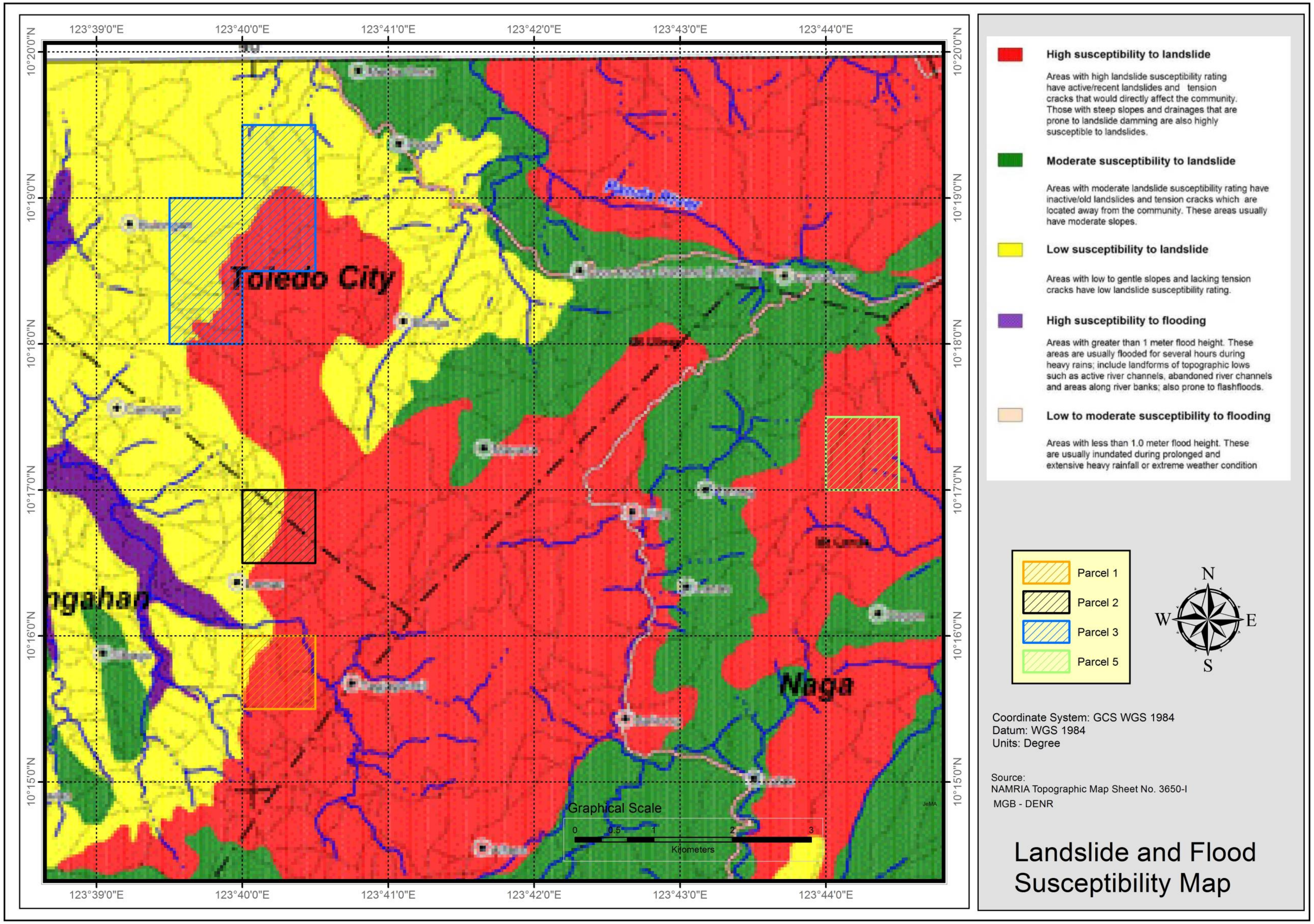


Figure 2-11: Landslide and Flooding Susceptibility of the Project Area

2.1.3 Pedology

Methodology

Soils Literature

The published reports, literatures of the soils and land use reconnaissance surveys and soils map of Cebu Province (1947), The Soils/Land Resources Project, The Physical Environment (Volume I), 1986 were gathered from the Bureau of Soils and Water Management (BSWM and served as references) . Climatic data from PAGASA were also gathered and incorporated elsewhere in the study. NAMRIA Topographic Map of the cities of Naga and Toledo (1:50,000 Scale) were also used as reference points to establish the soil sampling locations.

Reconnaissance and Ocular Surveys

A Reconnaissance and ocular survey was initially made by the Axceltechs EIA study team on June 23, 2016. Field work activities that involved the field assessments of the present land use, soil characterization and, soil sampling activities were made on June 24 - 26.

The study on soils, agriculture and land use covered the review of existing literatures and maps of the project area mentioned earlier. To date, there are very limited soils related studies, and soils related literature for the Cities of Naga and Toledo in the province of Cebu.

2.1.3.1 Soil Sampling

A. Disturbed Samplings

The soil Investigation studies covered the four (4) soil sampling locations within Parcel 1 Brgy. Tagjaguimit, City of Naga; Parcel 2, Brgy. Lamac, Municipality of Pinamungahan; Parcel 3, Brgy. Bulongan, Toledo City and, Parcel 5, Brgy. Cogon, City of Naga.

Site selection criteria of the soil sampling locations within the MPSA coverage were made in accordance with the present land use, slope and soil color. Their corresponding locations, geographic coordinates and photographs of the four sampling locations are presented in Table 1. 1.

From each soil sampling location, disturbed composite soil samples were collected within the 0 – 30 cm depth using an ordinary spade. The representative soil samples were collected randomly in a zigzag manner within the selected sampling sites. There are at least 15 random soil sampling sites for one composite sample. Presence of organic debris, stone fragments and other unwanted litters were carefully removed on site.

Each of the four (4) composite samples were mixed thoroughly in a big polyethylene bag, quartered twice, rejecting the three (3) quarter portions of the sample. From the remaining 1 quarter, approximately 2 kilograms of the samples were finally collected per location and kept in a 12” X 16” black polyethylene plastic bag and labeled accordingly.

All of the laboratory chemical analyses were done at the First Analytical Services and Technical Cooperative (F. A. S. T. Laboratories - Cebu) M.C. Briones Highway, Mandaue, Cebu City submitted on June 27, 2016 for the physical and chemical characteristics. The parameters requested are presented in Table 1.2. Results were reported on July 27, 2016. However, soil physical analysis (grain size analysis) were made in a separate Soils and Testing laboratory in the name of Geotechnics Philippines Inc., Sauyo Road Novaliches, Q.C.

Table 2-7: Soil Sampling locations and Coordinates of the Four Surface Soil Sampling Locations

Parcel 1 **Brgy. Tagjaguimit,** **City of Naga**	**Parcel 2** **Brgy. Lamac,** **Municipality of** **Pinamungahan**	**Parcel 3** **Brgy. Bulongan,** **Toledo City**	**Parcel 5** **Brgy. Cogon,** **City of Naga**
Coordinates			
Northing 10°15’50.8” **Easting** 123°40’38.6” Elevation: 304m	**Northing** 10°16’54.2” **Easting** 123°40’25.9” Elevation: 272m	**Northing** 10°18’16.2” **Easting** 123°39’24.5” Elevation: 115m	**Northing** 10°17’16.7” **Easting** 123°44’6.5” Elevation: 503m
			

Table 2-8: Requested Chemical and Physical Parameters

SOIL CHEMICAL PROPERTIES
pH
Organic Matter (%)
Nitrogen (%)
Available Phosphorus (ppm)
Electrical Conductivity (µS cm^{-1})

Exchangeable Bases Calcium (ppm) Magnesium (ppm) Sodium (ppm) Potassium (ppm)
Metallic Essential Micro nutrients Iron (ppm) Zinc (ppm)
Heavy Metals Lead (ppm) Mercury (ppm) Arsenic (ppm) Cadmium (ppm)
SOIL PHYSICAL PROPERTIES
Soil Texture Bulk density Profile (g cm^{-3})

B. Undisturbed Samplings

- Soil Profile Bulk Density

From the soil sampling sites, a separate undisturbed soil samples using a 100 cc stainless steel core rings were also collected for the profile laboratory bulk density determination at the 0 – 5, 30 – 35, 50 – 55, 100 – 105 cm depths. In this soil sampling activity, only Parcels 1 and 5 have a suitable soil profile depths where, undisturbed core sampling was accomplished. Parcels 2 and 3 have stony profile. This limit the sampling activity to be made. Figure 2 presents the soil profile bulk density sampling for Parcel 1 and Parcel 5.

Table 2-9: Soil Bulk Density Profile Samplings in Parcel 1 and Parcel 5.

Parcel 1 Brgy. Tagjaguimit, City of Naga	**Parcel 5** Brgy. Cogon, City of Naga

- Slake test

Slake test or test for soil friability was done in situ and, is an indicator of soil cohesiveness especially when wet. This soil physical property determine the soil stability even when mechanical manipulation is employed (i.e. tillage). The assessment should be done with dry soil samples and is further explained below:

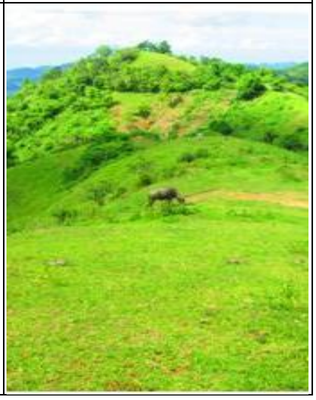
A soil fragment (at least 1 cm x 1 cm in size) is gently immersed in distilled or rainwater and response to wetting is observed for a period of time (i.e. 10 minutes). The soil is therefore classified in terms of its response to wetting and is described below:

Slake test is not applicable on sandy/stony soils (**Class 0**).
Class 1 = Very unstable. Soil fragment disintegrates in <5 seconds; very fine bubbles may emerge.
Class 2 = Unstable. Soil fragment goes slumping within 5-10 seconds.
Class 3 = Moderately Stable. Slumping of sub-crust but most of the crust is intact.
Class 4 = Very Stable. No slumping of particles is evident after several minutes of being immersed in water; whole fragment remains intact with no swelling; large bubbles may emerge.

Soil correlation with the use of the old Soil Survey reports and maps of Cebu province were made in the identification and delineation of soil types and soil sampling locations. Primary information on the agricultural productivity, cultural practices, cropping calendar and use of farm inputs (agri-chemicals) were collected through informal interviews among the locals. The dominant land use of the four (4) soil sampling locations is presented in Table 1.3.

The impact of the proposed mining project on the soil and vegetation were assessed and the proven corresponding mitigation measures were given.

Table 2-10: Dominant Land Use of the Soil Sampling Locations

Parcel 1 Brgy. Tagjaguimit, City of Naga	**Parcel 2** Brgy. Lamac, Municipality of Pinamungahan	**Parcel 3** Brgy. Bulongan, Toledo City	**Parcel 5** Brgy. Cogon, City of Naga
Grassland/Shrubland and Patches of coconut	2^{nd} growth forest	Mixed Vegetation/Cropland	Mixed Cropland/Grassland Pasture
			

A soil sampling map is presented in Figure 2-12.

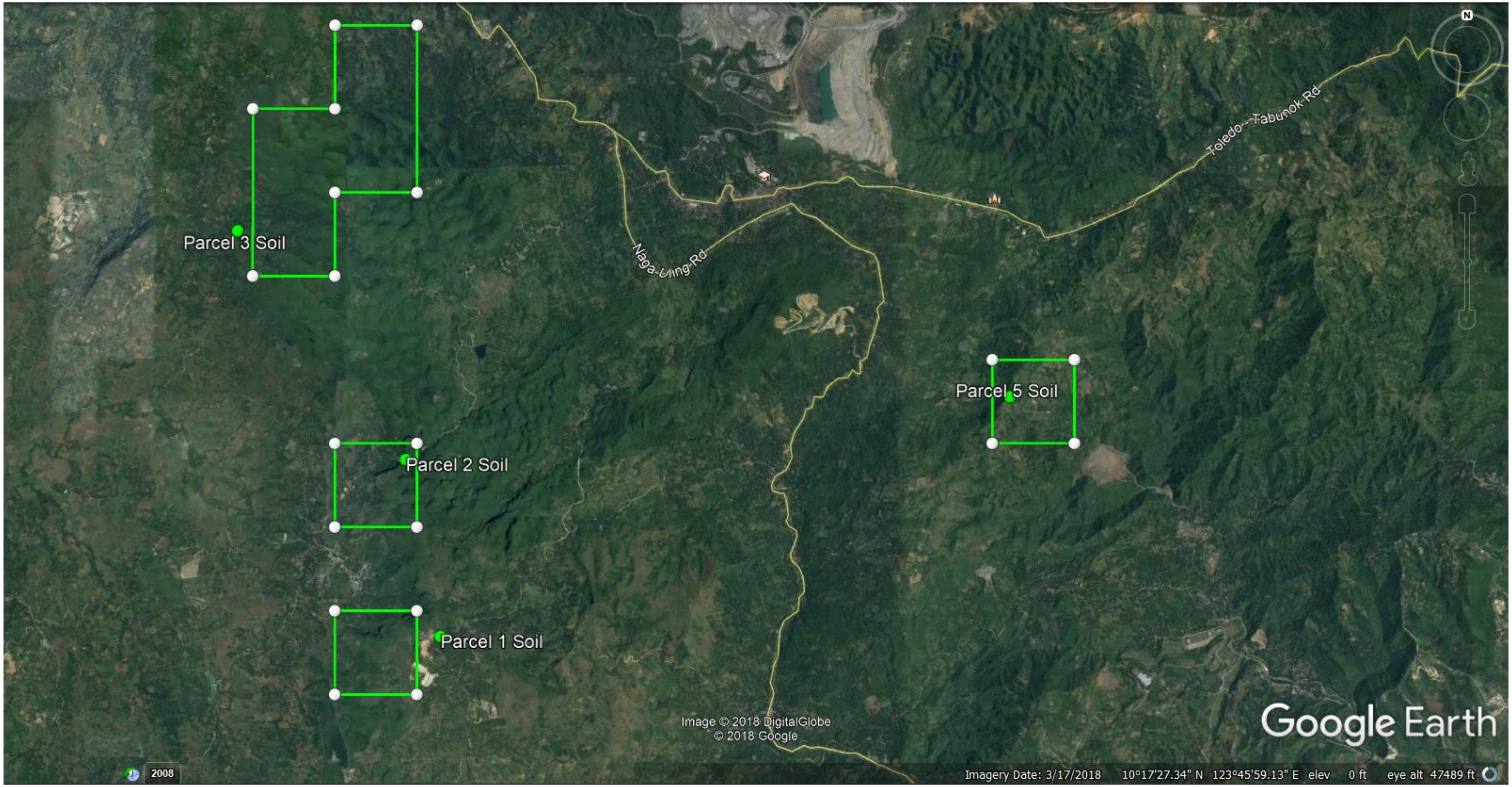


Figure 2-12: Soil Sampling Map

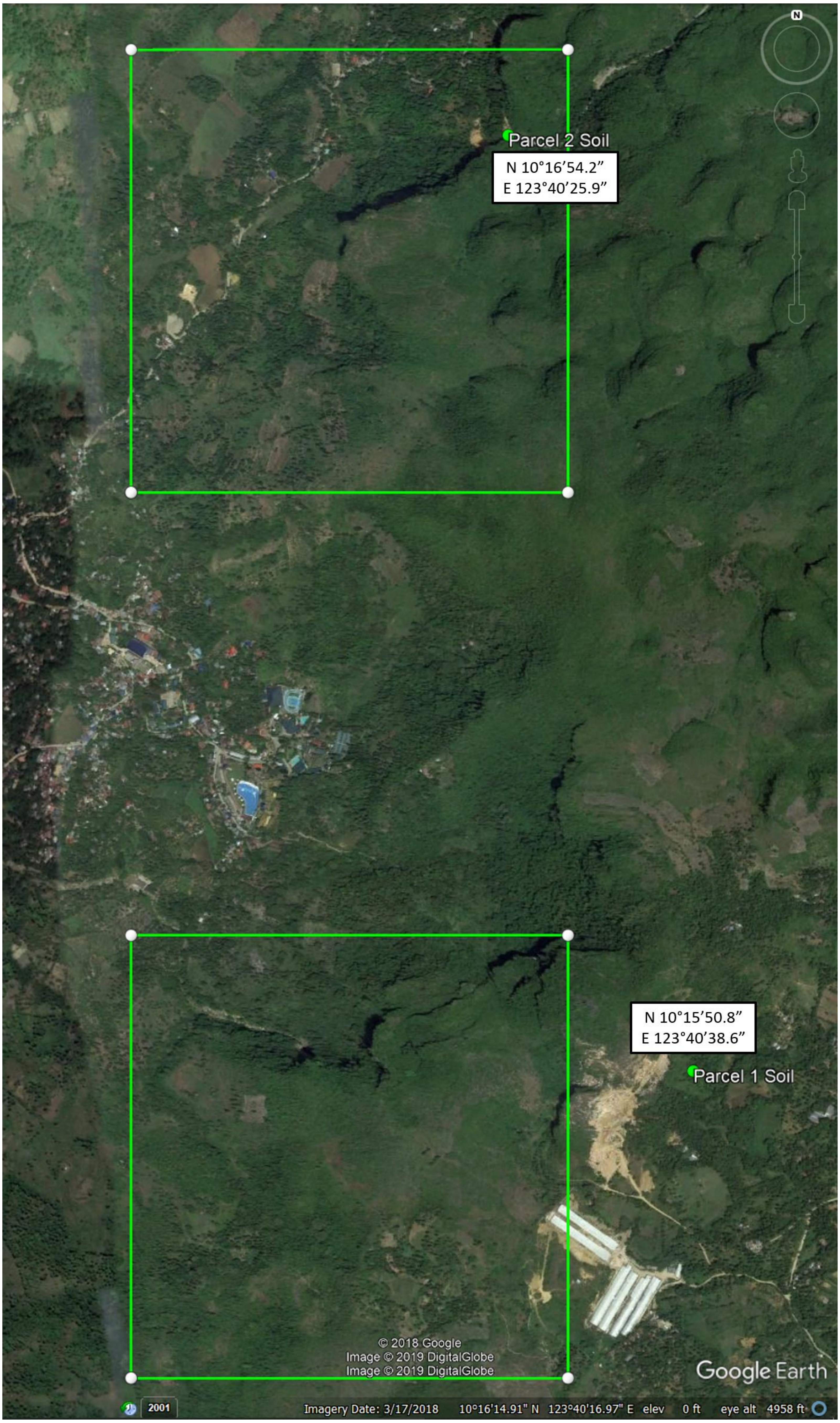


Figure 2-13: Soil Sampling Stations in Parcel 1 and 2

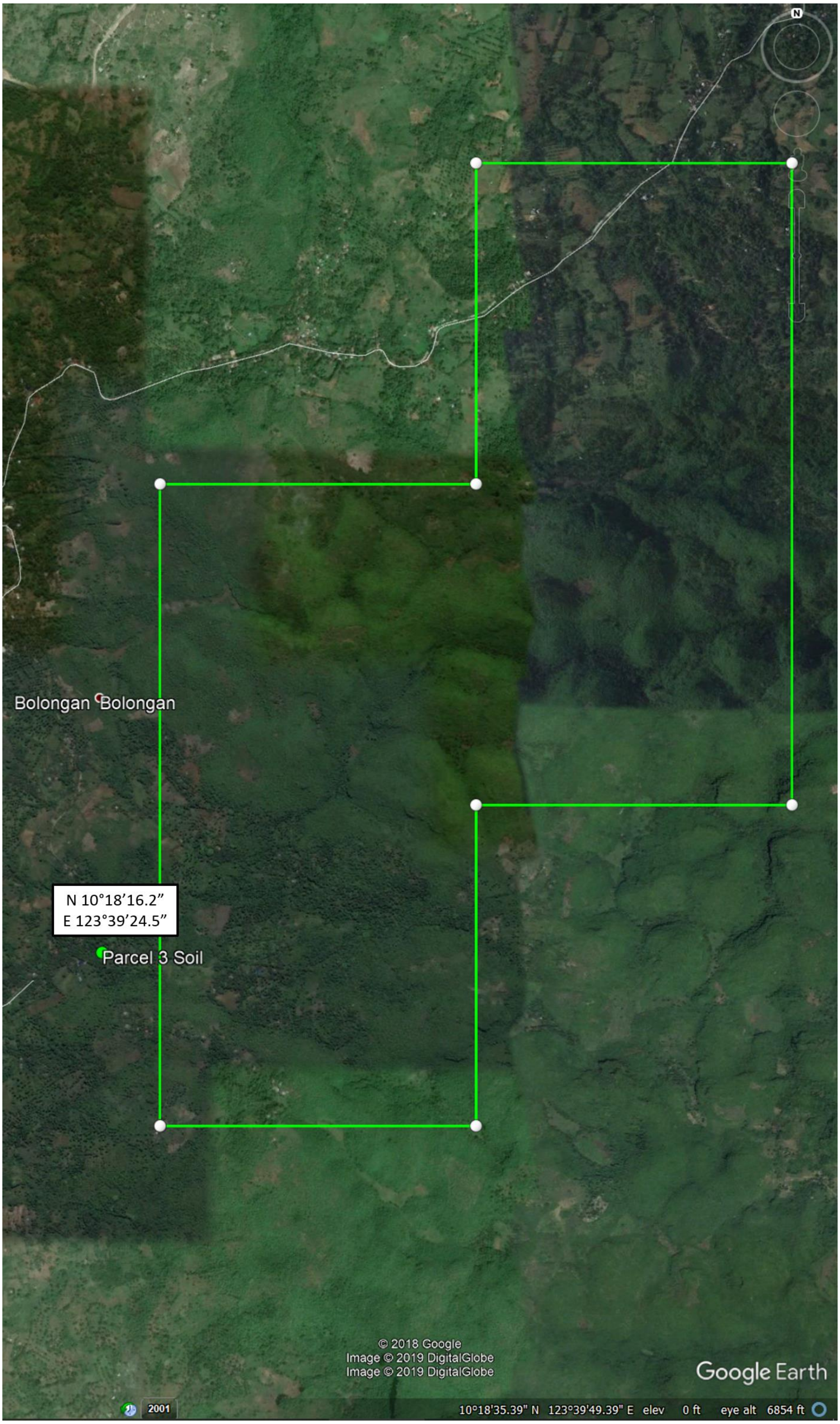


Figure 2-14: Soil Sampling Station in Parcel 3

Figure 2-15: Soil Sampling Station in Parcel 5

Soils of Cebu Province

A series is a group of soils that have the same genetic horizons, similar important morphological characteristics, and similar parent material. It comprises soils having essentially the same general color, structure, consistency, range of relief, natural drainage condition, and other important internal and external characteristics. In the establishment of a series a geographic name is selected, taken usually from the locality where the soil is first identified.

A soil series has one or more soil types, defined according to the texture of the upper part of the soil, or the surface of the soil. The class name such as sand, loamy sand, sandy clay loam, silty clay loam, clay loam or clay is added to the series name to give the complete name of the soil. The Soil type is the principal mapping unit.

A phase of a soil type is a variation within the type, differing from the soil type only in some minor features, generally external, that maybe of special significance. Differences in relief, stoniness, and extent or degree of erosion are shown as phases. A minor difference in relief may cause a change in agricultural operation or change in the machinery to be used. Further, the phase of a type with a slight degree of accelerated erosion may need fertilizer requirement and cultural management different from those of the real soil type.

The soils of Cebu Province were found to consist of eight (8) soil series, ten (10) soil types and two (2) phases. The distribution of these types and areas in hectares and proportion is shown in Table 1.5. These soil types and phases are divided into three (3) groups based on their drainage capabilities, relief and lime stone content are discussed below:

Table 2-11: Area of Each Cebu Soil Types, Proportionate Extent

Soil Type	Area in Hectares	Percent
Baguio Clay Loam	96,336	19%
Beach sand	1,660	0%
Bolinao Clay	58,575	12%
Bolinao Clay, Steep Phase	23,500	5%
Faraon clay	62,425	12%
Faraon Clay, Steep Phase	87,516	17%
Hydrosols	7,650	2%
Lugo Clay	98,321	19%
Mandaue Clay	28,220	6%
Mandaue Silt Loam	13,708	3%
Mantalongon Clay Loam	20,222	4%
Medellien Clay	7,710	2%
Area of unclassified islets	2,996	1%
Total Area	508,839	100%

Source: Provincial Planning and Development Office, Province of Cebu (2008).

A. Poorly Drained Lowland

Cebu Hydrosol – The marshes, swamplands, and all wetlands along the coast of Cebu which upon high tide were covered by sea water are classified under hydrosol. There are soils that have water which is the principal gross component. Soils in the hydrosol areas are accumulation or deposits of fine silt, clay, and sand forming into a low delta. Such soils have very poor agricultural value because of their poor drainage and high salt content. In the city of Mandaue, beds for salt making are constructed. Others use these areas as fishponds.

B. Moderately Drained Areas

These areas have a flat to very gently undulating surface. There are two soil series under this drainage condition, namely the Mandaue and Medellien series. The former is of alluvial formation while the latter is an upland soil that have been formed from limestone and shale. The soil types in these series are best agricultural soils in found in the province.

Soils in the Mandaue series are generally cultivated to lowland rice as the land is level and slightly compacted layers below the subsoil favor the retention of irrigation water. The Medellien soil on the other hand is devoted mostly to sugarcane production.

Mandaue Series

The alluvial soils of Cebu Province are classified under this series. These are young secondary soils of recent formation having almost flat topography. These soils have been deposited and formed along some of the big rivers on both sides of the coast on the central part of the island. These alluvial deposits consists of a series of layers of sand, silt and clay which in some places reach to a depth of about ten (10) meters.

The surface soil and the subsequent layers beneath are free of carbonates. The depth of groundwater varies from two (2) to five (5) meters.

Mandaue series are generally brown to light brown colored soils having fairly thick surface layer with a texture ranging sandy loam to clay loam.

Mandaue Clay Loam – The alluvial plains along the eastern coastal areas of Cebu having an aggregate area of 28,220 hectares are classified under this type.

Mandaue Silt Loam – This soil type that covers an area of 13,705 hectares is located in the western coastal part of Cebu from Asturias to Toledo City forming the low, level alluvial plains and fringing from mountain ranges.

Soil erosion on these types is not a problem. On the other hand, eroded materials from the upper areas are deposited on this type.

C. Calcareous Flat Upland

Medellien Series

Medellien soil, which is found on the northern part of Cebu is flat to gently undulating upland. Small areas are also distributed in Talisay, Oslob and Pacijan Island with an aggregated area of 7,710 hectares. The series represent about 1.58% of the land area of the province.

This soil type has a poorer drainage condition in contrast with the Mandaue series because, the surface soil and the soils beneath it have a heavier texture.

The soil of these series are cultivated to sugarcane, with corn as minor crops. The water table of the series ranges from four (4) to ten (10) meters below the surface of the ground.

Medellien Clay (159). This is the only type classified under the series. The surface soil of Medellien clay which ranges in thickness from 25 to 30 cm. has a characteristic of black color. Very sticky when wet and become hard when dry. The subsoil is as thick as the surface. The substratum which is also clayey has a much lighter color and also differs in structure and consistency.

This soil type is devoted mostly to the growing of sugarcane.

D. Calcareous Flat Lowland

Beach Sand – This soil type, as the name implies, is found in the coasts of Cebu province like Liloan, Danao City, Cebu City, Talisay City, Toledo city, Bantayan Island, and Camotes Islands. It has the same elevation as the Mandaue soils. This Soil Type is not extensively distributed as it represents only about 1,660 hectares.

This soil type being sandy textured, is well drained, allows the air to circulate freely and does not hold water. These conditions limit specific crop to grow. Coconut is noted to be very well adopted to this soil type.

E. Calcareous Hilly and Mountainous Areas

Soils in the province of Cebu are predominantly of limestone formation. Limestone is a form of sedimentary rock which originated from compact limy sediments. They are formed through the accumulation of coral animals that secrete limy materials which hardens and accumulate in thick deposits and is commonly called coralline limestone. Lime Deposit can be brought about by chemical precipitation of the lime in sea water. The rock formed this way is hard and massive. Another source of limestone rocks is the accumulation and deposition of fragments of sea shells.

The Calcareous soils in Cebu are located on the upland areas and majority of them are having a rolling to hilly and mountainous topography, clayey in texture and either black or red in color.

The Calcareous areas of Cebu are well drained both externally and internally. Being principally of the porous kind of limestone, makes water to percolate easily.

Faraon Series

Faraon is one of the several soil series classified under the category of calcareous hilly and mountainous areas. The topographic features of this series include areas that are rolling to hilly. The hilly areas, with rounded tops gradually rise in slopes. There are cases, however, where the slopes are very steep with as high as 45^0 angle or more and taper to pointed tops.

Generally Faraon soils are well drained. The topography of the land favors rapid flow of runoff. Water does not stagnate in pockets.

Native vegetation of Faraon soils is a wide association of second-growth and virgin forests. Groundwater table is seldom reached in the hilly areas.

There are two soil types identified under this series, namely Faraon clay and Faraon clay, steep phase. The former includes the rolling and smooth hilly areas while the latter consists of the very steep hills with narrow tops.

Faraon clay – This soil type is common along the coastal hilly areas of Cebu, including a small part in the Camotes Group. This type has an aggregate area of 40,435 hectares. The Intermediate layers are wanting and only the surface soil which is immediately followed by the bedrock appears more common. There are cases where true soils are formed as fast as the parent materials are developed.

Faraon clay varies in depth from ten (10) to twenty five (25) cm. Soil erosion, which is very prevalent on this type, has washed away the entire surface soil leaving only a part of the subsoil or sometimes exposing hard rocks.

Faraon soils are black. This color maybe attributed to organic matter. As this soil has been developed under alkaline condition, the alkali must have dissolved the organic matter which imparted color to the soil. In areas where severe sheet erosion has completely removed the surface soil, the subsoil appears gray.

The surface soil of this type is moderately friable except, when it is puddled. This soil type is widely utilized and planted to coconut, corn cassava, banana, and numerous kinds of fruit trees. The uncultivated areas are mostly abandoned farms where soil conditions do not warrant farming.

Faraon clay steep phase – This type differs from the Faraon clay in topography, because of its very rough topography and very steep slopes reaching as high as 100 percent. The hill tops are narrow and sharp. It is more generally more elevated than the Faraon clay type. This hills united together to form a long range. There is rarely any part in this soil type which does not have an undulating surface. This type has a total area of 87,516 hectares or about 17.98 percent of the land area of Cebu.

The soils of this type are also well drained. Water freely flows down the slope or percolates into the soil and through the porous rocks. In general, this type is widely covered by forest compared to the other types under this series. No groundwater was observed on this soil type.

The surface soil of this phase measures from ten (10) to fifteen (15) cm deep. It is shallower than the Faraon Clay. The Soil is also black in color, moderately friable when just dry and with granular structure. In highly eroded areas the surface appears white or gray. Erosion is very prevalent on this soil type.

In spite of its very steep slope, the area is also planted to coconut and corn.

Bolinao Clay – This type is most important soil of the Bolinao series. It is widely cultivated to economic crops. The chief characteristic of Bolinao clay is its red-colored surface soil. The surface soil is heavy clay and ranges in depth from fifteen (15) to twenty (20) cm. This soil is moderately friable when dry, but sticky when wet. When it contains the optimum amount of moisture it is friable and can be plowed easily. Unlike other clay soils, Bolinao clay does not harden and form surface crust upon drying. When dry, the soil remains just friable to almost powdery.

The subsoil of this type is also clayey just as thick as the surface with a brownish red color. In structure, it has a coarse good blocky form and slightly sticky consistency when wet but, slightly hard when dry.

This soil type, which exists principally on the northern part of Cebu like in San Remigio, Medellien, Daan Bantayan and in the islands of Mactan and Camotes is planted to mostly corn, some areas are cultivated to cassava, coconut, Kapok and Maguey.

Bolinao clay, steep phase – The roughly rolling and hilly areas classified under Bolinao Series fall under the steep phase. This type is found in Sogod, Bogo, and San Remigio on the northern part of Cebu and a portion in the Camotes islands with a total area of 23,500 hectares. This hilly areas are well drained as the runoff water easily finds its way to the streams and rivers. This type has a higher elevation than the original soil type under this series. The highest area is located in Dalaguete some 100 meters above sea level.

Generally, Bolinao steep phase is stonier in the surface than the Bolinao Clay. Likewise, there are also numerous limestone outcrops that make any farm operations unmanageable. This condition maybe attributed to frequent and severe erosion which naturally exposed the once buried rocks. The surface soil of this phase is thin having only an average of ten (10) cm. deep. It is also red in color, moderately friable when dry, but slightly plastic when wet. It has a good coarse blocky or granular structure that makes it easy to work on.

A large portion of this phase is not cultivated because of the rocky, depleted and eroded soil of the area. The cultivated portions are open land covered by shrubs, low growing trees of the molave type. In other portions cogon grass make up the rest of the soil cover of these phase.

The cultivated crops of this soil type include corn, cassava, coconut, tobacco, bananas and maguey. As on the other types under this series, coconut, kapok and many other crops are also chlorotic. Corn has a very poor stand on this soil phase.

Lugo Series

This soil series is also calcareous although parent rock material is made of shale. A wide area under this series is found on the northern part of Cebu. Another Large area is located on the central portion, and another area near the southern end of the province.

Lugo series are upland soils which are roughly rolling to almost hilly in topography that range in elevation from 75m to 180m above sea level for areas between the towns of Carcar and Barile and, from 90m to 220m for areas between Lugo and Bogo towns. These hilly areas may have wide and almost undulating tops that are adapted for cultivation but, has a rough terrain owing to the numerous gullies, streams and creeks which cut its surface.

Lugo soils are also well drained like Faraon. The drainage condition is mostly external or by runoff. These runoffs are responsible for severe soil erosion which is very noticeable on this soil. There is no instance of water logging occur on any part of this series.

Lugo series are residual soils which have been developed from shale rocks. These shale rocks are calcareous. Limestone rocks are not found on this soil series.

This soil series is widely cultivated to crops. Practically the whole area is denuded of forest trees. These are areas covered with cogon grass. These are abandoned farms whose soils are so badly eroded that no substantial crops can be grown.

Soil of the Lugo series is clayey and black in color, like those of the Faraon and Medellien. It is very sticky and plastic when wet, and tends to harden very slightly when dried. It has a fine granular structure which is very easy to work on with any agricultural implement. The subsoil is also clayey and has a dark brown to yellowish brown color.

Lugo clay – This soil type was referred to by some geologists as belonging to Barile Limy clay. Lugo clay, however, was first described and delineated as a soil type on the northern part of Cebu. The same type also exists between the towns of Carcar and Barili, and also between Sibonga and Dumanjug municipalities and, all together a total of 98,321 hectares.

This soil type is upland, roughly rolling to hilly areas which is dissected by numerous gullies and creeks. The hills have rounded tops while the slopes are oftentimes steep.

Lugo clay are residual soils developed from limy shale. It has a characteristic of being black surfaced soil which is rather thin, averaging 15 cm deep. Soil erosion is also severe on this soil type that, a greater part of the surface soil especially along the slopes has been washed down.

Corn, coconut, tobacco and sugarcane are the principal crops planted on this soil type.

F. Non Calcareous, Hilly, and Mountainous Areas

Some of the rugged mountainous areas occupying the central portion of Cebu Province are not calcareous. They are lofty mountains with a characteristic of having a deep and V-shaped gorges. The elevation of most of the peaks can reach as high as 1,000 meters above sea level. They have sharp-edged tops with very steep, precipitous slopes.

Vegetation in this region is mostly grass. Small patches of virgin forest still stand in widely distributed areas. The remainder of the area which constitutes a small portion is under cultivation. The grassland consists mostly of talahib, cogon, ferns and a mixture of low growing shrubs that are vegetation characteristic of areas having high altitude. Along the creeks are bamboo groves and second growth trees.

In general the area is well drained because of its topography. The drainage is mostly external as the water rapidly flows as runoff. Hence, the deeper layers of the soil have very little chance of getting wet.

These mountainous areas are believed to have been formed during the pre-Miocene period. Their bedrocks consist of igneous and metamorphic materials like diorite, quartz, andesite, slate, greenstone, sandstone, and shale which were partly coal bearing.

Baguio Series

This soil series occupies the north central portion of Cebu Province. It represents the highest, bold and rugged mountains. It is characterized by narrow, sharp-topped edges with steep, almost precipitous slopes, and separated from each other by deep V-shaped Gorges. Elevation ranges from 200 to 1,000 meters above sea level. Narrow and long valleys between the mountain ranges are common and well inhabited.

The bedrocks of these mountains which were classified as basement complex and emerged during the pre-Meiocene time consist of igneous rocks, diorite, quartz diorite, and andesite flows that make most of the big boulders along the Talisay-Toledo road.

Native vegetation of this soil series consists primarily of grassland with occasional patches of virgin forest and second growth trees. The grassland areas are dominantly vegetated with cogon grass intermixed with ground ferns and many kinds of low shrubs.

Soils of the Baguio series are fairly deep. It is much deeper than either the Faraon, Lugo, or Bolinao soils. There is only one soil type identified in this series. This is Baguio clay loam.

Baguio clay loam – The soil of this type, which is of residual formation, has dark brown to brown surface soil that ranges in depth from 20 to 30 cm. The surface soil is much thicker at the lower part of the slopes than on the tops or upper sides. Its medium coarse granular structure is desirable for plowing. This soil, however, tends to harden when plowed too wet.

The surface soil is fairly rich in organic matter. Those under grasslands have darker color than those under cultivation or under forest cover whose color tends toward the brighter tinge or brown. All these soil color reflect on the organic matter content of the soil.

It is situated on the central upper portion of the headwaters of many rivers that flow to the lower plain are located in this area. In addition, the watershed that collects water for Cebu City is also located on this soil type. Because of these important functions, it is advisable that this soil type be fully reforested.

Because of its high elevation, good quality vegetables are grown in this soil type. Spiny bamboos are also abundantly growing wild along gullies and banks of creeks. This soil type has an area of 96,336 hectares.

Mantalongon Series

This series is found only on the southern part of Cebu and on the central portion west of the town of Dalaguete. This series like that of the Baguio series is characterized by a high, rough mountain with steep slopes. Its altitude reaches up to 1000 meters. Because of this elevation, the weather is cool and rainfall is usually abundant. Rainfall in Mantalongon averages 2,353.5 mm per annum which is the maximum mean precipitation recorded in Cebu.

Soils of the Mantalongon series are residual materials having been developed from underlying rocks which were mostly shale, sandstone, and conglomerate. It is brown to light brown, friable and granular. The substratum is made of reddish brown to grayish brown colored shale rocks. The shale rocks have platy structure which is arranged in beds lying parallel. It is boundaries separating each soil layer are smooth and gradual.

Mantalongon clay loam – This soil type is found on the south central portion of Cebu occupying the highly elevated and very rugged mountains between the towns of Dalaguete and Badian. The topography of this soil type, although very irregular, has rather smooth surface, unlike that of Baguio clay loam which has sharp-edged tops. It, however, has also steep slopes.

Mantalongon clay loam is dominantly covered by cogon grass. There are very few small patches of forest. The remaining areas are planted to coconut, corn, bananas, abaca, sweet potatoes, and some lowland rice.

Mantolongon soils which range from 10 to 25cm deep are light to dark brown in color. It is fairly friable and can be easily worked. However, because of its steep slopes only small patches can be cultivated.

Mantalongon clay loam is well adopted to growing semi-temperate crops. The area is noted for the production of cabbage, lettuce, cauliflower, everlasting and some trees like pines. On account of the high elevation which is over 1,000 meters above sea level, with rainfall evenly distributed throughout the year. This soil type has an area of 20,225 hectares.

2.1.3.2 Soil erosion / loss of topsoil / overburden

Soil is generally a variable mixture of minerals, organic matter, water and air. It covers the earth in a thin layer and primarily gives mechanical support to plants. It is the product of action of the physical, biological, and chemical forces upon the rocks for thousands of years. Soil formation is apparently a slow process. Soil characteristics vary greatly from place to place. It is, therefore, very necessary to understand these characteristics because, the more we understand these characteristics, the more we can manage the soil in determining the capacity of the soil to produce the products needed by man.

Figure 2-16 shows the Soil Map of the Project area (Cities of Toledo and Naga in red outline). Based on the soil survey and assessment conducted, Parcels 1, 2 and 3 belongs to the Lugo clay series (156). Lugo clay is the only type under this series and has the following characteristics (Table 2.1). Parcel 5 on the other hand belongs to the Mandaue Clay Loam series (157). For brevity, the typical soil profile morphological characteristics of the Mandaue Clay Loam series is presented in Table 2.2.

Table 2-12: Typical Soil Morphological Characteristics of Lugo Clay

Depth (cm)	Characteristics
0 - 20	A dark gray to black surface layer; heavy clay with medium to fine granular structure; very sticky and plastic when wet but slightly friable when dry. Upon drying soil particles do not clod nor harden like other clays. It is fairly rich in organic matter and devoid of any skeleton.
20 - 30	A light yellowish brown clay with a good coarse granular structure that is sticky and plastic when wet but friable when dry. There is no coarse skeleton. Soft concretion-like limestone which are spherical to irregularly shaped forms are present in this layer. This

Depth (cm)	Characteristics
	Layer is separated from the layer above by a smooth and diffused boundary. Organic matter content is less than that of the surface soil.
30 - 70	Brownish gray layer speckled with dark orange parent material. Consist of consolidated weathered shale, gritty or powdery in feel. When wet it is also sticky but not plastic. It is brittle when dry. The relative content of organic matter is much less than that of the surface soil.
70 - 150	This layer extends down to an indefinite depth and consists of calcareous shale that is grayish white speckled with orange. It is slightly sticky when wet but not plastic. It is brittle either dry or wet. Shale is in thin horizontal planes from 5 to 10 centimeters thick.

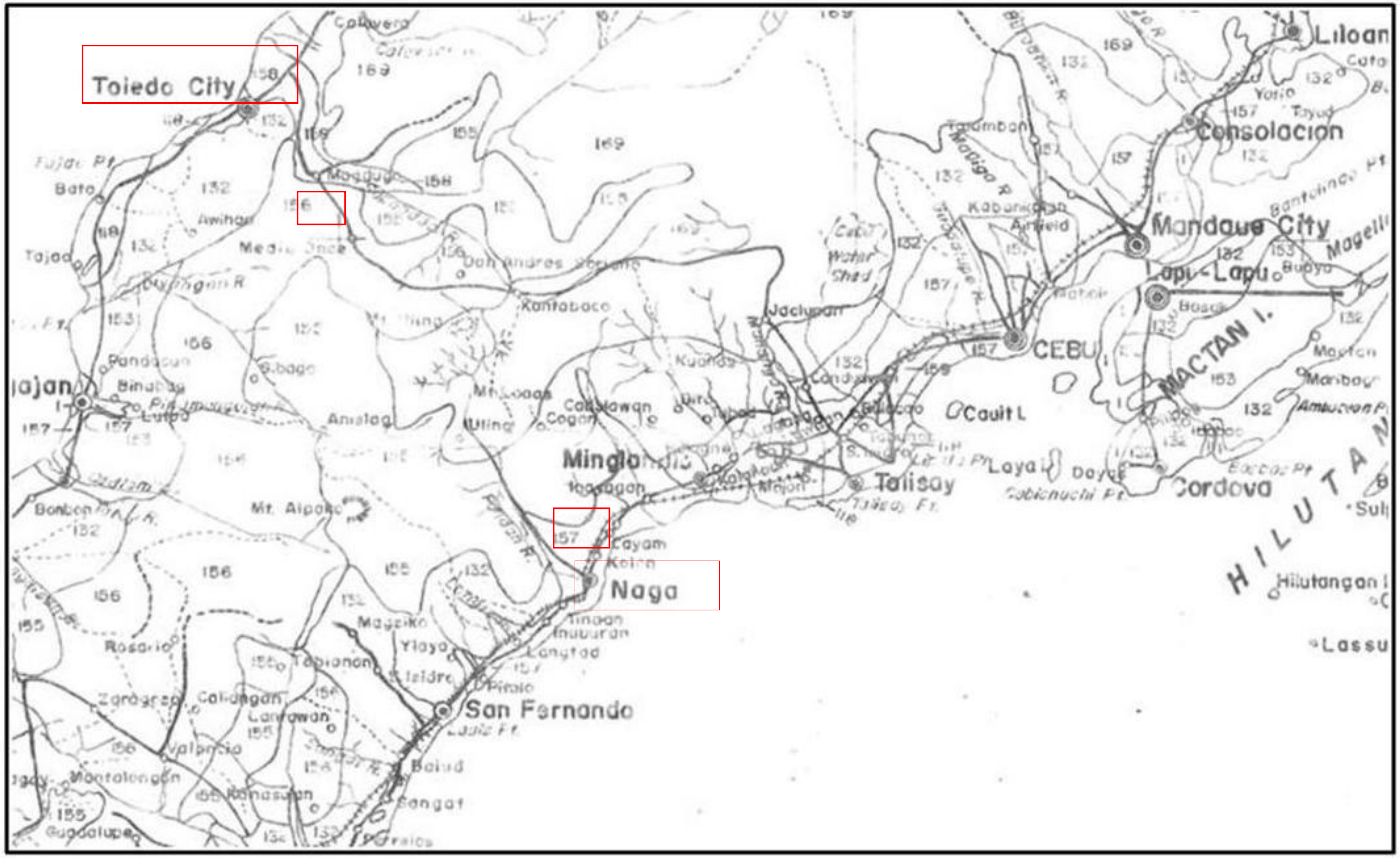


Figure 2-16: Soil Map of the Project area (Cities of Toledo and Naga), Province of Cebu Indicating Soil Series Numbers

Table 2-13: Typical Soil Morphological Characteristics of Mandaue Clay Loam (157)

Depth (cm)	Characteristics
0 - 20	Surface layer, light brown to dark brown gray clay loam; good to poor coarse blocky structure. When wet, it is moderately friable to slightly hard but hard when dry. It has a moderate amount of organic matter it is non calcareous but slightly to moderately alkaline. There are no stones or boulders of any kind in this layer. Thickness varies from 20 to 30 centimeters.
20 - 50	Dark brown to dark grayish brown clay loam; good coarse blocky structure. When wet, it is slightly compact and hard, and when dry, it is very hard and compact. Poor in organic matter; non calcareous; with pH 7.96 which is medium alkaline. Separated from the above layer by a wavy and diffused boundary.
50 - 120	Yellowish brown clay loam, with a moderately coarse columnar structure. When dry it is hard and compact but becomes only slightly soft and compact when wet. It is also non- calcareous with a pH value of 7.84 which is medium alkaline. No coarse skeleton, Separated from the above layer by a wavy and diffused boundary.
120- 150	Yellowish brown with mottling of brown to dark brown clay loam. It has a medium coarse granular structure and the same consistency as the above layer. Also non-calcareous and free of any coarse skeleton. This layer has a pH value of 7.84 which is slightly alkaline. Separated from the above layer by a wavy and diffused boundary. Some times in deep layer of this series may be found pebbles of river wash origin.

Soil Physical Properties of Sampling Locations

Soil Texture

Soil Texture refers to the relative proportion of the sand, silt and clay of the soil matrix as a whole. The amount of any of these soil aggregates greatly influence soil structure and consistency. The soil texture has a considerable effect on many factors which includes plant growth as it determines the amount of nutrients, gas, soil and water movement and, the tillage requirements of particular soils. **Figure 2-17** presents the Soil textural analysis of the four (4) sampling locations within the project site. All of the sampling locations have a clay texture. The heaviest textured soil is parcel 3 having a clay/silt percentage of 95. The rest of the sampling sites have a medium texture.

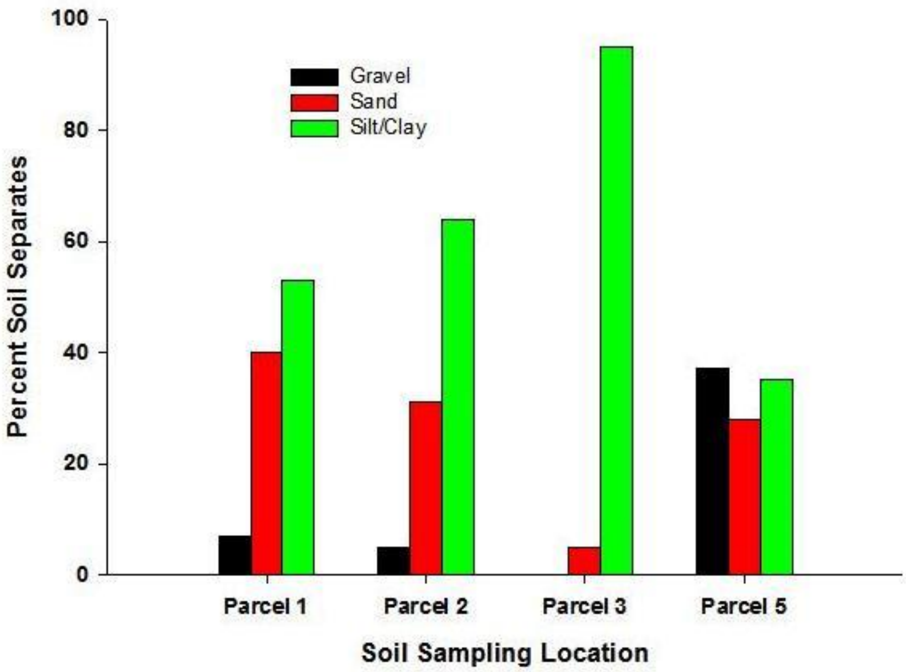


Figure 2-17: Soil Textural Analysis of the Soil Sampling Locations

Slake Test

Slaking is the breakdown of large, air-dry soil aggregates (>2-5 mm) into smaller sized micro-aggregates (<0.25 mm) when they are suddenly immersed in water. Slaking occurs when aggregates are not strong enough to withstand internal stresses caused by rapid water uptake. Internal stresses result from differential swelling of clay particles, trapped and escaping air in soil pores, rapid release of heat during wetting, and the mechanical action of moving water.

In contrast to slaking, tests for aggregate stability measure how well soil withstands external destructive forces, such as the splashing impact of raindrops. Poor aggregate stability and slaking resulted in a detached soil particles that settle into the soil micropores, and cause surface sealing, reduced infiltration and plant available water, and increased runoff and erosion.

Why it is important: Slaking indicates the stability of soil aggregates resistance to erosion and suggests how well soil can maintain its structure to provide water and air for plants and soil biota when it is rapidly wetted. Limited slaking suggests that organic matter is present in soil to help bind soil particles and micro-aggregates into larger, stable aggregates.

This test is not applicable in sandy and stony soils. This therefore allowed that parcels 1, 3 and 5 to be tested. Parcel 2 has a stony surface soil rendering it to be classified as Class 0.

Slake test of Parcel 1 is shown in **Figure 2-18** (start of the slake test) and, **Figure 2-19** (end of the Slake test). The soil fragment (at least 2 – 5 cm x 2 – 5 cm in size) was taken at the immediate soil surface.

Soil response to wetting is observed for a period of 10 minutes. The result shows that the soil can be classified as Class 4 or very stable (**Figure 2-19**). There is no slumping of particles is evident after 10 minutes of being immersed in water. The whole fragment remains intact with no evidence of swelling or disintegration of particles.

Figure 2-18: Start of Slake Test, Parcel 1

Figure 2-19: 10 Minutes After Slake Test, Parcel 1

Similarly, Parcel 3 surface soil wet cohesiveness was tested in situ during the field soil sampling activities. A representative fragment of the soil surface is collected and immersed in distilled water inside a stainless steel basin (**Figure 2-20**). A period of 10 minutes of water submergence is allowed before observance of any slaking property. **Figure 2-21** showed after 10 minutes of water immersion, there was no slumping of particles the whole fragment remains intact, no evidence of swelling or disintegration of particles was observed. This soil is therefore classified as Class 4 or very stable.

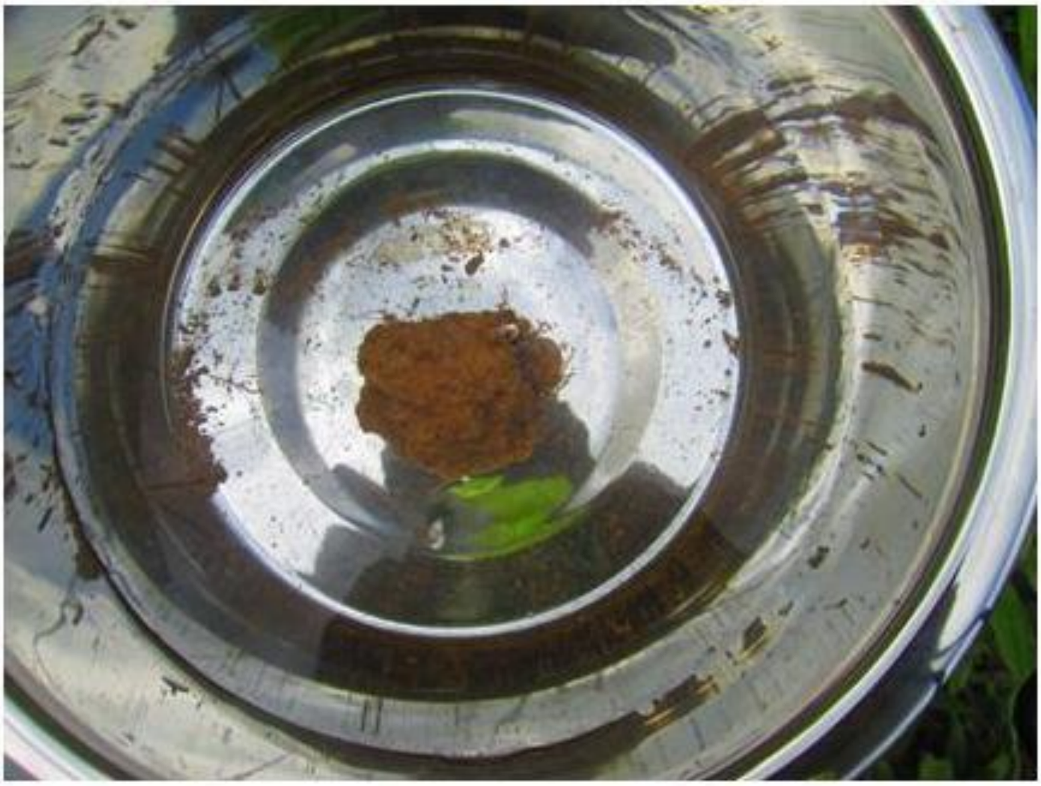


Figure 2-20: Start of Slake Test, Parcel 3

Figure 2-21: 10 Minutes After Slake Test, Parcel 3

The Slake test procedure is repeated in Parcel 5. (**Figure 2-22**). A period of 10 minutes of water submergence is allowed before observance of any slaking property of the soil. **Figure 2-23** shows that the soil of Parcel 5 is very stable (Class 4). There was no slumping of sub-crust.

Figure 2-22: Start of Slake Test, Parcel 5

Figure 2-23: 10 Minutes After Slake Test of Parcel 5

2.1.3.3 Change in soil quality/fertility

A summary of the soil sampling results are given in **Table 2-14** and **Table 2-16**.

Table 2-14: Results of Nutrients Analysis in reference to the BSWM Standards

Location/Coordinates	Soil Type	Parameters									
		pH	OM	N	P	K	Na	Ca	Mg	Zn	Fe
Brgy. Tagjaguimit, City of Naga (Parcel I) N 10°15'50.8" E 123°40'38.6"	Mandaue Clay Loam	7.26	2.61	0.13	13.8	307	76.4	9900	878	31	20,400
Brgy. Lamac, Municipality of Pinamungahan (Parcel II) N 10°16'54.2" E 123°40'25.9"	Mandaue Clay Loam	7.98	1.82	0.1	6.3	508	208	48500	1596	41	15,500
Brgy. Bulongan, Toledo City (Parcel III) N 10°18'16.2" E 123°39'24.5"	Lugo Clay	7.93	1.47	0.12	4.99	84.5	200	9800	655	48	25,300
Brgy Cogon , City of Naga (Parcel V) N 10°17'16.7"	Mandaue Clay Loam	5.6	2.38	0.08	214	234	104	4000	3884	55	23,800

E 123°44'6.5"											

Adequate (Favorable)
Moderate (Moderately unfavorable)
Deficient (Unfavorable)

Table 2-15: BSWM Soil Fertility Rating

Soil Fertility Rating Guideline				
PARAMETER	**UNITS**	**Adequate (Favorable)**	**Moderate (Moderately Unfavorable)**	**Deficient (Unfavorable)**
Soil pH		5.5 – 8.5	5.0 – 5.5	<5.0 / > 8.5
Organic Matter	%	>3	2 - 3	<2
Nitrogen	ppm	0.6 – 1.0	0.3 – 0.6	<0.1
Phosphorus	ppm	20 - 30	>30	<10
Potassium	ppm	234 - 468	117 - 234	<39
Sodium	ppm	161 - 459	37 - 160	<23
Calcium	ppm	2,000 – 4,000	400 – 2,000	<200
Magnesium	ppm	360 - 840	120 - 360	<60
Zinc	ppm	>1.5	0.5 – 1.5	<0.5
Iron	ppm	2.5 – 4.4	>4.5	<2.5

Table 2-16: Metal Concentrations for All Soil Sampling Locations

Location/Coordinates	Soil Type	Metal Concentration of Soil Sampling Locations			
		Mercury	**Lead**	**Arsenic**	**Cadmium**
Brgy. Tagjaguimit, City of Naga (Parcel I) N 10°15'50.8" E 123°40'38.6"	Mandaue Clay Loam	0.1	0.48	3.1	**0.62**
Brgy. Lamac, Municipality of Pinamungahan (Parcel II) N 10°16'54.2" E 123°40'25.9"	Mandaue Clay Loam	0.1	3.5	5.7	**0.83**
Brgy. Bulongan, Toledo City (Parcel III) N 10°18'16.2" E 123°39'24.5"	Lugo Clay	0.1	5.92	**12.1**	**1.29**
Brgy Cogon , City of Naga (Parcel V) N 10°17'16.7" E 123°44'6.5"	Mandaue Clay Loam	0.1	8.97	2	**1.22**
US EPA STANDARD		**0.3**	**10**	**6.3**	**0.603**

Soil pH

Shown in **Figure 2-24** is the soil pH of the 4 soil sapling sites within the project area. The laboratory analysis using electrometric method revealed that the pH of the soil in Parcel 1 to be near neutral (7.26). Parcel 2 and 3 are having a pH value of 7.98 and 7.93 and is rated by the Bureau of Soils and Water Management (BSWM) to be moderately alkaline.

On the other hand, Parcel 5 soil sampling site soil reaction is rated as moderately acid. This is believed to be brought about by the land use (i.e. intensive cropping activity within the site), and now abandoned when the productivity becomes poor (personal communication among farmers). The low pH in this site is also indicated by the present vegetation (mainly grasses) that is undergoing various stages of litter decomposition at the surface. The process greatly affects the soil reaction most especially in the surface horizon, and is reflected by the latest soil testing activity.

The results reflect the information from the soil pH map presented in the Cebu Provincial Agricultural Profile by the Department of Agriculture, 2011 (**Figure 2-25**).

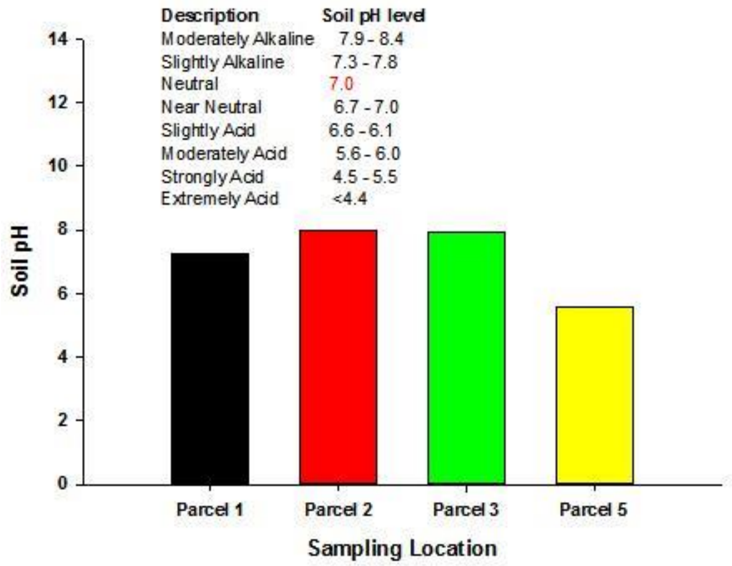
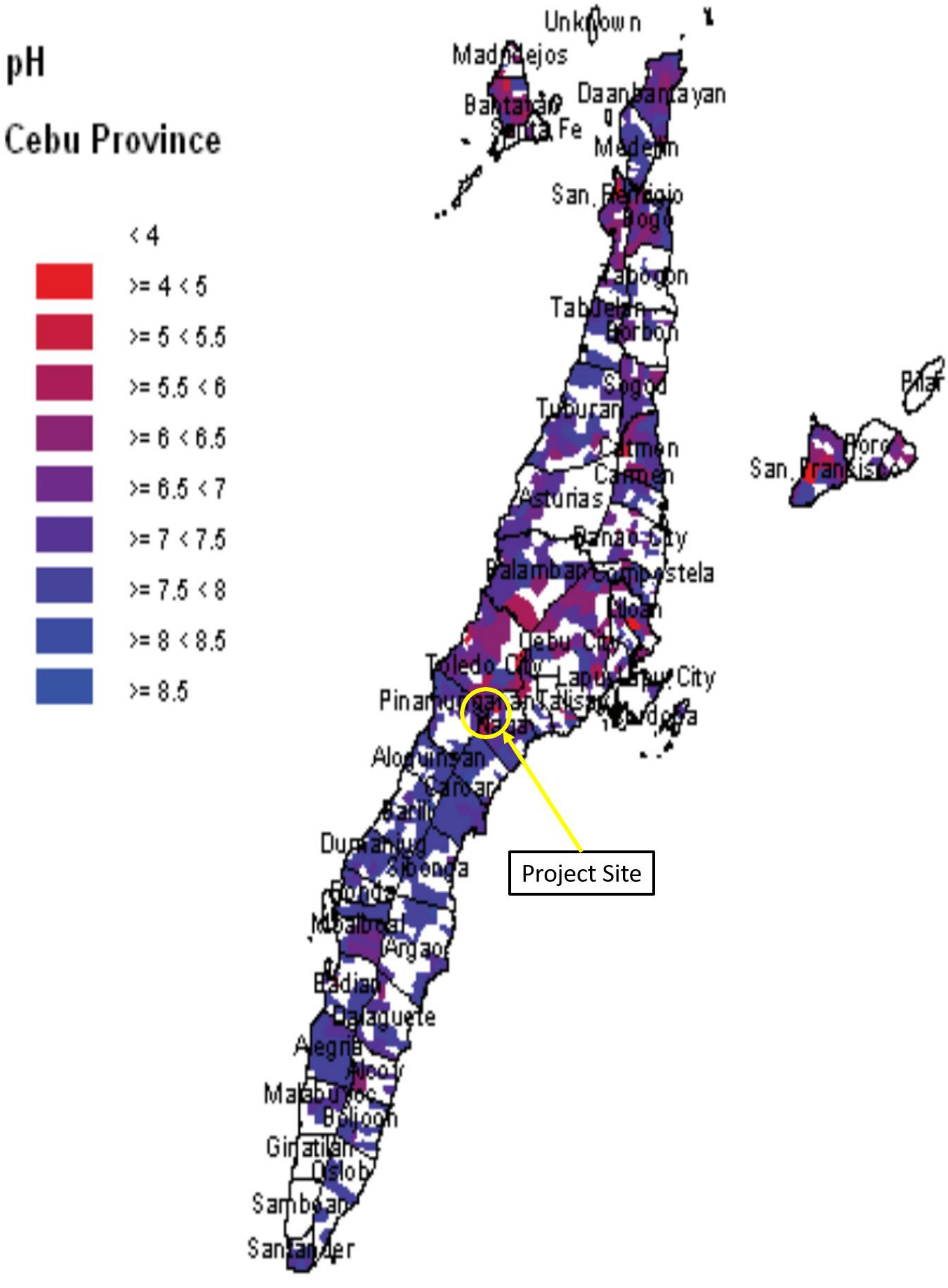


Figure 2-24: Soil pH of the 4 Soil Sampling locations



Source: Cebu Provincial Agricultural Profile, Department of Agriculture, Regional Field Unit – 7, 2011

Figure 2-25: Provincial Soil pH Map

Soil Organic Matter Content

Soil organic matter (SOM) is one of the important sources of organic nitrogen. It enhances the soil microbial activities, it also greatly influences the gas exchange of the soil matrix, and it improves the structure of the soil, increases soil water holding capacity, and cation exchange capacity.
The laboratory test of the surface soil in the project areas revealed that the soil in Parcel 1 and Parcel 5 have a medium level of (SOM) of 2.6 and 2.58%, respectively. Parcels 2 and 3 on the other hand, showed to have a low SOM of 1.82 and 1.47%, respectively (**Figure 2-26**). For optimum crop/plant production, the soil must have at least 3% SOM minimum. **Figure 2-27** shows the provincial soil organic matter of Cebu.

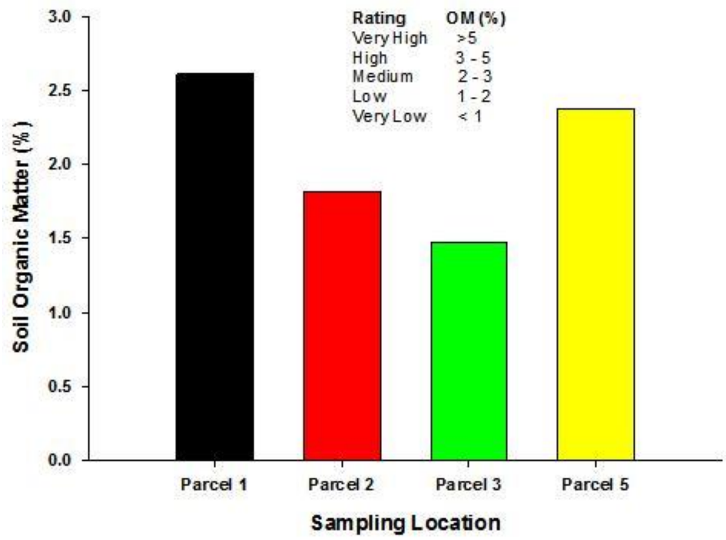
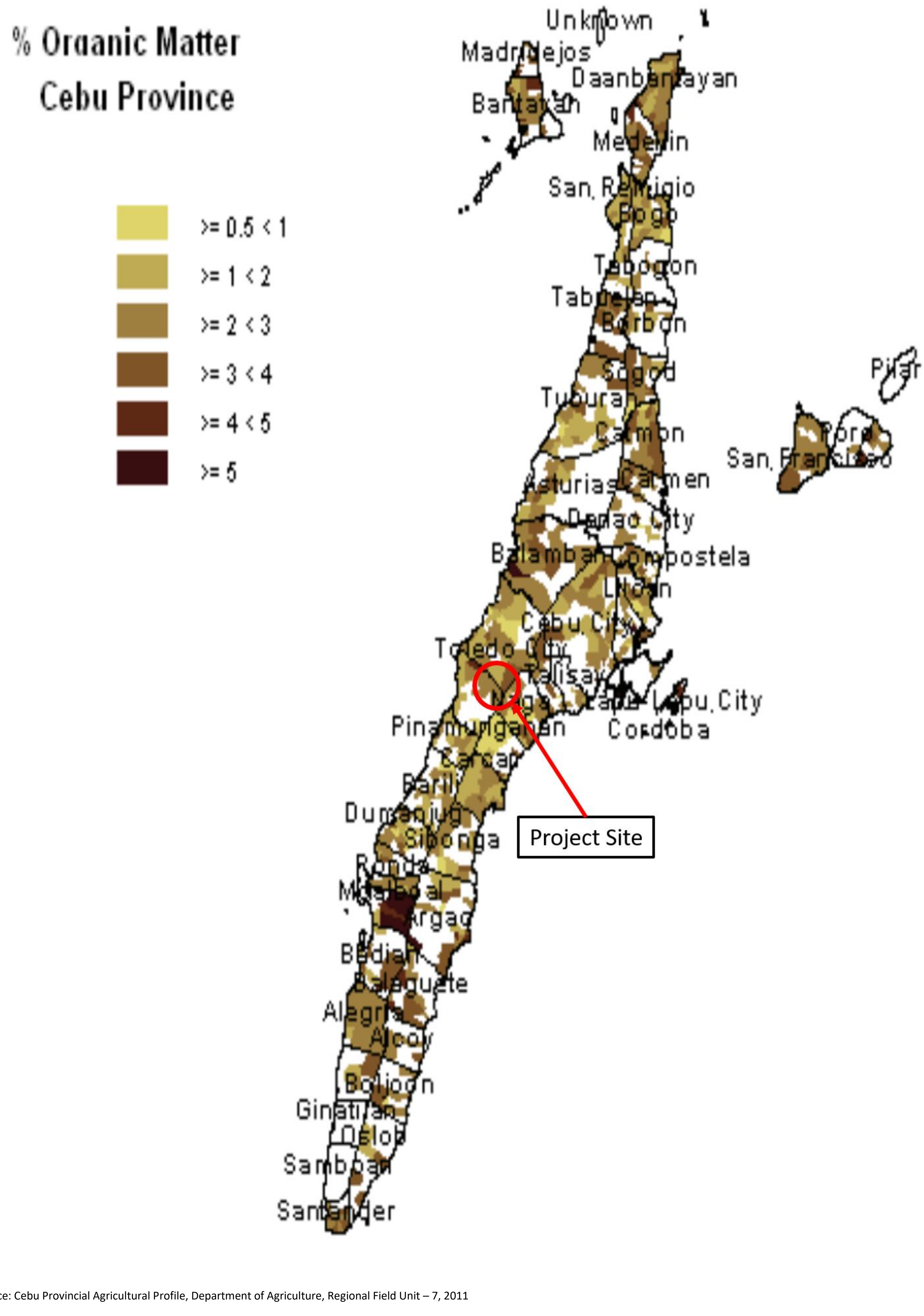


Figure 2-26: Soil Organic Matter Content



Source: Cebu Provincial Agricultural Profile, Department of Agriculture, Regional Field Unit – 7, 2011

Figure 2-27: Provincial Soil Organic Matter Map

Soil Total Nitrogen Content

Shown in **Figure 2-28** is the total nitrogen content of the soil sampling locations within the project site. All of the sampling sites indicated a very low nitrogen content in the surface soil that ranges from 0.06 - 0.13 %. Adequacy level standard value by the (BSWM) is 0.6 - 1% Total N. This observed low Nitrogen values in the surface soil can be attributed to the present land use of the area and the slope (i.e. > 18% slope) where, erosion is high. The surface soil was observed to be shallow and, can be attributed to erosion. Soil lost during the process carry not only the soil particles, these include all of the adsorbed nutrients. The erosion process exposed the subsurface soil which is less fertile.

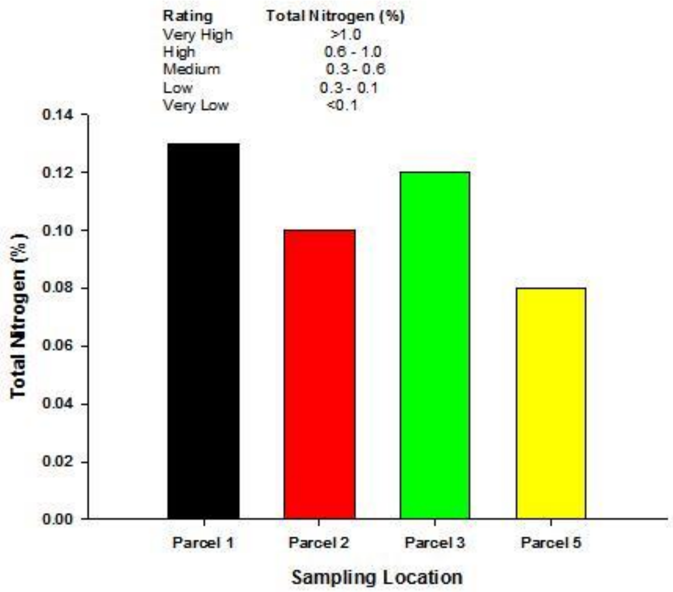


Figure 2-28: Total Nitrogen Content

Available Phosphorus of the Soil Sampling Locations

Generally most Philippine soils have deficient amount of available phosphorus (P). Large amount of this element is derived from the weathering of minerals. However mineralized P release to the soil is very slow. In most cases P is fixed because of either too high or low pH.

Based on the results of laboratory analysis using the colorimetric method of determining phosphorus when rated using the BSWM standards, Parcels 1 is having a low level of available phosphorus of 13.80 ppm. Parcel 2 and 3 exhibited Very low level of available phosphorus of 6.30, 4.99 ppm, respectively (**Figure 2-29**). Parcel 5 in contrast to the earlier mentioned parcels is having a very high rating of available phosphorus of 214 ppm. The result can be attributed to the present land use of the site where there is high cropping intensity. Farmers use indiscriminate amount of fertilizers such as urea (45% N) and Complete fertilizer (14 – 14 – 14) which contain available P. Residual traces of phosphorus can be easily detected by the soil test. Livestock like cattle and carabao and goat normally graze the area. All of these can contribute to the increase of available phosphorus in the surface soil. **Figure 2-30** shows the provincial soil phosphorus map.

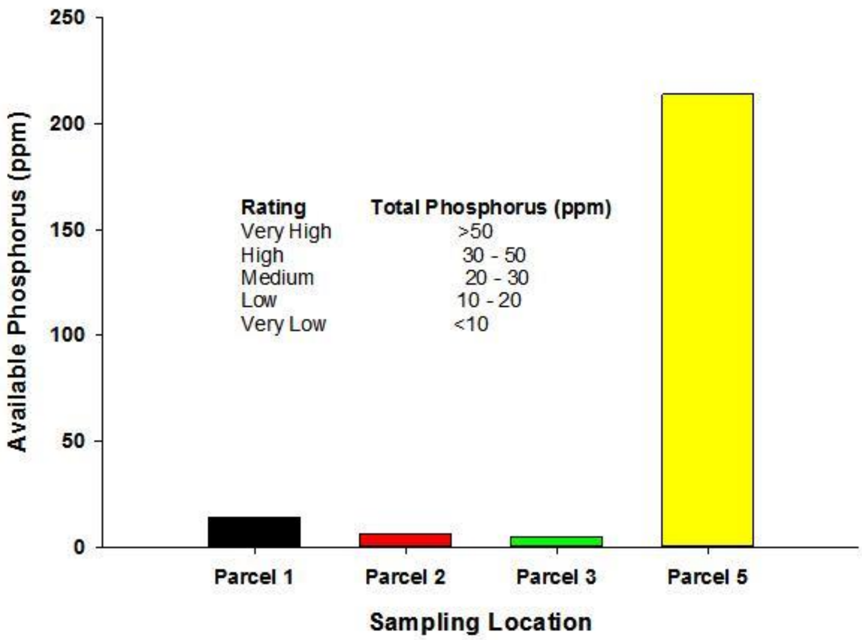
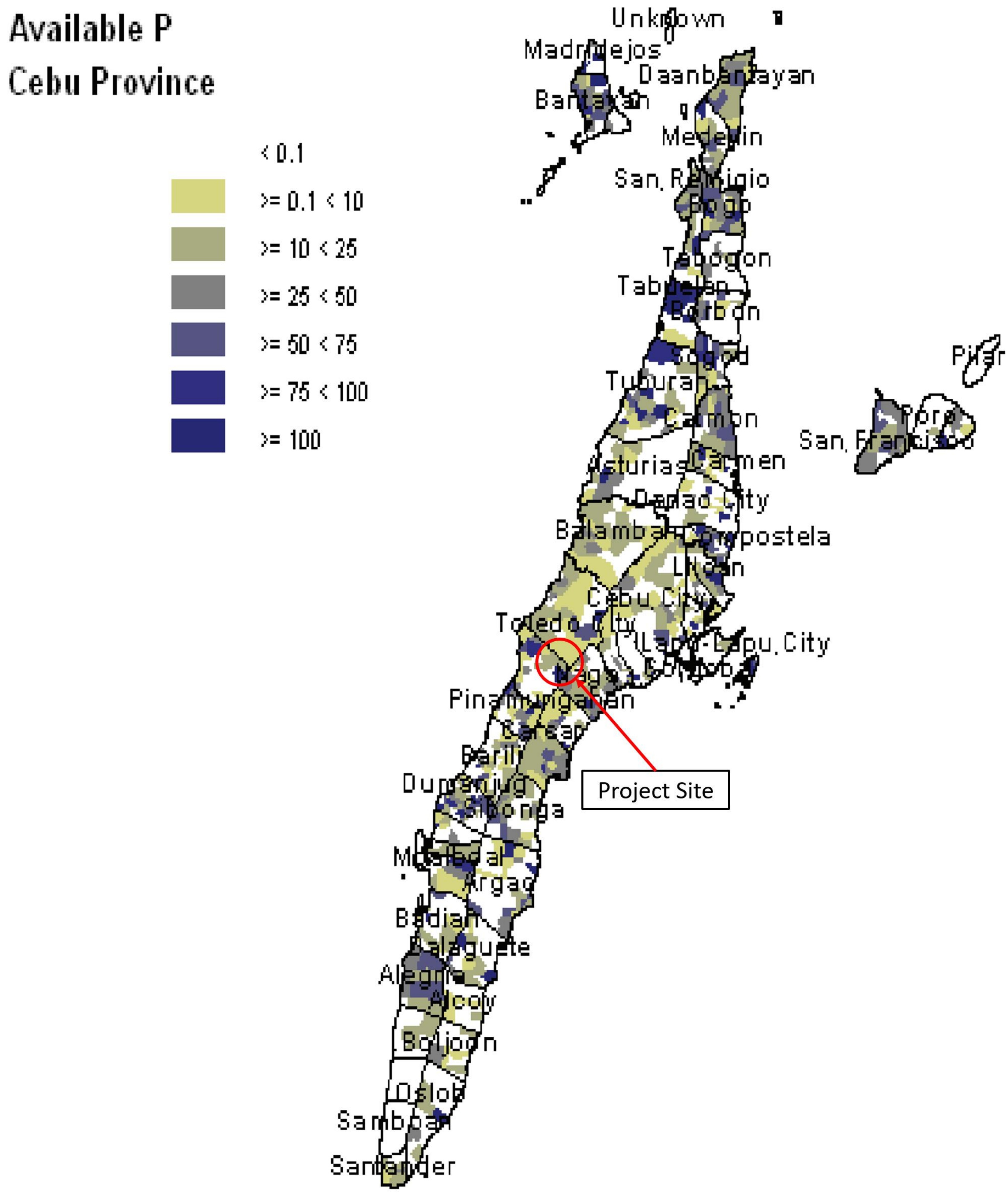


Figure 2-29: Total Phosphorus Content



Source: Cebu Provincial Agricultural Profile, Department of Agriculture, Regional Field Unit – 7, 2011

Figure 2-30: Provincial Soil Phosphorus Map

Soil Exchangeable Bases of the Sampling Locations

Using the BSWM standard for exchangeable Calcium (Ca), the laboratory test showed that Ca is abundant in all of the sampling locations. This is simply because, the soil parent material in all of the parcels sampled is limestone known to be high in calcium. Parcel 5 have the lowest amount of exchangeable Ca of 4,000ppm but, still rated to be high when compared to the standard. The highest was found in Parcel 3 of 69,800ppm (**Figure 2-31**).

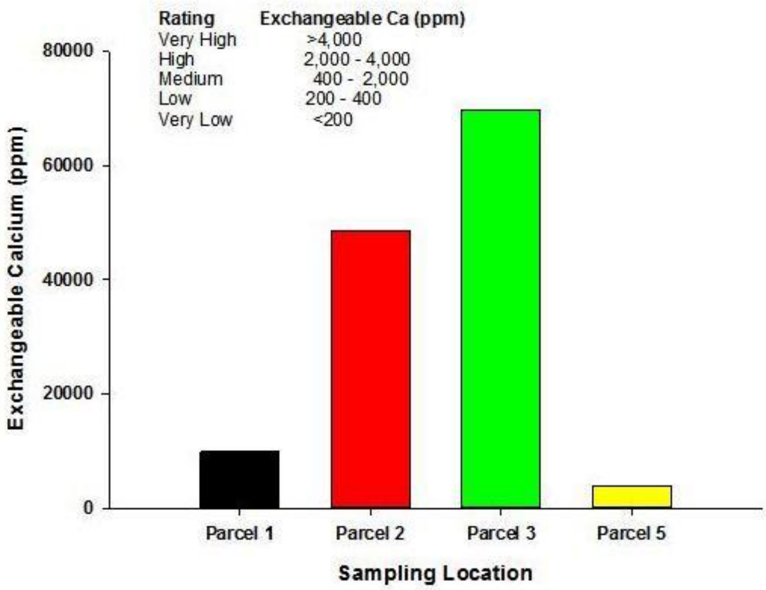


Figure 2-31: Exchangeable Calcium Content

Potassium (K) is one of the essential elements required by plants in large quantities. Basically, potassium is required in the development of young plants such as leaves, flowers and seeds and the quality of the produce. Three of the soils of all of the Parcels sampled have a high to very high level of Exchangeable K of 234; 307 and 508ppm for Parcels 5, 1, and 2, respectively. The lowest amount of exchangeable K was found in Parcel 3 of 84.5ppm and is rated low when compared to the BSWM standard (**Figure 2-32**). **Figure 2-33** shows the provincial soil phosphorus map.

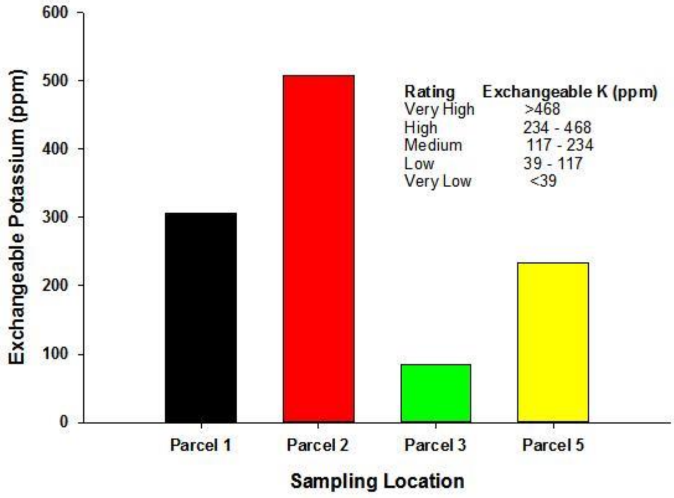
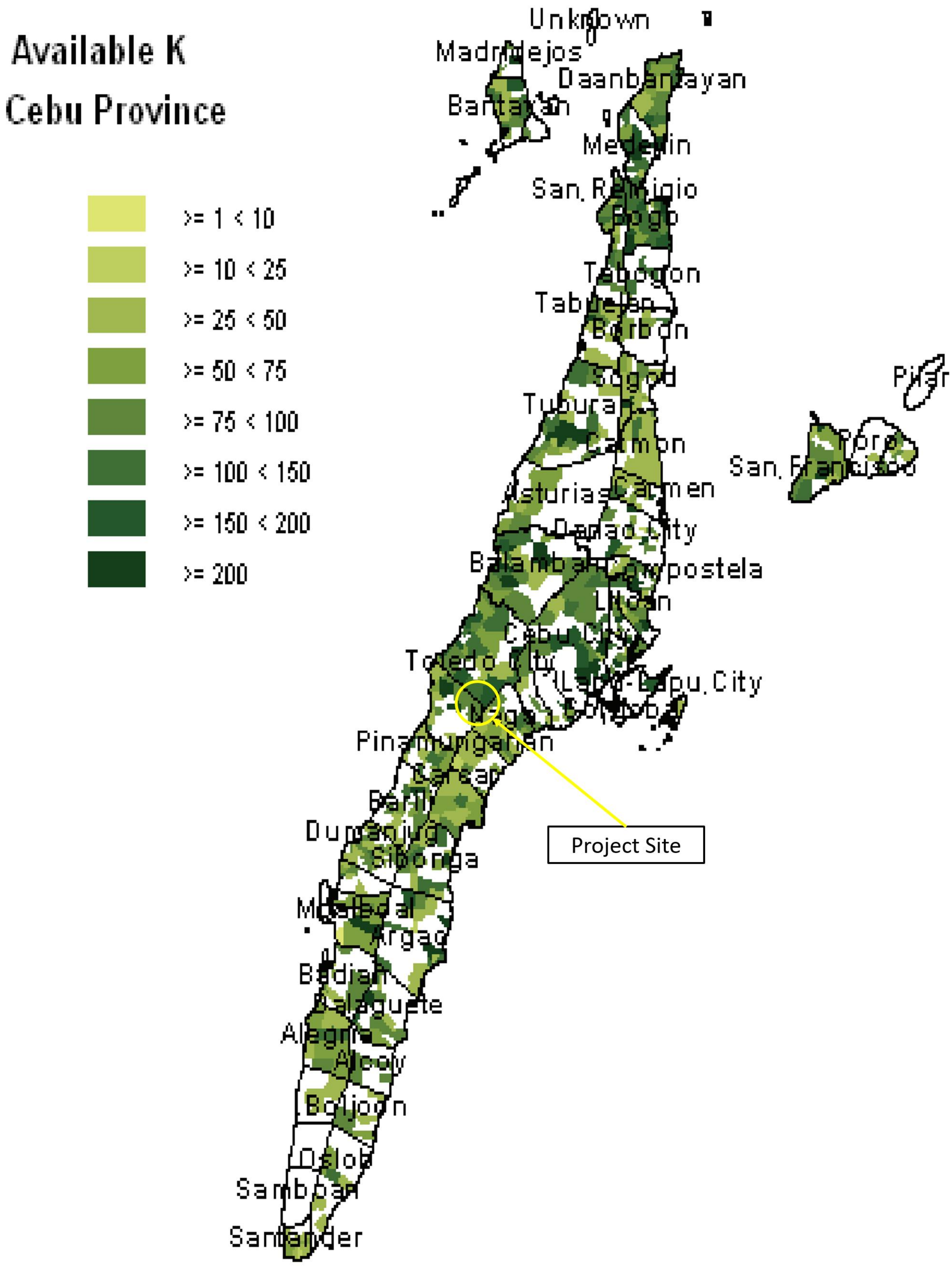


Figure 2-32: Exchangeable Potassium Content



Source: Cebu Provincial Agricultural Profile, Department of Agriculture, Regional Field Unit – 7, 2011

Figure 2-33: Provincial Soil Potassium Map

Magnesium (Mg) as an essential nutrients in higher plants is a component of the green pigment in the plant leaves (i.e. chlorophyll) and, act as catalyst to the translocation of phosphorus in the plant vascular tissues. It also aid in the formation of fats and oil in fruits.

The levels of exchangeable Mg is shown in **Figure 2-34**. Using the BSWM sets of standard for exchangeable Mg showed that all of the parcels sampled have a very high amount of exchangeable Mg. The lowest exchangeable Mg of 655.0ppm was given by Parcel 3. The highest on the other hand was given by Parcel 5 of 3,884.00ppm.

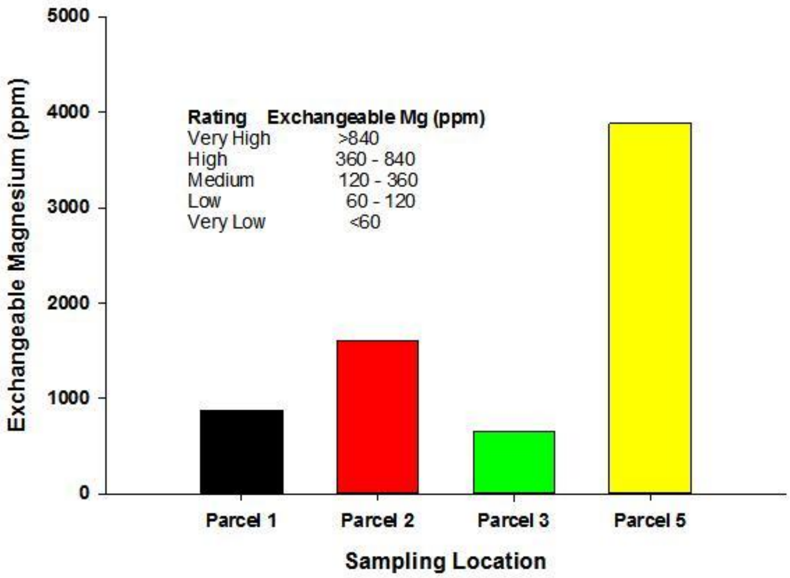


Figure 2-34: Exchangeable Magnesium Content

The exchangeable Sodium (Na) is very necessary for the plant in order to maintain turgidity of the cell wall and is also needed in large quantities by plants. However, excess level of this essential element in the soil is detrimental as it causes wilting as the plant loses water from their tissues thru plasmolysis. Sodium level of the soil is medium to high levels when compared to the BSWM standard (Figure 2.9) exchangeable amount of Exchangeable Na was found in Parcel 1 of 76.4ppm. The highest on the other hand was in Parcel 2 of 208.00ppm.

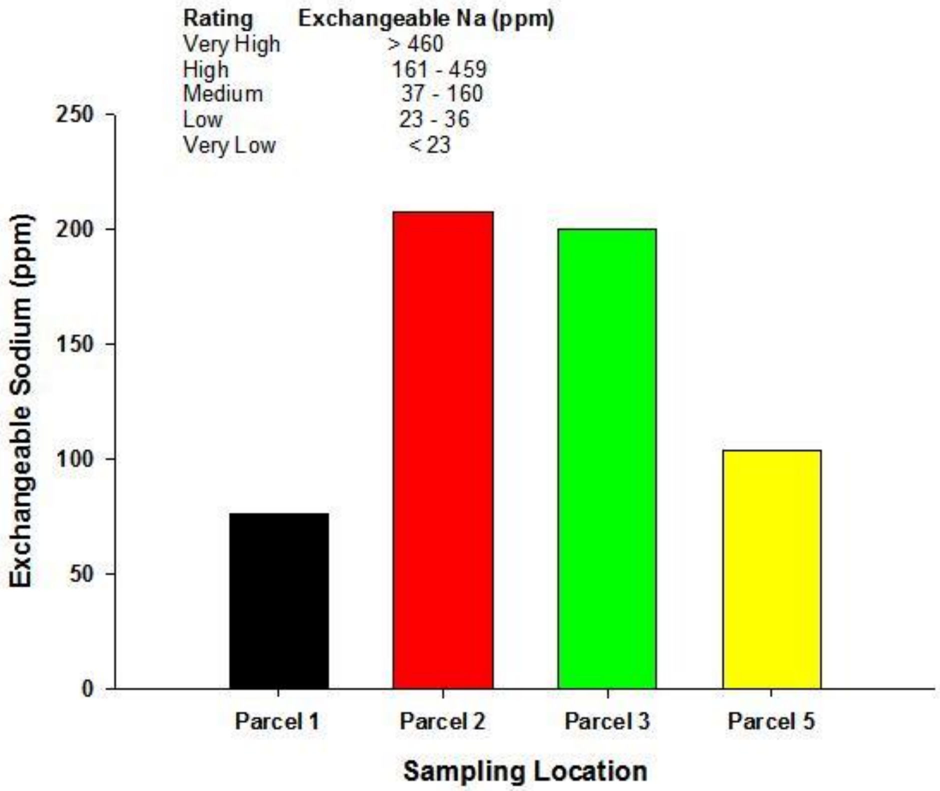


Figure 2-35: Exchangeable Sodium Content

Metallic Essential Micro nutrients of the Soil Sampling Locations

The metallic essential nutrients Iron (Fe) and Zinc (Zn) of the soil sampling locations analyses of the four (4) soil sampling locations in the project site is shown in Figure 2.10a and Figure 2.10b, respectively.

Iron (Fe) is essential in the synthesis and maintenance of chlorophyll in plants. Also, Fe has been strongly associated with protein metabolism. **Figure 2-36** showed that the soil of all parcels sampled have an adequate level of iron when compared to the BSWM standard. The lowest Fe content of 15,500ppm was inferred in Parcel 2 and, the highest was given by Parcel 3 of 25,300ppm.

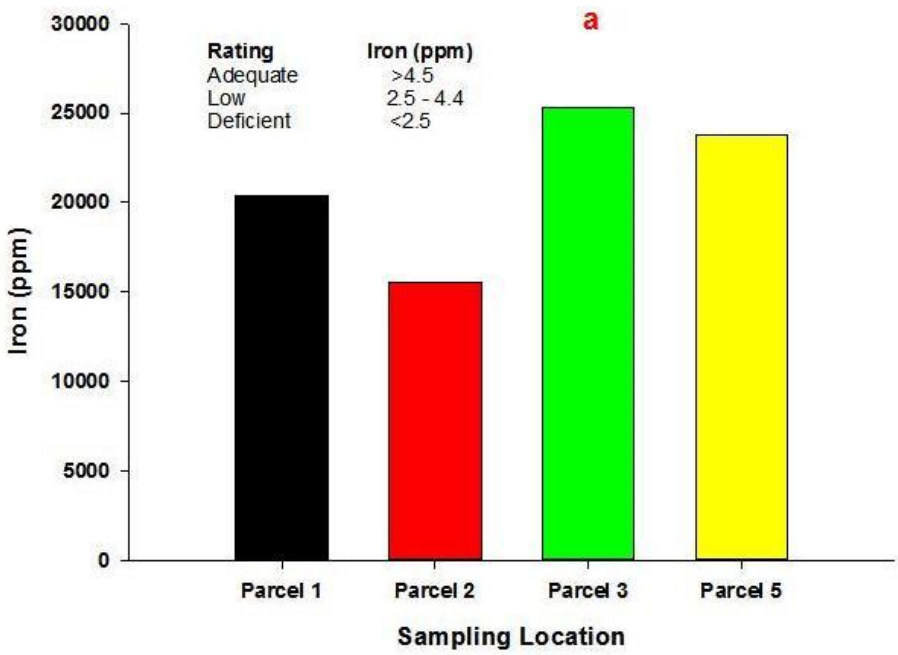


Figure 2-36: Metallic Essential Micro nutrient Iron

Figure 2-37 presents the zinc content of the sampling locations. This trace metal is Zn is an essential component of several metallo-enzymes in plants and, therefore is necessary for several different function in plant metabolism. Essential element Zn is commonly deficient in soils with high pH. However, on all of the Parcels sampled, they exhibited an adequate level of zinc. Parcel 1 have 31.0ppm of zinc which is the lowest. The highest level of zinc was found in Parcel 5 of 55.0ppm.

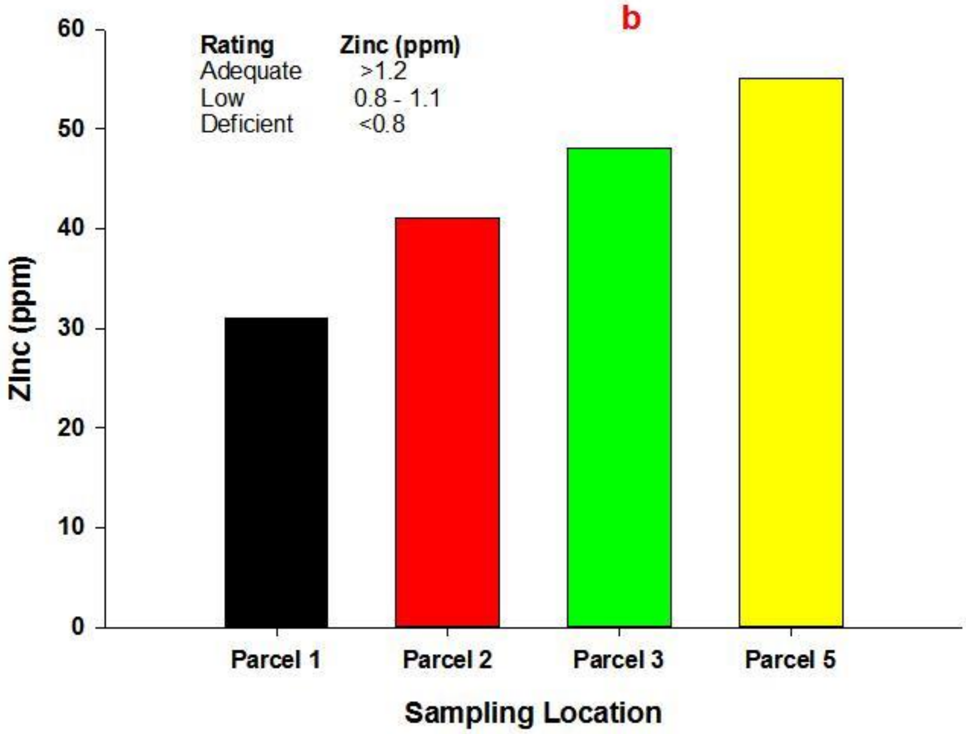


Figure 2-37: Metallic Essential Micro Nutrient Zinc

Heavy Metal Content

Results of the Heavy metal analysis were compared to the United States Environmental protection Agency (US EPA, 1974) standards for Arsenic, Cadmium, Lead and Mercury.

The heavy metal Arsenic (As) content of Parcels 1, 2 and 5 (**Figure 2-38**) did not exceed the US EPA standard levels of soil contamination of 6.3ppm of 5.70, 2.00, 3.10ppm, respectively. Again, this results can be attributed to the present land use. For example, Parcel 2 is a second growth forest that, there is no, agricultural activities and other anthropogenic activities that introduce As to the soil and, therefore can be considered as soil inherent As content. Parcel 3 soil sampling location on the other hand, exceeded the USEPA standard limit with As content of 12.10ppm. This is perhaps again, can be attributed to the present land use where, it is heavily farmed and, the constant use of agri-chemicals may have introduced the heavy metal in the soil. Further, accumulation of the heavy metal arsenic can be also attributed to the soil texture of the soil where it is clay, rendering very poor drainage and therefore limit leaching of the highly water soluble As.

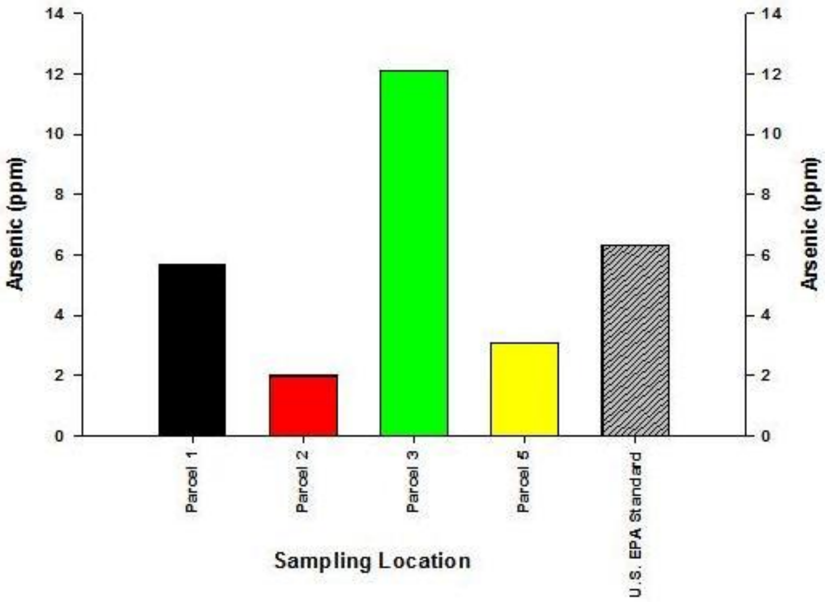


Figure 2-38: Heavy Metal Arsenic Content

Heavy metal Cadmium (Cd) soil laboratory analysis revealed that all soil of the sampling locations exceeded the US EPA standard for Cd of 0.603ppm. Cadmium is notably high in non-calcareous soils, hence, the high concentrations in areas where intensive addition of soil amendments like fertilizers and pesticides were made may have contributed to the observed elevated levels of Cd in the surface soil. The rest can be attributed to the inherent parent materials content of Cd and is apparent in Parcel 2 where not much interventions are employed (**Figure 2-39**).

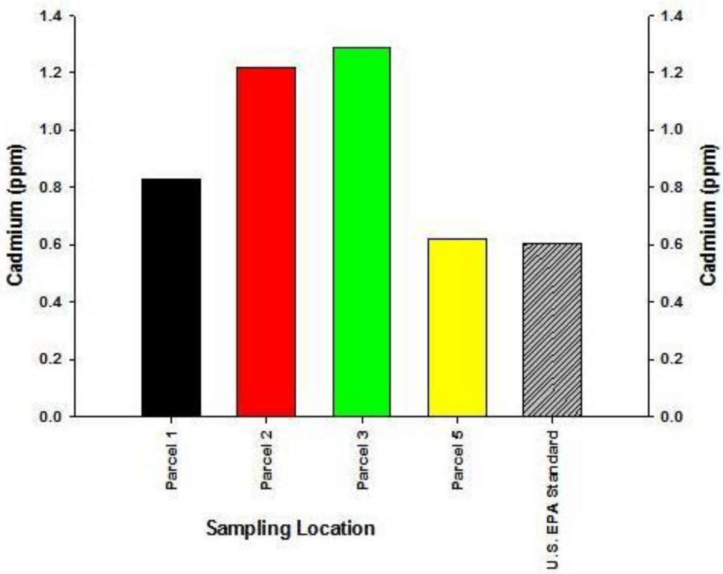


Figure 2-39 Heavy Metal Cadmium Content

In terms of the presence of Heavy metal Mercury (Hg), all of the soil sampling location have very low levels of Hg (i.e. <0.1ppm) when compared to the US EPA standard of 0.3 ppm and is presented in **Figure 2-40**.

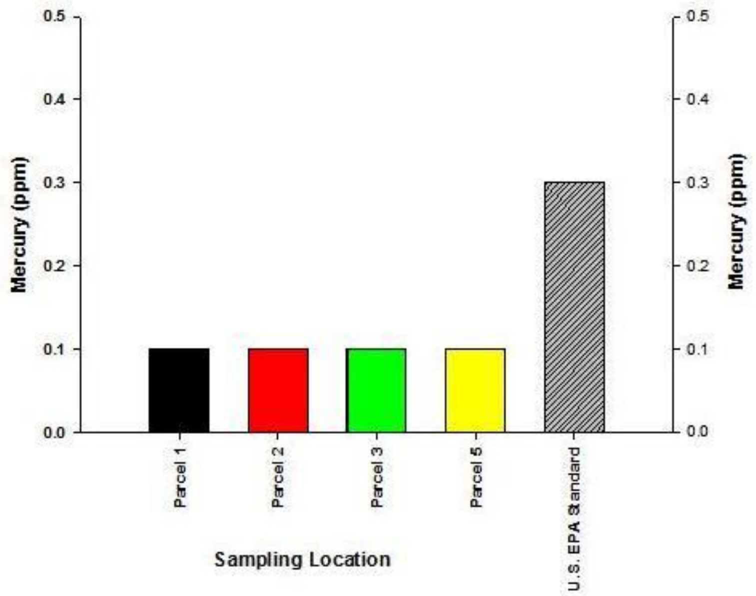


Figure 2-40: Heavy Metal Mercury Content

Soil lead becomes a health risk when directly ingested or inhaled as dust. Backyard garden produce, which has accumulated lead in its tissue or has soil particles adhering to it, can also be a hazard if eaten. Lead poisoning is a particular concern for young children (under the age of six) because their rapidly developing bodies are very sensitive to the effects of lead, and their play habits tend to increase exposure.

Lead (Pb) content of the four (4) soil sampling location are shown in **Figure 2-41**. Although, the presence of heavy metal Pb is detected it indicated to be still under the acceptable limit. Parcel 5 have the lowest level of Pb of 0.48ppm, and the highest level was found in Parcel 2 of 8.97ppm. The U.S. EPA standard is 10.0 ppm.

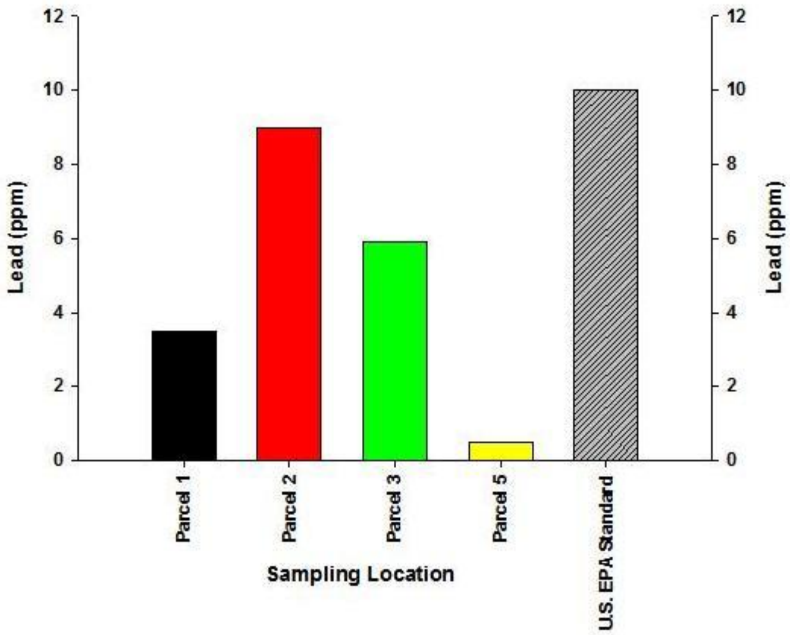


Figure 2-41: Heavy Metal Lead Content

2.1.3.4 Assessment of Impacts and Mitigating Measures

Natural Topography

Change in topography is inherent to any surface mining activity. Activities that would generate the most significant impact to geology and geomorphology are the site preparation (i.e. overburden removal and grading) and the quarrying activity itself.

To minimize the impact on the natural topography, mining activity will be conducted in conformance with the mining plan and bench parameter of at least 3m bench width and minimum of 10m bench height. The mined-out areas will be recontoured following the topography. The contours shall be appropriately designed (catch bench width, bench height, bench angle, general slope angle, slope height, etc.) based on the geology of the area and on the original land configuration of the area to be mined.

Haul Roads and Access Roads

Quarry development will start from the construction of access/haul road within the quarry site, which is designed to facilitate opening of benches. The haul road is set to have a width of 15 meters with a maximum grade of 8–10%.

Movement of large machinery across the landscape during development and quarry operations may lead to soil compaction. As the soil is compacted, infiltration and percolation rates as well as soil porosity drastically decline. With this, the potential of the soil for plant establishment is compromised due to less pore spaces that impede the movement of oxygen and water through the soil profile. In addition, as water is unable to percolate down through the soil, it inevitably will move across the landscape as surface runoff transporting loose soil which may reach nearby surface waters.

The haul ramp will be developed from the access road and initially following the natural topography of the area. The roads will be constructed with an overall width of about 30 m which incorporates provision for ditch and berm. Pre-emptive measures through implementation of appropriate slope/ground failure monitoring plan will be adopted to identify any instability at an early, non-critical stage so that safety measures can be initiated to prevent or minimize impacts.

Waste Stockpile Area

Waste stockpile area will be designated in the mine out area to accommodate waste and topsoil recovered as the project progress. The topsoil will be used in the progressive and final rehabilitation of the disturbed areas. Stockpile slope will be kept at a low angle and height to minimize slumping.

Stockpiling of the topsoil for prolonged periods may deteriorate the biological components in the soil deteriorating its quality. Stripping of soil at unsuitable moisture content (i.e. when wet or saturated) may also lead to compaction and loss of soil structure.

Recovered topsoil during operation will immediately be used as potting medium in the nursery or can immediately be spread to a previously mined area. Since stripping of the topsoil and overburden material is proposed to be done ahead of quarrying phase, stockpiling of topsoil in the early stages of the project is inevitable. With this, topsoil will initially be piled on designated topsoil areas. Drainage canals will be provided to divert surface runoff away from the piles as well as to collect storm water intercepted within the stockpile area to the designated sedimentation ponds.

To avoid soil erosion or down cutting of the base of stockpiles, stockpiles will not be placed on natural drainage lines. Weep holes will also be placed to drain off accumulated water inside the stockpile and also for better soil aeration to maintain or enhance the growth of beneficial microorganisms in the soil. To avoid the deterioration of the soil quality, the topsoil will be stored in small mounds no more than 3-meters high. An embankment grade of approximately 1V:4H (or depending on the angle of repose) will be followed to limit the potential for erosion of the outer pile face. In addition, topsoil stockpiles will be seeded and fertilized. The addition of biosolids, compost, manure, crop/plant residues or other readily available organic-matter-rich materials will also help enhance the biological growth in the soil as well as improve soil structure thus will be considered in the rehabilitation plan. The stockpile will be properly protected from the direct exposure to high temperatures and strong winds by planting of N-fixing leguminous cover crops.

Contaminated Land

Soil contamination may also occur due to accidental spill of oil and fuel (hydrocarbons) and improper disposal of domestic waste.

Waste oils and lubricants shall be properly handled, stored and disposed in accordance with RA 6969. Hazardous materials and wastes shall be contained in areas with lining or in storage tanks. Safety procedures shall be implemented to avoid spillage. In case of accidental spills, contaminated soil shall immediately be removed to avoid further dispersion of contaminants. Spill kits shall be made available at all times.

2.1.4 Terrestrial Ecology

The forest types of Cebu Island are identified as mangrove forest, beach forest, molave forest of the coastal plain, the molave forest of the hill zone, and the dipterocarp forest of the higher elevation (Seidenschwarz, 1988).

The island's remaining forests are characterized mainly by forest over limestone, in its original and regenerating state. These cover only 17km^2 which is about 0.3% of the total land area of Cebu (Jakosalem et al., 2012; Dutson et al., 1993). These are fairly well-studied as critical habitats of fauna of Cebu. In particular, forest patches of Tabunan, Dalaguete, Boljoon, Argao, Alcoy, Alegria, Carmen, Alegria-Malabuyoc, Mananga Watershed Reserve, Kotkot-Lusaran Watershed Reserve (Anon, 2008; Jakosalem et al., 2012; Paguntalan and Jakosalem, undated; Orlanes, 2002; Hafner et al., 2003). The forest over limestone is the equivalent of the molave forest of the coastal plain and hill zone in the forest classification of Seidenschwarz (1988).

The forest in Tabunan is characterized with a multi-storey vertical strata with emergent, canopy and lower canopy layers and with an average of 82.66% crown closure, by Orlanes (2002). Within a 600 m^2, 111 species in 71 genera and 36 families have been documented. Dutson et al. (1993) however that there is no more closed canopy dipterocarp in Cebu.

Some of the species which are commonly documented in these forests, outside of the study sites are: Swietenia macrophylla, Leucaena leucocephala, Gmelina arborea, Tectona grandis, Albizia saman, Sterculia philippinensis, Diospyros philippensis, Cinnamomum cebuense, Alstonia macrophylla, Palaquium philippense, Melia dubia, Vitex parviflora, Casuarina rumphiana, Canarium sp., Artocarpus sp., Buchanania sp., Nauclea sp., Pittosporum pentandrum, Medinilla albiflora, Ficus spp., Homolanthus sp., Mallotus sp., Syzygium sp., Macaranga sp., Leea sp., Dillenia sp., Mangifera sp., Eucalyptus sp. Calamus sp. Helicia sp., Melastoma sp., Leucosyke capitellata, Dracaena sp., Breynia sp., Lansium domesticum, Musa textiles, Colocasia esculenta and ferns like Platycerium and Asplenium (Anon, 2008; Anon, 2014; Jakosalem et al., 2012; Orlanes, 2002; Paguntalan and Jakosalem, undated; Paguntalan and Jakosalem, 2008).

The study sites of the proposed Cebu quarry project was not covered by any of these published studies. These are located a few kilometers from Carmen Copper Consolidated, a leader in the copper mining sub-sector (Cinco, 2012) and the Tabunan forest which is within the Cebu Central Protected Landscape. It is north of the other well-studied forests of Southern Cebu which are declared as Key Biodiversity Areas (KBA) or proposed as a Local Conservation Area (LCS).

2.1.4.1 Methodology

Vegetation Study

Five study sites were designated to represent the four parcels (Parcel 1, Parcel 2, Parcel 3, and Parcel 5). Since Parcel 3 was a big area, it was then divided into two study sites (Parcel 3A and 3B). **Table 2-17** shows the study sites coordinates per parcel.

Table 2-17: Description of the location of the Study Sites

Parcel	Description of Location of Study Sites	Waypoint Reference	Latitude	Longitude	Altitude	Date/Time
I	**Operational Quarry Site**	**277**	**10°15’53.9”N**	**123°40’23.7”E**	**292**	**June 25 11:25**
		278	10°15’53.4”N	123°40’24.4”E	290	11:36
		279	10°15’53.5”N	123°40’23.0”E	308	11:46
		280	10°15’53.7”N	123°40’22.8”E	308	12:01
		281	10°15’52.5”N	123°40’23.1”E	291	12:11
II	**Along the road and cliff**	**266**	**10°16’58.6”N**	**123°40’20.7”E**	**275**	**June 24 15:04**

Parcel	Description of Location of Study Sites	Waypoint Reference	Latitude	Longitude	Altitude	Date/Time
		267	10°16'57.8"N	123°40'20.5"E	280	15:12
		268	10°16'57.7"N	123°40'21.0"E	303	15:29
		269	10°16'57.3"N	123°40'20.5"E	317	15:47
		270	10°16'57.0"N	123°40'20.3"E	320	15:50
3A	**Limestone hill with small village**	**252**	**10°18'17.8"N**	**123°39'32.6"E**	**160**	**June 24 8:52**
		253	10°18'17.4"N	123°39'33.7"E	164	8:53
		254	10°18'16.6"N	123°39'37.2"E	174	9:01
		255	10°18'13.5"N	123°39'40.2"E	190	9:07
		256	10°18'13.3"N	123°39'40.5"E	190	9:08
		257	10°18'12.0"N	123°39'42.1"E	193	9:10
		258	10°18'10.2"N	123°39'42.2"E	199	9:20
3B	**Limestone hills with small village**	**259**	**10°18'58.6"N**	**123°40'28.9"E**	**289**	**13.43**
		260	10°18'57.8"N	123°40'28.6"E	308	13:49
		261	10°18'57.3"N	123°40'28.0"E	311	13:56
		262	10°18'57.4"N	123°40'29.2"E	323	14:05
		263	10°18'57.1"N	123°40'29.4"E	333	14:11
		264	10°18'58.0"N	123°40'28.6"E	325	14:15
		265	10°18'57.1"N	123°40'26.8"E	340	14:18
V	**Rest house**	**271**	**10°17'20.9"N**	**123°55'01.6"E**	**525**	**Jun 25 9:22**
		272	10°17'22.7"N	123°44'01.8"E	539	9:35
		273	10°17'21.9"N	123°44'02.9"E	535	9:52
		274	10°17'22.8"N	123°44'04.0"E	531	10:01
		275	10°17'22.3"N	123°44'01.4"E	534	10:14:23
		276	10°17'22.3"N	123°44'01.3"E	533	10:14:54

Within each study site, 2-3 plots were established. These plots represented the different forest types or states of integrity of the forest type within the area. If only one forest type of the same state of integrity was found, then the plots were established at different altitudes.

The sampling sites for the Terrestrial Ecology is shown in **Figure 2-42**.

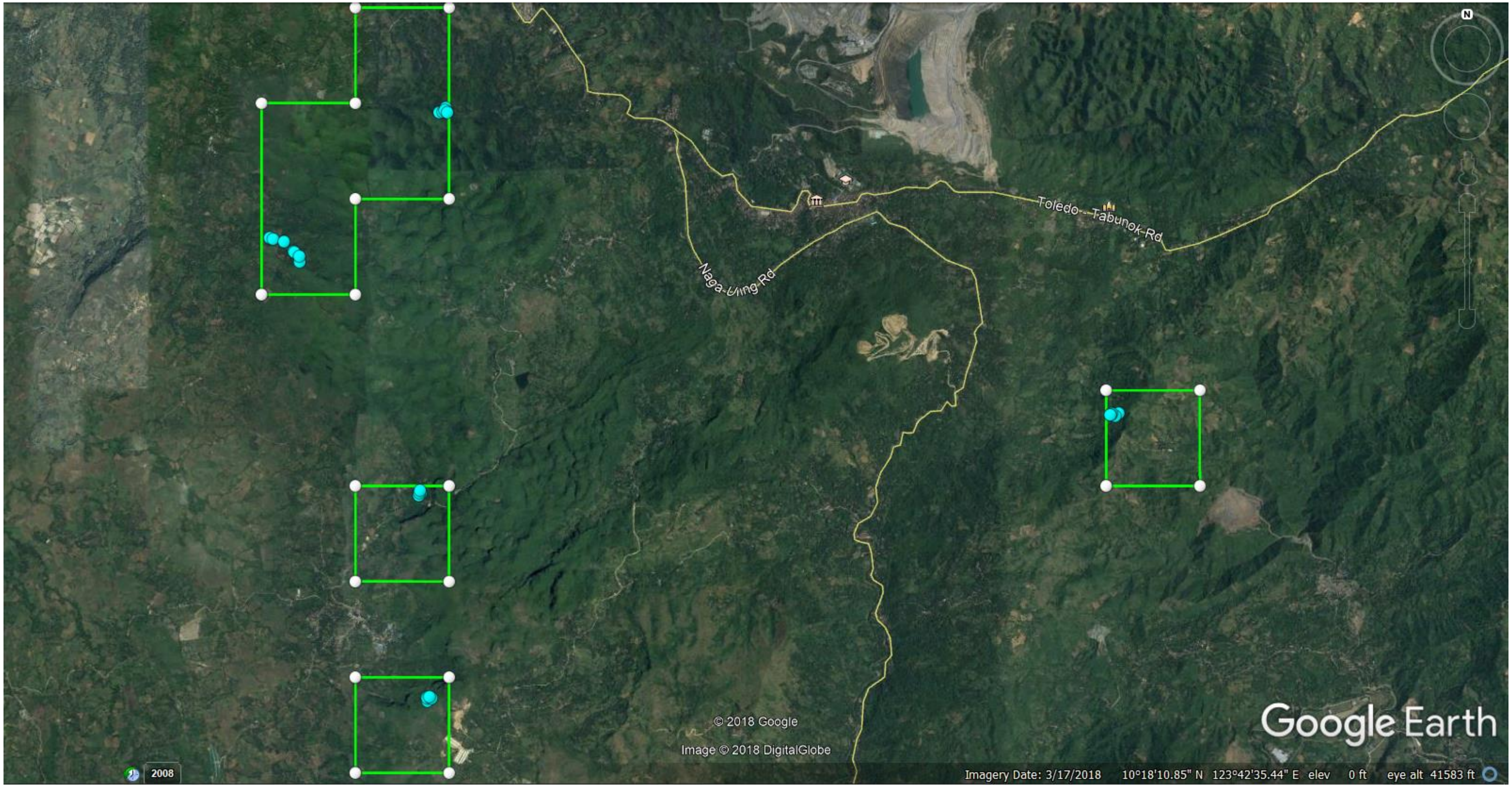


Figure 2-42: Terrestrial Ecology Sampling Map

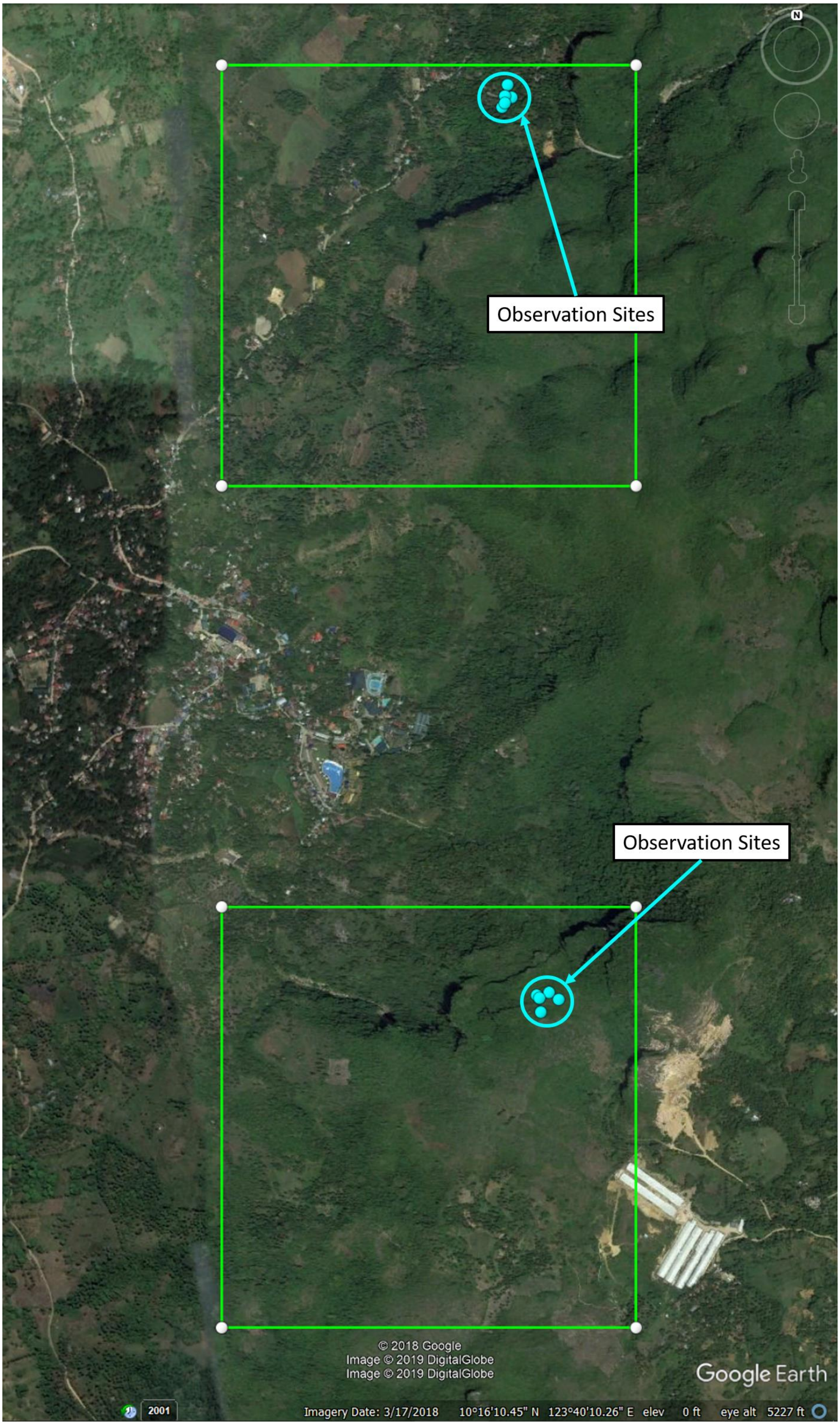


Figure 2-43: Terrestrial Ecology Observation Points in Parcels 1 and 2

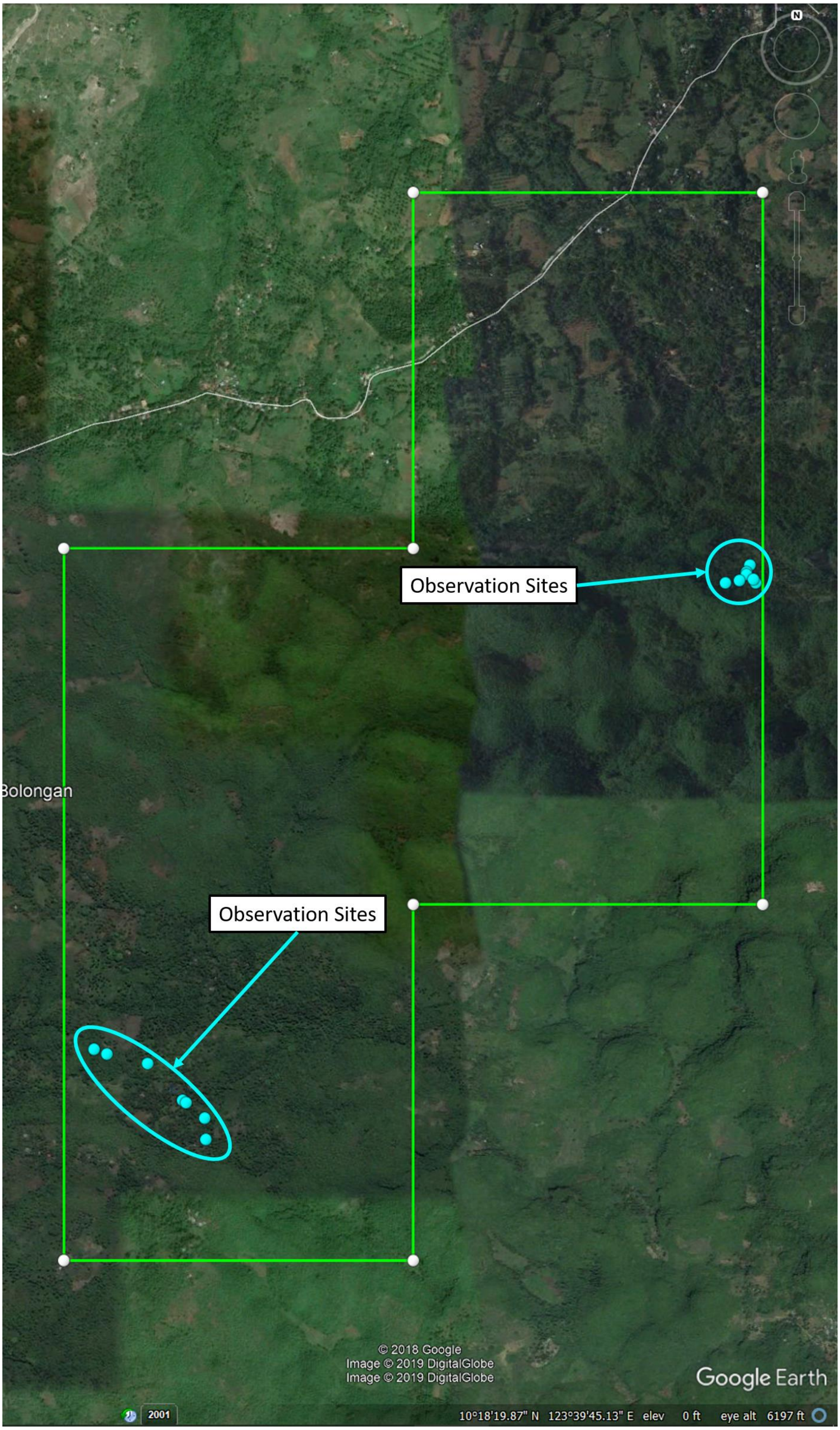


Figure 2-44: Terrestrial Ecology Observation Points in Parcel 3

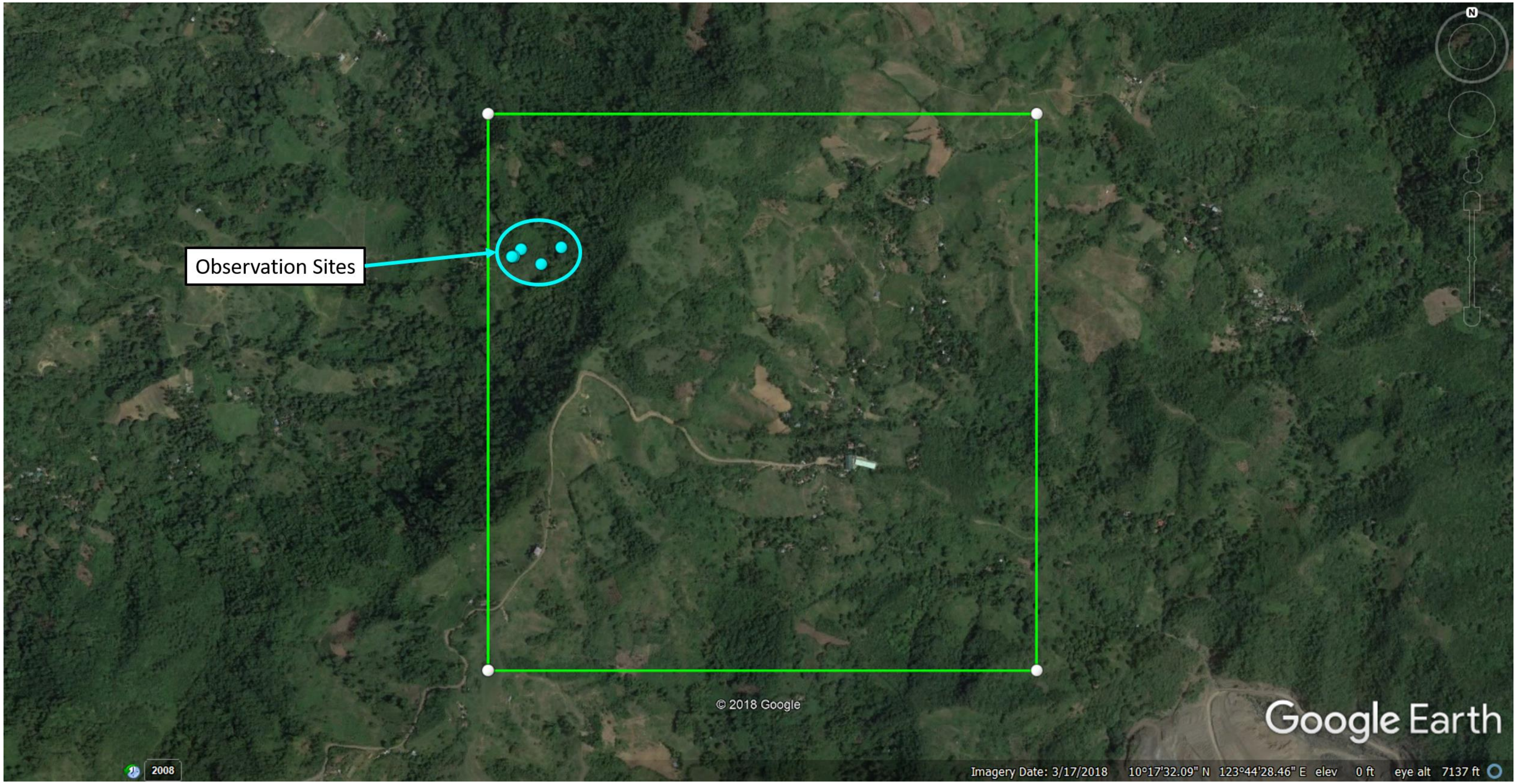


Figure 2-45: Terrestrial Ecology Observation Points in Parcel 5

The plots were 25m^2 with dimensions of 5x5m. Since the trees were only less than 10cm^2, only the number of individuals per plot were counted and the frequency as they occur in the different plots was considered to derive the importance value index.

Ecological Indices, such as Shannon-Wiener Species Diversity Index, Margalef Species Richness Index, and Equitability Index were computed to estimate and compare the species diversity of the plots within each Study Site or Parcel (**Figure 2-46**). The data of all the plots within each Study Site or Parcel were then combined for the calculation of Study Site or Parcel's respective Species Diversity and Equitability Indices. These indices were used to estimate diversity index taking into account number of species and relative abundance of different species in order to generate a better analysis of community composition or structure (Magurran, 1988; Henderson and Seaby, 1997).

Shannon-Wiener Diversity Index:

$$H = -\sum_{i=1}^{S} p_i * \ln p_i$$

Margalef Species Richness Index:

$$D_{Mg} = \frac{(S-1)}{\ln N}$$

Equitability Index:

$$E_H = \frac{H}{Hmax} = \frac{H}{\ln S}$$

Relative Density:

$$\frac{\text{Number of Individuals of Species}}{\text{Total Number of Individuals of all Species}} \times 100$$

Relative Frequency:

$$\frac{\text{Number of Occurrences of Species}}{\text{Total Number of Occurences of all Species}} \times 100$$

Importance Value Index:

Relative Density + Relative Frequency

Figure 2-46: Ecological Indices Formulae

The dominant species was also identified per parcel based on the calculated Importance Value Index of the species which is derived based on the species relative abundance (relative density) and relative occurrence (relative frequency). Relative basal area is not derived as the diameter of the thin stems were not measured.

Floristic Inventory

Samples of plants species were collected in triplicates to serve as voucher specimens. These were then pressed in old newspapers and preserved with denatured alcohol, and dried in an oven. These were then identified by comparison with specimens in the Philippine National Herbarium, comparison with digital images from on-line sources, photos and illustrations from published print sources, and use of identification keys in literature.

Wildlife Inventory

To determine the avifauna in the site, a 100m transect walk was conducted for each of the five study sites. All birds observed and/or heard were recorded using their species/local name. Interviews were also conducted to gather additional information on the bird species observed by the locals in the area.

The mammal inventory was also carried out through the same transects used for the birds. Mammals observed were recorded using there species/local name. Interviews were also conducted to ask locals about mammals they observed in the area.

Amphibians, reptiles and invertebrates were observed and recorded mainly through the 100m transect line but whenever possible opportunistic catching was employed. Area along the established transect was thoroughly checked and searched. Aside from the species identification, other relevant information on each site were also noted and recorded. Upon capture, photographs were taken and the captured individuals were returned to the site of capture.

Secondary literature and databases were also surveyed for information on flora and fauna of the forests of Cebu.

2.1.4.2 Vegetation removal and loss of habitat

Description of the Vegetation

The dominant vegetation of the study sites is forest over limestone, particularly a scrub vegetation. It is composed mostly of thin-stemmed trees, not more than 10cm diameter. These are also low trees of about 5 – 8m height, and small crowns. A few emergent trees may occur within the scrub forest. Most of these forests are either intact or fairly undisturbed tracts of vegetation in an advanced state of succession, remnants of the original vegetation and/or highly disturbed forests in the early stages of succession.

The suite of species found in scrub type of vegetation include Gomphia serrata, Cratoxylum sumatranum, Wendlandia sp., Flueggea virosa, Alstonia macrophylla, Neonauclea formicaria, Heterospathe philippinensis, Alchornea rugosa, Aglaia cumingiana, Polyscias nodosa, and Ficus spp., among others.

In more disturbed vegetation (i.e. Parcel 5) where only small fragments of the original vegetation remain, typical secondary forest species occur like *Macaranga grandifolia, Macaranga tanarius, Mallotus sp., Homalanthus populneus, Melochia umbellata*, *Commersonia bartramia*, *Acalypha amentacea,* and several *Ficus* spp. can also be found. Species of *Breynia, Phyllanthus, Glochidion, Flemingia strobilifera,* and *Urena lobata,* grow on the loose rocks and thin soils of the forest floor.

The cultivated landscape is composed of corn fields and backyard fruit trees like Mangifera indica, Artocarpus heterophyllus, Syzygium cuminii, Garcinia mangostana, Cocos nucifera, Psidium guajava, Bixa orellana, Muntingia calabura, Theobroma cacao, and Musa sp. with other crops used by the locals like Leucaena leucocephala and Gliricidia sepium for firewood and fodder.

No pure strands of reforestation species was found. Some escapes from reforestation areas sporadically thrive on the edges of the forest like *Gmelina arborea, Swietenia macrophylla, Tectona grandis, Leucaena leucocephala,* and *Acacia auriculiformis.*

Description of the Flora

There are 14 species of ferns in 11 genera and 8 families. These form dense mats, occasional small clusters, and singly as individuals. *Nephrolepis* spp. and *Sphaerostephanos unitus* occur as dense mats in more open or exposed disturbed areas. Two species of *Drynaria* (*D. sparsiflora* and *D. quercifolia*) can be found attached on trees or rock formations. *Pteris vittata*, a common fern in mining areas, can be found here singly on pockets of soil. The other species of *Davallia*, *Microsorum*, *Adiantum*, *Lygodium, Selaginella,* and *Tectaria* are found in shaded and moist conditions.

There are also 180 species of angiosperms or flowering plants, in 157 genera, and 67 families in the study sites (**Table 2-18**). Of these, 10 species are endemic to Philippines, which include *Parishia malabog, Semecarpus glauciphyllus, Alstonia macrophylla, Parsonia alboflavescens,* *Wrightia candollei, Heterospathe philippinensis, Trichosanthes villosa* subsp. *mindorensis, Ficus balete, Ficus gigantifolia,* and *Ardisia romanii.*

Table 2-18: Taxonomic List of Plants Found in the Study

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Davalliaceae	*Davallia solida*		Exotic	
Lygodiaceae	*Lygodium japonicum*		Exotic	
Nephrolepidaceae	*Nephrolepis spp.*	Least Concern (IUCN 2019)		
Polypodiaceae	*Drynaria quercifolia*	Vulnerable (DENR, 2007)		
Polypodiaceae	*Drynaria sparsisora*			
Polypodiaceae	*Phymatosorus scolopendria*	Vulnerable (DENR, 2007)		Invasive species (IUCN, 2010)
Polypodiaceae	*Microsorum sp.*	Least Concern (IUCN 2019)		
Pteridaceae	*Adiantum caudatum*			
Pteridaceae	*Adiantum tenerum*			
Pteridaceae	*Pteris vittata*	Least Concern (IUCN 2019)		
Selaginellaceae	*Selaginella sp.*			
Tectariaceae	*Tectaria devexca*			
Thelypteridaceae	*Sphaerostephanos unitus*			
Thelypteridaceae	*Pneumatopteris sp*			
Acanthaceae	*Hemigraphis sp.*			
Amaranthaceae	*Amaranthus spinosus*			
Anacardiaceae	*Buchanania arborescens*			
Anacardiaceae	*Koordersiodendron pinnatum*	Vulnerable (DENR, 2007), Threatened (DENR, 2017)		
Anacardiaceae	*Mangifera indica*	Data Deficient (IUCN 2019)		
Anacardiaceae	*Parishia malabog*		Endemic	
Anacardiaceae	*Semecarpus glauciphyllus*		Endemic	
Annonaceae	*Annona reticulata*			
Annonaceae	*Artabotrys sp.*			
Annonaceae	*Goniothalamus sp.*			
Annonaceae	*Uvaria grandiflora*			
Apiaceae	*Centella asiatica*	Least Concern (IUCN 2019)		
Apocynaceae	*Alstonia macrophylla*	Least Concern (IUCN, 2017)	Endemic	
Apocynaceae	*Dischidia hirsuta*			
Apocynaceae	*Parsonsia alboflavescens*			
Apocynaceae	*Tabernaemontana pandacaqui*			
Apocynaceae	*Wrightia candollei*		Endemic	

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Araceae	*Alocasia sp.*			
Araceae	*Colocasia esculenta*	Least Concern (IUCN 2019)		
Araceae	*Epipremnum pinnatum*			
Araceae	*Pothoidium sp.*			
Araceae	*Pothos rumphii*			
Araceae	*Syngonium sp.*			
Araliaceae	*Polyscias aherniana*			
Araliaceae	*Polyscias nodosa*	Least Concern (IUCN 2019)		
Araliaceae	*Schefflera sp.*			
Arecaceae	*Areca catechu*			
Arecaceae	*Cocos nucifera*			
Arecaceae	*Corypha sp.*			
Arecaceae	*Heterospathe philippinensis*		Endemic	
Asteraceae	*Artemisia sp.*			
Asteraceae	*Blumea balsamifera*			
Asteraceae	*Chromolaena odorata*			
Asteraceae	*Mikania scandens*	Secure (NatureServe)		
Begoniaceae	*Begonia sp.*			
Bixaceae	*Bixa Orellana*			
Boraginaceae	*Ehretia macrophylla*			
Campanulaceae	*Isotoma sp.*			
Clusiaceae	*Garcinia mangostana*			
Commelinaceae	*Commelina sp.*			
Convolvulaceae	*Merremia peltata*			
Convolvulaceae	*Merremia tridentata*			
Crassulaceae	*Bryophyllum pinnatum*			
Cucurbitaceae	*Trichosanthes villosa subsp. mindorensis*		Endemic	
Dilleniaceae	*Dillenia sp.*			
Dioscoreaceae	*Dioscorea sp.*			
Dipterocarpaceae	*Shorea sp.*			
Elaeocarpaceae	*Muntingia calabura*			
Euphorbiaceae	*Acalypha amentacea*			
Euphorbiaceae	*Actephila sp.*			
Euphorbiaceae	*Alchornea rugosa*			

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Euphorbiaceae	*Breynia sp.*			
Euphorbiaceae	*Croton sp.*			
Euphorbiaceae	*Euphorbia hirta*			
Euphorbiaceae	*Phyllanthus littoralis*	Least Concern (IUCN 2019)		
Euphorbiaceae	*Homalanthus populneus*	Least Concern (IUCN 2019)		
Euphorbiaceae	*Macaranga grandifolia*	Vulnerable (IUCN 2019)		
Euphorbiaceae	*Macaranga tanarius*			
Euphorbiaceae	*Mallotus sp.*			
Euphorbiaceae	*Manihot esculenta*			
Fabaceae	*Acacia auriculiformis*	Least Concern (IUCN 2019)		
Fabaceae	*Albizzia sp.*			
Fabaceae	*Alysicarpus sp.*			
Fabaceae	*Archidendron clypearia*			
Fabaceae	*Bauhinia sp.*			
Fabaceae	*Caesalpinia latisiliqua*			
Fabaceae	*Calopogonium sp.*			
Fabaceae	*Crotalaria sp.*			
Fabaceae	*Desmodium heterocarpon*			
Fabaceae	*Flemingia strobilifera*			
Fabaceae	*Gliricidia sepium*			
Fabaceae	*Intsia bijuga*	Vulnerable (IUCN 2019)		
Fabaceae	*Leucaena leucocephala*			
Fabaceae	*Mimosa pudica*	Least Concern (IUCN 2019)		
Fabaceae	*Phanera sp.*			
Fabaceae	*Pterocarpus indicus*	Critically Endangered (DENR, 2007), Vulnerable (DENR, 2017), Endangered (IUCN, 2019)		
Fabaceae	*Samanea saman*	Secure (NatureServe)		
Fabaceae	*Senna alata*	Secure (NatureServe)		
Fabaceae	*Uraria lagopoides*			
Flacourtiacae	*Flacourtia sp.*			
Gesneriaceae	*Aeschynanthus sp.*			
Gesneriaceae	*Rhynchotechum discolor*			
Hypericaceae	*Cratoxylum sumatranum*	Least Concern (IUCN 2019)		

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Lamiaceae	*Callicarpa sp.*			
Lamiaceae	*Gmelina arborea*			
Lamiaceae	*Hyptis sp.*			
Lamiaceae	*Leucas decemdentata*			
Lamiaceae	*Stachytarpheta jamaicensis*			
Lamiaceae	*Tectona grandis*			
Lauraceae	*Litsea glutinosa*			
Leeaceae	*Leea manillensis*			
Loranthaceae	*Amyema sp.*			
Lythraceae	*Lagerstroemia indica*	Least Concern (IUCN 2019)		
Malpighiaceae	*Hiptage luzonica*			
Malvaceae	*Commersonia bartramia*			
Malvaceae	*Melochia umbellata*			
Malvaceae	*Theobroma cacao*			
Malvaceae	*Urena lobata*			
Melastomataceae	*Medinilla sp.*			
Meliaceae	*Aglaia cumingiana*	Vulnerable (DENR, 2007), Threatened (DENR, 2017), Vulnerable (IUCN, 2019)		
Meliaceae	*Melia azedarach*	Least Concern (IUCN 2019)		
Meliaceae	*Swietenia macrophylla*	Vulnerable (IUCN, 2019)		
Meliaceae	*Unidentified*			
Menispermaceae	*Menispermaceae*			
Moraceae	*Artocarpus sp.*			
Moraceae	*Artocarpus heterophyllus*			
Moraceae	*Cecropia peltata*			
Moraceae	*Ficus balete*		Endemic	
Moraceae	*Ficus botryocarpa*			
Moraceae	*Ficus chrysolepis*			
Moraceae	*Ficus cumingii*			
Moraceae	*Ficus gigantifolia*		Endemic	
Moraceae	*Ficus pedunculosa*			
Moraceae	*Ficus pseudopalma*			
Moraceae	*Ficus septica*			
Moraceae	*Ficus sp.*			

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Moraceae	*Ficus subulata*			
Moraceae	*Ficus ulmifolia*			
Moraceae	*Streblus sp.*			
Musaceae	*Musa sp.*			
Myrtaceae	*Decaspermum sp.*			
Myrtaceae	*Psidium guajava*			
Myrtaceae	*Syzygium cuminii*			
Myrtaceae	*Syzygium spp.*			
Ochnaceae	*Gomphia serrata*	Least Concern (IUCN, 2019)		
Oleaceae	*Jasminum sp.*			
Onagraceae	*Jussiaea sp.*			
Onagraceae	*Ludwigia hyssopifolia*	Least Concern (IUCN, 2019)		
Orchidaceae	*Geodorum densiflorum*			
Orchidaceae	*Nervilia sp.*			
Pandanaceae	*Pandanus sp.*			
Phyllanthaceae	*Antidesma sp.*			
Phyllanthaceae	*Breynia spp.*			
Phyllanthaceae	*Flueggea virosa*			
Phyllanthaceae	*Phyllanthus spp.*			
Primulaceae	*Ardisia serrata*			
Primulaceae	*Ardisia romanii*	Threatened (DENR, 2007), Vulnerable (DENR, 2017)	Endemic	
Piperaceae	*Piper spp.*			
Pittosporaceae	*Pittosporum pentandrum*			
Poaceae	*Eleusine indica*	Least Concern (IUCN, 2019)		
Poaceae	*Panicum repens*	Least Concern (IUCN, 2019)		
Poaceae	*Paspalum conjugatum*	Least Concern (IUCN, 2019)		
Poaceae	*Saccharum spontaneum*	Least Concern (IUCN, 2019)		
Poaceae	*Themeda intermedia*			
Poaceae	*Thysanolaena latifolia*			
Poaceae	*Zea mays*			
Rosaceae	*Rubus sp.*			
Rubiaceae	*Canthium sp.*			
Rubiaceae	*Hedyotis sp.*			

Family	Scientific Name	Conservation Status	Native/Endemic/exotic	Invasive
Rubiaceae	*Ixora macrophylla*			
Rubiaceae	*Morinda citrifolia*			
Rubiaceae	*Mussaenda sp.*			
Rubiaceae	*Neonauclea formicaria*			
Rubiaceae	*Wendlandia sp.*			
Rutaceae	*Citrus sp.*			
Rutaceae	*Melicope sp.*			
Rutaceae	*Micromelum sp.*			
Salicaceae	*Homalium sp.*			
Sapindaceae	*Arytera sp. or Alectryon sp.*			
Sapindaceae	*Cardiospermum halicacabum*			
Sapindaceae	*Guioa sp.*			
Sapindaceae	*Harpullia cupanioides*			
Solanaceae	*Solanum diphyllum*			
Solanaceae	*Solanum erianthum*			
Taccaceae	*Tacca palmata*			
Theaceae	*Gordonia sp.*			
Thymelaeaceae	*Wikstoremia sp.*			
Tliaceae	*Colona serratifolia*			
Ulmaceae	*Celtis sp,*			
Ulmaceae	*Trema orientalis*	*Trema orientalis*		
Urticaceae	*Boehmeria heterophylla*			
Urticaceae	*Elatostema sp.*			
Urticaceae	*Leucosyke capitellata*			
Urticaceae	*Maoutia sp.*			
Moraceae	*Poikilospermum suaveolens*			
Verbenaceae	*Lantana camara*			
Verbenaceae	*Vitex parviflora*	Endangered (DENR, 2007), Endangered (DENR, 2017), Vulnerable (IUCN, 2019)		
Vitaceae	*Ampelocissus sp.*			
Vitaceae	*Tetrastigma sp.*			
Zingiberaceae	*Alpinia sp.*			

There are plants in the study sites which have been assessed to be threatened and included in the National List of Threatened Philippine Plants (DENR, 2007 and DENR, 2017). These are *Pterocarpus indicus* (Vulnerable), *Vitex parviflora* (Endangered), *Koordersiodendron pinnatum* (Threatened)*, Drynaria quercifolia* (Vulnerable)*, Microsorum scolopendria* (Vulnerable), and *Ardisia romanii* (Other Threatened Species).

Globally, Pterocarpus indicus, Aglaia cumingiana, and Vitex parviflora are assessed as Vulnerable while Gomphia serrata, Alstonia macrophylla, and Ludwigia hyssopifolia are considered as Low Risk and Least Concern (IUCN, 2017).

Secondary forest tree species also occur, but less commonly than the forest over limestone trees, which include *Macaranga grandifolius, Macaranga tanarius, Acalypha amentacea, Homalanthus populneus*, and *Commersonia bartramia*.

Weed species are mostly found on open areas and edges of natural stands of forests. These include *Mimosa pudica, Lantana camara, Blumea balsamifera, Chromolaena odorata, Mikania scandens, Crotalaria* sp., *Desmodium* sp., among others.

The most widespread of the species, as these were recorded in 4-5 of the study sites, are *Breynia sp., Cratoxylum sumatranum,* an unidentified species (Meliaceae), *Flueggea virosa, Neonauclea formicaria, Alstonia macrophylla, Phyllanthus* sp., and *Wendlandia* sp*.*

Tectaria devexca is also a limestone-specific species.

Description of the Study Sites/Parcels

Study Site/Parcel 1

This Study Site is within Parcel 1 where there is a quarrying activity. The vegetation in the vicinity of Parcel 1 is highly modified, with either land bare and exposed or sparsely covered with vegetation, mostly grasses and weeds.

In the proposed site for development, there are two vegetation types, i.e. an open scrub with sparse trees and a dense scrub forest. There are about 12-25 species of plants (trees, shrubs, herbs, and ferns) in a 25m^2 plot. **Table 2-19** shows the diversity by sampling plot.

Table 2-19: Diversity of Plots per Study Site

Parcel 1	A	B	C	D
Number of Species	12	25	14	12
Shannon-Wiener Index	2.441	3.149	2.552	2.393
Margalef Index	4.168	6.989	4.415	3.967
Equitability	0.61	0.827	0.67	0.629
Parcel 2	**A**	**B**		
Number of Species	13	31		
Shannon-Wiener Index	2.394	3.329		
Margalef Index	3.375	7.708		
Equitability	0.668	0.929		
Parcel 3 A	**A**	**B**	**C**	
Number of Species	16	20	23	
Shannon-Wiener Index	2.622	2.753	2.968	
Margalef Index	4.666	5.302	6.005	
Equitability	0.661	0.693	0.748	
Parcel 3 B	**A**	**B**	**C**	
Number of Species	17	13	15	
Shannon-Wiener Index	2.738	2.513	2.537	
Margalef Index	4.911	4.328	4.158	
Equitability	0.822	0.754	0.761	
Parcel 5	**A**	**B**	**C**	
Number of Species	10	18	25	
Shannon-Wiener Index	2.206	2.803	3.108	
Margalef Index	3.4	4.744	6.506	
Equitability	0.598	0.76	0.843	

The dense scrub forest, represented by two plots has a higher species diversity (Shannon-Weiner Index: 3.149), species richness (Margalef Index: 6.989) and Equitability Index (0.827) compared to that of the open scrub, represented by one plot (Shannon-Weiner Index: 2.393-2.552, Margalef Index: 3.967-4.168, Equitability Index: 0.61-0.67).

In both vegetation types, the dominant tree species are *Wendlandia* sp., *Alstonia macrophylla, Ficus pseudopalma, Solanum erianthum* and *Neonauclea formicaria* (**Table 2-20**). The ground flora is composed of *Nephrolepis* sp., *Crotalaria* sp., *Lantana camara, Cardiospermum halicacaum* and *Blumea balsamifera* which are spruced occasionally in different parts of the open scrubland. Other tree species which may be found are *Cratoxylum sumatranum, Heterospathe philippinensis, Ficus septica, F. ulmifolia, Buchanania arborescens, Homalanthus populneus,* and *Polyscias* spp. *Heterospathe philippinensis* is an emergent tree rising over the low trees in the area.

Table 2-20: Importance Index Value of Parcel 1

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Wendlandia sp.	4.00	5	1	6.35	11.35
Nephrolepis sp.	4.00	5	1	6.35	11.35
Crotalaria sp.	5.00	6.25	0.75	4.76	11.01
Alstonia macrophylla	4.00	5	0.75	4.76	9.76
Lantana camara	5.00	6.25	0.5	3.17	9.42

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Ficus pseudopalma	3.00	3.75	0.75	4.76	8.51
Cardiospermum halicacabum	4.00	5	0.5	3.17	8.17
Solanum erianthum	3.00	3.75	0.5	3.17	6.92
Neonauclea formicaria	3.00	3.75	0.5	3.17	6.92
Blumea balsamifera	3.00	3.75	0.5	3.17	6.92
Citrus sp.	2.00	2.5	0.5	3.17	5.67
Cratoxylum sumtranum	2.00	2.5	0.5	3.17	5.67
Heterospathe philippinensis	2.00	2.5	0.5	3.17	5.67
Breynia sp.	2.00	2.5	0.5	3.17	5.67
Carmona retusa	2.00	2.5	0.5	3.17	5.67
Alchornea rugosa	3.00	3.75	0.25	1.59	5.34
Ficus septica	2.00	2.5	0.25	1.59	4.09
Psidium guajava	2.00	2.5	0.25	1.59	4.09
Phyllanthus spp.	2.00	2.5	0.25	1.59	4.09
Adiantum caudatum	2.00	2.5	0.25	1.59	4.09
Acalypha amentacea	1.00	1.25	0.25	1.59	2.84
Aglaia cumingiana	1.00	1.25	0.25	1.59	2.84
Buchanania arborescens	1.00	1.25	0.25	1.59	2.84
Ficus ulmifolia	1.00	1.25	0.25	1.59	2.84
Homalanthus populneus	1.00	1.25	0.25	1.59	2.84
Meliaceae	1.00	1.25	0.25	1.59	2.84
Polyscias aherniana	1.00	1.25	0.25	1.59	2.84
Polyscias nodosa	1.00	1.25	0.25	1.59	2.84
Schefflera sp.	1.00	1.25	0.25	1.59	2.84
Drynaria quercifolia	1.00	1.25	0.25	1.59	2.84
Epipremnum pinnatum	1.00	1.25	0.25	1.59	2.84
Leucas decemdentata	1.00	1.25	0.25	1.59	2.84
Medinilla sp.	1.00	1.25	0.25	1.59	2.84
Piper sp. 3	1.00	1.25	0.25	1.59	2.84
Pneumatopteris	1.00	1.25	0.25	1.59	2.84
Rubus sp.	1.00	1.25	0.25	1.59	2.84
Uvaria grandiflora	1.00	1.25	0.25	1.59	2.84
Solanum diphyllum	1.00	1.25	0.25	1.59	2.84
Sphaerostephanos unitus	1.00	1.25	0.25	1.59	2.84
Urena lobata	1.00	1.25	0.25	1.59	2.84
Adiantum tenerum	1.00	1.25	0.25	1.59	2.84
Total	80.00	100	15.75	100.00	200.00

Study Site 2/Parcel 2

Study Site 2 is within Parcel 2 which is a small hill, characteristic of the limestone landscape in many parts of Cebu. The hill, on one of its slopes, is vertically exposed and without vegetation. The other hills in the vicinity are of the same state.

Two plots were established within the site to represent two vegetation types: the open scrub and closed or dense scrub forest. There were 13-31 of ferns and flowering plant species within a 25m^2 plot of vegetation (**Table 2-19**).

The open scrub vegetation has lower species diversity index (Shannon-Wiener: 2.394), species richness index (Margalef 3.375), and Equitability Index (0.668) than the dense scrub forest (Shannon-Wiener: 3.329; Margalef: 7.708; Equitability Index: 0.929).

The dominant tree species are *Ficus septica, Syzygium sp., Alstonia macrophylla, Cratoxylum sumatranum,* and *Gomphia serrata* (**Table 2-21**). The ground flora in this closed scrub forest is composed of *Urena lobata, Dischidia* sp., *Phyllanthus* sp., *Breynia* sp., and ferns like *Adiantum tenerum, Drynaria sparsisora, Hemigraphis,* and *Amyema*. The more exposed vegetation yields weedy species like *Stachytarpheta jamaicensis*, *Eleusine indica*, *Crotalaria* sp., and *Lantana camara*.

Table 2-21: Importance Index Value of Parcel 2

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Stachytarpheta jamaicensis	8.00	9.52	1.00	4.55	14.07
Urena lobata	6.00	7.14	1.00	4.55	11.69
Dischidia sp.	5.00	5.95	1.00	4.55	10.50
Phyllanthus sp.	5.00	5.95	1.00	4.55	10.50
Adiantum tenerum	4.00	4.76	1.00	4.55	9.31
Eleusine indica	5.00	5.95	0.50	2.27	8.23
Breynia sp.	3.00	3.57	1.00	4.55	8.12
Drynaria sparsisora	3.00	3.57	1.00	4.55	8.12
Crotalaria	4.00	4.76	0.50	2.27	7.03
Ficus septica	2.00	2.38	1.00	4.55	6.93
Syzygium sp. 1	2.00	2.38	1.00	4.55	6.93
Alstonia macrophylla	3.00	3.57	0.50	2.27	5.84
Cratoxylum sumatranum	3.00	3.57	0.50	2.27	5.84
Hemigraphis sp.	3.00	3.57	0.50	2.27	5.84
Amyema sp.	2.00	2.38	0.50	2.27	4.65
Gomphia serrata	2.00	2.38	0.50	2.27	4.65
Flueggea virosa	2.00	2.38	0.50	2.27	4.65
Dioscorea sp.	2.00	2.38	0.50	2.27	4.65
Lantana camara	2.00	2.38	0.50	2.27	4.65
Leucas decemdentata	2.00	2.38	0.50	2.27	4.65
Selaginella sp.	2.00	2.38	0.50	2.27	4.65
Alchornea rugosa	1.00	1.19	0.50	2.27	3.46
Arytera sp.	1.00	1.19	0.50	2.27	3.46
Decaspermum sp.	1.00	1.19	0.50	2.27	3.46
Meliaceae	1.00	1.19	0.50	2.27	3.46
Syzygium sp. 2	1.00	1.19	0.50	2.27	3.46
Wendlandia	1.00	1.19	0.50	2.27	3.46
Homalium sp.	1.00	1.19	0.50	2.27	3.46
Liana	1.00	1.19	0.50	2.27	3.46
Medinilla sp.	1.00	1.19	0.50	2.27	3.46
Melicope sp.	1.00	1.19	0.50	2.27	3.46
Pteris vittata	1.00	1.19	0.50	2.27	3.46
Sapindaceae sp.	1.00	1.19	0.50	2.27	3.46
Solanum diphyllum	1.00	1.19	0.50	2.27	3.46
Solanum erianthum	1.00	1.19	0.50	2.27	3.46
Total	**84.00**	**100.00**	**22.00**	**100.00**	**200.00**

Study Site 3/Parcel 3A

Study Site 3 is within Parcel 3 which is one of the massive hills in the area which are covered with scrub vegetation or forest over limestone, with a slope facing other hills within the range. The area is bounded by a small village where the flora consists of cultivated crops like corn and *Manihot esculenta*, cultivated fruit trees, i.e. *Mangifera indica*, *Cocos nucifera, Artocarpus heterophyllus,* and a few individuals of *Swietenia macrophylla* and *Gmelina arborea.* In more open and untended areas, thickets of *Psidium guajava*, *Blumea balsamifera,* and dense cover of *Nephrolepis* sp. occur.

The plots were established at low, mid, and top elevation of the hill. It was noted that the species diversity and species richness increase with altitude (Shannon-Wiener: 2.672-2.968; Margalef: 4.66-6.005). The Equitability Index (0.661-0.748) also indicates high evenness of species at higher elevation. There are about 16-23 individuals in a sample plot of 25m^2 in this study site.

The dominant tree species are Cratoxylum sumatranum, Flueggea virosa, Gomphia serrata, Ficus gigantifolia, Wendlandia sp., Ficus pseudopalma, and Neonauclea formicaria (**Table 2-22**). The ground vegetation is dominated by Phyllanthus sp., Flemingia sp., Piper sp., and ferns like Pteris vittata and Davallia sp. The fairly undisturbed state of the forest is evidenced by the presence of terrestrial orchids like Nervilia sp. and Geodorum sp., which occur in shaded and moist conditions.

Table 2-22: Importance Index Value of Parcel 3a

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Cratoxylum sumatranum	13.00	13.00	1.00	5.08	18.08
Flueggea virosa	12.00	12.00	1.00	5.08	17.08
Gomphia serrata	8.00	8.00	1.00	5.08	13.08
Ficus gigantifolia	6.00	6.00	1.00	5.08	11.08
Phyllanthus sp.	5.00	5.00	0.67	3.39	8.39
Wendlandia sp.	5.00	5.00	0.67	3.39	8.39
Ficus pseudopalma	3.00	3.00	1.00	5.08	8.08
Flemingia sp.	3.00	3.00	1.00	5.08	8.08
Macaranga tanarius	4.00	4.00	0.67	3.39	7.39
Neonauclea formicaria	3.00	3.00	0.67	3.39	6.39
Piper sp.	3.00	3.00	0.67	3.39	6.39
Ficus sp.	2.00	2.00	0.67	3.39	5.39
Glochidion sp.	2.00	2.00	0.67	3.39	5.39
Maoutia sp.	2.00	2.00	0.67	3.39	5.39
Microsorum sp.	2.00	2.00	0.67	3.39	5.39
Pteris vittata	2.00	2.00	0.67	3.39	5.39
Alstonia macrophylla	2.00	2.00	0.33	1.69	3.69
Davallia sp.	2.00	2.00	0.33	1.69	3.69
Ixora macrophylla	2.00	2.00	0.33	1.69	3.69
Pothoidium sp.	2.00	2.00	0.33	1.69	3.69

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Adiantum caudatum	1.00	1.00	0.33	1.69	2.69
Breynia sp.	1.00	1.00	0.33	1.69	2.69
Canthium sp.	1.00	1.00	0.33	1.69	2.69
Discorea sp.	1.00	1.00	0.33	1.69	2.69
Ficus botryocarpa	1.00	1.00	0.33	1.69	2.69
Ficus ulmifolia	1.00	1.00	0.33	1.69	2.69
Geodorum densiflorum	1.00	1.00	0.33	1.69	2.69
Gmelina arborea	1.00	1.00	0.33	1.69	2.69
Heterospathe philippinensis	1.00	1.00	0.33	1.69	2.69
Meliaceae	1.00	1.00	0.33	1.69	2.69
Melicope sp.	1.00	1.00	0.33	1.69	2.69
Microsorum scolopendria	1.00	1.00	0.33	1.69	2.69
Nervilia sp.	1.00	1.00	0.33	1.69	2.69
Polyscias aherniana	1.00	1.00	0.33	1.69	2.69
Schefflera sp.	1.00	1.00	0.33	1.69	2.69
Tabernaemontana pandacaqui	1.00	1.00	0.33	1.69	2.69
Tectaria devexca	1.00	1.00	0.33	1.69	2.69
Total	**100.00**	**100.00**	**19.67**	**100.00**	**200.00**

Study Site 4/Parcel 3B

Study Site 4 or Parcel 3B, is on the other side of Study Site 3 (Parcel 3A), with a more gradual and wind exposed slope. Only about 13-17 species can be found in a 25m^2 plot. The Species Diversity and Species Richness are comparable to Study Site 3/Parcel 3A which ranges from 2.513-2.738 for Shannon-Wiener Index and 4.158 – 4.911 for Margalef Index. The Equitability Index ranges from 0.754-0.822.

As in Study Site 3/Parcel 3A, the prevailing vegetation is a dense scrub dominated by similar species like Gomphia serrata, Flueggea virosa, Harpullia cupainioides, Acalypha amentacea, Neonauclea formicaria, Cratoxylum sumatranum, Alstonia macrophylla, and Wendlandia sp. The ground vegetation is dominated by Phyllanthus sp., Breynia sp., and Piper sp. A few unique plants (not found in other plots) are found here like Ardisia romanii, Ardisia pyramidalis, and Canthium sp (**Table 2-23**).

Table 2-23: Importance Index Value of Parcel 3b

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Gomphia serrata	8.00	11.27	1.00	6.67	17.93
Phyllanthus sp.	7.00	9.86	1.00	6.67	16.53
Flueggea virosa	6.00	8.45	1.00	6.67	15.12
Harpullia cupainioides	6.00	8.45	1.00	6.67	15.12
Acalypha amentacea	4.00	5.63	1.00	6.67	12.30
Neonauclea sp.	5.00	7.04	0.67	4.44	11.49
Breynia sp. 1	3.00	4.23	1.00	6.67	10.89

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Piper sp. 2	4.00	5.63	0.67	4.44	10.08
Ardisia pyramidalis	3.00	4.23	0.67	4.44	8.67
Ficus pedunculosa	3.00	4.23	0.67	4.44	8.67
Cratoxylum sumatranum	4.00	5.63	1.00	6.67	12.30
Alstonia macrophylla	2.00	2.82	0.67	4.44	7.26
Ardisia romanii	2.00	2.82	0.67	4.44	7.26
Wendlandia sp.	2.00	2.82	0.67	4.44	7.26
Alchornea rugosa	2.00	2.82	0.33	2.22	5.04
Uvaria lagopodioides	2.00	2.82	0.33	2.22	5.04
Antidesma sp.	1.00	1.41	0.33	2.22	3.63
Artocarpus sp. 1	1.00	1.41	0.33	2.22	3.63
Buchanania arborescens	1.00	1.41	0.33	2.22	3.63
Canthium sp.	1.00	1.41	0.33	2.22	3.63
Meliaceae	1.00	1.41	0.33	2.22	3.63
Polyscias nodosa	1.00	1.41	0.33	2.22	3.63
Syzygium sp.	1.00	1.41	0.33	2.22	3.63
Wikstroemia sp.	1.00	1.41	0.33	2.22	3.63
Total	**71.00**	**100.00**	**15.00**	**100.00**	**200.00**

Study Site 5/Parcel 5

Study Site 4 is within Parcel 5 which is a highly disturbed area and is bounded by an upland farming village. The proposed site for development includes areas with cultivated fruit trees or crops like *Artocarpus heterophyllus, Mangifera indica, Theobroma cacao, Musa* sp., *Syzygium cuminii, Muntingia calabura,* and other trees for household use, as firewood and food for animals, like *Gliricidia sepium* and *Leucaena leucocephala.*

The number of species that may be found in a 25m^2 plot ranges from 10-25. Species diversity may range from 2.206 -3.108 (Shannon-Wiener Index) and species richness 3.4-6.506 (Margalef Index). Equitability Index ranges from 0.598-0.843.

These remnants of forests which occur as small fragments or strands of plant thickets is dominantly composed of *Cratoxylum sumatranum, Trema orientalis, Ficus ulmifolia, Flueggea virosa,* and *Neonauclea formicaria.* Secondary forest trees also occur like *Acalypha amentacea, Homalanthus populneus, Macaranga tanarius, Commersonia bartramia, Melochia umbellata,* and *Colona serratifolia*, indicating its disturbed state. Non-tree species found are *Nephrolepis* sp., *Breynia* sp., *Flemingia* sp. *Lygodium japonicum, Desmodium* sp., and *Dioscorea* sp (**Table 2-24**).

Table 2-24: Importance Index Value of Parcel 5

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Cratoxylum sumatranum	7.00	7.78	1.00	5.88	13.66
Nephrolepis sp.	9.00	10.00	0.33	1.96	11.96
Psidium guajava	7.00	7.78	0.67	3.92	11.70

Species	Density	Relative Density	Frequency	Relative Frequency	Index Value
Trema orientalis	5.00	5.56	1.00	5.88	11.44
Breynia sp.	5.00	5.56	0.67	3.92	9.48
Ficus ulmifolia	3.00	3.33	1.00	5.88	9.22
Trema sp.	3.00	3.33	1.00	5.88	9.22
Flemingia sp.	4.00	4.44	0.67	3.92	8.37
Flueggea virosa	4.00	4.44	0.67	3.92	8.37
Neonauclea formicaria	4.00	4.44	0.67	3.92	8.37
Acalypha amentacea	3.00	3.33	0.67	3.92	7.25
Buchanania sp.	3.00	3.33	0.67	3.92	7.25
Homalanthus populneus	3.00	3.33	0.67	3.92	7.25
Poikilospermum suaveolens	3.00	3.33	0.67	3.92	7.25
Drynaria quercifolia	2.00	2.22	0.67	3.92	6.14
Macaranga tanarius	2.00	2.22	0.67	3.92	6.14
Lygodium japonicum	3.00	3.33	0.33	1.96	5.29
Commersonia bartramia	2.00	2.22	0.33	1.96	4.18
Ficus botryocarpa	2.00	2.22	0.33	1.96	4.18
Leucosyke capitellata	2.00	2.22	0.33	1.96	4.18
Melochia umbellata	2.00	2.22	0.33	1.96	4.18
Muntingia calabura	2.00	2.22	0.33	1.96	4.18
Albizia sp.	1.00	1.11	0.33	1.96	3.07
Colona serratifolia	1.00	1.11	0.33	1.96	3.07
Desmodium sp.	1.00	1.11	0.33	1.96	3.07
Dioscorea sp.	1.00	1.11	0.33	1.96	3.07
Ficus cumingii	1.00	1.11	0.33	1.96	3.07
Ficus septica	1.00	1.11	0.33	1.96	3.07
Gliricida sepium	1.00	1.11	0.33	1.96	3.07
Kalanchoe pinnata	1.00	1.11	0.33	1.96	3.07
Melia	1.00	1.11	0.33	1.96	3.07
Merremia tridentata	1.00	1.11	0.33	1.96	3.07
Total	90.00	100.00	17.00	100.00	200.00

Comparison of the Vegetation of the Study Sites/Parcels

Of the five study sites, Parcels 2 and 3 (A&B) are partly disturbed scrub vegetation in an advanced stage of development. These are composed of a suite of tree species which typically occur in forest over limestone.

The species diversity ranges from 2.949-3.341 (Shannon-Wiener Index), species richness 5.396-7.674 (Margalef Index) while Equitability Index ranges from 0.894-0.94 for the combined plot data within each of these study sites representing this vegetation type. There also are about 24 to 37 species in a 25m^2 plot in this vegetation type.

Parcel 1 also has a natural stand of vegetation which is exposed to the threats of the quarry activity. It is in a disturbed state brought about by the clearing of some areas for the expansion of the quarry site. In spite of its disturbed state, it has the highest species diversity (Shannon-Wiener Index 3.542), species richness (Margalef Index: 9.128) and Equitabiltiy Index of 0.954. It should however be noted that the calculated indices represent the combined data of two different forest types, i.e. an open scrub with sparse trees and a dense scrub vegetation.

In contrast, the landscape of Parcel 5 has been mainly modified by the local people through agricultural activities and forest product harvesting, with just fragments or strands of the original vegetation left. The Species Diversity Index of the combined plot data for the study site is 3.191 (Shannon-Wiener Index), Species Richness Index 6.667 (Margalef Index) and its Equitability Index is 0.929. **Table 2-25** shows the summary of the study sites.

Table 2-25: Summary Description of Study Sites

	Parcel 1	Parcel 2	Parcel 3A	Parcel 3B	Parcel 5
Type of vegetation	open scrub and dense scrub forest	dense scrub forest	dense scrub forest	dense scrub forest	cultivated land; forest fragments or strands
Status of Integrity	Highly disturbed	Partly disturbed	Advanced state of development	Advanced state of development	Highly disturbed
Dominant tree species	*Wendlandia sp.*	*Ficus septica*	*Cratoxylum sumatranum*	*Gomphia serrata*	*Cratoxylum sumatranum*
	Alstonia macrophylla	*Syzygium sp. 1*	*Flueggea virosa*	*Flueggea virosa*	*Trema orientalis*
	Ficus pseudopalma	*Alstonia macrophylla*	*Gomphioa serrata*	*Harpullia cupainioides*	*Ficus ulmifolia*
	Solanum erianthum	*Cratoxylum sumatranum*	*Ficus gigantifolia*	*Acalypha amentacea*	*Flueggea virosa*
	Neonauclea formicaria	*Gomphia serrata*	*Wendlandia sp.*	*Neonauclea formicaria*	*Neonauclea formicaria*
Dominant ground species	*Nephrolepis sp.*	*Stachytarpheta jamaicensis*	*Phyllanthus sp.*	*Phyllanthus sp.*	*Nephrolepis sp.*
	Crotalaria sp.	*Urena lobata*	*Flemingia sp.*	*Breynia sp.*	*Psidium guajava*
	Lantana camara	*Dischidia sp.*	*Piper sp.*	*Piper sp.*	*Breynia sp.*
	Cardiospermum halicacabum	*Phyllanthus sp.*	*Ficus sp.*	*Alchornea rugosa*	*Flemingia sp.*
	Blumea balsamifera	*Adiantum tenerum*	*Glochidion sp.*	*Cathium sp.*	*Drynaria quersifolia*
Number of Species	41	35	37	24	31
Shannon-Wiener Index	3.542	3.341	3.227	2.949	3.191
Margalef Index	9.128	7.674	7.817	5.396	6.667
Equitability	0.954	0.94	0.894	0.928	0.929

Insert consolidated data/discussion/table of previously conducted (as part of monitoring, if any) flora and fauna survey for Parcel 1

2.1.4.3 Threat to existence and/or loss of important local species

Wildlife Species Composition and Noteworthy Species

A total of 36 species of vertebrate fauna and several undetermined invertebrates were recorded in the five study sites, through on-site interviews with locals, and though desktop research. The survey revealed 25 species of birds, 2 species of mammals, 9 species of herpetofauna (reptiles and amphibians), and undetermined number of invertebrates. **Table 2-26** shows the list of species found in the study sites.

The terrestrial expert was not able to trap, nor capture, faunal specimens since the observation sites are near areas with frequent disturbances (quarry sites, highways, residential areas, agricultural areas). A qualitative assessment was conducted instead to mitigate the project's impact on the terrestrial fauna of the area.

Table 2-26: Taxonomic List of Wildlife in the Study Sites

Classification	Scientific Name	Common Name
AVIFAUNA		
Order Strigiformes		
Family: Tytonidae		
	Tyto longimembris	Eastern Grass Owl, Kwago
Order Gruiformes		
Family: Rallidae		
	Gallirallus torquatus	Barred Rail
Order Apodiformes		
Family: Apodidae		
	Collocalia esculenta	Glossy Swiftlet
	Collocalia troglodytes	Pygmy Swiftlet
	Aerodramus amelis	Grey Swiftlet
Order Coraciiformes		
Family: Alcedinidae		
	Halcyon smyrnensis	White-throated Kingfisher
Order Columbiformes		
Family: Columbidae		
	Geopelia striata	Zebra Dove
	Streptopelia bitorquata	Island Collared-Dove
	Treron verans	Pink-necked green Pigeon
	Phapitreron leucotis	White-eared Brown Dove
	Chalcophaps indica	Emerald Dove
Order Cuculiformes		
Family: Cuculidae		
	Centropus viridis	Philippine Coucal
Order Passiformes		
Family: Pyncnonotidae		
	Pycnonotus goiavier	Yellow-vented Bulbul
	Ixos philippinus	Philippine Bulbul

Classification	Scientific Name	Common Name
Family: Sylviidae		
	Orthotomus castaneiceps	Philippine Tailorbird
	Megalurus timoriensis	Tawny Grassbird
	Cisticola juncidis	Zitting Cisticola
Family: Turdidae		
	Copsychus saularis	Oriental Magpie-robin
Family: Rhipidurae		
	Rhipidura javanica	Pied Fantail
Family: Laniidae		
	Lanius cristatus	Brown Shrike, Taras/Panalan
	Lanius schach	Long-tail Shrike
Family: Nectariniidae		
	Nectarinia jugularis	Olive-backed Sunbird
Family: Dicaeidae		
	Dicaeum austral	Red-keeled Flowerpecker
Family: Estrildidae		
	Lonchora atricapilla	Chestnut Munia, Maya
Family Passeridae		
	Passer montanus	Eurasian Tree Sparrow, Maya
MAMMALIAN FAUNA		
Order Primates		
Family: Cercopithecidae		
	Macaca fasicularis	Crab-eating Macaque, Unggoy
Order Carnivora		
Family: Viveridae		
	Viverra tangalunga	Malayan Civet
*Various species insectivorous bats and fruit bats might roost in caves and limestone forest.		
HERPETOFAUNA		
Order Squamata		
Family: Pythonidae		
	Python reticulatus	Python/Sawa
Family: Phasianidae		
	Varanus nuchalis	Bayawak
Family: Scincidae		
	Lamprolepis smaragdina	Green Tree-skink
	Eutropis indesprensa	Ground Skink
	Parvoscincus steerei	Small Ground Skink
Family: Gekkonidae		
	Gekko gecko	Tokay Gecko
Order Anura		
Family: Bufonidae		
	Rhinella marina	Marine Toad
Family: Ceratobractchidae		
	Platymantis dorsalis	Common Forest Frog
Family: Microphylidae		
	Kaloula picta	Slender-digit Narrow-mouth Frog
INVERTEBRATES		
Millipedes, various Insects (ants, beetles, moths, butterflies, dragonfly, etc.) and native/endemic land snails.		

Majority of the species recorded were native/resident species with at least 24 species (67%) that are not endemic. This followed by 11 endemic species (30%) and one invasive species (3%).

Parcel 1, Parcel 2 and Parcel 3A-3B have fragmented to primary growth forest over limestone which support various endemic species, while Parcel 5 supports few native wildlife because of the extent of disturbance. Cebu island endemic birds and herpetofauna were not observed on the sites. However, the importance of the forest stand cannot be underestimated as it is located between Tabunan forest and Alcoy forest, two of the remaining habitats of the Cebu noteworthy wildlife species forest thus may serve as a good forest corridor for what may be the two sub-populations.

In general, the area was found to have less diversity and abundance of wildlife compared with more complex ecosystem in a lowland evergreen rainforest or a dipterocarp forest. But this area constitute the remaining vital native forest patches of Cebu that support native, endemic and threatened species.

2.1.4.4 Threat to abundance, frequency, and distribution of important species

Birds

The 25 species of birds belong to 15 families and 7 orders. Majority of this are native/resident species but not endemic with 17 (72%) species which is followed by seven (11%) endemic species and one (5%) migratory species. The seven (7) endemics to the Philippines are *Collocalia troglodytes* (Pygmy Swift), *Aerodramus amelis* (Grey Sweftlet), *Phapitreron leucotis* (White-eared Brown Dove), *Centropus viridis* (Philippine Coucal), *Ixos philippinus* (Philippine Bulbul), *Orthotomus castaneiceps* (Philippine Tailorbird) and *Dicaeum australe* (Red-keeled Flowerpecker). Those endemic birds have fairly-widespread to widespread distribution in the Philippines and can manage to adapt and survive in open and disturbed areas. In terms of population status, none of the recorded birds are listed under any threatened status.

It was also observed in Parcel 1 that several species of swifts and swiftlets (including the endemics) utilize narrow caves and steep cliffs as their roosting and breeding sites. While in Parcel 5, only common native birds were observed due to the highly fragmented patch of vegetation and other cultivated or propagated fruit trees.

The Order Passeriformes is the most represented with 13 species, mostly insectivores and omnivores, which are highly adaptable to open disturbed areas. Emerald doves, zebra doves, rails and other medium-size birds were hunted for food by the local people.

The presence of endemic species serves as a good biological indicator of disturbances or deterioration of the environment. The forest patch of Parcel 2 and Parcel 3A-3B with remaining limestone forest, will also serve as forest corridor of endemic birds from its north in Tabunan forest and Alcoy forest in the south.

Mammals

The mammals that were reported to be found in the forests by the locals were the crab-eating macaque (*Macaca fasicularis*) and Malayan civet (*Viverra tangalunga*) in which the latter species' excrement was documented in Parcel 3. It was also noted that bats, both microchiropterans (insectivorous bats) and megachiropterans (fruit bats), though not observed in the surveyed area are believed to roost in the caves and remnant limestone forest. Most likely, Parcel 1, Parcel 2, Parcel 3A-3B could support various species because of the presence of caves and abundant food plants of these wildlife (i.e. *Ficus* sp., *Syzygium sp.*), and prey (various species of invertebrates) which could support native, endemic, and threatened species.

Parcel 5 could no longer support mammalian population because of the degree of disturbance of the vegetation and other anthropogenic factors. Small terrestrial mammals like rats or shrews were not observed in the field nor actually seen during the day by local informants. However, it is also likely that these small mammals are present in the area only that they are cryptic or nocturnal in habits.

Reptiles and Amphibians

During the survey, various species of amphibians and reptiles were observed and heard in the area especially in the Parcel 1, 2 and 3A-3B which still have remaining tracks of limestone forest. While in Parcel 5, only the invasive marine toad (*Rhinella marina*) was observed because of the poor condition of the vegetation could not support native/endemic species. In Parcel 1, 2, and 3A-3B, the limestone or karst substrates can sustain the relative moisture condition needed for most amphibians to survive. The presence on the site of certain plant taxa/species belonging to *Pandanus* sp. Arecaceae, Araceae (*Alocasia* sp.), Aspleniaceae (*Asplenium* spp.), Polypodiaceae (*Microsorum* sp., *Drynaria* sp.), among others, serve as the major microhabitat attributes to the relatively rich amphibian diversity in the area. Further taxonomic and phylogenetic study are needed to be done on the genus *Platymantis* sp. found in the limestone forest that might represent a cryptic species and new to science.

Cebu endemic fossorial species such as *Malayotyplops ypogius* (Cebu blind snake) and *Brachymeles cebuensis* (Cebu worm skink) were not observed in the area but most likely is present in Parcel 2 and Parcel 3A-3B because of the damp forest litter on the ground. According to the locals, they were able to observe monitor lizard (*Varanus nuchalis*) and python (*Python reticulatus*) in Parcel 3A-3B and Parcel 2 which they occasionally hunted for food. Thorough surveys should be conducted on this site to further document various native, endemic and threatened species which are also found in Tabunan and Alcoy forests.

Invertebrates

Aside from the avian, mammalian, and herps fauna, the invertebrates which were observed in the area includes millipedes, dragonflies, damselflies, water striders, leaf bugs, ants and bees, beetles, moths and butterflies, praying mantis, jumping spiders, freshwater crabs, and freshwater shrimp in the small streams. It was noted that most of invertebrates have relative lower abundance and diversity compared with other forest types like dipterocarp or lowland evergreen rainforests. Particularly, moths and butterflies were observed in low densities and this may be due to the lack of preferred host plants and food plants in the area. But still Parcel 3A-3B and Parcel 2 with primary-growth and secondary-growth limestone forest could still support various endemic and threatened invertebrates which are found only in the island of Cebu.

2.1.4.5 Assessment of Impacts and Mitigating Measures

Development of the project site may cause siltation and loss of habitats to the wildlife. Conforming to the observation of Kummer et al. (1994) on the causes of environmental degradation in Cebu, siltation in Cebu is due to natural erosion as a result of its terrain and climate, agriculture (which can be controlled by the local people) and non-agricultural activity. The proposed development will possibly contribute significantly to the siltation or sedimentation in the lowlands thus interventions may include planting of indigenous species in **a stature** and **composition** similar to the forest over limestone or dense scrub vegetation. This may be done by planting seedlings of the thin-stemmed species in close proximity to each other.

In case where a dense scrub vegetation is present, a buffer zone for the more intact forest stand outside of these Parcels must be prioritized and maintained. Therefore, development of the project site should be limited and should conform to the management strategy of the other more intact forests in the area.

Seeds and seedlings of the indigenous species may be collected directly from the forests and propagated in nurseries by the local people.

Threatened species of flora encountered during mine activities will be noted and propagated in the nursery. Propagated species will eventually be used for rehabilitation of mined out areas. Mine plans also show that only a portions of the MPSA area would be affected, leaving enough space to serve as buffer, and remain undistrubed for the fauna to migrate away from the mine area.

2.2 Water

2.2.1 Hydrology/Hydrogeology

The province of Cebu has numerous river systems and tributaries all throughout the island. **Figure 2-47** shows the tributaries going through the project site. The noted major creek passing through the site is the Udlom Creek, in Parcel 1. This creek carries the run off and effluents from the nearby rice farms, animal farms, and communities.

Most households and major water suppliers in Cebu makes use of the island's groundwater sources for their daily needs. Since the prominent mineral of Cebu soil is limestone, rain runoffs goes directly to water tables due to less water retention.

It is worth noting, however, that the only major tributary within the MPSA is a small portion of the Udlom Creek, which is a seasonal creek that serves as a drainiage for the nearby community and poultry farm. It only has water during the rainy season, and goes dry during summer months.

Parcel 2 and 3

The main drainage body of these parcels are the Pandan River on the northeast, and the Cabiangan River to the west. Majority of the creek tributaries, however, lead to the Cabiangan River.

Parcel 5

Run off from Parcel 5 drains mainly towards the head waters of the Pandan River to the north, Abuno River to the southeast, and Pandan River again on the west. The creeks and tributaries are used for irrigation by the community. Their drinking water are extracted through deepwells.

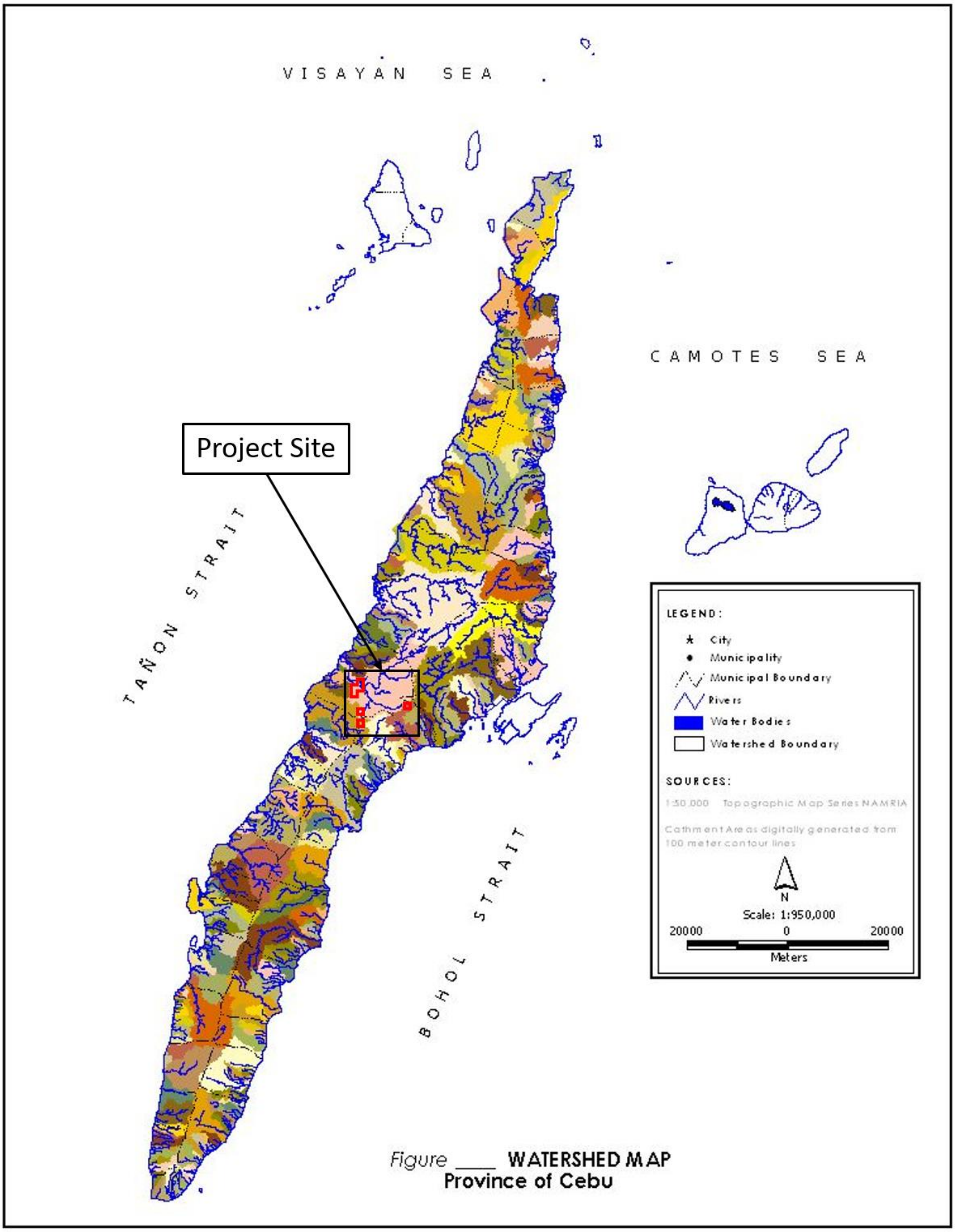


Figure 2-47: Watershed Map of Cebu

2.2.1.1 Change in drainage morphology / inducement of flooding / reduction in stream volumetric flow

There are no major body of water going through the project sites. Udlom Creek passes through the side of the target quarry area, and could be easily avoided during operation. There would also be no diversion of water systems. The outlet from the sedimentation ponds will be constructed to join in the existing drainage or canals. During the quarry activities, there would be removal of topsoil, which would be transferred to a stockpile. The stockpile is going to be placed away from Udlom Creek to avoid sedimentation, and possible landslide that could block the waterflow.

2.2.1.2 Change in stream, lake water depth

Sediments could be transported to the tributaries and river systems by surface runoffs. This would lead to blockages and rise in the depth. Sedimentation ponds will constructed on the project sites to minimize the sediments going into the tributaries from the quarry activities.

Soils in the province of Cebu are predominantly of limestone formation. Limestone is a sedimentary rock that is composed of calcium carbonate. These may have formed through the accumulation of marine invertebrates or through the chemical precipitation of calcium carbonate.

The Calcareous soils in Cebu are located on the upland areas and majority of them are having a rolling to hilly and mountainous topography, clayey in texture and either black or red in color. The soil of the project area belongs to the moderately drained areas of the province

These areas have a flat to gently undulating surface. There are two soil series under this drainage condition, namely the Mandaue and Medellien series. The former is of alluvial formation while the latter is an upland soil that have been formed from limestone and shale. The soil types in these series are best agricultural soils in found in the province (i.e. Mandaue clay loam and Lugo Clay).

Soils in the Mandaue series are generally cultivated to lowland rice as the land is level and slightly compacted layers below the subsoil favor the retention of irrigation water. The Medellien soil on the other hand is devoted mostly to sugarcane production.

These soils when tested for rapid wetting (Slaking Test) have shown to be very stable (see Section 2.1.3.2). The Soil crust remain intact when subjected to saturated conditions. There is no instance of water logging occur on any part of this series and very minimal erosion brought about by either surface runoff and flooding. In relation to erosion by the action of water, these soils are noted to be resistant to sheet and gully erosion and is brought about by the presence of high calcium in the soil.

2.2.1.3 Depletion of water resources / competition in water use

The quarry activities would not be utilizing the water sources within the project site. The primary water utility will be for domestic use like washing of equipment, spraying over dusty areas, and drinking of the workers. Water source for such activities will be sourced from local water districts or water suppliers.

2.2.1.4 Impacts to Floods and Droughts and Effects of Climate Change

The projected seasonal temperature increase, seasonal rainfall change and, frequency of extreme events in 2020 and 2050 of PAGASA (Climate Change in the Philippines, February 2011) under the medium-range emission scenario are shown in **Table 2-27**. According to the publication, all areas of the Philippines will get warmer, more so in the relatively warmer summer months. Mean temperatures in all areas in the Philippines are expected to rise by 0.9°C to 1.1°C in 2020 and by 1.8°C to 2.2°C in 2050. Likewise, all seasonal mean temperatures will also have increases in these time slices; and these increases during the four seasons are quite consistent in all parts of the country. Largest temperature increase is projected during the summer (MAM) season.

In Cebu province there is a projected temperature increase during the summer months (MAM) of 1.2°C in 2020 and a projected increase of 2.4°C in 2050.

Generally, there is reduction in rainfall in most parts of the country during the summer (MAM) season. However, rainfall increase is likely during the southwest monsoon (JJA) season until the transition (SON) season in most areas of Luzon and Visayas, and also, during the northeast monsoon (DJF) season, particularly, in provinces/areas characterized as Type II climate in 2020 and 2050. There is however, generally decreasing trend in rainfall in Mindanao, especially by 2050.

Cebu Province is under the Type III climate (seasons not very pronounced, relatively dry from November to April and wet for the rest of the year). The projection shows an increase of about

7.7 mm rainfall during the wettest months (SON) and an average increase of 0.8mm on the driest months of the year (MAM).

The projection, however, shows reduction in the number of days when rainfall is more than 150 mm (
Table 2-29), which can be associated to prolonged drought. In the years 2006 to 2035, PAGASA predicts the occurrence of four (4) extreme rainfall events while seventeen (17) is expected during years 2036 – 2065.

With regards to the impact of the proposed modification of the QVPI Project to flooding, since there will be slow and minimal ground disturbance considering the nature of Marble quarrying and extraction process. This is coupled by the inherent parent material characteristics of being highly fragmented and porous nature of the Marble quarry, therefore, rate of runoff and the water infiltration rate will not be altered, thus, the project does not contribute in any manner to flooding.

Table 2-27: Seasonal Temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in the province of Cebu

Province	Station	OSERVED BASELINE (1971 – 2000)				Change in 2020 (2006 - 2035)				Change in 2050 (2036 – 2065)			
		DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Cebu	Mactan	26.8	28.4	28.2	27.9	0.9	1.2	1.1	1.0	1.9	2.4	2.1	1.9

Table 2-28: Seasonal rainfall change (in %) in 2020 and 2050 under medium-range emissionscenario in the province of Cebu

Province	Station	OSERVED BASELINE (1971 – 2000)				Change in 2020 (2006 - 2035)				Change in 2050 (2036 – 2065)			
		DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Cebu	Mactan	324	228.3	595.1	607.4	17.7	0.8	7.7	7.7	19.6	0.5	18.9	17.8

Table 2-29: Frequency of extreme events in 2020 and 2050 under medium – range emission scenario in Cebu

Province	Station	No. of Days w/ Tmax >35 ºC			No of Dry Days			No of Days w/Rainfall >150mm		
		Observed ('71 –'00)	2020	2050	Observed ('71 –'00)	2020	2050	Observed ('71 –'00)	2020	2050
Cebu	Mactan	25	1488	2463	7112	5720	5693	12	4	17

2.2.2 Oceanography

The project site is located approximately 8km from the northern and southern shores of the Cebu Island. There would be no port facility to be constructed for this project, so the study in oceanography was not included in this report.

2.2.3 Water Quality

This section presents the results of the baseline water quality sampling activities held on June 24 – 26, 2016. The data were used to assess the project potential impacts to the ground and stream waters within and outside of the project site.

The national and local regulations used in the water quality assessment, water quality sampling stations, sampling procedures, analytical methods and the limitations of the study are detailed in the succeeding subsections.

National and Local Regulations on Water Quality

The national legislation for the protection and conservation of water bodies in the country is the Republic Act No. 9275 (RA 9275), The Philippine Clean Water Act of 2004 (CWA 2004). Pursuant to the section 19e and 19f of this act, the Department of Environment and Natural Resources (DENR) is the implementing arm in the implementation of the Rules and Regulations (IRR) of CWA 2004 under the Administrative Order No. 10, series of 2005 (DAO 2005-10) for the prevention and abatement of water pollution.

The DENR Administrative Order 08, series of 2016 hereby adopts and promulgates these Water Quality Guidelines (WQG) and General Effluent Standards (GES).The DAO 2016-08 was the guidelines used in assessing the current conditions of the streams water within or near the project site.

The groundwater quality of the sampling sites were assessed according to the drinking water guidelines specified in the Department of Health (DOH) Administrative Order 2007-12, otherwise known as the Philippine National Standards for Drinking Water 2007 (PNSDW 2007).

Sampling Sites

A total of seven (7) sampling sites that include ground and stream waters were established within and outside the project area.

Groundwater sampling stations were established at the Barangay sources of potable water and non-potable water supply. Five (5) sampling sites were established at the areas surrounding the project area. The groundwater sampling stations descriptions and their locations are presented in **Table 2-30**.

There is only one natural water way named Udlom Creek that was sampled within the project site, in Parcel 1. The downstream and upstream portions of the creek was sampled. This comprises the two (2) stream water stations established within the project site. **Table 2-31** provides description of the stream water sampling sites. After the baseline sampling conducted for this study, QVPI used 3 monitoring stations instead of 2, to improve the monitoring data of the water quality.

Sampling Methodology

In-situ Measurements

Hand held multi tester meter (Eutech Instrument CyberScan PCD 650 Model) was used to determine the level of dissolved oxygen (DO) in the surface water, ambient temperature (°C), electrical conductivity (EC µS/cm), pH, and Total Suspended Solids (TSS, mg/L) of the ground and stream waters. All equipment was calibrated prior to sampling to ensure the validity and reliability of the data gathered. The sampling areas are shown in **Table 2-30** and **Table 2-31**, and **Figure 2-48**.

Table 2-30: Groundwater Quality Sampling Stations

Sampling Station	Photo	Groundwater Source and Sampling locations	Coordinates
GW1		**Groundwater Type:** Spring **Location**: Parcel 3,Brgy. Bulongan,Toledo City	**Latitude:** 10°18’20.6”N **Longitude:** 123°39’22.8”E Elev.: 105m
GW2		**Groundwater Type:** Spring Box **Location:** Parcel 3,Brgy. Bulongan,Toledo City	**Latitude:** 10°18’16.6”N **Longitude:** 123°39’24.0”E Elev.: 113m

Sampling Station	Photo	Groundwater Source and Sampling locations	Coordinates
GW3		**Groundwater Type:** Spring Box **Location:** Parcel 2,Lamac City of Naga	**Latitude:** 10°16’47.5”N **Longitude:** 123°40’7.7”E Elev.: 163m
GW4		**Groundwater Type:** Spring Box **Location:** Parcel 1, Tagbuang Tubig, City of Naga	**Latitude:** 10°15’51.1”N **Longitude:** 123°40’38.2”E Elev.: 304m
GW5		**Groundwater Type:** Spring Box **Location:** Parcel 5,Brgy. Cogon, City of Naga	**Latitude:** 10°17’14.0”N **Longitude:** 123°44’6.3”E Elev.: 484m

Table 2-31: Stream Water Quality Sampling Stations on the Udlom Creek

Sampling Station	Photo	Location of Water Body	Coordinates
SW1 Downstream		Sampling Location: Parcel 1 (Udlom Creek) Taghaguimit, Tagbuang Tubig, City of Naga	**Latitude:** 10°15’47.6”N **Longitude:** 123°40’28.6”E Elev.: 277m

Sampling Station	Photo	Location of Water Body	Coordinates
SW2 Upstream		Sampling Location: Parcel 1 (Udlom Creek) Taghaguimit, Tagbuang Tubig, City of Naga	**Latitude:** 10°15'39.6"N **Longitude:** 123°40'39.2"E Elev.: 280m

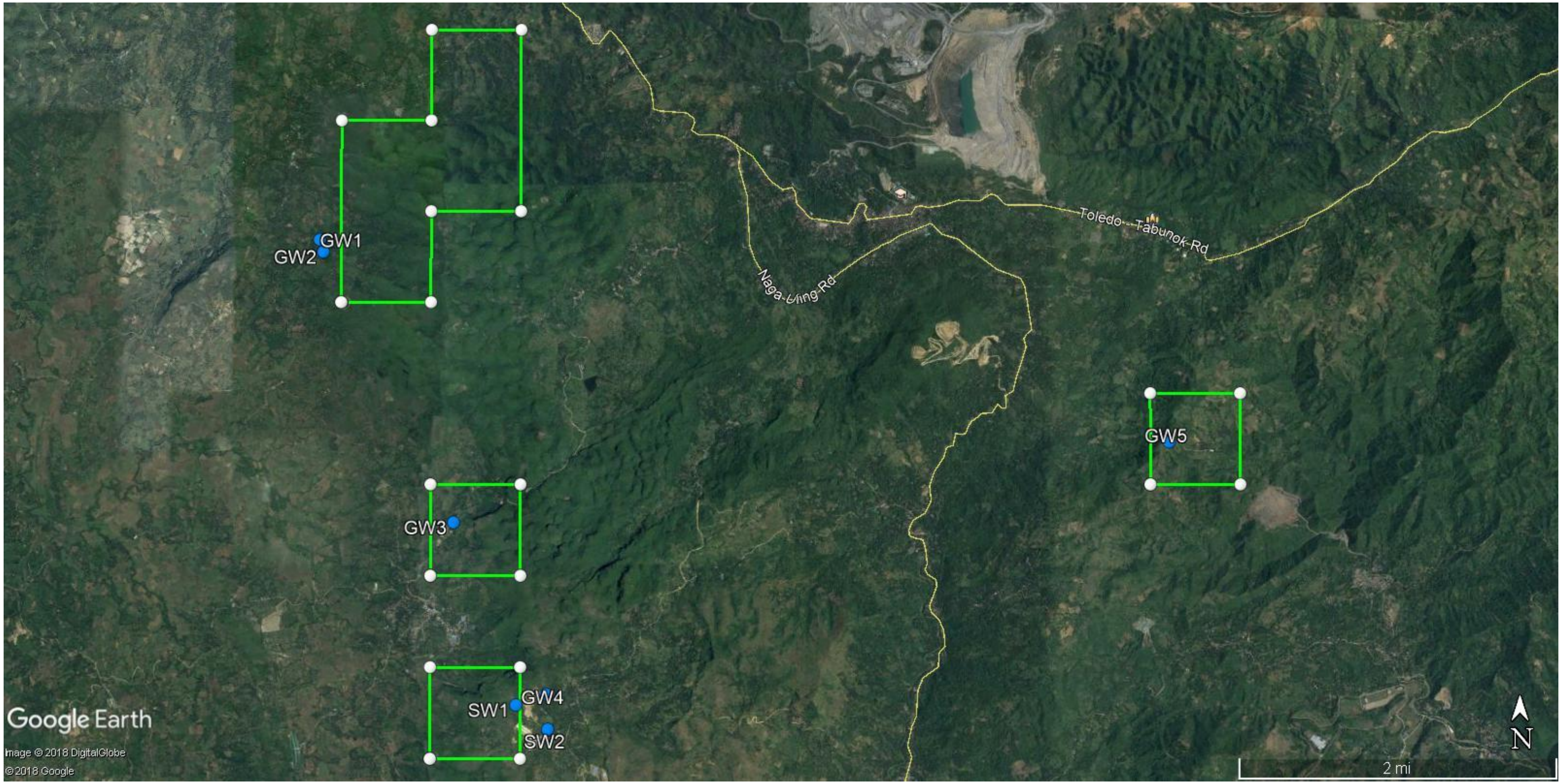


Figure 2-48: Water Sampling Locations

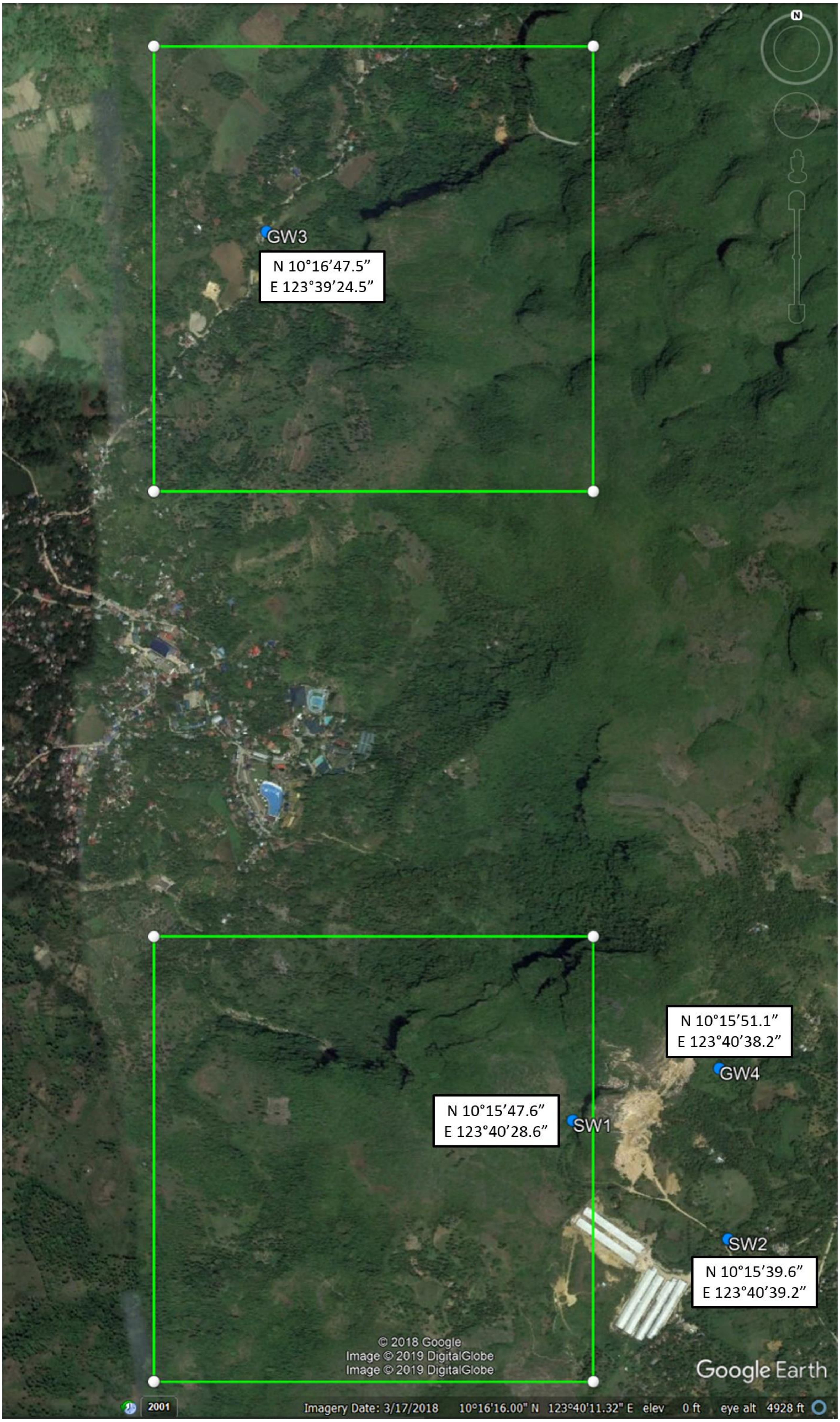


Figure 2-49: Water Sampling Stations in Parcels 1 and 2

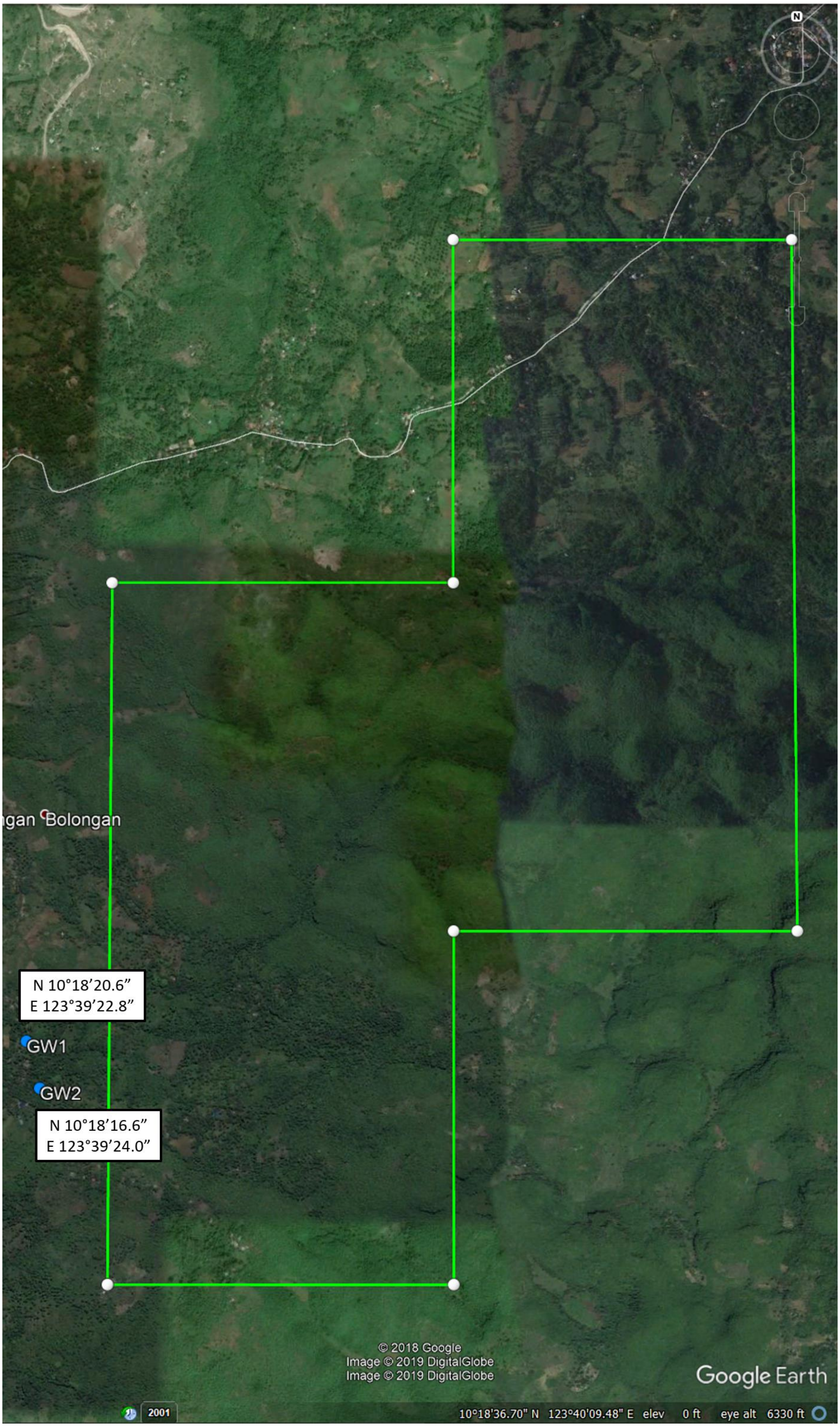


Figure 2-50: Water Sampling Stations in Parcel 3

Figure 2-51: Water Sampling Station in Parcel 5

Sampling and Handling Procedures

Water sampling Handling techniques are based on the water quality monitoring manual issued by the Environmental Management Bureau, DENR (2008).

Groundwater Samples were obtained directly from the main sources of water supply like spring box, concrete water reservoir. Sampling containers were directly filled with water from the faucets (**Figure 2-52**).

Figure 2-52: Groundwater Sample Collection at a Spring Box

The middle portion of the selected surface water collection site having the deepest water level and with fastest current was chosen as the sampling point. Grab water samples were collected by first rinsing the container at least three times with the stream water before the actual sample collection. Sampling was made by submerging the Fast laboratory provided containers, facing downward at a depth approximately 20 cm or whenever the water depth of stream permits (**Figure 2-53**). Sterilized Bottles for coliform were only filled to the line to allow headspace for proper mixing of samples. Samples for oil and grease were obtained from the surface of the water using wide mouthed glass bottles and immediately covered with aluminum foil prevent any oil and grease from adhering to the container cap.

Figure 2-53: Stream Grab Water Sampling

Parameters, Preservation and Analytical Methods for Stream and Groundwater Quality

The Physical and chemical properties, organic and inorganic composition, level of bacteriological contamination and the presence of heavy metals were determined by subjecting all of samples to analyses and is presented in Table 2.3.

Table 2-32: Lists of Parameters Analyzed for Ground and Stream Water Quality

Physical and Chemical Properties	- pH - Temperature - Electrical Conductivity - Oil and grease - Biochemical Oxygen Demand - Total Dissolved Solids - Chemical Oxygen Demand - Total Suspended Solids - Dissolved Oxygen
Bacteriological Parameters	- Total Coliform - Fecal Coliform
Metals and Cations	- Arsenic (As) - Cadmium (Cd) - Lead (Pb) - Mercury (Hg) - Chromium (Cr^{+6})

For every parameters it requires a specific type of container and volume. Sampling containers were prepared according to the specifications approved by the PNSDW and DAO 2016 – 08 for the ground and surface water quality, respectively. All of the Samples were submitted within 6 hours to the F.A. S. T. laboratory In Mandaue City and , is accredited by DENR and Certified by the department of Trade and Industry (DTI) as conforming to PNS ISO/IEC 17025:2005. The bottle requirements and maximum holding time are detailed in **Table 2-33**.

Table 2-33: Container Requirements and Sample Maximum Holding time

Parameters	Sample Volume	Container	Handling/ Preservation	Maximum Holding Time
TSS & TDS	1L	Polyethylene washed with phosphate-free detergent and ion free water	Cool stored at ≤ 6°C	7 Days
BOD & COD	1L	Polyethylene washed with phosphate-free detergent and ion free water	Cool stored at ≤ 6°C	48 hours
Total Coliform Fecal Coliform	250 ml	Glass, sterilized	Cool stored at < 10°C	6 hours
Oil and Grease	1L	Wide mouthed glass, with Aluminum foil	Cool stored at ≤ 6°C	28 Days
Cr^{+6}	500 ml	Polyethylene rinsed with Nitric Acid (HNO_3)	Cool stored at ≤ 6°C	28 Days
Total Metals - Arsenic (As) - Cadmium (Cd) - Total Calcium (Ca) - Lead (Pb) - Mercury (Hg)	1L	Polyethylene rinsed with Nitric Acid (HNO_3)	Cool stored at ≤ 6°C; Filtered on site	6 Months

Table 2-34: Laboratory Analytical Methods

Parameters	Laboratory Method	Method of Detection Limit
Physical and Chemical Properties		
BOD	5210 B 5-Day BOD Test	1mg/L
Oil and Grease	5520 B Partition – Gravimetric	1.94mg/L
Chemical Oxygen Demand	5220 B Open Reflux	-
TSS	2540 D Gravimetric	2.5mg/L
TDS	Gravimetry	1.0mg/L
Bacterial Parameters		
Total Coliform	Multiple Tube Fermentation Technique	1.1MPN/100 ml
Fecal Coliform	Multiple Tube Fermentation Technique	1.1MPN/100 ml
Total Metals		
-Arsenic (As)	Silver Diethyldithiocarbamate- Colorimetric	0.01mg/L
- Cadmium (Cd)	3030 F. Nitric-Hydrochloric Acid Digestion 3111 B. Direct Air-Acetvlene Flame AAS	0.002mg/L
- Chromium ($Cr^{+}6$)	Flame Atomic Absorption Spectrometric	0.005mg/L
- Lead (Pb)	Flame Atomic Absorption Spectrometric	0.01mg/L
- Mercury (Hg)	31 12 B. Cold Vapor AAS Spectrometric	0.001mg/L

Table 2-34 lists the laboratory methods used by F.A.S.T. laboratory for the analysis of samples, the corresponding method detection limits. These analytical methods are included in the list of test procedures Reference: APHA-AWWA and WEF 2012 Standard Methods for the Examination of Water and Wastewater, 22nd ed. Further, these are the same procedures as described in the DAO 2016-08 and PNSDW, 2007.

The Water Quality of the ground and surface water within and outside the proposed QVPI Cebu Marble and Aggregates Project were assessed based on the Local guidelines (DAO 2016 - 08 and, PNSDW 2007) and available related data pertaining to water quality.

Groundwater

Groundwater sources within and outside the project area are mostly for drinking and domestic consumption, hence, the laboratory water quality tests were compared to the PNSDW 2007 values (i.e. inorganic chemical constituent with health significance, microbiological quality and physical and chemical acceptability aspects.

Stream

The DAO 2016 - 08 describes the classification and beneficial use of fresh water bodies in the Philippines. This Guideline prescribes water quality criteria for a water body corresponding to the water designated best use of the water source.

Table 2-35: DAO 2016 - 08 Water Body Classification and Usage of Fresh Waters

Classification	Beneficial Use*
Class AA	Public Water Supply Class I This class is intended primarily for waters having watersheds, which are uninhabited and / or otherwise declared as protected areas, and which require only approved disinfection to meet the latest PNSDW.
Class A	Public Water Supply Class II - Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration, and disinfection) to meet the PNSDW 2007.
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, swimming, etc.).
Class C	1. Fishery Water For the propagation and growth of fish and other aquatic resources 2. Recreational Water Class II – For boating, fishing, or similar activities 3. For Agriculture, Irrigation, and Livestock Watering
Class D	Navigable waters

*Note: For unclassified water bodies, classification shall be based on the beneficial use as determined by the Environmental Management Bureau (EMB).

2.2.3.1 Groundwater Quality

Groundwater Microbiological Quality of the Project Site

The groundwater sampling stations within the project area utilizes the water coming from springs for drinking and other domestic water use. Exception is the GW1, where it is presently used as water hole for domestic animals and for plant watering.

In terms of the presence of pathogens in the groundwater stations sampled, all of the GW sampling stations have elevated total coliform when compared to the PNSDW 2007. Highest total coliform counts were detected in GW5 (Parcel 5, Brgy. Cogon, City of Naga) of 14,000.00 MPN/100ml. The lowest of 2,700.00MPN/100ml in GW4 (Parcel 1, Tagbuang Tubig, City of Naga). This is perhaps due to the very leaky subsurface soil conditions of the MPSA area, and the present land use where, animal droppings can contaminate both storm and agricultural runoffs that can reach the aquifers of the Barangays.

Three of the groundwater sampling station is used by the local population as their source of drinking water. Based on these results, a conventional treatment process as prescribed by PNSDW 2007 (i.e. coagulation, sedimentation, filtration, and disinfection) shall be used to completely eliminate pathogens before it can be used safely for drinking.

Sources of coliform in groundwater can include: Agricultural runoff, Effluent from septic systems or sewage discharges, Infiltration of domestic or wild animal fecal matter.

Poor well maintenance and the construction (particularly shallow dug wells) can also increase the risk of bacteria and other harmful organisms getting into a well water supply.

Elevated levels of fecal coliforms in all of the GW sampling Stations were also observed. GW5 fecal coliform is 3900MPN/100ml. The rest of the sampling stations is having fecal coliform of 1,700MPN/100ml. Again, when these waters are intended to be used for drinking, the conventional treatment process prescribed by the PNSDW 2007 shall be imposed.

Figure 2-54 and **Figure 2-55** presents the groundwater quality assessments for fecal and total coliform content made on the four (4) QVPI parcels and Barangays that encompasses the project site, alongside with the PNSDW 2007 limits.

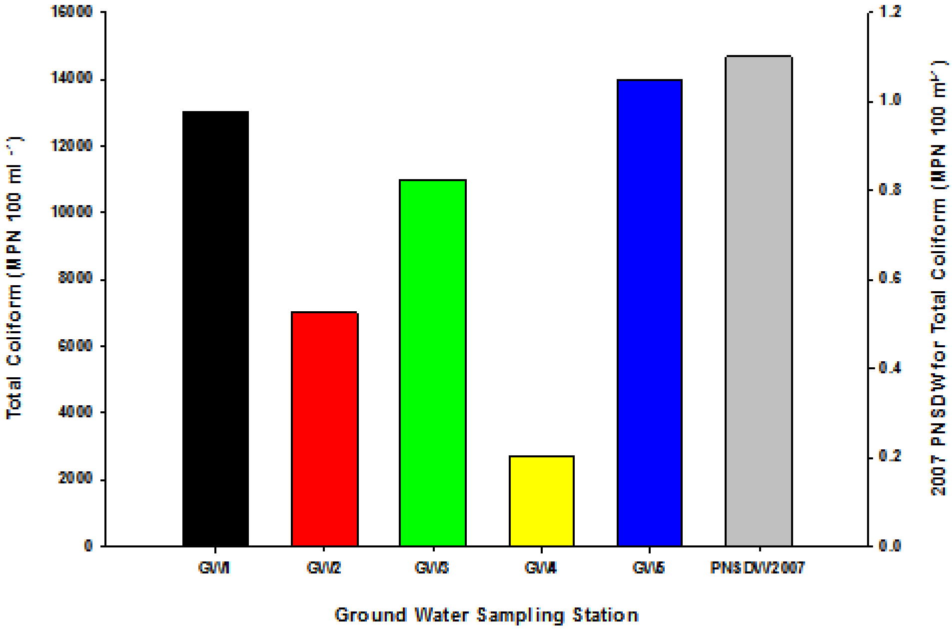


Figure 2-54: Groundwater Total Coliform Count

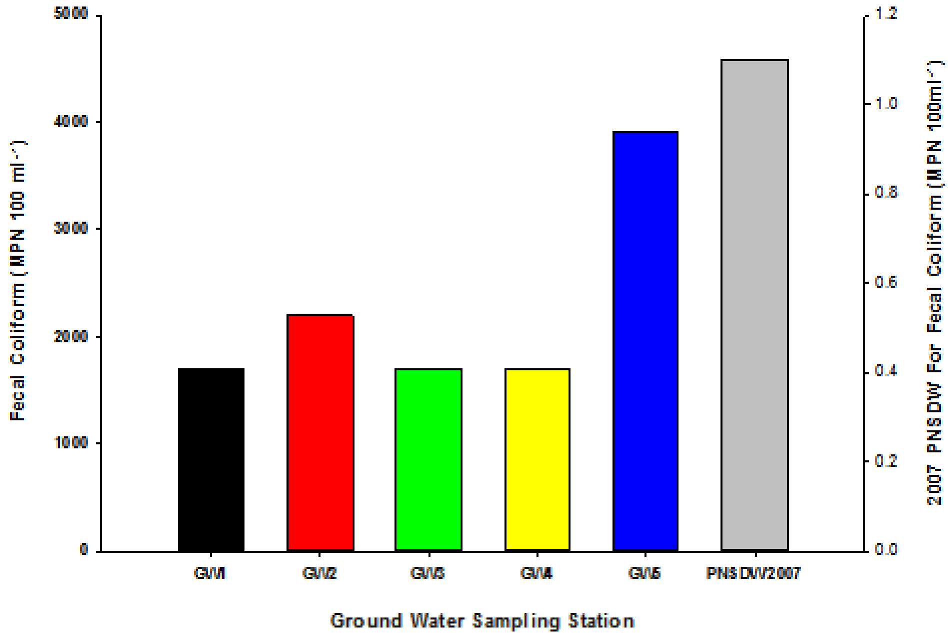


Figure 2-55: Groundwater Fecal Coliform Count

Physical and Chemical Quality for Acceptable Aspects of the Project site

All of the Groundwater stations pH level (**Figure 2-56**) show a neutral reaction and is considered to be acceptable when compared to the upper limit (pH 8.5) of the PNSDW 2007 standard.

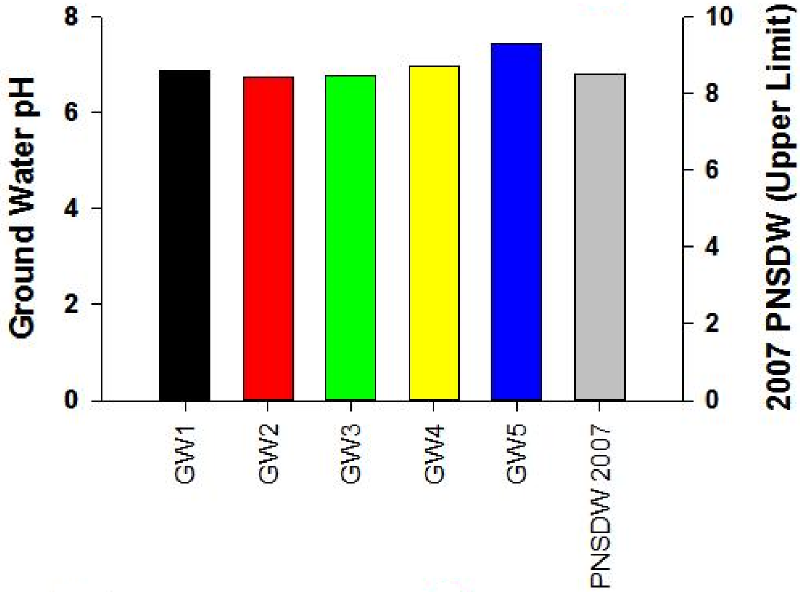


Figure 2-56: Groundwater pH Levels

Groundwater temperature as shown in **Figure 2-57** ranges from 25.6°C to 30°C. An increasing temperature trend was observed where, water sampling started at 9:00am to 1:05pm. The observed temperature difference from the groundwater sampling locations of 4.4°C therefore can be attributed to the time of day when sampling was made.

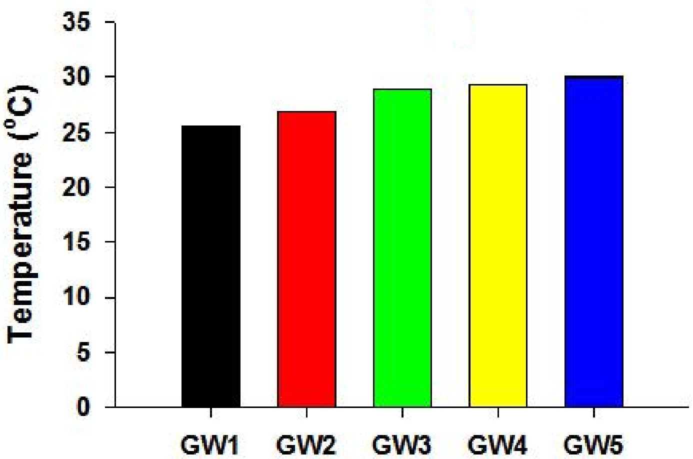


Figure 2-57: Groundwater Temperature Levels

Figure 2-58 also shows the oil and grease laboratory test for all the groundwater sampling stations. The parameter have no applicable standard using the PNSDW 2007. Result showed that all of the groundwater station have less than the detection limit of 1.94mg/l. For presentation purposes all of the ground water sampling locations were given the same values of 1.94 mg/l.

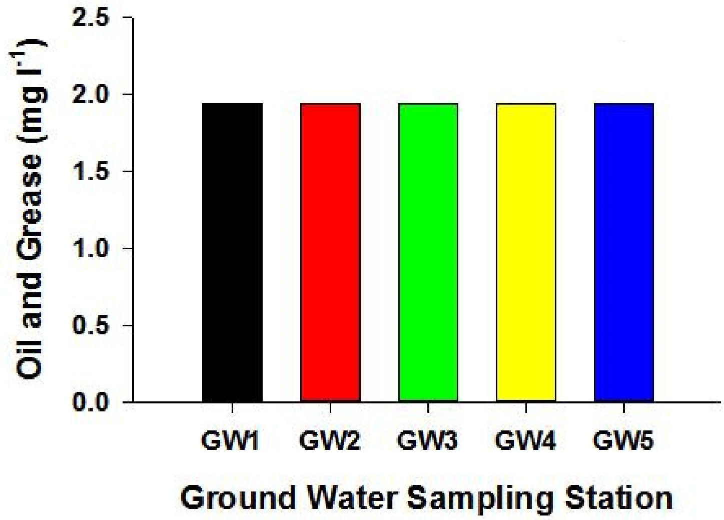


Figure 2-58: Groundwater Oil and Grease Levels

Dissolved Solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water. **Figure 2-59** shows the concentrations of dissolved inorganic ions over all the 5 groundwater sampling station were higher than the PNSDW 2007 standard of 500mg/L. In this case drinking water in these groundwater sampling stations is not acceptable. Although many health specialists believe that ideal drinking water should be under 50ppm or lower.

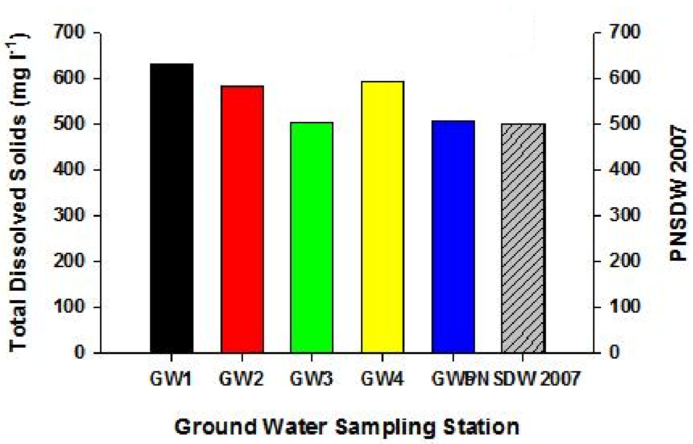


Figure 2-59: Groundwater Total Dissolved Solids Levels

Figure 2-60 shows the dissolved oxygen (DO) content of 5 groundwater sampling stations. Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality. The lowest DO levels were given by GW2 and GW3 (Parcel 3 and Parcel 2) of 4.01, 4.02mg/L, respectively. The highest DO content of the groundwater stations is in GW 5 of 8.6mg/L. The parameter have no applicable standard under the PNSDW 2007.

Dissolved oxygen levels is highly affected by temperature, salinity and pressure changes. As such, dissolved oxygen levels can range from less than 1mg/L to more than 20mg/L depending on how all of these factors interact. The effect of temperature in the amount of DO in groundwater is clearly demonstrated in GW5. Ambient water temperature of 30°C gave an equivalent reading of 8.6mg/L, in contrast with GW 1 and GW2 of 6.74, 4.01mg/L sample readings temperature taken between 25.6–26.80°C, respectively.

Moreover, oxygen affects a vast number of other water indicators, not only biochemical but esthetic ones like the odor, clarity and taste. Consequently, Dissolved oxygen is perhaps the most well-established indicator of water quality.

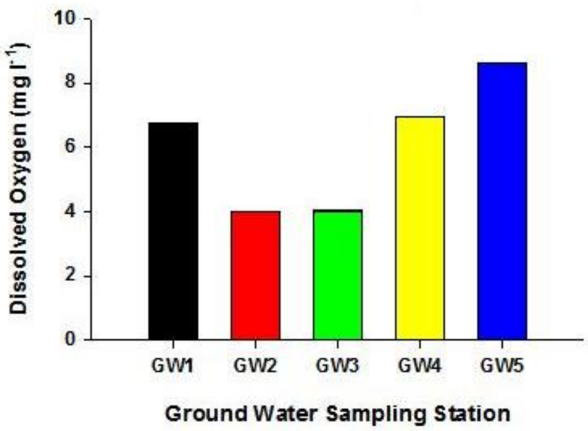


Figure 2-60: Groundwater Dissolved Oxygen Levels

Also shown in **Figure 2-61** are the electrical conductivity (EC) readings of the five Groundwater sampling stations. This parameter is one of those with no applicable standards (i.e. PNSDW 2007, DAO2016 -08).

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. The more ions that are present, the higher the conductivity of water. Likewise, the fewer ions that are in the water, the less conductive it is. Distilled or deionized water can act as an insulator due to its very low (if not negligible) conductivity value. Sea water, on the other hand, has a very high conductivity.

If the groundwater is intended for irrigation and drinking purposes high EC readings are indicators of its harmful effects both to human and plant life. Using the BSWM standard on the EC reading of all the groundwater sampling stations in all of the parcels is having a medium rating and is considered to be appropriate when used as irrigation water. Moreover, as a general rule, if the EC reading of more than 1µS/cm the water therefore cannot be used for irrigation purposes because of its high salt content.

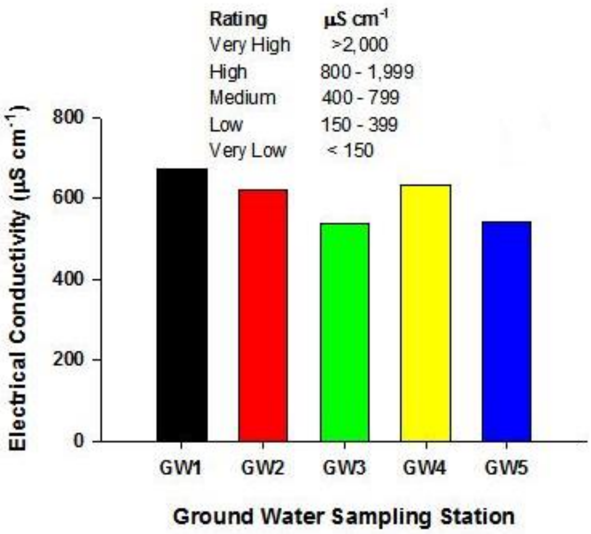


Figure 2-61: Groundwater Conductivity Levels

In environmental chemistry, the COD test is commonly used to indirectly measure the amount of organic compounds in water. The parameter is very useful to those concerned with water quality since they represent the amount of oxygen necessary for the aerobic biological oxidation of the organics in a water sample to carbon dioxide and water. **Figure 2-62** showed that GW2 sampling station have the lowest COD levels of 1mg/L and the highest is given by GW5 of 9mg/L. The rest of the GW sampling stations have the same COD of 2mg/L. The lower the value the better is the water quality. In other countries like India, COD standard is zero (0) for their drinking water.

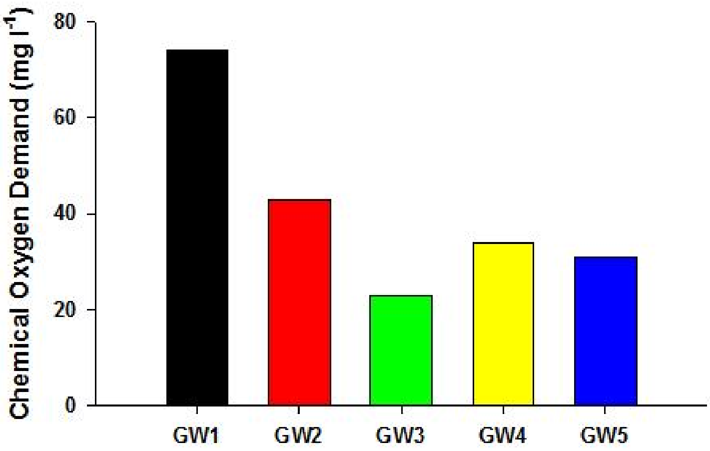


Figure 2-62: Groundwater Chemical Oxygen Demand Levels

Biological oxygen demand (BOD) on the other hand, is a measure of the amount of oxygen consumed by the bacteria that are decomposing organic matter. Similarly the lower the value in the water the more acceptable is the groundwater for drinking purposes. All of the GW sampling station have BOD levels of more than 1mg/L (**Figure 2-63**). This indicate that these waters are contaminated and is not supposed to be not safe as source of drinking water.

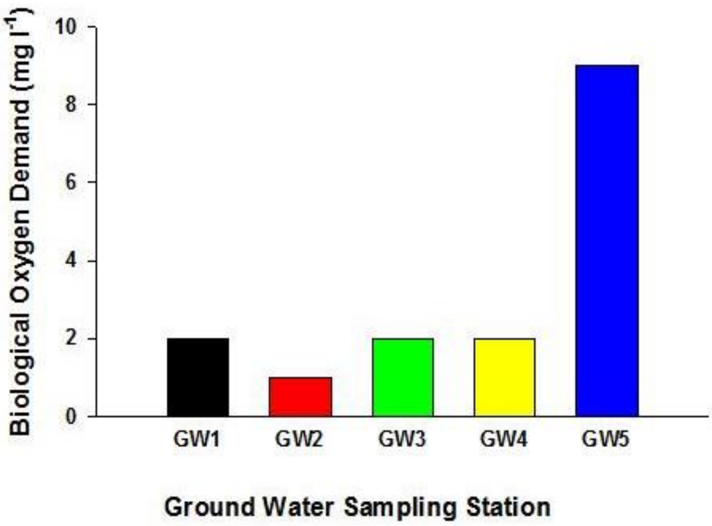


Figure 2-63: Groundwater Biological Oxygen Demand Levels

Inorganic Chemical Constituent of the Project site

Heavy metals are naturally occurring elements that have a high atomic weight and a density at least 5 times greater than that of water. Their multiple industrial, domestic, agricultural, medical and technological applications have led to their wide distribution in the environment; raising concerns over their potential effects on human health and the environment. Their toxicity depends on several factors including the dose, route of exposure, and chemical species, as well as the age, gender, genetics, and nutritional status of exposed individuals. Because of their high degree of toxicity, arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of public health significance.

Figure 2-64 to **Figure 2-68** show the metallic contents that are dissolved with the groundwater. The levels of Metallic mercury of the ground water sampling locations are presented in **Figure 2-64**. Laboratory analysis shows that all of the sampling locations have a negligible Hg content of <0.001 mg/l (i.e. less than the method detection limit). For presentation purposes all of the sampling locations have the same value of <0.001 mg/l and compared to the PNSDW 2007 standard of 0.001 mg/l for Hg.

Other inorganic chemical constituent (i.e. lead, Hexavalent Chromium and Cadmium) are also having negligible levels that is less than the method detection limit of 0.01 0.005, and 0.002 mg/l respectively. Exception is the elevated level of arsenic in GW1, 0.020 mg/l (**Figure 2-68**). This is twice the limit set by the PNSDW 2007 of .001 mg/l. This result can be anthropogenic in nature considering the present land use near GW1 (Crop land, small scale Mango plantation). Farmers are constantly applying pesticides and other Agri-chemicals which is a good source of arsenic and may have reached the ground water.

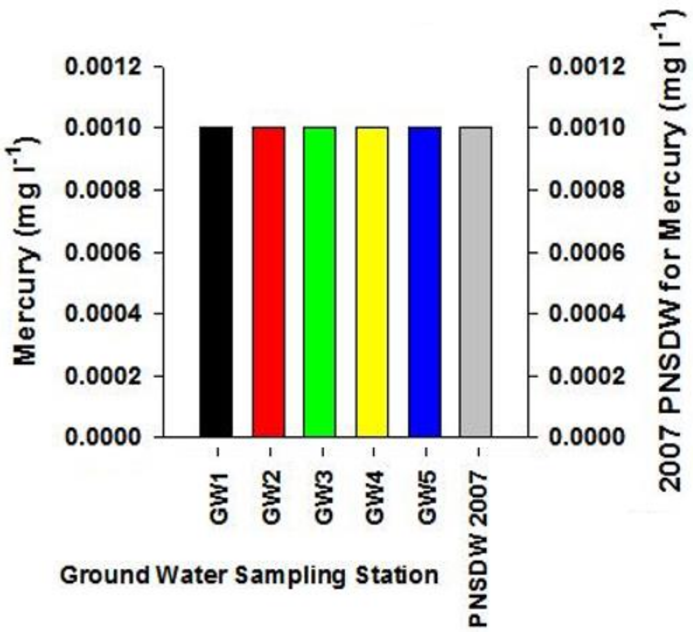


Figure 2-64: Groundwater Mercury Levels

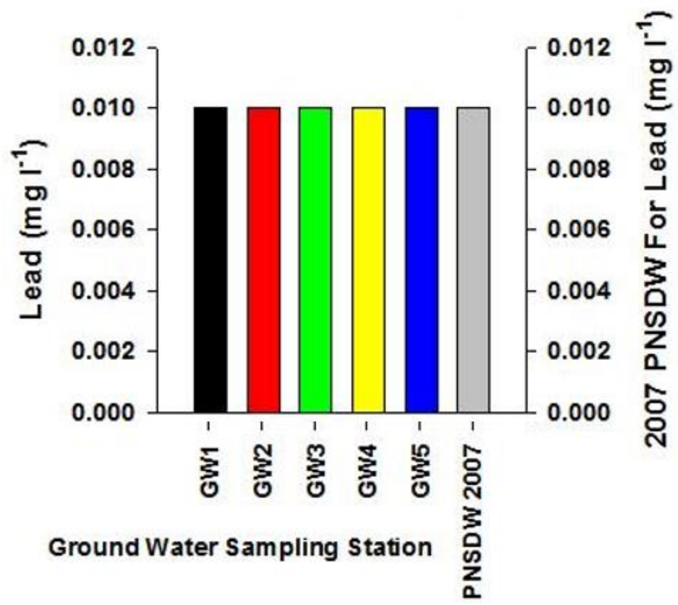


Figure 2-65: Groundwater Lead Levels

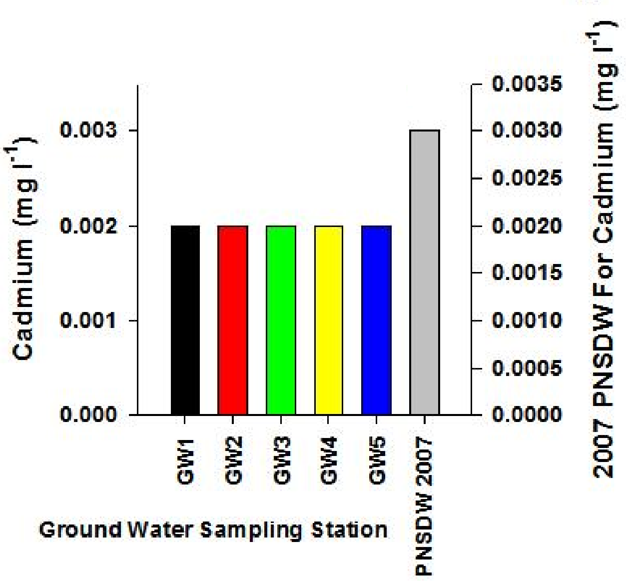


Figure 2-66: Groundwater Cadmium Levels

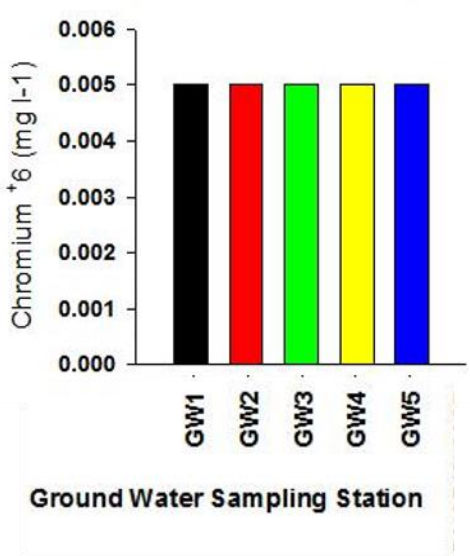


Figure 2-67: Groundwater Hexavalent Chromium Levels

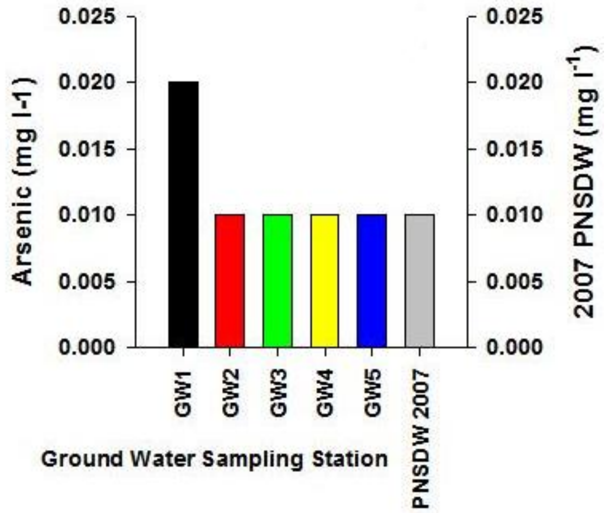


Figure 2-68: Groundwater Arsenic Levels

2.2.3.2 Degradation of surface water quality

Surface Water Microbiological Quality of the Project Site

There is only one river system encountered in the QVPI project areas, the downstream and upstream portion of the Udlom Creek. In all surface water stations sampled showed the presence of coliform bacteria (**Figure 2-69**). Though the total coliform counts laboratory analysis results of the Downstream (SW1) and Upstream (SW2) showed to be below the DAO 2016-08 standard for Class C fresh bodies of water of 10,000 MPM/100ml, these areas are within the highly disturbed portion of the project site. High agricultural activity and, perhaps the ongoing construction of a large scale poultry production housing that is very near to SW2 grab water sampling station, may have triggered the presence of the bacterial organism.

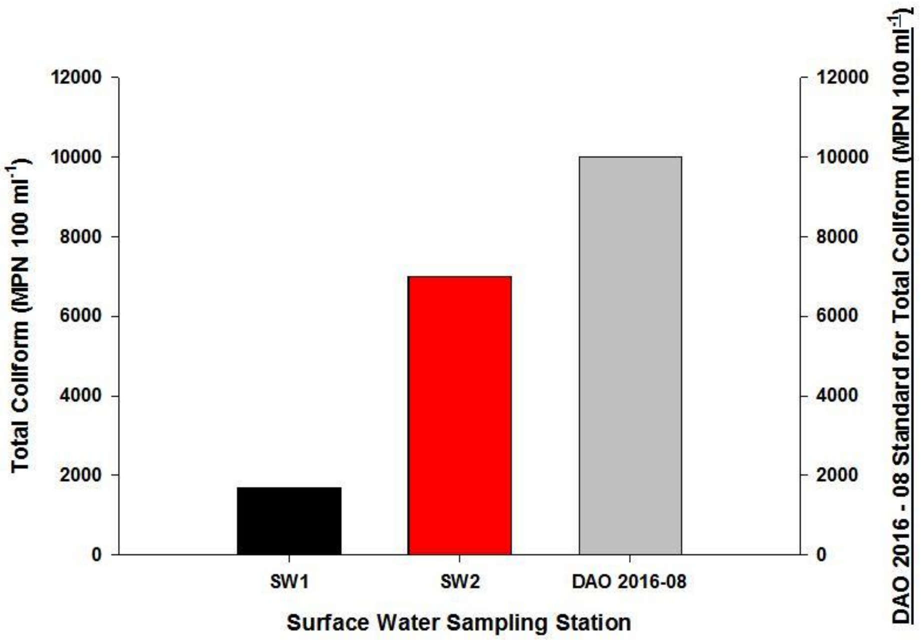


Figure 2-69: Surface Water Total Coliform Count

Fecal Coliform were also observed in all sampling stations and are above the standard set by the DAO 2016 - 08 fresh water guidelines for Class C waters of 400 MPN/100 ml (**Figure 2-70**). The SW1 and SW2 stations have elevated fecal coliform count of 680 and 1,700 MPN/100 ml, respectively. These values can be highly attributed to the high agricultural activity going on throughout the year. Drainage and runoff waters enter these river system. Farming activity in most cases use livestock (carabaos) for land their land preparation, these animals are seen bathing on the water ways. These areas are also observed to be highly populated thus, human excreta and domestic wastes from these barangays greatly contribute to the presence of high fecal coliform.

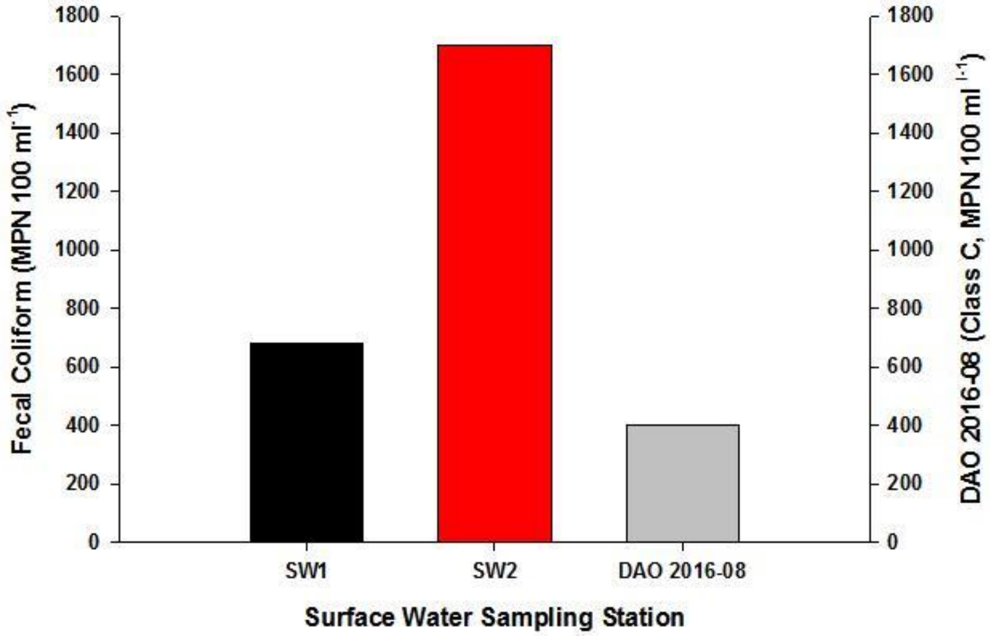


Figure 2-70: Surface Water Fecal Coliform Count

Physical and Chemical Quality for Acceptable Aspects of the Project site

Figure 2-71 shows the surface water reaction pH level of the sampling stations. SW1 and SW2 have a slightly alkaline reaction of 7.55 and 7.83 respectively. This is a common reaction in limestone areas.

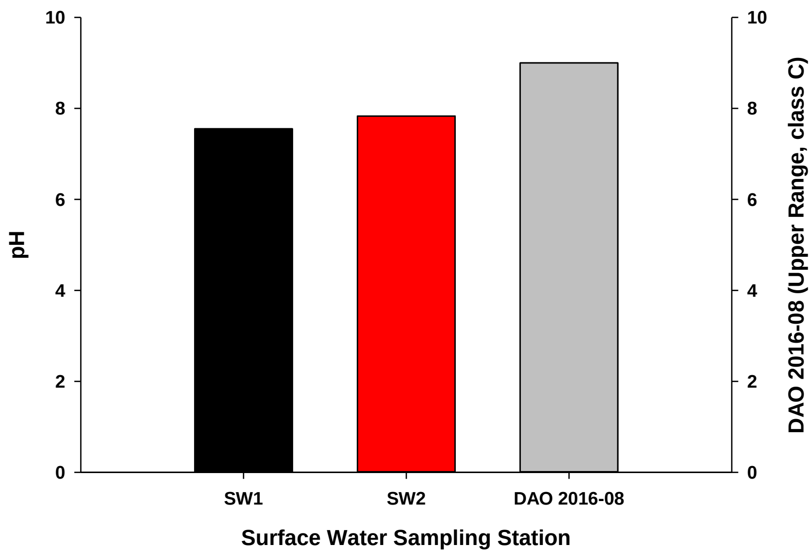


Figure 2-71: Surface Water pH Level

Surface water temperature of the downstream (SW1) and upstream (SW2) sampling stations, as shown in **Figure 2-72**, are 30 and 27.4°C, respectively. This values are normal surface water readings. Any variation in the temperature can be attributed to the time of day when sampling was made.

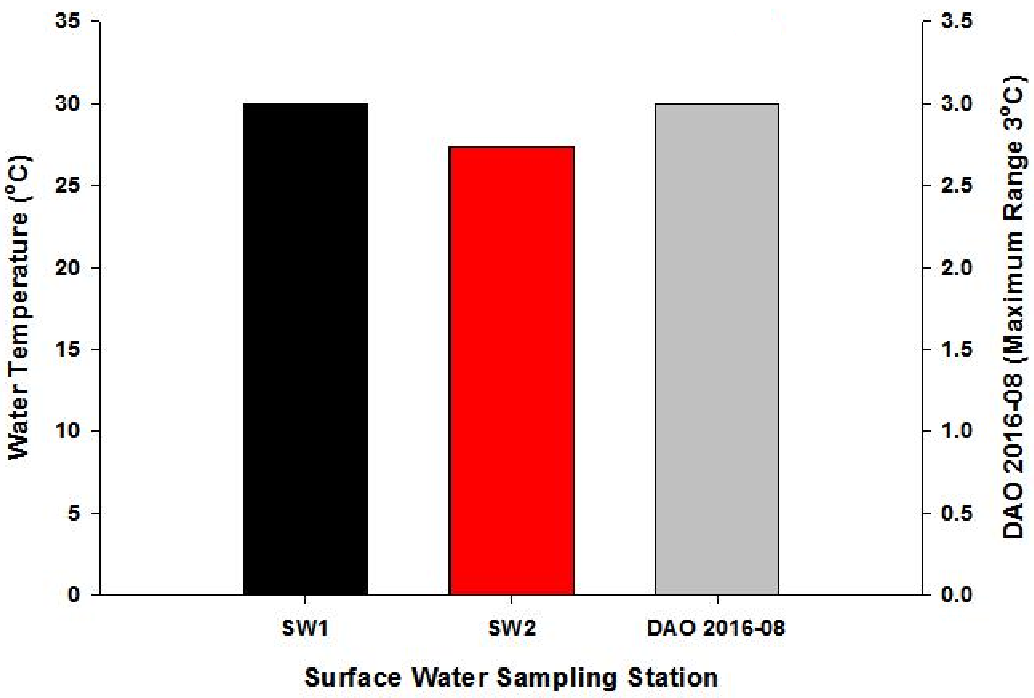


Figure 2-72: Surface Water Temperature Levels

Figure 2-73 shows the oil and grease laboratory test to the two surface water sampling station. There is no applicable standard using the PNSDW 2007. Result showed that all of the groundwater station have less than the detection limit of 1.94mg/L. This indicate the absence of oil and grease on the surface water of the Project area.

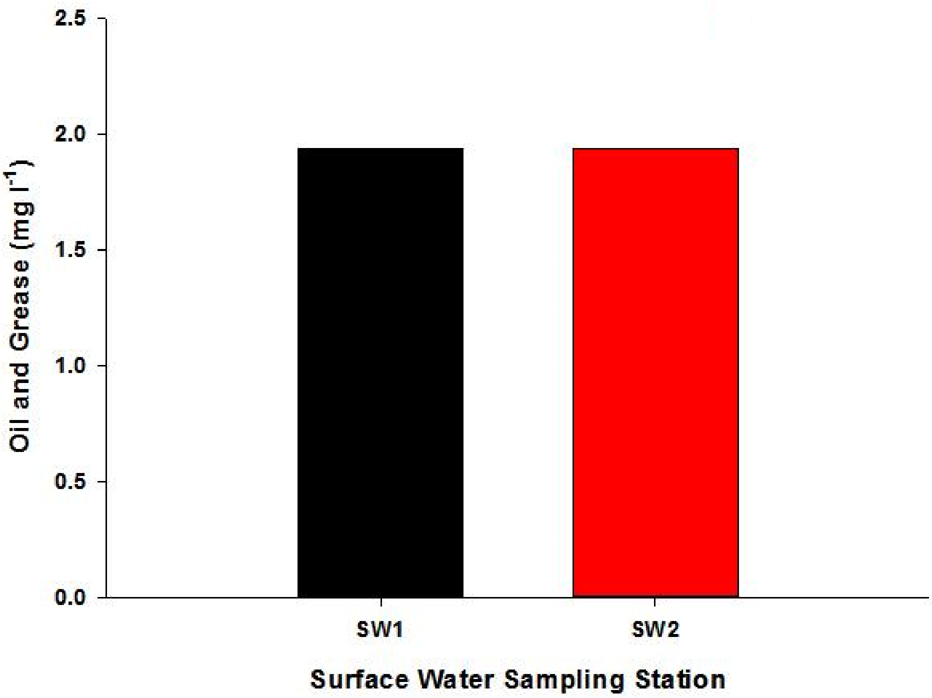


Figure 2-73: Surface Water Oil and Grease Levels

The surface water sampling stations electrical conductivity (EC) readings as shown in **Figure 2-74** gave a medium rating of when compared to the BSWM standards. The lower reading was recorded in the downstream of the Udlom Creek (SW1) of 507.7µS/cm. The upstream portion of the river gave a higher reading of 746.5µS/cm. Results indicated, these surface water coming from Udlom Creek can be safely used for irrigation purposes.

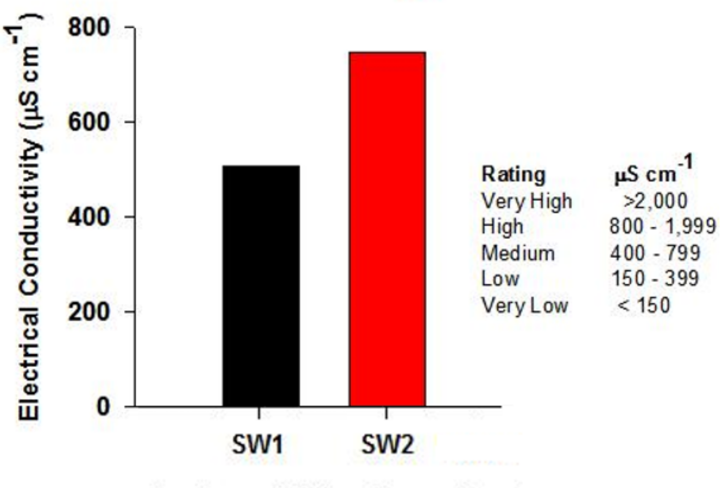


Figure 2-74: Surface Water Conductivity Levels

Total Dissolved Solids (TDS) (**Figure 2-75**) usually refers to the mineral content of water, although it can also include dissolved organic material. In essence, TDS is the total amount of material remaining after evaporation of the water. TDS include common salts such as sodium, chloride, calcium, magnesium, potassium, sulphates and bicarbonates.

The parameter have no applicable standard under the DAO 2016-08. However, the US EPA have set 500mg/L to provide for palatability of drinking water. Downstream portion of the sampling station (SW1) gave a lower reading of 477.7mg/L when compared to the upstream portion of Udlom Creek (SW2) of 701.3mg/L.

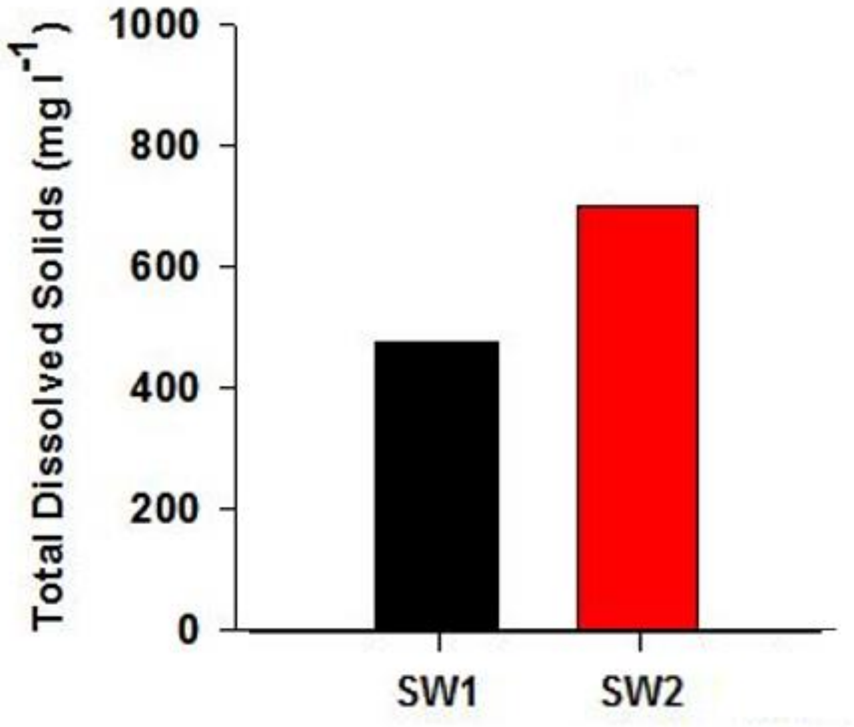


Figure 2-75: Surface Water Total Dissolved Solids Levels

The Total Suspended Solids (TSS) in the two surface water sampling station is shown in **Figure 2-76**. TSS are the most visible indicators of water quality. These suspended particles can come from soil erosion, runoff, discharges, stirred bottom sediments or algal blooms. While it is possible for some streams to have naturally high levels of suspended solids, clear water is usually considered an indicator of healthy water. The downstream and upstream surface water sampling station have a TSS reading of 57.0 and 44.0mg/L, respectively. This is lower to the standard set by the DAO 2016-08 of 100mg/L for Class C surface waters. Most people consider water with TSS concentration less than 20mg/L to be clear. Water with TSS levels between 40 and 80mg/L tends to appear cloudy, while water with concentrations over 150mg/L to be dirty.

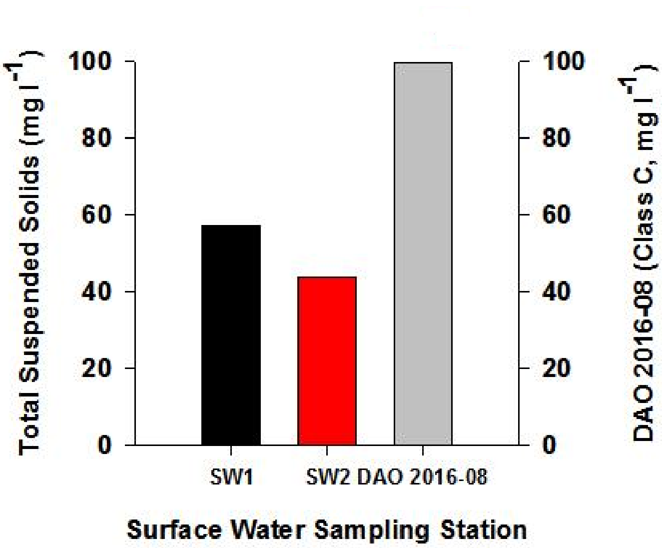


Figure 2-76: Surface Water Total Suspended Solids Levels

Level of COD in the surface water sampling stations (SW1 and SW2) show an increasing level of 42 52mg/L, respectively. Again, this water chemical property is one of the water parameters with no standard values using the DAO 2016-08. However, COD determine the amount of organic pollutants found in surface water (e.g. lakes and rivers). A lower COD level is desired before any surface water can be utilized for its best use. Advanced countries use a maximum oxygen demand between 200 and 1000mg/L must be reached before waste water or industrial water can be returned to the environment. Therefore, COD level in the two SW sampling station is acceptable for domestic use. The COD levels of the sampling sites are shown in **Figure 2-77**.

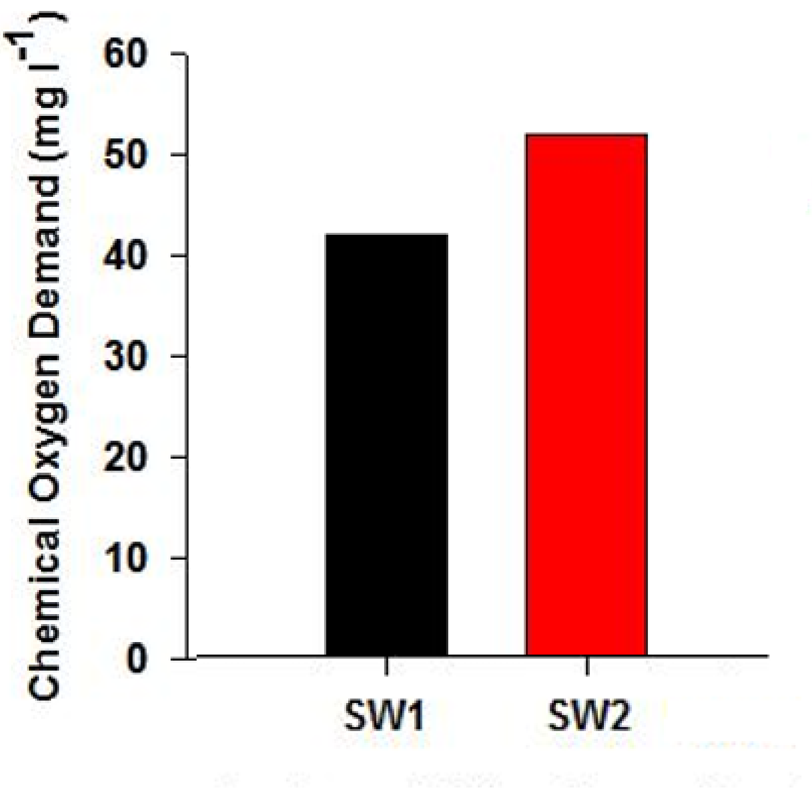


Figure 2-77: Surface Water Chemical Oxygen Demand Levels

In terms of the DO level of the SW water sampling station, the level of DO in comparison to the DAO 2016-08 standard is higher with 4.85 and 5.68mg/L, respectively. The levels indicate that fish and other aquatic animals can thrive in this waters. The amount of dissolved oxygen in streams is dependent on the water temperature, the quantity of sediment in the stream, the amount of oxygen taken out of the system by respiring and decaying organisms, and the amount of oxygen put back into the system by photosynthesizing plants, stream flow, and aeration. **Figure 2-78** shows the DO levels from the sampling sites, compared to DAO 2016-08 standard.

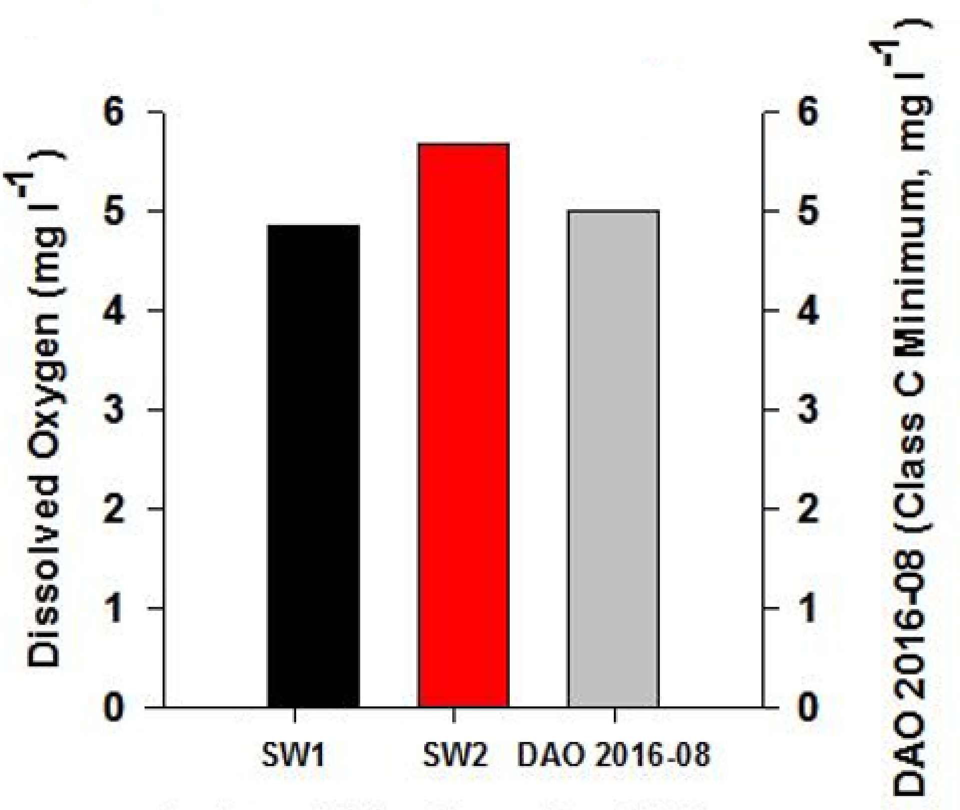


Figure 2-78: Surface Water Dissolved Oxygen Levels

Biochemical oxygen demand (BOD) is a measure of the amount of oxygen that bacteria will consume while decomposing organic matter under aerobic conditions. BOD is determined by incubating a sealed sample of water for five days and measuring the loss of oxygen from the beginning to the end of the test. When compared to the DAO 2016 -08 standard for BOD, the SW2 (upstream) have 17mg/L, which exceeded the standard BOD levels of 7mg/L. In contrast, the W1 (downstream) is below the Dao 2016-08 standard with only 4 mg/L (**Figure 2-79**).

This result indicated that surface water flowing and coming from the upstream portion of the water body sampled (i.e. Udlom Creek) with high BOD, it will accelerate bacterial growth in the river and consume the oxygen levels in the river. The oxygen may diminish to levels that are lethal for most fish and many aquatic insects. It is therefore desirable to have a low BOD values in surface waters specially the effluent water or runoff. Organic matter discharges from the nearby community and agricultural industries contirbute to raising the BOD levels over the prescribed limit.

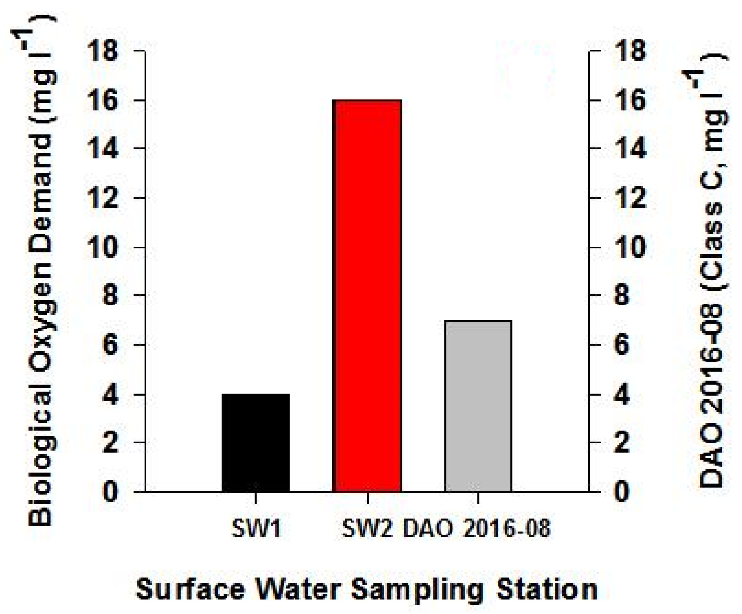


Figure 2-79: Surface Water Biological Oxygen Demand Levels

Inorganic Chemical Constituent of the Project site

In terms of metals and the wet chemistry tests conducted, all of the stream water sampling stations passed the DAO 2016 - 08 fresh water guidelines for Class C waters (**Figure 2-80** and **Figure 2-83**). This indicate that, the natural bodies of water around the QVPI MPSA does not contain elevated levels of heavy metals.

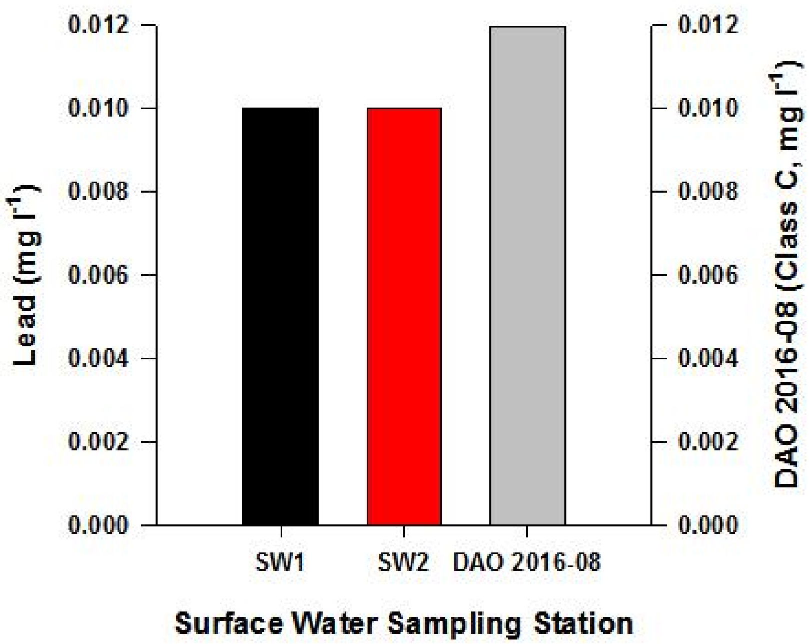


Figure 2-80: Surface Water Lead Content

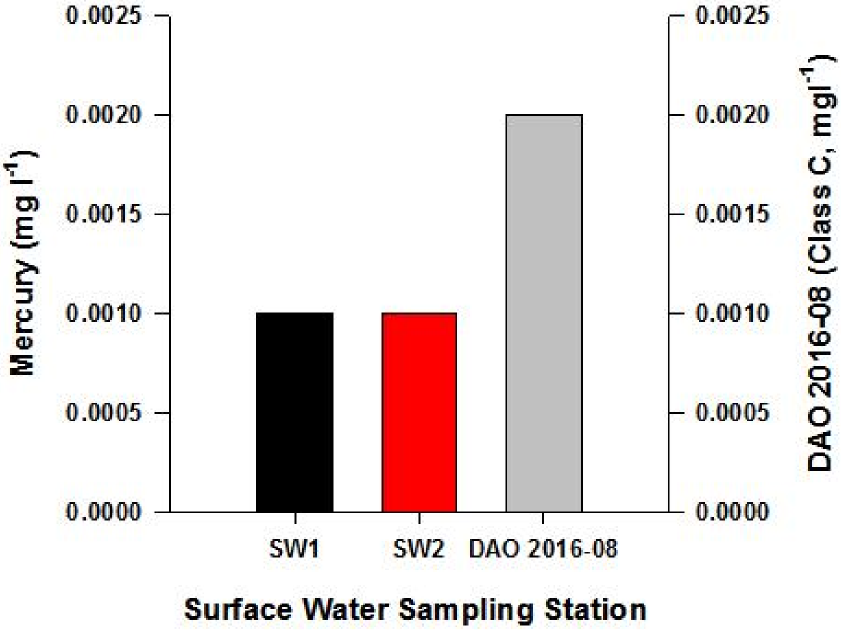


Figure 2-81: Surface Water Mercury Content

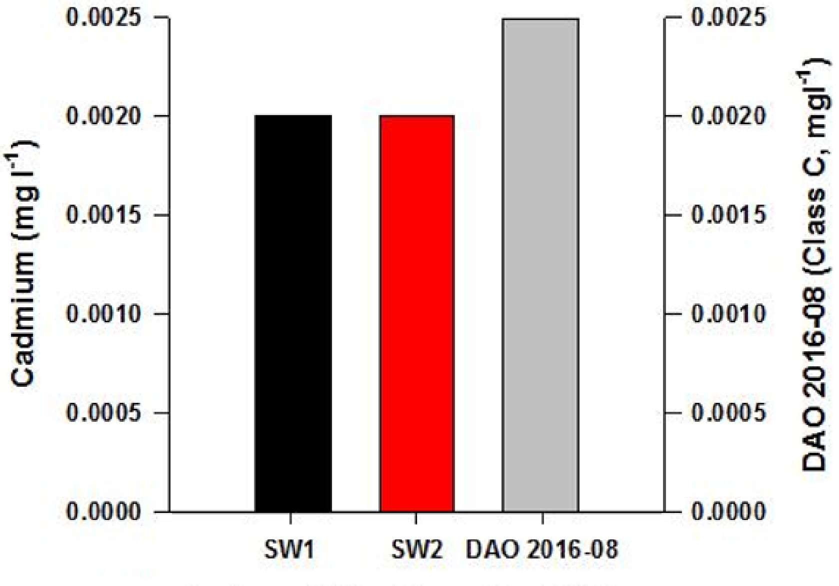


Figure 2-82: Surface Water Cadmium Content

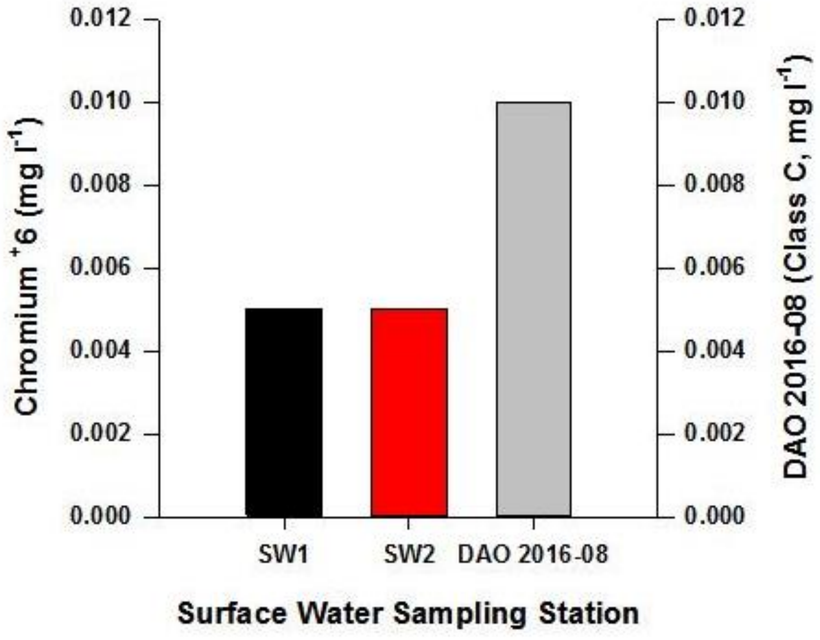


Figure 2-83: Surface Water Chromium Content

A summary of the results is given in Table 2-36.

Table 2-36: Summary of Laboratory Results

Parameters	SW1	SW2	GW1	GW2	GW3	GW4	GW5	Standards
pH	7.55	7.83	6.89	6.74	6.78	6.99	7.43	6.5 – 8.5 (PNSDW) 6.5 – 9.0 (DAO2016-8)
TDS (mg/l)	477.7	701.3	631.1	584.8	506.1	593.8	509.1	500 (PNSDW)
DO (mg/l)	4.85	5.68	6.74	4.01	4.02	6.95	8.61	5.0 (DAO2016-8)
Conductivity (µS/cm)	507.7	746.5	672.0	622.2	537.4	632.4	542.2	1,000 (BSWM)
Total Coliform (MPN/100ml)	1,700	7,000	13,000	7,000	11,000	2,700	14,000	<1.1 (PNSDW & DAO2016-8)
Fecal Coliform (MPN/100ml)	680	1,700	1,700	2,200	1,700	1,700	3,900	<1.1 (PNSDW & DAO2016-8)
BOD (mg/L)	4	16	2	1	2	2	9	7 (DAO2016-8)
COD (mg/L)	42	52	74	43	23	34	31	100 (DAO2016-8)
O&G (mg/L)	<1.94	<1.94	<1.94	<1.94	<1.94	<1.94	<1.94	2.0 (DAO2016-8)
TSS (mg/L)	57	44	5	1	1	1	1	80 (DAO2016-8)
Hg (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001 (PNSDW) 0.002 (DAO2016-8)
Pb (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 (PNSDW) 0.05 (DAO2016-8)
Cd (mg/L)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003 (PNSDW) 0.005 (DAO2016-8)
As (mg/L)	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.05 (PNSDW) 0.02 (DAO2016-8)
Cr^{+6} (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05 (Total Cr, PNSDW) 0.01 (DAO2016-8)

2.2.4 Water Quality Monitoring of Parcel 1

The water quality monitoring stations for Parcel 1 are presented below:

Figure 2-84: Parcel 1 Water Monitoring Stations

2.2.4.1 Dissolved Oxygen

Water quality monitoring for all stations covering February 2017 to Octoober 2018 (except April to Oct station 2, and Jun, Sept and Oct Station 3) recorded high results for dissolve oxygen. The high concentration of DO indicates that fish and other aquatic animals can thrive in this water, or high activity on the water body.

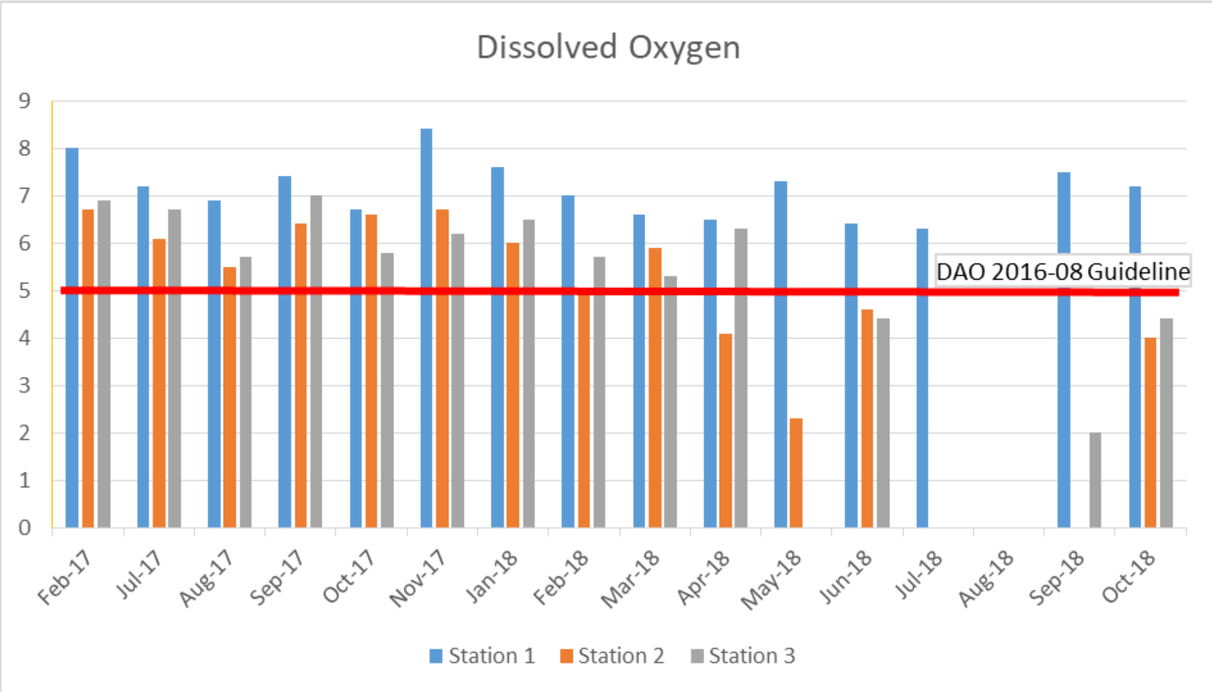


Figure 2-85: DO Levels from Parcel 1 Monitoring Stations

2.2.4.2 Biological Oxygen Demand

BOD levels in July 2017, August 2017, March to July 2018, and September to October 2018 exceeded the standard set by DENR. Excessive BOD concentration will accelerate the bacterial growth and consume the oxygen levels in the river that may affect the aquatic resources in the river.

A spike on the BOD level was observed during the sampling conducted in May and July 2018. The sampling coincided with the discharge of the nearby poultry farm into the Udlom Creek, and being summer, the water level was not enough to dilute the discharge.

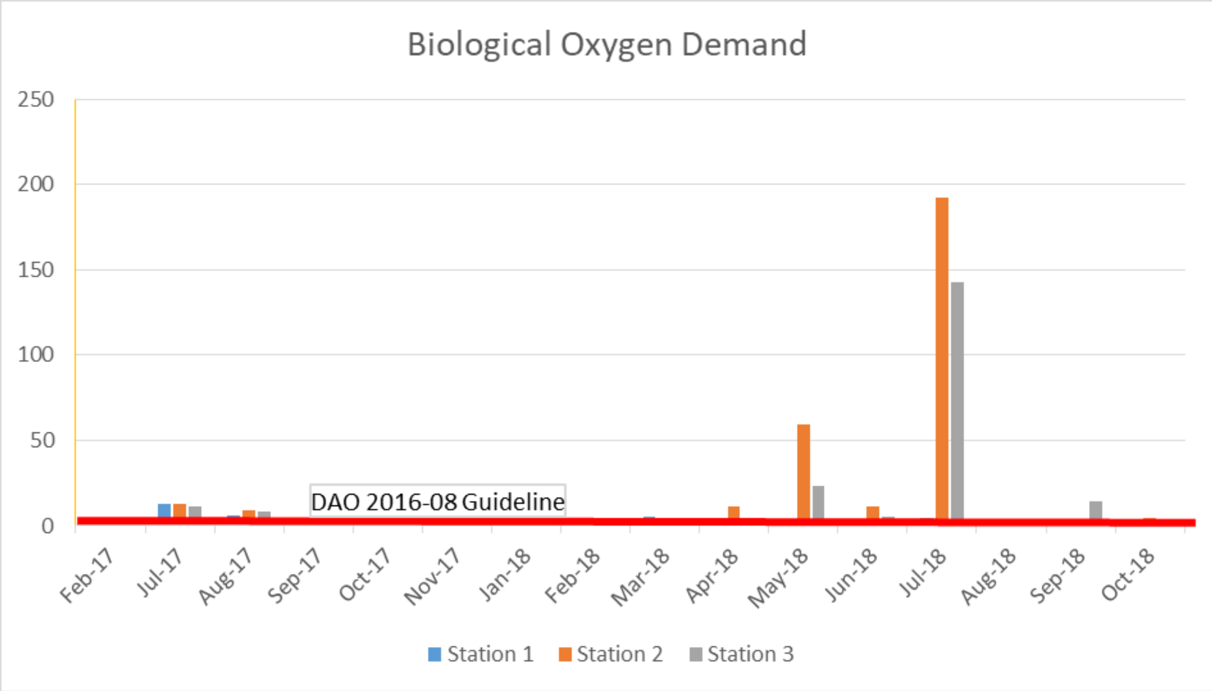


Figure 2-86: BOD Levels from Parcel 1 Monitoring Stations

2.2.4.3 pH

Almost all of the sampling stations recorded pH levels within the DENR Standards. The limestone deposits present in the area helps in neutralizing water pollutants that might lower the creek's pH.

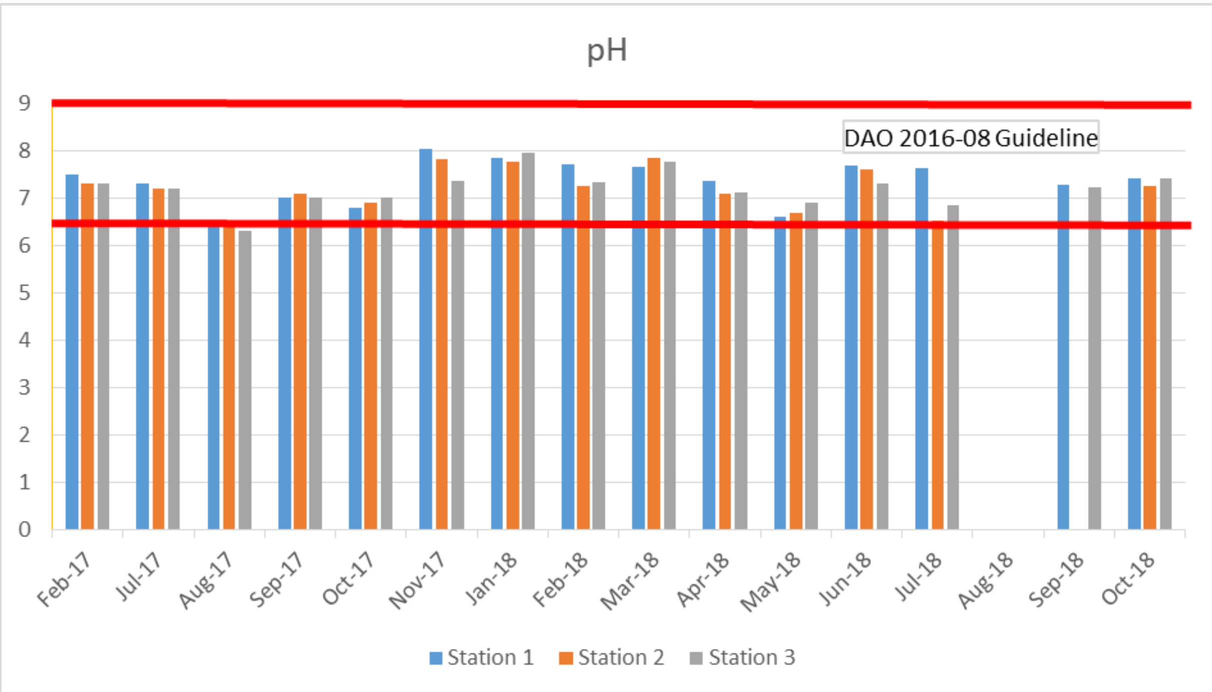


Figure 2-87: pH Levels from Parcel 1 Monitoring Stations

2.2.4.4 Total Suspended Solids

Majority of the TSS monitoring results are within the DENR standard, only Station 2 Sept 2017, Station 1 March 2018 and July 2018 exceeded the DAO 2016-08 DENR standard.

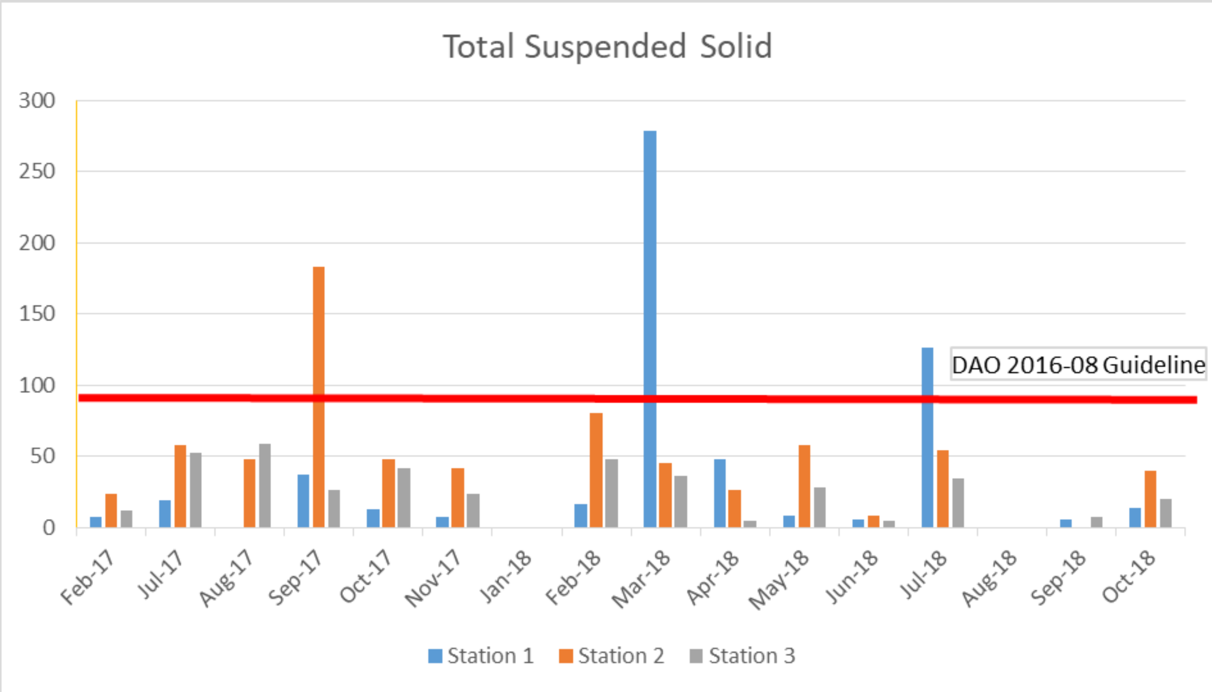


Figure 2-88: TSS Levels from Parcel 1 Monitoring Stations

2.2.4.5 Assessment of Impacts and Mitigating Measures

Quarrying activities will entail removal of vegetation and stripping of topsoil to be able to expose and extract the materials. These activities may result to accelerated erosion in which, silt materials that are carried by surface runoff may potentially reach the rivers draining the area. If not mitigated, eroded materials reaching the waterways may cause siltation of rivers and increase their total suspended solids and turbidity.

Series of siltation ponds will be constructed within the project area. These ponds shall be appropriately designed to effectively arrest the silt coming from the quarry area to meet the required water quality of the recycled water and DAO 35 effluent standards in case of water discharge. Sediments shall be impounded from the first to the third pond in succession. While the second pond is utilized, the first pond shall be drained and allowed to dry and desilted. Recovered silt materials will be used to backfill mined out areas. The third pond shall act as a buffer for the first two ponds and shall be the source of recycled water for road sprinkling.

An overall pit drainage management will be implemented in such a way that pit drainage will be directed towards the toe of the benches. From the benches, the drainage will be directed to silt traps. All drainage coming from the active areas will eventually pass thru a siltation pond.

The current operation (14 hectares quarry) has an existing siltation ponds and pit drainage to mitigate possible water contamination. Also, monthly water quality sampling is done for monitoring purposes.

As for domestic water use, septic tanks will be constructed on the project site for the employee's use. This would mitigate the rise of BOD levels due to the discharge of wastewater directly into the water bodies.

2.2.5 Freshwater Ecology

This section deals with the effects of the project on the organisms that thrive within the only nearby body of water, Udlom Creek. Udlom Creek is the closest natural body of water to the project site, located on the northeastern part of Parcel 1, and traversing from west to east, where it flows to the communities.

2.2.5.1 Threat to Existence and/or Loss of Important Local Species and Habitat

The Udlom Creek is bounded on both sides by drainages coming from agricultural areas, and a chicken farm. Nearby communities also direct their drainage towards the creek. However, the creek remains seasonal. It does not have water present during the summer months, but has flowing water during the monsoon season. During dry seasons, large organisms like catfish and frogs tend to hide in areas where there is constant water, or move to a different water source. On the other hand, small organisms, like benthos, algae, and planktons dies off once the creek dries up.

The common of the phytoplankton in the area belong to the Cyanobacteria phylum, or blue-green algae, which is common in freshwater sources globally. Under right conditions, cyanobacteria is known to reproduce at a high rate, causing algal blooms, which is dangerous to the environment since they release cyanotoxins. In this case, however, there are no algal blooms observed since the water near the project site have just come in during the time of sampling.

Comparison photos of the site during dry and wet seasons are given in Figure 2-89 and Figure 2-90.

Figure 2-89: The Udlom Creek during Dry Season

Figure 2-90: The Udlom Creek during Wet Season

2.2.5.2 Assessment on Impacts and Mitigating Measures

The project activities would generate sedimentations to the Udlom Creek during rains, or the settling of airborne dust particles on the water's surface. This would cause interference on the photosynthetic process of phytoplanktons, and gas exchange with aquatic organisms. During dry seasons, when the creek is dried up, sediment depositions could raise the level of the creek, and make shallower during the wet season. As a mtigating measure, the proponent would sprinkle water over dry open roads. The buffer zone around the mine area will also be maintained to avoid the dust from reaching the nearby community, and minimize the sediments going towatds the creek during wet season.

2.2.6 Marine Ecology

The project site is located approximately 8km from the northern and southern shores of the Cebu Island. There would be no port facility to be constructed for this project, so the study in marine ecology was not included in this report.

2.3 Air

2.3.1 Meteorology/Climatology

2.3.1.1 Change in the local micro-climate

The climate of Cebu belongs to Type 3 of the Modified Coronas Classification having indistinct wet and dry seasons. This type of climate is relatively dry from November to April and wet the rest of the year (**Figure 2-91**).

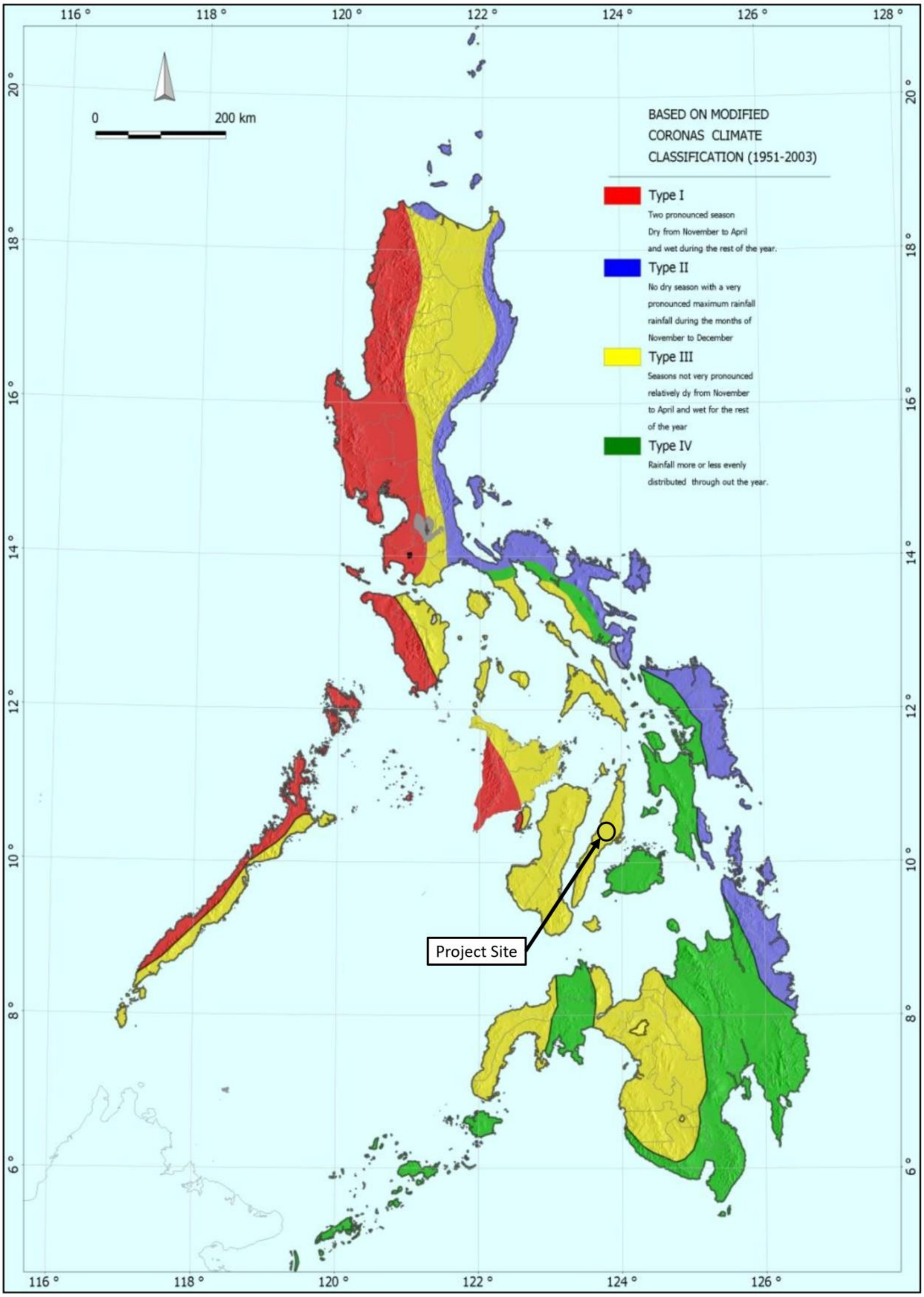


Figure 2-91: Climate Map of the Philippines

Data on climatological normals and projections on temperature and rainfall data, were obtained from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). Climatological data used for Region 7 were from the nearest PAGASA synoptic station located Mactan International Airport, Cebu. The observed ranges, and estimated projections by 2020 and 2050 are presented in **Figure 2-92**.

Table a: Seasonal temperature increases (in °C) in 2020 and 2050 under medium-range emission scenario in provinces in Region 7

	OBSERVED BASELINE (1971-2000)				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Region 7												
BOHOL	26.6	28.0	28.2	27.8	0.9	1.2	1.2	1.0	1.8	2.3	2.3	1.9
CEBU	26.8	28.4	28.2	27.9	0.9	1.2	1.1	1.0	1.9	2.4	2.1	1.9
NEGROS ORIENTAL	27.0	28.4	28.0	27.8	0.9	1.2	1.0	1.0	1.9	2.3	2.0	1.9

Table b: Seasonal rainfall change (in %) in 2020 and 2050 under medium-range emission scenario in provinces in Region 7

	OBSERVED BASELINE (1971-2000) mm				CHANGE in 2020 (2006-2035)				CHANGE in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Region 7												
BOHOL	376.1	209.6	412.9	514.5	9.8	-7.1	4.5	6.8	21.2	-11.9	18.9	22.6
CEBU	324.0	228.3	595.1	607.4	17.7	0.8	7.7	7.7	19.6	0.5	18.9	17.8
NEGROS ORIENTAL	225.8	226.0	639.5	636.9	15.0	-4.9	9.3	4.7	17.4	-6.8	20.7	10.5

Table c: Frequency of extreme events in 2020 and 2050 under medium-range emission scenario in provinces in Region 7

Provinces	Stations	No. of Days w/ Tmax >35 °C			No. of Dry Days			No. of Days w/ Rainfall >100mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
BOHOL	Tagbilaran	260	1710	3413	8176	6836	6473	15	21	23
CEBU	Mactan	25	1488	2463	7112	5720	5693	12	4	17
NEGROS ORIENTAL	Dumaguete	66	826	1499	8451	6032	5642	5	7	6

Note:

- For Siquijor, use values of Dumaguete.

Figure 2-92: PAGASA Observed Climatological Ranges, and 2020 & 2050 Projections

Rainfall

Rainfall normal values recorded in Mactan Synoptic Station reflect the characteristics of a Type 3 climate having relatively indistinct seasons. Relatively low amounts of rainfall were recorded during the months of November to April ranging from 324mm to 228.3mm. The months of June to October experience high amounts of rainfall ranging from 595.1mm to 607.4mm. Lowest monthly rainfall is typically experienced March to May. On the other hand, highest monthly rainfall usually occurs between September to November. The average annual rainfall is estimated to rise by 8.48% in 2020, and 14.20% by 2050 according to PAGASA's projections.

Temperature

Average temperatures recorded in the area typically vary between 26.8°C and 28.4°C with an annual average equal to 27.8°C. This is projected to rise by an average of 1.05°C by 2020, and 2.08°C by 2050.

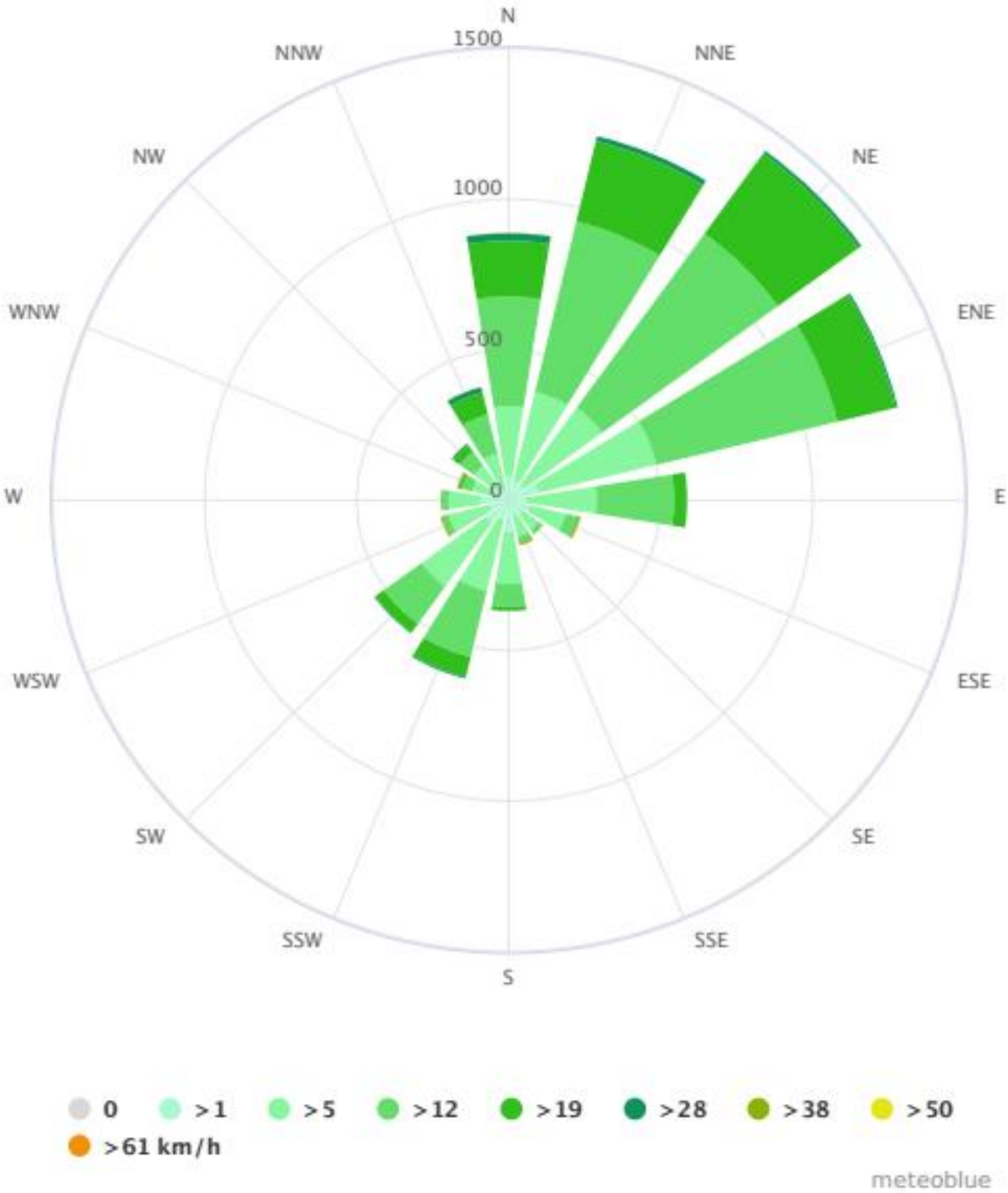
Tropical Cyclones/Typhoons

Between 1971-2000, there were a total of 25 extreme climatological events observed in Cebu. This includes extreme temperature changes, dry days, and extreme rainfall. Occurrence of such events is expected to rise to 1488 by 2020, and 2463 by 2050.

Wind Speed and Direction

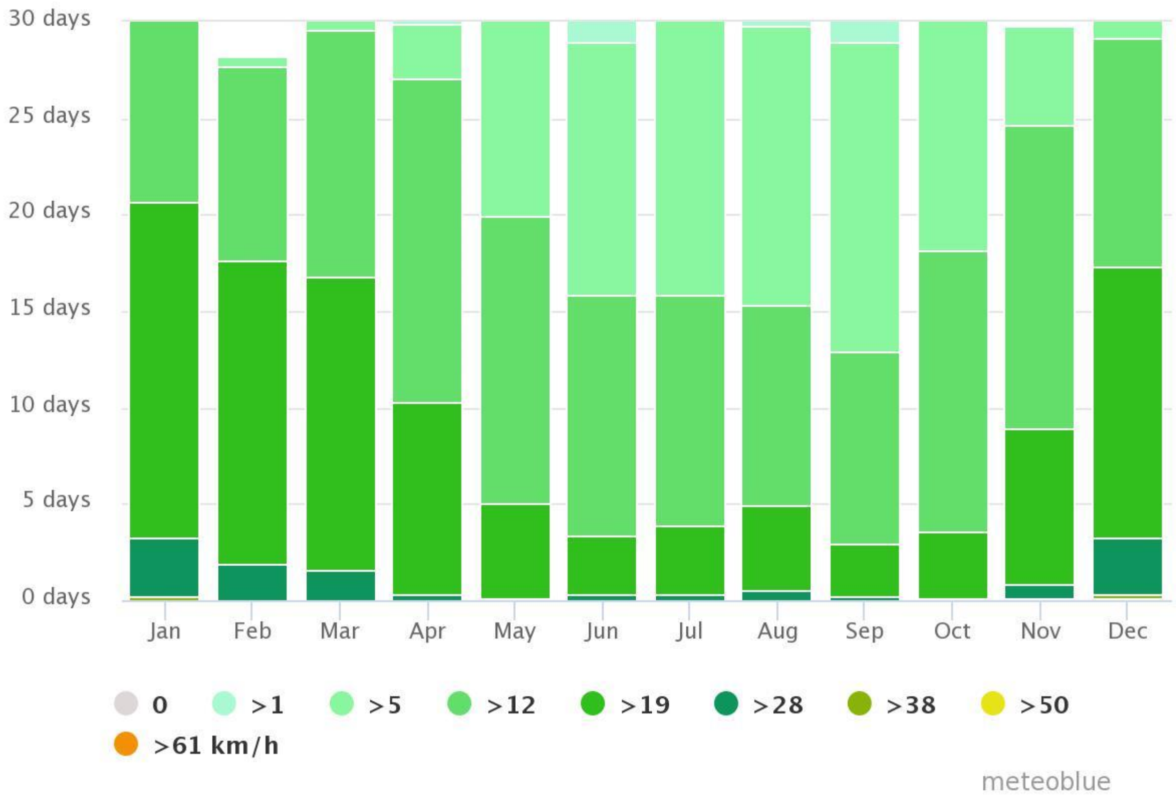
The prevailing wind direction for most of the year is north-easterly from March to December. Wind speed, on the other hand, is strong during December to April, and relatively calm from June to October. Movements of air streams in the area are generally influenced by Southwest Monsoon (*Habagat*) which affects the country from May to September. Rainfall during the wet months is usually brought by this phenomenon.

Figure 2-93 presents the wind rose diagram and frequency table of wind speed and direction for Cebu, while **Figure 2-94** presents the average wind speeds per month.



Source: https://www.meteoblue.com/en/weather/forecast/modelclimate/cebu-city_philippines_1717512

Figure 2-93: Wind Rose Diagram for Cebu



Source: https://www.meteoblue.com/en/weather/forecast/modelclimate/cebu-city_philippines_1717512

Figure 2-94: Annual Average Wind Speeds

2.3.1.2 Contribution in terms of greenhouse gas emission

The contribution of the project to global climate change was assessed by identifying possible sources and sinks of greenhouse gases (GHGs). Greenhouse gas emissions of the project are limited to carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4).

Carbon dioxide enters the atmosphere through the burning of fossil fuels, solid waste, trees and wood products, and also as a result of other chemical reaction. It is also removed from the atmosphere (or “sequestered”) when it is absorbed by plants as part of the biological carbon cycle. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills. (US EPA)

GHG emissions of the project would mainly come from land clearing/land use conversion, burning of fossil fuels. The amount of GHG emissions will depend on the vegetation’s biomass and actual fuel consumption. The Intergovernmental Panel on Climate Change (IPCC) has set guidelines for national GHG inventories. However, it was pointed out by IPCC that for land-use change and forestry, calculations of emissions have inherently large uncertainties and errors. Removal of vegetation cover leads to CO_2 emissions because the carbon sequestered in the plants is emitted to the atmosphere if not counter-balanced by revegetation. With this, GHG contribution as a result of land clearing can be considered relatively small. Progressive rehabilitation of mined-out and degraded areas will be implemented to offset the GHG emissions of the project due to land clearing (removal of carbon sink). On the other hand, GHG emissions contributed by burning of fuel would mainly come from the use of equipment for mining, transport of ores and other activities that use energy from burning fossil fuels. When fossil fuels are burned to produce energy, the carbon stored in them is emitted almost entirely as CO_2. Emissions of fossil fuel GHGs shall be mitigated through regular vehicle/equipment maintenance to maximize fuel efficiency.

2.3.2 Air Quality

2.3.2.1 Degradation of air quality (remove inappropriate heading)

Axceltechs, Inc. hired the services of CRL Calabarquez Corporation to conduct ambient air sampling test within the location defined on **Table 2-37**. The project includes ambient air and noise monitoring for 24 hours in terms of parameters specified in **Table 2-38**. The sites were chosen to cover the span of the MPSA area and community. Although the windrose indicate that the primary wind direction blow towards NNE, these sites are closest to the primary receptors in the community. These communities would, however, not be directly affected by the quarry, even if some are within MPSA boundaries, since the quarry activities would be limited to the quarry area, as specified in the mine plans from **Figure 1-22** to . The sampling was conducted on January 17-22, 2017.

Table 2-37: Sampling Location and Coordinates

Station Name	Coordinates
Station A1: Parcel 1 Tagjagumit Elementary School	N 10°15’52.60” E 123°40’45.51”
Station A2: Parcel 2 Near Community Deep Well	N 10°16’47.85” E 123°40’9.89”
Station A3: Parcel 3 Near Chapel	N 10°18’18.97” E 123°39’22.56”
Station A4: Parcel 5 Near Cogon Chapel	N 10°17’11.19” E 123°44’18.22”

Table 2-38: Air Quality Compounds and Parameters Tested

Sampling Station Name/Description	Parameters Tested*	
	Ambient	Noise
Station A1: Parcel 1 Tagjagumit Elementary School	TSP, PM_{10}, NO_2, SO_2	Yes
Station A2: Parcel 2 Near Community Deep Well	TSP, PM_{10}, NO_2, SO_2	Yes
Station A3: Parcel 3 Near Chapel	TSP, PM_{10}, NO_2, SO_2	Yes
Station A4: Parcel 5 Near Cogon Chapel	TSP, PM_{10}, NO_2, SO_2	Yes

*TSP = Total Suspended Particles; PM_{10} = Particulate Matter at 10μ; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Hg = Mercury; NO_2 = Nitrogen Dioxide; SO_2 = Sulfur Dioxide

This section of the report will be used to evaluate actual concentration of air pollutants as baseline data at the project site. The will also serve as a pertinent document for the firm's compliance with the Department of Environment and Natural Resources (DENR). The results are then compared with the DENR Standards under National Ambient Air Quality Standards (NAAQS) and National Ambient Air Quality Guideline Values (NAAQGV) of Republic Act 8749 or known as the Philippine Clean Air Act of 1999 and with standards under National Institute for Occupational Safety and Health (NIOSH).

The Air Sampling Map is shown in Figure 2-95.

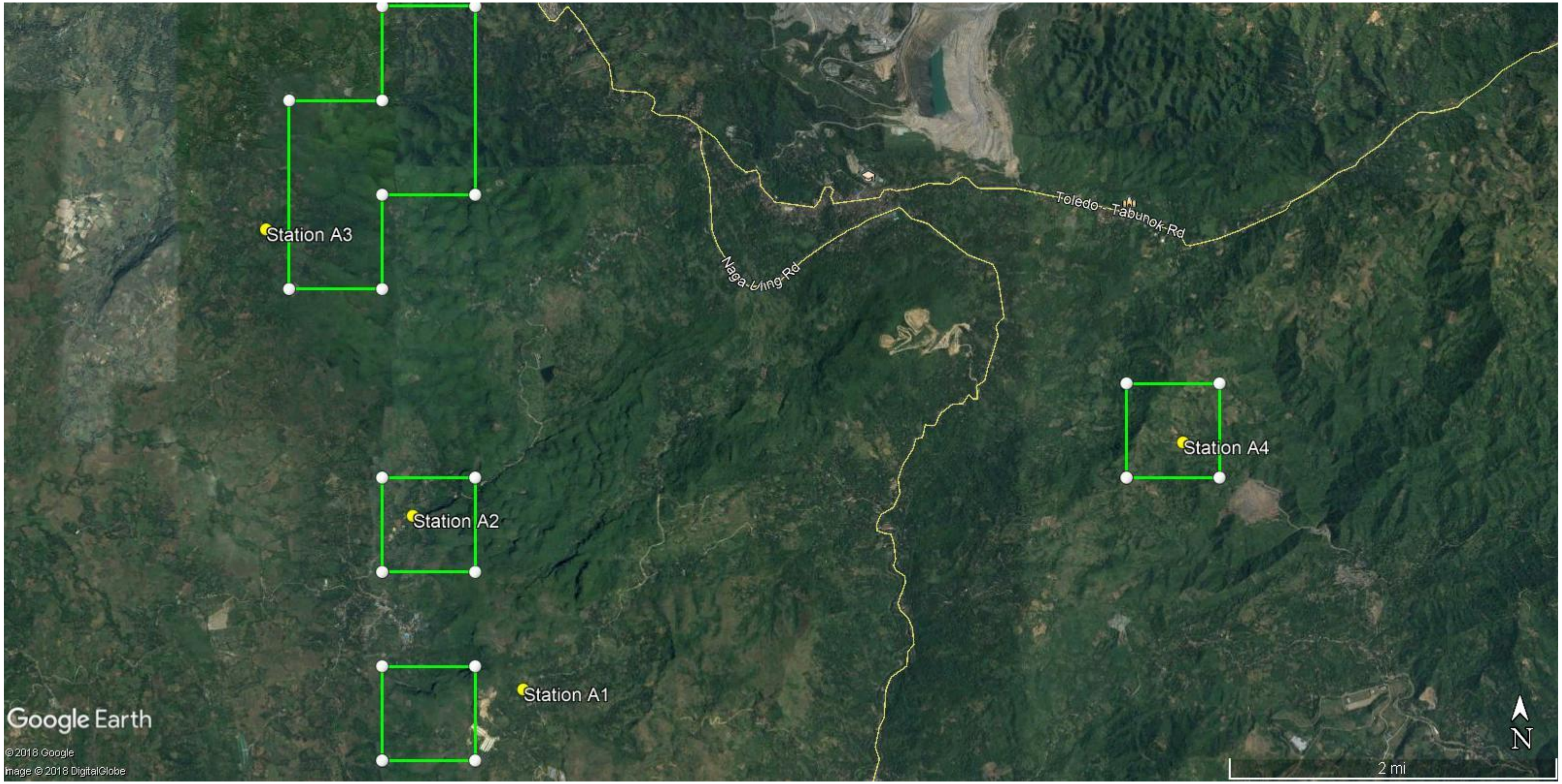


Figure 2-95: Air Sampling Map

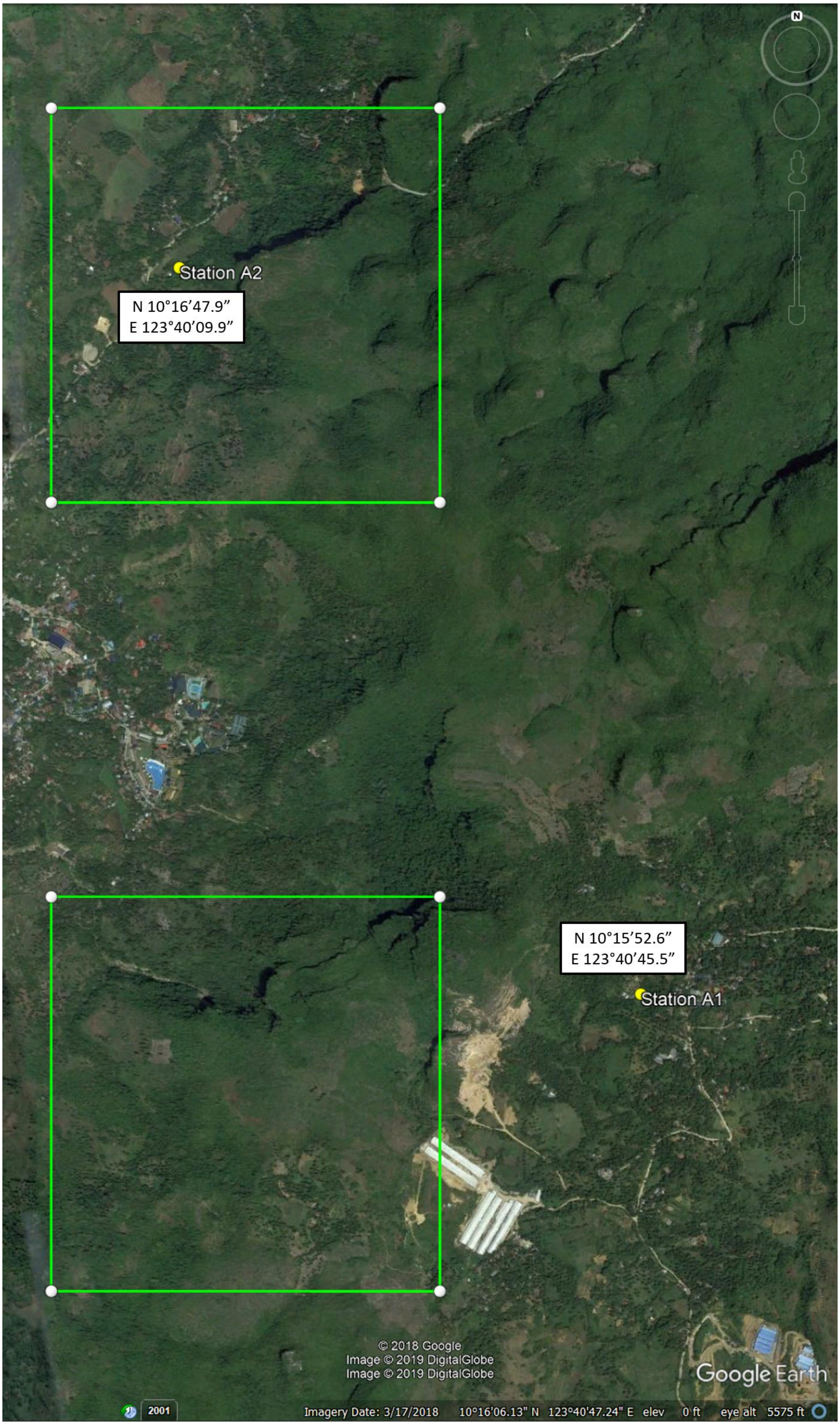


Figure 2-96: Air Sampling Stations in Parcels 1 and 2

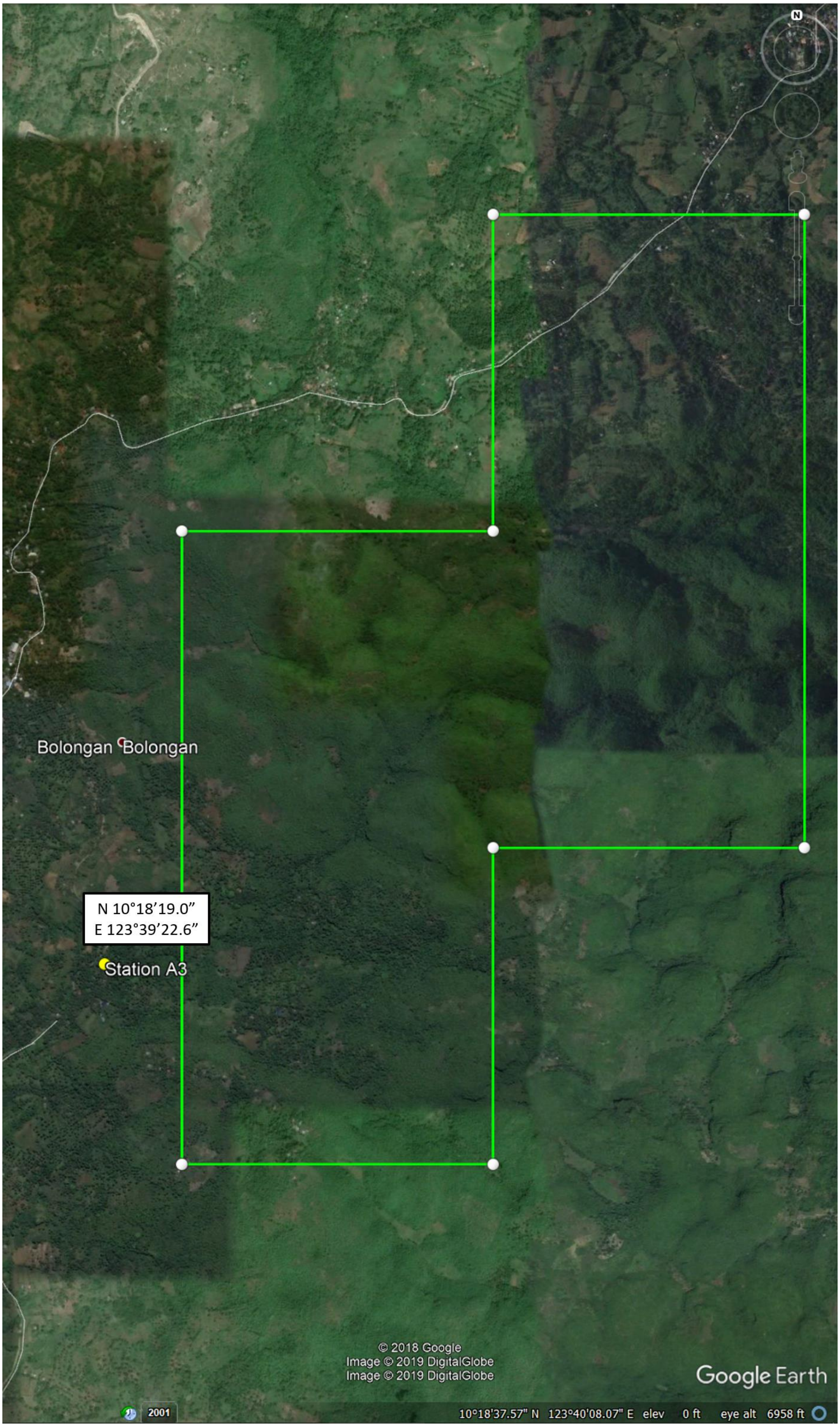


Figure 2-97: Air Sampling Station in Parcel 3

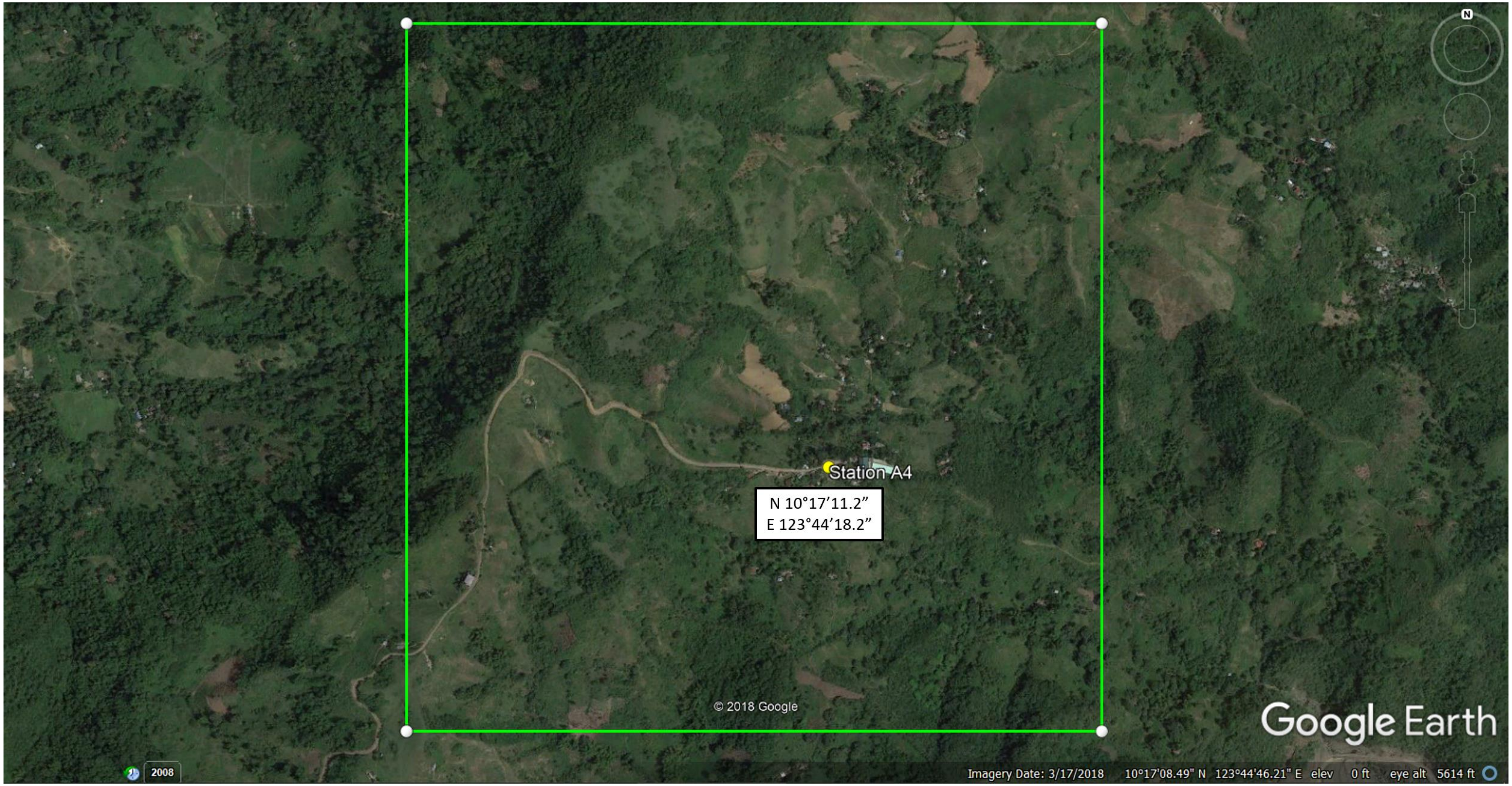


Figure 2-98: Air Sampling Station in Parcel 5

Sampling Equipment

There were three (3) types of ambient air sampler used (see **Table 2-39**).

Table 2-39: Ambient Air Monitoring Equipment Specifications

Equipment Name/Description	Brand/Model	Testing Capabilites
High Volume Sampler	Tisch Environmental/5005	TSP
Dual Channel Dust Sampler	Instrumex	PM10
Personal Sampler	SKC	NO_2, SO_2
Anemometer	Lutron	Wind Speed

*TSP = Total Suspended Particles; PM_{10} = Particulate Matter at 10µ; As = Arsenic; Cd = Cadmium; Cr = Chromium; Pb = Lead; Hg = Mercury; NO_2 = Nitrogen Dioxide; SO_2 = Sulfur Dioxide

The high volume sampler is equipped with all-weather shelter timer and flowchart meter and is powered by electricity through external power sources. The personal sampler is equipped with flow meter powered by external/internal power sources and a low flow controller. It is attached to parallel tubing with two (2) pieces of midget impingers. For SO_2, the bubbler has a straight orifice nozzle while for NO_2 the bubbler has a fritted nozzle. While for the anemometer, it has a range of 0.4 m/s - 30.0 m/s and is calibrated against standards that are traceable to National Institute of Standards and Technology (NIST).

Sampling Methods

The ambient air quality monitoring conducted by CRL Calabarquez Corporation was performed at an elevation of at least two (2) meters above the ground level and sampling was strategically stationed within the vicinity and immediate community of the project site. After sampling was conducted for each station, the gas samples were carefully recovered in the sampling bottles and preserved at low temperature and were immediately submitted to the laboratory for analysis.
Filtration Method by High Volume Sampler (for TSP Sampling)

Principle of Sampling - Ambient air was drawn through a glass fiber filter over a period of time. Particles having a diameter of 20-50 µm were collected ordinarily. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of TSP.

Reference Method (EPA, Appendix J to Part 50) (for PM_{10} Sampling)

Principle of Sampling - Ambient air was drawn at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within PM_{10} size range. The particles were collected in a glass fiber filter over the specified sampling period and determined by measuring gravimetrically. The filter paper containing the sample was weighed hence the final weight of the sample over that of the standard volume of air sampled gave the concentration of PM_{10}.

Absorption in Liquids for Gaseous Pollutants (for NO_2, SO_2 SAMPLING)

Principle of Sampling - A known volume of air (0.4L/min for NO_2, 0.5L/min for SO_2) was sampled with a wet-chemical system where a constant volume of air sample passes through a suitable reagent (absorbing reagent) that was reactive to the specific pollutant desired. As the air sample passes through the bubbler rack, the air diffuses forming air bubbles and slowly reacts to the chemical reagent forming a complex ion. The SKC personal sampler was calibrated with NIST traceable digital calibrator to assure its accuracy. The samples were then analyzed using prescribed and approved methods.

Results

The results of the air sampling is given below:

Table 2-40: Observed 24-hours Ambient Air Concentrations

Station No.	Location	Date and Time of Sampling	TSP	PM_{10}	NO_2	SO_2
A1	Parcel 1 Tagjagumit Elementary School	Jan. 17-18, 2017 1125H - 1125H	23.6	15.4	2.7	ND
A2	Station A2: Parcel 2 Near Community Deep Well	Jan. 17-18, 2017 1415H - 1415H	8.9	3.0	1.9	ND
A3	Station A3: Parcel 3 Near Chapel	Jan. 17-18, 2017 1629H - 1629H	23.2	2.5	1.8	3.7
A4	Station A4: Parcel 5 Near Cogon Chapel	Jan. 17-18, 2017 1415H - 1415H	19.7	1.7	1.6	3.2
DENR Standard (NAAQGV)	24-hr Sampling	24-hr Sampling	**230**	**150**	**150**	**180**

ND = Not Detected or Below the Method Detection Limit for SO_2 = 0.60µg
N/A = No Applicable DENR Standard

It could be observed that all parameters are below the threshold levels specified in DENR Standards, over a 24-hours observation period. This could be attributed to the remoteness of the project site and community. There are several other mining companies that could be found in the vicinity of the MPSA area, however due to a moratorium from DENR, all mining companies in Cebu have paused their operations.

2.3.2.2 Increase in the ambient noise level

Sampling Equipment

A digital sound level meter (precision type) was used in the noise monitoring activity conducted by CRL Calabarquez Corporation. The sound level meter used was Lutron that meets the ANSI-SI.4 1983 standard. The equipment has a range of 30 dB and maximum of 130 dB and resolution of 0.1 dB. This noise meter has internal oscillation system with 1Khzsquare wave generator for calibration.

Sampling Methodology

The noise measurement was conducted within the three (3) stations. The lowest and highest noise levels monitored were manually recorded. The multiple sounds reading each station was recorded and summarized by getting its logarithmic average. The result of this gave the equivalent noise level (Leq).

Results

The results of the noise levels reading during the 24-hour observation periods are given in **Table 2-41** to **Table 2-43**.

Table 2-41: Observed 24-hour Noise Level Propagation in Decibels dB(A) at Station A1

Sampling Time	Average dB(A)	DENR Standard Maximum Allowable NoiseLevel, dB(A)***	Remarks
January 17-18, 2017, 1020H - 1220H	52.4	50	Exceeded
1220H - 1420H	53.8	50	Exceeded
1420H - 1620H	48.5	50	Within
1620H - 1820H	50.5	50	Exceeded
1820H - 2020H	47.0	45	Exceeded
2020H - 2220H	45.5	45	Exceeded
2220H - 0020H	45.0	40	Exceeded
0020H - 0220H	44.0	40	Exceeded
0220H - 0420H	43.4	40	Exceeded
0420H - 0620H	43.5	40	Exceeded
0620H - 0820H	52.0	45	Exceeded

*AveLeq = $10*\text{Log}\{[(10^{(Min/10)}+10^{(Max/10)})/2]\}$
***Category "D" A section primarily as a heavy industrial area
0900 H – 1800 H – 75 dB (Daytime) [Maximum allowable limit based on division of 24-hour sampling]
1800 H – 2200 H – 70 dB (Evening) [Maximum allowable limit based on division of 24-hour sampling]
2200 H – 0500 H – 65 dB (Nighttime) [Maximum allowable limit based on division of 24-hour sampling]
0500 H – 0900 H – 70 dB (Morning) [Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 2-42: Observed 24-hour Noise Level Propagation in Decibels dB(A) at Station A2

Sampling Time	Average dB(A)	DENR Standard Maximum Allowable Noise Level, dB(A)***	Remarks
January 18-19, 2017, 1349H - 1549H	45.5	50	Within
1549H - 1749H	44.9	50	Within
1749H - 1949H	45.3	50	Within
1949H - 2149H	**45.2**	45	Exceeded
2149H - 2349H	43.9	45	Within
2349H - 0149H	**42.7**	40	Exceeded
0149H - 0349H	**41.4**	40	Exceeded
0349H - 0549H	**41.2**	40	Exceeded
0549H - 0749H	**45.3**	45	Exceeded
0749H - 0949H	**47.5**	45	Exceeded
0949H - 1149H	47.4	50	Within
1149H - 1349H	49.5	50	Within

*AveLeq = 10*Log{[(10$^{(Min/10)}$+10$^{(Max/10)}$)/2]}
***Category "D" A section primarily as a heavy industrial area
0900 H – 1800 H – 75 dB (Daytime) [Maximum allowable limit based on division of 24-hour sampling]
1800 H – 2200 H – 70 dB (Evening) [Maximum allowable limit based on division of 24-hour sampling]
2200 H – 0500 H – 65 dB (Nighttime) [Maximum allowable limit based on division of 24-hour sampling]
0500 H – 0900 H – 70 dB (Morning) [Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 2-43: Observed 24-hour Noise Level Propagation in Decibels dB(A) at Station A3

Sampling Time	Average dB(A)	DENR Standard Maximum Allowable Noise Level, dB(A)***	Remarks
January 18-19, 2017, 1518H - 1718H	45.6	50	Within
1718H - 1918H	45.1	50	Within
1918H - 2118H	44.1	45	Within
2118H - 2318H	44.2	45	Within
2318H - 0118H	**42.3**	40	Exceeded
0118H - 0318H	**41.2**	40	Exceeded
0318H - 0518H	**40.3**	40	Exceeded
0518H - 0718H	41.0	45	Within
0718H - 0918H	43.7	45	Within
0918H - 1118H	40.9	50	Within
1118H - 1318H	42.9	50	Within
1318H - 1518H	47.3	50	Within

*AveLeq = 10*Log{[(10$^{(Min/10)}$+10$^{(Max/10)}$)/2]}
***Category "A" A section primarily as a residential area
0900 H – 1800 H – 75 dB (Daytime) [Maximum allowable limit based on division of 24-hour sampling]
1800 H – 2200 H – 70 dB (Evening) [Maximum allowable limit based on division of 24-hour sampling]
2200 H – 0500 H – 65 dB (Nighttime) [Maximum allowable limit based on division of 24-hour sampling]
0500 H – 0900 H – 70 dB (Morning) [Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Table 2-44: Observed 24-hour Noise Level Propagation in Decibels dB(A) at Station A4

Sampling Time	Average dB(A)	DENR Standard Maximum Allowable Noise Level, dB(A)***	Remarks
January 21-22, 2017, 1042H - 1242H	**52.4**	50	Exceeded
1242H - 1442H	**50.2**	50	Exceeded
1442H - 1642H	**61.0**	50	Exceeded
1642H - 1842H	**65.3**	50	Exceeded
1842H - 2042H	**56.9**	45	Exceeded
2042H - 2242H	**49.3**	45	Exceeded

Sampling Time	Average dB(A)	DENR Standard Maximum Allowable Noise Level, dB(A)***	Remarks
2242H - 0042H	**52.9**	40	Exceeded
0042H - 0242H	**46.2**	40	Exceeded
0242H - 0442H	**46.0**	40	Exceeded
0442H - 0642H	**48.3**	40	Exceeded
0642H - 0842H	**54.8**	45	Exceeded
0842H - 1042H	**69.0**	45	Exceeded

*AveLeq = 10*Log{[(10$^{(Min/10)}$+10$^{(Max/10)}$)/2]}
***Category "A" A section primarily as a residential area
0900 H – 1800 H – 75 dB (Daytime) [Maximum allowable limit based on division of 24-hour sampling]
1800 H – 2200 H – 70 dB (Evening) [Maximum allowable limit based on division of 24-hour sampling]
2200 H – 0500 H – 65 dB (Nighttime) [Maximum allowable limit based on division of 24-hour sampling]
0500 H – 0900 H – 70 dB (Morning) [Maximum allowable limit based on division of 24-hour sampling]
Note: Monitoring was conducted on a 2-hour interval. In practice, the start of sampling time is used as the basis for noise divisions.

Noise measurement was conducted 4 times every 2 hours interval so that a representative reading of noise level propagation will be monitored with respect to the time increment based on a 24-hour monitoring test. Monitoring was conducted on a sunny, cloudy and rainy weather associated with light to moderate winds. The prevailing winds at the time of sampling came from various directions. Measured noise level at all stations which exceeded the DENR Standard for noise mostly came from occasional passing vehicles, dogs, roosters, insects, birds, residential area, school activities, and from airplane/helicopter.

2.3.2.3 Assessment of Impacts and Mitigating Measures

The project's primary impact on ambient air quality is the generation of TSP and PM_{10}, from the crushers and the transport of minerals over dry open roads. NO_x and SO_x is also generated by the operation of heavy machineries and generator sets during the mineral extraction.

In order to mitigate the dispersion of the pollutants into the community, the proponent shall maintain the buffer zone between the project site and the nearby community. Particularly if the nearby community is located on the north-eastern boundary of the mine area, where there are strong prevailing winds during March to December as indicated in the wind rose for Cebu. The crushers would also have to be properly maintained to minimize the emmision of particulates into the air. Heavy machineries and vehicles must have their engines regularly checked to minimize generation of NO_x and SO_x.

Parcel 1 and 2

The nearest communities to these parcels are situated between the 2, and east of Parcel 1. Considering the wind rose of Cebu, the community that would be greatly affected by the project would be the one on the east of Parcel 1. Station A1 of the Air Quality Sampling is situated within the community, and did not register any exceedances on the air quality standards, nor did Station A2, within Parcel 2. The noise level readings however showed exceedances at several periods within a day, in both stations. This was due to the sampling stations being situated within the communities. Noise came from passing vehicles, anthropological activities, and animal noises.

Parcel 3

The main community near Parcel 3 lie along the national road that goes through the western and northern portion of the site. Being near the national road, Station A3 registered noise levels exceeding the prescribed standard during night time. This was attributed to the noise coming from passing vehicles, and noisy celebrations by the community. Air quality from this station did not show any exceedances.

Parcel 5

The community is within the boundaries of Parcel 5, but the mine area will be placed south of the community. Other quarry areas could also be found northeast and southwest of the MPSA boundary. Due to the proximity, the buffer between the mine area and the community would be properly observed and monitored to minimize the effects of the project. Air quality sampling did not find any exceedances in the area. However, the noise levels show exceedances due to the noise coming from the community and the school nearby.

According to the PAGASA climatological projections, Cebu would experience increase in rainfall and and temperatues. The open roads within the project site would have to be sprinkled with water during the dry season to avoid the suspension of particles into the air during transport of materials.

The noise generated by the project activities could also impact the nearby communities. Blasting and crushing activities generates high noise levels that could be harmful during long exposure times. Proper PPEs will be provided by the proponent for employees working near the crusher, and during blasting schedules. Buffer zones around crushers will also be extablished to minimize the noise reaching the nearby communities. Blasting schedules will be properly displayed within the communities, and warning signals will used before the actual blasting.

2.4 People

The focus of the study is the six (6) barangays within two (2) cities and one (1) municipality of the Province of Cebu. The barangays include Cogon, and Tagjaguimit in the City of Naga; Lamac in the Municipality of Pinamungahan; and Bulongan, Media Once, and Poog in Toledo City.

The barangays are within the Mineral Production Sharing Agreement area of Quarry Ventures Philippines, Inc. denominated as MPSA No. III-98-VII which was divided into four (4) parcels. The six (6) barangays are identified as the direct impact areas and the remaining barangays within the City of Naga, Municipality of Pinamungahan, and Toledo City are considered as the indirect impact areas.

Table 2-45: Direct Impact Barangays by MPSA Parcel

Parcel	City/ Municipality	Barangay
1	City of Naga	Tagjaguimit
	Pinamungahan	Lamac
2	City of Naga	Tagjaguimit
3	City of Toledo	Bulongan
		Media Once
		Poog
5	City of Naga	Cogon

Methodology

Various methods were employed in gathering information on the socio-economic conditions of the impact barangays. These methods include the review of secondary data, the conduct of perception survey, focus group discussions, and information, education, and communication.
The preparer looked-into the available secondary data from concerned local government units and other relevant agencies to establish the socio-economic condition of the impact communities. These include the following:

- Barangay Profile;
- City/Municipal Comprehensive Land Use Plan (CLUP);
- 2010 Census of Population and Household, Philippine Statistics Authority;
- 2015 Census of Population and Household, Philippine Statistics Authority.

It is of note that during the data gathering for this report on site, it was found out that the data from the municipality, cities, and barangays are severly lacking, with the latest CLUPs available being from 1995 (Municipality of Pinamungahan), 1996 (Naga City), and 2006 (Toledo City). The barangays also doesn’t have any update profile available, nor were they covered by the Community-Based Monitoring System (CBMS) Program. For this report, the affected barangays were asked by the Preparers to manually fill up a CBMS Barangay Profile form to the best of their capacity. The latest data is used in this report when available and applicable. A certification from the covered cities and municipality is attached as **Annex 13**, stating that the latest version of the CLUP is still being processed.

2.4.1.1 Demographic Baseline Information of Impact Areas

Population Size and Growth Rate

The project area encompasses two (2) cities and one (1) municipality within Cebu Province: the City of Naga, Municipality of Pinamungahan, and Toledo City. Based on the population data of the Philippine Statistics Authority (PSA), the population of City of Naga and Municipality of Pinamungahan grew a little faster than Cebu Province, while Toledo City has the slowest population growth rate from 2010 to 2015 (**Table 2-46**).

The City of Naga is a component city covering twenty-nine (29) barangays. Its population grew by 2.6% which accounts for 14,292 persons within five (5) years. It has a total land area of 10,197 hectares.

The Municipality if Pinamungahan is classified as 2nd Income class municipality with Php45 million or more but less than Php55 million average annual income. Pinamungahan has a total land area of 10,916, encompassing twenty-six (26) barangays. Its population growth rate from 2010 to 2015 was 2.6% or 7,977 persons.

Toledo City is a 3rd Income Class Component City. It has an average annual income of Php35 million or more but less than Php45 million. With a population growth rate of 1.7%, its population grew by 13,610 persons from 2010 to 2015. It has a total land area of 21,628 hectares covering thirty-nine (39) barangays.

Table 2-46: Population and Growth Rate of Impact Cities and Municipality, 2010 and 2015

Area	2010 Population	2015 Population	Population Growth Rate (%)
Cebu Province (excluding Cebu, Mandaue, and Lapu-Lapu Cities)	2,613,842	2,938,982	2.3
City of Naga	101,458	115,750	2.6
Pinamungahan Municipality	57,978	65,955	2.6
Toledo City	156,725	170,335	1.7

Sources: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)
2015 Census of Population (Philippine Statistics Authority, 2016)

Population information within the impact barangays is presented in **Table 2-47**. Among the impact barangays, Lamac in Pinamungahan has the highest population growth rate of 5.7% (1,486 persons) while Tagjaguimit in the City of Naga has the lowest with 0.13% (15 persons) within five (5) years covering 2010 to 2015.

Table 2-47: Population and Growth Rate of Impact Cities and Municipality, 2010 and 2015

City/Municipality	Barangay	2010 Population	2015 Population	Population Growth Rate (%)
City of Naga	Cogon	3,583	4,267	3.5
	Tagjaguimit	2,302	2,317	0.13
Pinamungahan Muncipality	Lamac	4,467	5,953	5.7
Toledo City	Bulongan	2,359	2,647	2.3
	Media Once	6,477	7,128	1.9
	Poog	5,662	5,989	1.1

Sources: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)
2015 Census of Population (Philippine Statistics Authority, 2016)

The latest data gathered from the Barangay Profiles of 2018 are presented below:

Table 2-48: Population Data from Barangay Profiles (2018)

City/Municipality	Barangay	Population
City of Naga	Cogon	4,267
	Tagjaguimit	3,064
Pinamungahan Muncipality	Lamac	6,361
Toledo City	Bulongan	2,653
	Media Once	7,364
	Poog	6,039

Population Composition

Based on the sex and age-group disaggregated data from PSA, Cebu Province has a young population. Majority or 10.92% of its population were 5 to 9 years old. A high percentage were also noted in 10 to 14 years and 15 to 19 years age groups. The sex ratio in 2015 was 103:100 or there were 103 males for every 100 female population. It was observed, however, that females have higher life expectancy than males. (**Table 2-49**)

Table 2-49: Household Population by Age Group and Sex, and Age Composition: CEBU (Excluding Cities of Cebu, Lapu-Lapu, and Mandaue), 2015

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	134,843	69,718	65,125	2.23%
1 – 4	535,613	277,384	258,229	8.86%
5 – 9	659,602	340,479	319,123	10.92%

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
10 – 14	627,617	323,501	304,116	10.39%
15 – 19	592,544	303,162	289,382	9.81%
20 – 24	567,332	286,998	280,334	9.39%
25 – 29	499,352	254,311	245,041	8.26%
30 – 34	433,173	222,560	210,613	7.17%
35 – 3 9	386,046	198,020	188,026	6.39%
40 – 44	337,940	172,980	164,960	5.59%
45 – 49	301,521	152,661	148,860	4.99%
50 – 54	259,243	129,940	129,303	4.29%
55 – 59	213,818	105,529	108,289	3.54%
60 – 64	171,426	81,388	90,038	2.84%
65 – 69	121,368	55,386	65,982	2.01%
70 – 74	85,446	36,698	48,748	1.41%
75 – 79	59,424	23,517	35,907	0.98%
80 years old & over	55,595	19,228	36,367	0.92%
Total	**6,041,903**	**3,053,460**	**2,988,443**	**100.00**

Source: 2015 Census of Population (Philippine Statistics Authority, 2016)

Table 2-50 presents the sex and age-group disaggregated data on population for the City of Naga. It also has a very young population, similar to the Cebu Province. Most of its inhabitants fall within the age groups of 5 to 9 years old (11.31%), 10 to 14 years old (10.79%), and 15 to 19 years old (9.96%). It has the same sex ratio as the Cebu Province.

Table 2-50: Household Population by Age Group and Sex, and Age Composition: City of Naga, 2015

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	2,593	1,355	1,238	2.24%
1 – 4	10,375	5,465	4,910	8.96%
5 – 9	13,092	6,796	6,296	11.31%
10 – 14	12,494	6,527	5,967	10.79%
15 – 19	11,523	5,831	5,692	9.96%
20 – 24	11,036	5,649	5,387	9.53%
25 – 29	9,725	4,974	4,751	8.40%
30 – 34	8,485	4,352	4,133	7.33%
35 – 3 9	7,707	3,953	3,754	6.66%
40 – 44	6,534	3,339	3,195	5.64%
45 – 49	5,814	3,030	2,784	5.02%
50 – 54	4,757	2,402	2,355	4.11%
55 – 59	3,847	1,917	1,930	3.32%
60 – 64	2,989	1,511	1,478	2.58%
65 – 69	1,895	870	1,025	1.64%
70 – 74	1,242	540	702	1.07%
75 – 79	874	350	524	0.76%
80 years old & over	768	254	514	0.66%
Total	**115,750**	**59,115**	**56,635**	**100.00**

Source: 2015 Census of Population (Philippine Statistics Authority, 2016)

The population composition of the two (2) impact barangays within the City of Naga are shown in **Table 2-51** and **Table 2-52**. The dominant age groups in Barangay Cogon, in 2010, were 5 to 9 years old and 15 to 19 years old. Each age group composed of 11.92% of the total population. It has a sex ratio of 108:100 and females have higher life expectancy than males. As of 2018, there are 2,107 male and 2,160 are female residents in Cogon.

Table 2-51. Household Population by Age Group and Sex, and Age Composition: Barangay Cogon, City of Naga, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	100	51	49	2.79
1 – 4	354	183	171	9.88
5 – 9	427	215	212	11.92
10 – 14	424	228	196	11.83
15 – 19	427	222	205	11.92
20 – 24	337	168	169	9.41
25 – 29	292	162	130	8.15
30 – 34	255	135	120	7.12
35 – 3 9	198	97	101	5.53
40 – 44	184	110	74	5.14
45 – 49	152	80	72	4.24
50 – 54	110	49	61	3.07
55 – 59	112	59	53	3.13
60 – 64	64	31	33	1.79
65 – 69	57	24	33	1.59
70 – 74	36	19	17	1.00
75 – 79	31	18	13	0.87
80 years old & over	23	8	15	0.64
Total	**3,583**	**1,859**	**1,724**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangay Tagjaguimit, the age group in 2010 that has the biggest percentage was 10 to 14 years old (13.38%). This was followed by 5 to 9 years old (12.16%) and 15 to 19 years old (11.99%) age groups. There were 109 males for every 100 females. Females have higher expectancy rate than males. As of June 2018, there are 3,064 residents in Tagjaguimit, 1,581 are male and 1,483 are female.

Table 2-52: Household Population by Age Group and Sex, and Age Composition: Barangay Tagjaguimit, City of Naga, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
g	63	29	34	2.74
1 – 4	246	122	124	10.69
5 – 9	280	146	134	12.16
10 – 14	308	171	137	13.38
15 – 19	276	155	121	11.99

20 – 24	191	103	88	8.30
25 – 29	167	100	67	7.25
30 – 34	101	53	48	4.39
35 – 3 9	123	62	61	5.34
40 – 44	112	60	52	4.87
45 – 49	118	59	59	5.13
50 – 54	77	34	43	3.34
55 – 59	71	32	39	3.08
60 – 64	57	31	26	2.48
65 – 69	36	16	20	1.56
70 – 74	36	17	19	1.56
75 – 79	23	9	14	1.00
80 years old & over	17	3	14	0.74
Total	**2,302**	**1,202**	**1,100**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The 2015 census results on sex and age-group disaggregated data was used and shows a very young population in the Municipality of Pinamungahan. The majority of the population was 5-9 years old (12.37%). The male population dominates the population with 1.05:1 sex ratio (**Table 2-53**).

Table 2-53: Household Population by Age Group and Sex, and Age Composition: Municipality of Pinamungahan, 2015

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	1,572	810	762	2.38%
1 – 4	6,267	3,292	2,975	9.50%
5 – 9	8,160	4,302	3,858	12.37%
10 – 14	7,529	3,983	3,546	11.42%
15 – 19	6,684	3,474	3,210	10.13%
20 – 24	5,976	3,101	2,875	9.06%
25 – 29	5,127	2,671	2,456	7.77%
30 – 34	4,264	2,271	1,993	6.47%
35 – 3 9	3,893	2,019	1,874	5.90%
40 – 44	3,361	1,734	1,627	5.10%
45 – 49	2,993	1,478	1,515	4.54%
50 – 54	2,711	1,376	1,335	4.11%
55 – 59	2,239	1,112	1,127	3.39%
60 – 64	1,767	814	953	2.68%
65 – 69	1,211	566	645	1.84%
70 – 74	980	424	556	1.49%
75 – 79	631	250	381	0.96%
80 years old & over	590	223	367	0.89%
Total	**65,955**	**33,900**	**32,055**	**100.00**

Source: 2015 Census of Population (Philippine Statistics Authority, 2016)

The biggest percentage of the 2010 population of Barangay Lamac is within the 10 to 14 years old age group (10.77%). This was followed closely by the 15 to 19 years old age group with 10.63%.

The ratio of males to females is approximately 1:1 (**Table 2-54**). As of 2018, there are 6,852 residents in Lamac, 3,511 are male and 3,341 are female.

Table 2-54: Household Population by Age Group and Sex, and Age Composition: Barangay Lamac, Municipality of Pinamungahan, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	88	49	39	1.97
1 – 4	415	223	192	9.29
5 – 9	448	231	217	10.03
10 – 14	481	237	244	10.77
15 – 19	475	223	252	10.63
20 – 24	378	198	180	8.46
25 – 29	349	187	162	7.81
30 – 34	329	166	163	7.37
35 – 3 9	317	160	157	7.10
40 – 44	274	135	139	6.13
45 – 49	211	114	97	4.72
50 – 54	163	81	82	3.65
55 – 59	156	70	86	3.49
60 – 64	126	55	71	2.82
65 – 69	99	42	57	2.22
70 – 74	74	32	42	1.66
75 – 79	43	21	22	0.96
80 years old & over	41	20	21	0.92
Total	4,467	2,244	2,223	100.00

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The 2015 population of Toledo City is 6% of the total household population of Cebu Province. The sex and age-group disaggregated data of Toledo City reveals that the highest percentage among age-group is within 5 to 9 years old (12.07%). Male population dominates the females with 105:100 sex ratio. It was observed, however, that females have higher life expectancy than males (**Table 2-55**).

Table 2-55: Household Population by Age Group and Sex, and Age Composition: Toledo City, 2015

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	4,176	2,137	2,039	2.45%
1 – 4	16,450	8,540	7,910	9.66%
5 – 9	20,268	10,555	9,713	11.90%
10 – 14	18,648	9,625	9,023	10.95%
15 – 19	17,119	8,827	8,292	10.05%
20 – 24	15,852	8,147	7,705	9.31%

Age Group	2015 Population			Age Composition (%)
	Both Sexes	Males	Females	
25 – 29	13,875	7,243	6,632	8.15%
30 – 34	11,868	6,220	5,648	6.97%
35 – 3 9	10,532	5,506	5,026	6.18%
40 – 44	9,065	4,649	4,416	5.32%
45 – 49	7,752	3,935	3,817	4.55%
50 – 54	6,730	3,385	3,345	3.95%
55 – 59	5,806	2,906	2,900	3.41%
60 – 64	4,609	2,235	2,374	2.71%
65 – 69	3,169	1,487	1,682	1.86%
70 – 74	2,139	960	1,179	1.26%
75 – 79	1,361	624	737	0.80%
80 years old & over	916	368	548	0.54%
Total	**170,335**	**87,349**	**82,986**	**100.00**

Source: 2015 Census of Population (Philippine Statistics Authority, 2016)

Majority of the population of Barangay Bulongan in 2010 was within ages 5 to 9 years old (13.78%), 10 to 14 years old (12.38%), and 1 to 4 years old (11.36%). It has a sex ratio of 106:100 where males dominated the total population (**Table 2-56**). As of 2018, there are 2,653 residents in Bulongan, 1,220 are male and 1,433 are female.

Table 2-56: Household Population by Age Group and Sex, and Age Composition: Barangay Bulongan, Toledo City, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	72	28	44	3.05
1 – 4	268	135	133	11.36
5 – 9	325	169	156	13.78
10 – 14	292	155	137	12.38
15 – 19	218	118	100	9.24
20 – 24	174	92	82	7.38
25 – 29	161	90	71	6.82
30 – 34	158	87	71	6.70
35 – 3 9	136	72	64	5.77
40 – 44	113	59	54	4.79
45 – 49	115	54	61	4.87
50 – 54	99	47	52	4.20
55 – 59	75	36	39	3.18
60 – 64	61	31	30	2.59
65 – 69	39	16	23	1.65
70 – 74	24	11	13	1.02
75 – 79	17	7	10	0.72
80 years old & over	12	5	7	0.51
Total	**2,359**	**1,212**	**1,147**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangay Media Once, the age group in 2010 that has the biggest percentage was 10 to 14 years old (12.26%). This was followed by 5 to 9 years old (11.87%) and 15 to 19 years old (11.24%)

age groups. There were 108 males for every 100 females (**Table 2-57**). As of 2018, there are 7,364 residents in Media Once.

Table 2-57: Household Population by Age Group and Sex, and Age Composition: Barangay Media Once, Toledo City, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	182	93	89	2.81
1 – 4	675	345	330	10.42
5 – 9	769	417	352	11.87
10 – 14	794	415	379	12.26
15 – 19	728	376	352	11.24
20 – 24	612	319	293	9.45
25 – 29	494	271	223	7.63
30 – 34	409	216	193	6.31
35 – 3 9	416	207	209	6.42
40 – 44	343	170	173	5.30
45 – 49	290	150	140	4.48
50 – 54	250	126	124	3.86
55 – 59	175	96	79	2.70
60 – 64	133	67	66	2.05
65 – 69	81	38	43	1.25
70 – 74	56	30	26	0.86
75 – 79	39	20	19	0.60
80 years old & over	31	12	19	0.48
Total	**6,477**	**3,368**	**3,109**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The majority of the 2010 population in Barangay Poog was 5 to 9 years old (13.23%). This is followed by age groups within 10 to 14 years old (11.44%) and 15 to 19 years old (11.07%). The barangay has a sex ratio of 108:100 or 108 males for every 100 female population (**Table 2-58).** As of 2018, there are 6,039 residents in Poog, 3,108 are male and 2,931 are female.

Table 2-58: Household Population by Age Group and Sex, and Age Composition: Barangay Poog, Toledo City, 2010

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
Under 1	154	78	76	2.72
1 – 4	593	313	280	10.47
5 – 9	749	385	364	13.23
10 – 14	648	341	307	11.44
15 – 19	627	326	301	11.07
20 – 24	545	293	252	9.63
25 – 29	434	242	192	7.67
30 – 34	369	196	173	6.52
35 – 3 9	331	157	174	5.85
40 – 44	282	142	140	4.98
45 – 49	229	127	102	4.04

Age Group	2010 Population			Age Composition (%)
	Both Sexes	Males	Females	
50 – 54	226	116	110	3.99
55 – 59	166	79	87	2.93
60 – 64	116	55	61	2.05
65 – 69	85	42	43	1.50
70 – 74	55	27	28	0.97
75 – 79	27	10	17	0.48
80 years old & over	26	10	16	0.46
Total	**5,662**	**2,939**	**2,723**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Based on 2010 data from PSA, the Municipality of Pinamungahan has the highest dependency ratio as compared to the City of Naga and Toledo City, which indicated 70 young (0 -14 years old) and old dependents (65 years old and above) for every 100 working population. **Table 2-59** also shows that Toledo City has the highest number of working age population (15 and 64 years old).

Table 2-59: Age Dependency Ratio of Impact Cities and Municipality, 2010

Age Group	City of Naga		Pinamungahan Municipality		Toledo City	
	No.	Dependency Ratio	No.	Dependency Ratio	No.	Dependency Ratio
Working Age (15 and 64)	62,288		34,220		94,163	
Dependent Population	39,170	63:100	23,758	70:100	62,562	66:100
Young (0 -14)	35,020	56:100	20,794	61:100	55,978	59:100
Old (65 and above)	4,150	6:100	2,964	9:100	6,584	7:100

Source: Computed based on 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Among the barangays within the City of Naga, Tagjaguimit has the highest dependency ratio of 78:100. This means that for every 100 working-age population there were about 78 dependents, 69 young dependents and 9 old dependents. (**Table 2-60**)

Table 2-60. Age Dependency Ratio of Impact Barangays within the City of Naga, 2010

Age Group	Cogon		Tagjaguimit	
	No.	Dependency Ratio	No.	Dependency Ratio
Working Age (15 and 64)	2,131		1,293	
Dependent Population	1,452	68:100	1,009	78:100
Young (0 -14)	1,305	61:100	897	69:100
Old (65 and above)	147	7:100	112	9:100

Source: Computed based on 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In the Municipality of Pinamungahan, Lamac has a dependency ratio of 61 young and old dependents for every 100 working-age population. This is slightly lower than the average dependency ratio in the municipality. (**Table 2-61**)

Table 2-61: Age Dependency Ratio of Impact Barangays within the Municipality of Pinamungahan, 2010

Age Group	Lamac	
	No.	Dependency Ratio
Working Age (15 and 64)	2,778	
Dependent Population	1,689	61:100
Young (0 -14)	1,432	55:100
Old (65 and above)	257	6:100

Source: Computed based on 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Barangay Bulongan has the highest dependency ratio among the three (3) impact barangays within Toledo City. **Table 2-62** indicated 80 dependent population for every 100 working-age population. Barangay Bulongan have the same ratio of the old population dependent on the working-age population which is 7:100.

Table 2-62. Age Dependency Ratio of Impact Barangays within Toledo City, 2010

Age Group	Bulongan		Media Once		Poog	
	No.	Dependency Ratio	No.	Dependency Ratio	No.	Dependency Ratio
Working Age (15 and 64)	1,310		3,850		3,325	
Dependent Population	1,049	80:100	2,627	68:100	2,337	70:100
Young (0 -14)	957	73:100	2,420	63:100	2,144	65:100
Old (65 and above)	92	7:100	207	5:100	193	5:100

Source: Computed based on 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Population Distribution

Based on available data presented in **Table 2-63**, the most densely populated impact barangay is Media Once in Toledo City. The gross population density of Media Once is eleven (11) persons per hectare of land.

Table 2-63: Population Density of Impact Barangays, 2015

City/Municipality	Barangay	2015 Population	Land Area (Hectares)	Population Density (No. of Persons per Hectare)
City of Naga	Cogon	4,267	715.3287	5.97
	Tagjaguimit	2,317	537.4519	4.31
Pinamungahan Muncipality	Lamac	5,953	589.12	10.1
Toledo City	Bulongan	2,647	725	3.65
	Media Once	7,128	621.0984	11.48
	Poog	5,989	-	-

Sources: 2015 Census of Population (Philippine Statistics Authority, 2016)

PSA data on 2015 Census of Population indicate that Cebu Province has an average household size of 4.4. The same household size was observed in the City of Naga and Toledo City. The Municipality of Pinamunganhan, as presented in **Table 2-64**, has the highest average household size which is 4.8 or almost 5 members.

Table 2-64: Household Population, Number of Households, and Average Household Size of Impact Cities and Municipality, 2015

Area	2015 Households Population	Number of Households	Average Households Size
Cebu Province (excluding Cebu, Mandaue, and Lapu-Lapu Cities)	2,928,034	669,322	4.4
City of Naga	115,409	26,177	4.4
Pinamungahan Municipality	65,937	13,874	4.8
Toledo City	169,714	38,259	4.4

Sources: 2015 Census of Population (Philippine Statistics Authority, 2016)

Other Demographic Information

Ethnicity

The residents of the impact barangays in the City of Naga has eleven (11) different ethnicities. Most residents across the impact barangays are Cebuanos. (**Table 2-65**)

Table 2-65: Ethnicity in the Impact Areas within the City of Naga, 2010

Ethnicity	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Aromanen-Manobo	0	-	0	-
Bisaya/Binisaya	3	0.08	0	-
Cebuano	3,577	99.83	2,296	99.74
Cotabateño	0	-	0	-
Cotabateño-Chavacano	0	-	2	0.09
Cuyonon/Cuyonen	0	-	0	-
Hiligaynon Ilonggo	1	0.03	0	-
Maranao	2	0.06	0	-
Sama Bangingi	0	-	3	0.13
Tagalog	0	-	0	-
Waray	0	-	1	0.04
Total	**3,583**	**100.00**	**2,302**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

As presented in **Table 2-66**, the majority of the ethnic groupings in Lamac is Cebuano followed by Caviteño-Chavacano.

Table 2-66: Ethnicity in the Impact Areas within the Municipality of Pinamungahan, 2010

Ethnicity	Barangays	
	Lamac	
	No.	%
Aeta/Ayta	1	0.02
Bisaya/Binisaya	0	-
Boholano	2	0.04
Caviteño-Chavacano	4	0.09
Cebuano	4,453	99.69
Cotabateño-Chavacano	3	0.07
Diangan	0	-
Tagalog	1	0.02
Waray	1	0.02
Zambageño-Chavacano	1	0.02
Total	**4,467**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The dominant ethnic groups in the three (3) impact barangays in Toledo City is Cebuano. Though there are residents who belong to other ethnicities, such as Hiligaynon and Tagalog to name a few. (**Table 2-67**)

Table 2-67: Ethnicity in the Impact Areas within Toledo City, 2010

Ethnicity	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Abelling/ Abellen/ Aberling/ Aborlin	0	-	8	0.12	0	-

Ethnicity	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Bantoanon	0	-	0	-	10	0.18
Batangan	0	-	0	-	1	0.02
Bikol/Bicol	0	-	4	0.06	6	0.11
Bisaya/Binisaya	0	-	0	-	52	0.92
Boholano	0	-	0	-	19	0.34
Bukidnon	3	0.13	0	-	0	-
Caviteño-Chavacano	0	-	0	-	6	0.11
Cebuano	2,351	99.66	6,454	99.64	5,494	97.03
Cotabateño	1	0.04	1	0.02	0	-
Davaweño	0	-	0	-	2	0.04
Hiligaynon Ilonggo	4	0.17	1	0.02	25	0.44
Ilianen	0	-	0	-	0	-
Ilocano	0	-	0	-	1	0.02
Masbateño/Masbatenon	0	-	0	-	4	0.07
Pangasinan/Panggalato	0	-	0	-	1	0.02
Sama Bangingi	0	-	0	-	0	-
Surigaonon	0	-	0	-	7	0.12
Tagalog	0	-	3	0.05	13	0.23
Waray	0	-	1	0.02	10	0.18
Zambageño-Chavacano	0	-	0	-	3	0.05
Total	**2,359**	**100.00**	**6,477**	**100.00**	**5,662**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Marital Status

Table 2-68 presents the marital status of the residents in the impact barangays within the City of Naga. In Barangays Cogon (43.38%) and Tagjaguimit (47.23%), the majority are single.

Table 2-68: Household Population 10 Years Old and Over by Marital Status in the Impact Areas within the City of Naga, 2010

Marital Status	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Single	1172	43.38	809	47.23
Married	1156	42.78	789	46.06
Widowed	85	3.15	56	3.27
Divorced/Separated	12	0.44	13	0.76
Common-law/ Live in	272	10.07	40	2.34
Unknown	5	0.19	6	0.35
Total	**2,702**	**100.00**	**1,713**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In the impact barangay within the Municipality of Pinamungahan, the marital status of the population in Barangay Lamac, more half of the population are married, as presented in **Table 2-69**.

Table 2-69: Household Population 10 Years Old and Over by Marital Status in the Impact Areas within the Municipality of Pinamungahan, 2010

Marital Status	Barangays	
	Lamac	
	No.	%
Single	1,349	38.37
Married	1,826	51.93
Widowed	166	4.72
Divorced/Separated	29	0.82
Common-law/ Live in	146	4.15
Unknown	0	-
Total	**3,516**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Of the household population 10 years old and over in the impact barangays in Toledo City, the majority are married except for Barangay Poog where single status dominates the population. The details of the marital status of the population within the impact barangays in Toledo City is presented in **Table 2-70**.

Table 2-70: Household Population 10 Years Old and Over by Marital Status in the Impact Areas within Toledo City, 2010

Marital Status	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Single	706	41.68	2130	43.91	1882	45.18
Married	788	46.52	2312	47.66	1796	43.11
Widowed	74	4.37	159	3.28	145	3.48
Divorced/Separated	18	1.06	24	0.49	48	1.15
Common-law/ Live in	103	6.08	220	4.54	295	7.08
Unknown	5	0.30	6	0.12	0	45.18
Total	**1,694**	**100.00**	**4,851**	**100.00**	**4,166**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Religion

The religion of most of the residents residing in the impact barangays within the City of Naga is Roman Catholic. Other religions such as Evangelicals, Iglesia ni Kristo, and Seventh Day Adventists are also present. (**Table 2-71**)

Table 2-71: Religious Affiliation in the Impact Areas within the City of Naga, 2010

Religion	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Bible Baptist Church	0	-	0	-
Evangelicals (Philippine Council of Evangelical Churches)	20	0.56	15	0.65

Religion	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Iglesia ni Cristo	14	0.39	0	-
Jesus is Lord Church	0	-	0	-
Roman Catholic including Catholic Charismatic	3,541	98.83	2,287	99.35
Seventh Day Adventist	5	0.14	0	-
Other Religious Affiliations	3	0.08	0	-
Total	**3,583**	**100.00**	**2,302**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Shown in **Table 2-72** is the list of religious affiliations of the residents within Lamac indicates that majority are Roman Catholics. Thirty-six (36) or almost 1 percent of the population belong to Church of Jesus Christ of the Latter Day Saints.

Table 2-72: Religious Affiliation in the Impact Areas within the Municipality of Pinamungahan, 2010

Religion	Barangays	
	Lamac	
	No.	%
Aglipay	0	-
Association of Fundamental Baptist Churches in the Philippines	1	0.02
Bible Baptist Church	6	0.13
Church of Jesus Christ of the Latter Day Saints	36	0.81
Evangelicals (Philippine Council of Evangelical Churches)	6	0.13
Faith Tabernacle Church (Living Rock Ministries)	6	0.13
Lutheran Church of the Philippines	0	-
Philippine Grace Gospel	0	-
Philippine Independent Catholic Church	4	0.09
Roman Catholic including Catholic Charismatic	4,333	97.00
Seventh Day Adventist	5	0.11
Other Religious Affiliations	70	1.57
Tribal Religions	0	-
Total	**4,467**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The most dominant religion in the impact barangays for Toledo City is Roman Catholic. It was also observed that a considerable number of residents from the five (5) barangays are also members of other religious organizations such as Aglipay, Bible Baptist Church, Evangelicals, and Iglesia ni Cristo. (**Table 2-73**)

Table 2-73: Religious Affiliation in the Impact Areas within Toledo City, 2010

Religion	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Aglipay	142	6.02	31	0.48	0	-

Religion	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Association of Fundamental Baptist Churches in the Philippines	0	-	0	-	0	-
Bible Baptist Church	3	0.13	4	0.06	44	0.78
Buddhist	0	-	2	0.03	1	0.02
Church of Christ	0	-	1	0.02	2	0.04
Church of Jesus Christ of the Latter Day Saints	0	-	15	0.23	5	0.09
Evangelicals (Philippine Council of Evangelical Churches)	19	0.81	36	0.56	24	0.42
Higher Ground Baptist Mission	0	-	0	-	0	-
Iglesia ni Cristo	0	-	68	1.05	25	0.44
Islam	0	-	0	-	0	-
Jehovah's Witness	0	-	43	0.66	9	0.16
Jesus is Alive Community Incorporated	0	-	1	0.02	0	-
Non-Roman Catholic and Protestant (National Council of Churches in the Philippines)	1	0.04	0	-	0	-
Philippine Benevolent Missionaries Association	0	-	7	0.11	0	-
Philippine Ecumenical Christian Church	0	-	1	0.02	0	-
Philippine Good News Ministries	0	-	0	-	0	-
Philippine Grace Gospel	1	0.04	0	-	0	-
Philippine Independent Catholic Church	4	0.17	46	0.71	0	-
Potter's House Christian Center	0	-	0	-	1	0.02
Roman Catholic including Catholic Charismatic	2,169	91.95	6,079	93.86	5,488	96.93
Seventh Day Adventist	0	-	1	0.02	20	0.35
United Church of Christ in the Philippines	0	-	119	1.84	0	-
Other Protestants	0	-	4	0.06	6	0.11
Other Religious Affiliations	17	0.72	18	0.28	32	0.57
Tribal Religions	0	-	1	0.02	5	0.09
None	3	0.13	0	-	0	-
Total	**2,359**	**100.00**	**6,477**	**100.00**	**5,662**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Highest Educational Attainment

The educational profile of the population in the three (3) impact barangays in the City of Naga is presented in **Table 2-74**. Most of the school-age residents in the three (3) impact barangays reached the elementary level of education. A few from the impact barangays had completed college education and academic degree holders: 55 or 1.76% in Cogon; and 12 or 0.60% in Tagjaguimit.

Table 2-74: Highest Grade/Year Completed by School Age in the Impact Areas within the City of Naga, 2010

Grade/Year	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
No Grade Completed	299	9.56	169	8.48
Preschool	78	2.49	71	3.56
Elementary Level	1,203	38.45	907	45.51
Elementary Graduate	421	13.45	282	14.15
High School Level	459	14.67	303	15.20
High School Graduate	509	16.27	222	11.14
Post-Secondary Level	13	0.42	0	-
Post-Secondary Graduate	24	0.77	4	0.20
College Level	65	2.08	23	1.15
Academic Degree Holder	55	1.76	12	0.60
Post Baccalaureate	1	0.03	0	-
Not Reported	2	0.06	0	-
Total	**3,129**	**100.00**	**1,993**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Majority of the school-age population in Lamac have reached elementary education, 1,447 or 36.5%. Shown in **Table 2-75** that 16.20% of the school-age population in Barangay Lamac reached high school education while another 16.20% complete high school education.

Table 2-75: Highest Grade/Year Completed by School Age in the Impact Areas within the Municipality of Pinamungahan, 2010

Grade/Year	Barangays	
	Lamac	
	No.	%
No Grade Completed	191	4.82
Preschool	91	2.30
Elementary Level	1,447	36.50
Elementary Graduate	583	14.71
High School Level	642	16.20
High School Graduate	642	16.20
Post-Secondary Level	0	-
Post-Secondary Graduate	29	0.73
College Level	208	5.25
Academic Degree Holder	129	3.25
Post Baccalaureate	2	0.05
Not Reported	0	-
Total	**3,964**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Consistent with the data from other impact barangays, most of the school-age population within the impact barangays in Toledo City reached the elementary level of education. Barangay Media Once has the highest percentage of the school-age population that reached the elementary level with 18.42% (1,035) as shown in **Table 2-76**.

Table 2-76: Highest Grade/Year Completed by School Age in the Impact Areas within Toledo City, 2010

Grade/Year	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
No Grade Completed	116	5.75	309	5.50	189	3.85
Preschool	84	4.16	126	2.24	215	4.37
Elementary Level	764	37.84	2,210	39.32	1,657	33.71
Elementary Graduate	298	14.76	474	8.43	473	9.62
High School Level	294	14.56	1,035	18.42	850	17.29
High School Graduate	319	15.80	882	15.69	743	15.12
Post-Secondary Level	3	0.15	12	0.21	26	0.53
Post-Secondary Graduate	9	0.45	18	0.32	42	0.85
College Level	89	4.41	325	5.78	383	7.79
Academic Degree Holder	43	2.13	227	4.04	324	6.59
Post Baccalaureate	0	-	0	-	12	0.24
Not Reported	0	-	2	0.04	1	0.02
Total	**2,019**	**100.00**	**5,620**	**100.00**	**4,915**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Housing

Majority of housing units in Barangays Cogon and Tagjaguimit were built in 2001 to 2005. Houses in Barangay Cogon that were built in 2001 to 2005 comprises 28.76% or 222 of the total housing units. (**Table 2-77**)

Table 2-77: Year Building/House was Built by First Household within the Housing Unit in the Impact Areas within the City of Naga, 2010

Year	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
2010	12	1.55	23	4.65
2009	44	5.70	29	5.86
2008	42	5.44	27	5.45
2007	35	4.53	38	7.68
2006	38	4.92	33	6.67
2001-2005	222	28.76	119	24.04
1991-2000	184	23.83	111	22.42
1981-1990	87	11.27	55	11.11
1971-1980	46	5.96	26	5.25
1970 or Earlier	13	1.68	13	2.63
Not Applicable	2	0.26	1	0.20
Don't Know	15	1.94	10	2.02
Not Reported	32	4.15	10	2.02

Year	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Total	**772**	**100.00**	**495**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Housing units in Barangay Lamac were built in 1991 to 2000. In Barangay Lamac houses that were built in 1991 to 2000 comprises 307 or 27% of the total housing units. (**Table 2-78**)

Table 2-78: Year Building/House was Built by First Household within the Housing Unit in the Impact Areas within the Municipality of Pinamungahan, 2010

Year	Barangays	
	Lamac	
	No.	%
2010	12	1.06
2009	38	3.34
2008	52	4.57
2007	30	2.64
2006	69	6.07
2001-2005	228	20.05
1991-2000	307	27.00
1981-1990	151	13.28
1971-1980	53	4.66
1970 or Earlier	24	2.11
Not Applicable	0	-
Don't Know	122	10.73
Not Reported	51	4.49
Total	**1137**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangays Bulongan, Media Once, and Poog most of the housing units were built in 1991 to 2000. It is also observed in **Table 2-79** that a considerable number of houses were built in 1970 or earlier.

Table 2-79: Year Building/House was Built by First Household within the Housing Unit in the Impact Areas within Toledo City, 2010

Year	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
2010	14	2.55	37	2.70	23	1.96
2009	37	6.74	101	7.38	49	4.18
2008	19	3.46	88	6.43	61	5.20
2007	23	4.19	81	5.92	64	5.46
2006	18	3.28	85	6.21	56	4.77
2001-2005	108	19.67	275	20.10	200	17.05
1991-2000	139	25.32	297	21.71	338	28.82
1981-1990	66	12.02	170	12.43	192	16.37
1971-1980	35	6.38	89	6.51	99	8.44

Year	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
1970 or Earlier	24	4.37	31	2.27	33	2.81
Not Applicable	0	-	6	0.44	6	0.51
Don't Know	12	2.19	50	3.65	1	0.09
Not Reported	54	9.84	58	4.24	51	4.35
Total	**549**	**100.00**	**1368**	**100.00**	**1173**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Most of the housing units in Barangay Cogon were built in lots that are rented-free with the consent of the owner. However, in Barangay Tagjaguimit, the majority or 63.23% of the residents built their housing units on their own or amortized lots.

Table 2-80: Tenure Status of the Lot by First Household within the Housing Unit in the Impact Areas within the City of Naga, 2010

Type of Building/House	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Owned/Amortized	365	47.28	313	63.23
Rented	12	1.55	9	1.82
Rent-free With Consent of Owner	354	45.85	152	30.71
Rent-free Without Consent of Owner	5	0.65	2	0.40
Not Applicable	0	-	1	0.20
Not Reported	36	4.66	18	3.64
Total	**772**	**100.00**	**495**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangay Lamac most of the housing units (406 or 98.78%) were built in owned or amortized lots. (**Table 2-81**)

Table 2-81: Tenure Status of the Lot by First Household within the Housing Unit in the Impact Areas within the Municipality of Pinamungahan, 2010

Tenure Status	Barangays	
	Lamac	
	No.	%
Owned/Amortized	508	44.68
Rented	32	2.81
Rent-free With Consent of Owner	539	47.41
Rent-free Without Consent of Owner	4	0.35
Not Applicable	0	-
Not Reported	54	4.75
Total	**1137**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Barangay Media Once has the most number of housing units (1,368) among the impact barangays in Toledo City. These housing units are mostly built in lots that are owned or amortized (568 or

41.52%). In Barangay Poog 35.89% or 421 housing units were built in owned/amortized lots and 349 or 33.59% of the housing units were built in a rented lots. In Barangay Bulongan, most of the housing units were built on lots that are rent-free with the consent of owners. (**Table 2-82**)

Table 2-82: Tenure Status of the Lot by First Household within the Housing Unit in the Impact Areas within Toledo City, 2010

Tenure Status	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Owned/Amortized	170	30.97	568	41.52	421	35.89
Rented	32	5.83	161	11.77	394	33.59
Rent-free With Consent of Owner	292	53.19	559	40.86	275	23.44
Rent-free Without Consent of Owner	0	-	12	0.88	6	0.51
Not Applicable	0	-	0	-	2	0.17
Not Reported	55	10.02	68	4.97	75	6.39
Total	**549**	**100.00**	**1,368**	**100.00**	**1,173**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Majority of the type of housing units within the six (6) impact barangays are single houses, as presented in Table 2-83, Table 2-84, and Table 2-85. In Barangay Cogon, duplex type of house was also built. In Tagjaguimit, two (2) commercial/industrial/agricultural type of building/house are also present.

Table 2-83: Type of Building/House in the Impact Areas within the City of Naga, 2010

Type of Building/House	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Single House	770	99.74	493	99.60
Duplex	2	0.26	0	-
Multi-unit Residential	0	-	0	-
Commercial/Industrial/Agricultural	0	-	2	0.40
Institutional Living Quarter	0	-	0	-
Other Housing Unit	0	-	0	-
Not Reported	0	-	0	-
Total	**772**	**100.00**	**495**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Duplex and Multi-unit Residential type of housing are found in Barangay Lamac. There is also one (1) institutional living quarter built in this barangay.

Table 2-84: Type of Building/House in the Impact Areas within the Municipality of Pinamungahan, 2010

Type of Building/House	Barangays	
	Lamac	
	No.	%
Single House	1097	96.48
Duplex	21	1.85
Multi-unit Residential	15	1.32
Commercial/Industrial/Agricultural	0	-
Institutional Living Quarter	1	0.09
Other Housing Unit	0	-
Not Reported	3	0.26
Total	**1,137**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Duplex type of housing is also prevalent in Barangays Media Once and Poog. Multi-unit Residential also built in these barangays while two (2) commercial/industrial/agricultural type of building/house was built in Barangay Poog.

Table 2-85: Type of Building/House in the Impact Areas within Toledo City, 2010

Type of Building/House	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Single House	549	100.00	1349	98.61	1082	92.24
Duplex	0	-	14	1.02	44	3.75
Multi-unit Residential	0	-	5	0.37	45	3.84
Commercial/ Industrial/ Agricultural	0	-	0	-	2	0.17
Institutional Living Quarter	0	-	0	-	0	-
Other Housing Unit	0	-	0	-	0	-
Not Reported	0	-	0	-	0	-
Total	**549**	**100.00**	**1,368**	**100.00**	**1,173**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The dominant housing in the impact barangays within the City of Naga is made of galvanized iron/aluminum roof materials. A considerable number of housing units with roofing materials that are made of light materials like cogon, nipa, or anahaw.

Table 2-86: Construction Materials of the Roof by First Household within the Housing Unit in the Impact Areas within the City of Naga, 2010

Roof Materials	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Galvanized Iron/Aluminum	726	94.04	462	93.33
Tile Concrete/Clay Tile	0	-	0	-
Half Galvanized Iron and Half Concrete	0	-	0	-
Wood	0	-	2	0.40
Cogon/Nipa/Anahaw	40	5.18	31	6.26
Asbestos	0	-	0	-

Roof Materials	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Makeshift/Salvaged/Improvised Materials	1	0.13	0	-
Others	3	0.39	0	-
Not Reported	2	0.26	0	-
Total	**772**	**100.00**	**495**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Though the roofing materials of housing units within the impact barangays in Pinamungahan are mostly galvanized iron or aluminum, a quite number of housing units have roofs that are made of cogon, nipa, or anahaw.

Table 2-87: Construction Materials of the Roof by First Household within the Housing Unit in the Impact Areas within the Municipality of Pinamungahan, 2010

Roof Materials	Barangays	
	Lamac	
	No.	%
Galvanized Iron/Aluminum	990	87.07
Tile Concrete/Clay Tile	2	0.18
Half Galvanized Iron and Half Concrete	4	0.35
Wood	12	1.06
Cogon/Nipa/Anahaw	129	11.35
Asbestos	0	-
Makeshift/Salvaged/Improvised Materials	0	-
Others	0	-
Not Reported	0	-
Total	**1137**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

The same description as the other impact barangays, roof materials used in the housing units built within the impact barangays in Toledo City is mostly galvanized iron or aluminum. There are also housing units that used cogon, nipa, or anahaw as well as wood as roofing materials.

Table 2-88: Construction Materials of the Roof by First Household within the Housing Unit in the Impact Areas within Toledo City, 2010

Roof Materials	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Galvanized Iron/ Aluminum	486	88.52	1265	92.47	1011	86.19
Tile Concrete/ Clay Tile	0	-	1	0.07	9	0.77
Half Galvanized Iron and Half Concrete	2	0.36	1	0.07	76	6.48
Wood	0	-	1	0.07	13	1.11
Cogon/Nipa/ Anahaw	60	10.93	99	7.24	53	4.52
Makeshift/Salvaged/ Improvised Materials	0	-	1	0.07	10	0.85
Others	1	0.18	0	-	1	0.09
Total	**549**	**100.00**	**1368**	**100.00**	**1173**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Outer wall materials of housing units in Barangay Tagjaguimit (42.22) are mostly made of wood. A Higher percentage of housing units made of bamboo, sawali, cogon, or nipa were also noted in these two (2) barangays. In Barangay Cogon, the majority of the housing units' outer wall is made from light materials such as bamboo, sawali, cogon, or nipa (31.99%). (**Table 2-89**)

Table 2-89: Construction Materials of the Outer Walls by First Household within the Housing Unit in the Impact Areas within the City of Naga, 2010

Outer Walls Materials	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Concrete/ Brick/ Stone	174	22.54	51	10.30
Wood	194	25.13	209	42.22
Half Concrete/ Brick/ Stone and Half Wood	132	17.10	39	7.88
Galvanized Iron/ Aluminum	1	0.13	3	0.61
Bamboo/ Sawali/ Cogon/ Nipa	247	31.99	192	38.79
Makeshift/ Salvaged/ Improvised Materials	5	0.65	1	0.20
Others	15	1.94	0	-
Not Reported	4	0.52	0	-
Total	**772**	**100.00**	**495**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Majority of the housing units in Barangays Lamac are made of wood (40.72%), and concrete (35.09%). (**Table 2-90**)

Table 2-90: Construction Materials of the Outer Walls by First Household within the Housing Unit in the Impact Areas within the Municipality of Pinamungahan, 2010

Outer Walls Materials	Barangays	
	Lamac	
	No.	%
Concrete/ Brick/ Stone	399	35.09
Wood	463	40.72
Half Concrete/ Brick/ Stone and Half Wood	105	9.23
Galvanized Iron/ Aluminum	1	0.09
Bamboo/ Sawali/ Cogon/ Nipa	154	13.54
Makeshift/ Salvaged/ Improvised Materials	2	0.18
Not Reported	13	1.14
Total	**1137**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangays Media Once and Poog, the majority used concrete, brick, or stone as outer wall materials of the housing units. In Barangay Bulongan, the majority of the housing units are made of bamboo, sawali, cogon, or nipa. (**Table 2-91**)

Table 2-91: Construction Materials of the Outer Walls by First Household within the Housing Unit in the Impact Areas within Toledo City, 2010

Outer Walls Materials	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Concrete/ Brick/ Stone	137	24.95	452	33.04	450	38.36
Wood	158	28.78	343	25.07	325	27.71
Half Concrete/ Brick/ Stone and Half Wood	59	10.75	228	16.67	247	21.06
Galvanized Iron/ Aluminum	0	-	2	0.15	7	0.60
Bamboo/ Sawali/ Cogon/ Nipa	184	33.52	339	24.78	133	11.34
Makeshift/ Salvaged/ Improvised Materials	10	1.82	4	0.29	8	0.68
Others	1	0.18	0	-	0	-
Not Reported	0	-	0	-	3	0.26
Total	**549**	**100.00**	**1368**	**100.00**	**1173**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

2.4.2 Migration Pattern

There are 98 to 99 percent of the population in Barangays Cogon and Tagjaguimit were already residing in Cebu Province in 2005. About 2 percent of the population migrated in Cebu. In Barangay Tagjaguimit, 2010 data showed that one (1) resident lived in the province was Ilocos Norte while two (2) residents came from Negros Orinetal five (5) years ago. (**Table 2-92**)

Table 2-92: Place of Residence Five Years Ago in the Impact Areas within the City of Naga, 2010

Province/City	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
City of Manila	5	0.16	0	-
City of Las Piñas	2	0.06	0	-
Ilocos Norte	0	-	1	0.05
Cavite	1	0.03	0	-
Quezon	2	0.06	0	-
Negros Occidental	7	0.22	0	-
Bohol	3	0.10	0	-
Cebu	3,099	99.04	1,990	99.85
Negros Oriental	2	0.06	2	0.10
Leyte	3	0.10	0	-
Misamis Oriental	1	0.03	0	-
Cotabato (North Cotabato)	2	0.06	0	-
South Cotabato	2	0.06	0	-
Total	**3129**	**100.00**	**1993**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

As presented in **Table 2-93**, some residents from the impact barangays within the City of Naga came from other city or municipality in Cebu five (5) years prior to 2010. In Barangay Cogon, twenty-eight individuals from Barangay Cogon were found to be residing in Minglanilla five (5) years prior to 2010.

Table 2-93. Place of Residence in Cebu Province Five Years Ago in the Impact Areas within the City of Naga, 2010

City/Municipality in Cebu Province	Barangays			
	Cogon		Tagjaguimit	
	No.	%	No.	%
Alcantara	1	0.03	0	-
Barili	1	0.03	0	-
Carmen	1	0.03	0	-
Cebu City (Capital)	17	0.55	0	-
Danao City	1	0.03	0	-
Lapu-Lapu City (Opon)	2	0.06	0	-
Liloan	1	0.03	0	-
Mandaue City	2	0.06	0	-
Minglanilla	28	0.90	0	-
Moalboal	1	0.03	0	-
City of Naga	3,027	97.68	1,986	99.80
Pinamungahan	2	0.06	0	-
Ronda	1	0.03	0	-
City of Talisay	2	0.06	4	0.20
Toledo City	10	0.32	0	-
Cebu Total	**3,099**	**100.00**	**1,990**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Almost all of the residents in Barangay Lamac stayed within Cebu Province for more than five years. As shown in **Table 2-94**, nine (9) residents in Barangay Lamac resided in other areas than Cebu Province in 2005.

Table 2-94: Place of Residence Five Years Ago in the Impact Areas within the Municipality of Pinamungahan, 2010

Province/City	Barangays	
	Lamac	
	No.	%
Rizal	2	0.05
Oriental Mindoro	4	0.10
Cebu	3955	99.77
Negros Oriental	1	0.03
Leyte	2	0.05
Total	**3,964**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Barangay Lamac, twenty-six (26) residents stayed in other cities/municipalities within Cebu. (**Table 2-95**)

Table 2-95: Place of Residence in Cebu Province Five Years Ago in the Impact Areas within the Municipality of Pinamungahan, 2010

City/Municipality in Cebu Province	Barangays	
	Lamac	
	No.	%
Aloguinsan	1	0.03
Balamban	1	0.03
Borbon	2	0.05
Cebu City (Capital)	12	0.30
Lapu-Lapu City (Opon)	3	0.08
Liloan	2	0.05
Minglanilla	1	0.03
Moalboal	2	0.05
Oslob	1	0.03
Pinamungahan	3,917	99.04
Ronda	1	0.03
Total	**3,943**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

In Toledo City, barangays Bulongan, Media Once, and Poog, have immigrants from other provinces.

Table 2-96: Place of Residence Five Years Ago of Population in the Impact Areas within Toledo City, 2010

Province/City	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
City of Manila	0	-	1	0.02	0	-
City of Marikina	2	0.10	0	-	0	-
Quezon City	0	-	1	0.02	1	0.02
Isabela	0	-	1	0.02	0	-
Laguna	0	-	5	0.09	0	-
Quezon	1	0.05	0	-	0	-
Camarines Sur	0	-	0	-	1	0.02
Masbate	0	-	1	0.02	3	0.06
Negros Occidental	0	-	0	-	8	0.16
Bohol	0	-	17	0.30	3	0.06
Cebu	2016	99.85	5588	99.43	4873	99.15
Negros Oriental	0	-	1	0.02	6	0.12
Leyte	0	-	0	-	8	0.16
Southern Leyte	0	-	0	-	1	0.02
Zamboanga Del Norte	0	-	1	0.02	0	-
Bukidnon	0	-	0	-	2	0.04
Lanao Del Norte	0	-	2	0.04	0	-
Misamis Oriental	0	-	1	0.02	0	-
Davao (Davao Del Norte)	0	-	0	-	5	0.10
Davao Del Sur	0	-	0	-	1	0.02
South Cotabato	0	-	0	-	1	0.02
Surigao Del Norte	0	-	0	-	2	0.04
Surigao Del Sur	0	-	1	0.02	0	-
Total	**2,019**	**100.00**	**5,620**	**100.00**	**4,915**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

Almost all of the residents from the impact Barangays in Toledo City who stayed within Cebu Province for the past five (5) years from 2010 resided within Toledo City. Only a few in-migrated from other city/municipality in Cebu Province as shown in **Table 2-97**.

Table 2-97: Place of Residence in Cebu Province Five Years Ago in the Impact Areas within Toledo City, 2010

City/Municipality in Cebu Province	Barangays					
	Bulongan		Media Once		Poog	
	No.	%	No.	%	No.	%
Alcoy	0	-	1	0.02	0	-
Balamban	0	-	0	-	0	-
Bantayan	0	-	2	0.04	9	0.18
Barili	0	-	1	0.02	0	-
Carmen	0	-	1	0.02	0	-
Cebu City (Capital)	4	0.20	0	-	30	0.62
Consolacion	0	-	1	0.02	0	-
Dalaguete	0	-	2	0.04	1	0.02
Danao City	1	0.05	1	0.02	0	-
Lapu-Lapu City (Opon)	0	-	5	0.09	7	0.14
Malabuyoc	0	-	0	-	1	0.02
Mandaue City	1	0.05	8	0.14	3	0.06
Medellin	0	-	0	-	6	0.12
Minglanilla	0	-	5	0.09	0	-
City of Naga	0	-	0	-	1	0.02
Pinamungahan	0	-	2	0.04	0	-
San Remigio	1	0.05	0	-	0	-
Tabogon	0	-	1	0.02	0	-
City of Talisay	0	-	0	-	2	0.04
Toledo City	2,009	99.65	5,558	99.46	4,813	98.77
Total	**2,016**	**100.00**	**5,588**	**100.00**	**4,873**	**100.00**

Source: 2010 Census of Population and Housing (Philippine Statistics Authority, 2011)

2.4.3 Socioeconomic Profile

2.4.3.1 Health and Sanitation

Data on health services of the impact cities and municipality were sourced from the Cities and Municipalities Competitive Index, and some from the 2018 barangay profiles.

The City of Naga has nine (9) doctors, 28 nurses, and 30 midwives deployed in public health facilities. While private medical facilities employ 286 doctors, 171 nurses, and 41 midwives. There are 31 private health facilities established in the City of Naga. Specifically to Cogon, they have eleven (11) health workers, one (1) nutrition scholar, and one (1) nurse. They also have a Health

Center within the barangay. In Tagjaguimit, there are nine (9) health workers, one (1) nutrition scholar, and one (1) midwife. A Health station is also present in the barangay.

In Pinamungahan there are three (3) doctors, thirteen (13) nurses, and eleven (11) midwives in 23 public health facilities, while only one (1) doctor is providing services in one (1) private clinic. Barangay Lamac has its own Health Station, with Health capability/skills training.

Public health services are being delivered in Toledo City with six (6) doctors, 50 nurses, and thirteen (13) midwives deployed in seven (7) health facilities. More doctors are into private practice, fifteen (15) doctors, one (1) nurse, and four (4) midwives work in private clinics and diagnostic centers within Toledo City. According to the barangay profiles, Bulongan has a health worker and a nutrition scholar, Media Once has two (2) health workers, and Poog has none. Out of the 3 barangays, only Bulongan and Poog have Health Centers.

2.4.3.2 Education

Data of PSA on basic literacy revealed that among the three host cities and municipality, the City of Naga has the highest percentage of literate population (98.47%). Data presented in **Table 2-98**, **Table 2-99**, and **Table 2-100** are the percentage of the population 10 years old and over, who can read, write and understand simple messages in any language or dialect.

Table 2-98: Literacy of the Household Population 10 Years Old and Over by Age Group in the City of Naga, 2015

Age Group	City of Naga		%
	Household Population 10 Years Old Over	Literate	
10 - 14	12,487	12,394	99.26
15 - 19	11,508	11,445	99.45
20 - 24	10,985	10,897	99.20
25 - 29	9,658	9,584	99.23
30 - 34	8,452	8,380	99.15
35 - 39	7,659	7,588	99.07
40 - 44	6,483	6,399	98.70
45 - 49	5,782	5,698	98.55
50 - 54	4,749	4,637	97.64
55 - 59	3,837	3,747	97.65
60 - 64	2,980	2,869	96.28
65 years old and over	4,771	4,342	91.01
Total	**89,351**	**87,980**	**98.47**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

The municipality of Pinamungahan has the lowest percentage on literacy, among the host communities. Based on the 2015 statistics, the literacy rate of Pinamungahan is 97.29% and the age group 65 years old and over has the highest illiteracy statistics.

Table 2-99: Literacy of the Household Population 10 Years Old and Over by Age Group in Pinamunhgahan Municipality, 2015

Age Group	Pinamungahan		%
	Household Population 10 Years Old Over	Literate	
10 - 14	7,529	7,459	99.07
15 - 19	6,681	6,629	99.22
20 - 24	5,975	5,925	99.16
25 - 29	5,124	5,060	98.75
30 - 34	4,259	4,197	98.54
35 - 39	3,893	3,826	98.28
40 - 44	3,359	3,291	97.98
45 - 49	2,991	2,896	96.82
50 - 54	2,710	2,585	95.39
55 - 59	2,239	2,136	95.40
60 - 64	1,767	1,638	92.70
65 years old and over	3,411	2,942	86.25
Total	**49,938**	**48,584**	**97.29**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

In Toledo City, there were about 2% of the population 10 years old and over who were considered illiterate. The highest percentage of illiteracy is observed among the 65 years old and above age groups.

Table 2-100: Literacy of the Household Population 10 Years Old and Over by Age Group in Toledo City, 2015

Age Group	Toledo City		%
	Household Population 10 Years Old Over	Literate	
10 - 14	18,588	18,494	99.49
15 - 19	17,054	16,967	99.49
20 - 24	15,779	15,673	99.33
25 - 29	13,791	13,715	99.45
30 - 34	11,788	11,694	99.20
35 - 39	10,462	10,336	98.80
40 - 44	9,000	8,876	98.62
45 - 49	7,713	7,555	97.95
50 - 54	6,703	6,540	97.57
55 - 59	5,794	5,619	96.98
60 - 64	4,601	4,446	96.63
65 years old and over	7,572	6,853	90.50
Total	**128,845**	**126,768**	**98.39**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

Table 2-101 present the out-of-school children (6 to 14 years old) and out –of-school youth (15 to 24 years) in the City of Naga. Out-of-school children are persons who are attending school while the out-of-school youth are those who are not attending school, have not finished any college or post -secondary course, and are not working. Almost all of the children in the City of Naga are attending school, while there were a lot of youth who are not attending school or currently working.

Table 2-101: Household Population 5 to 24 Years Old Who Were Currently Attending School by Age Group in the City of Naga, 2015

Age Group	City of Naga		%
	Household Population 5 to 24 Years Old	Household Population 5 to 24 Years Old Who Were Currently Attending School	
5 - 9	13,090	12,399	94.72
10 - 14	12,487	12,019	96.25
15 - 19	11,508	6,907	60.02
20 - 24	10,985	1,298	11.82
Total	**48,070**	**32,623**	**67.87**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

In the municipality of Pinamungahan, only 10% of the population of ages 20 to 24 years old are in school or who are currently employed. Higher percentage of children 5 to 14 years old within the municipality are currently attending school.

Table 2-102: Household Population 5 to 24 Years Old Who Were Currently Attending School by Age Group in Pinamungahan Municipality, 2015

Age Group	Pinamungahan		%
	Household Population 5 to 24 Years Old	Household Population 5 to 24 Years Old Who Were Currently Attending School	
5 - 9	8,160	7,856	96.27
10 - 14	7,529	7,391	98.17
15 - 19	6,681	3,847	57.58
20 - 24	5,975	598	10.01
Total	**28,345**	**19,692**	**69.47**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

In Toledo City, only 55.93% of the youth ages 15 to 19 years old were attending school and only 11.72% of 20 to 24 years old youth are in school or are currently employed.

Table 2-103: Household Population 5 to 24 Years Old Who Were Currently Attending School by Age Group in Toledo City, 2015

Age Group	Toledo City		%
	Household Population 5 to 24 Years Old	Household Population 5 to 24 Years Old Who Were Currently Attending School	
5 - 9	20,250	19,389	95.75
10 - 14	18,588	17,716	95.31
15 - 19	17,054	9,539	55.93
20 - 24	15,779	1,849	11.72
Total	**71,671**	**48,493**	**67.66**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

The public elementary and secondary schools present in the impact barangays are presented in **Table 2-104**.The number of enrollees during the school year 2015-2016 by gender is also shown. Each of the impact barangay has an elementary school. Secondary schools, from Grade 7 to 10, are accessible in all impact barangays within the City of Naga. Among the barangays in Pinamungahan, secondary school is only available in Barangay Lamac. In the impact barangays within Toledo City, secondary school is only available in barangays Media Once. Toledo City also has a vocational school that offers secondary education from Grade 7 to 11.

Table 2-104: Public Schools within the Impact Barangays

Name of Public School	Enrollees SY 2015-2016				
	Males		Females		Total
	No.	%	No.	%	
Elementary Schools					
Cogon Elementary School	212	49.77	214	50.23	426
Tagjaguimit Elementary School	315	51.89	292	48.11	607
Lamac Elementary School	687	55.58	549	44.42	1,236
Bulongan Elementary School	307	53.02	272	46.98	579
Media Once Elementary School	472	55.14	384	44.86	856
Poog Elementary School	509	54.15	431	45.85	940
Secondary Schools					
Cogon National High School	74	44.31	93	55.69	167
Tagjaguimit National High School	119	50.21	118	49.79	237
Lamac National High School	391	46.33	453	53.67	844
Media Once National High School	226	53.94	193	46.06	419
Toledo National Vocational School	434	46.32	503	53.68	937

2.4.3.3 Employment Profile

As presented in **Table 2-105**, most of the gainful workers (15 years old and above) residing in the impact cities and municipality are Craft and Related Trades Workers. The PSA workers in this occupational group apply specific knowledge and skills in the fields to construct and maintain buildings, form metal, erect metal structures, set machine tools, or make, fit, maintain and repair machinery, equipment or tools, carry out printing work, produce or process foodstuffs, textiles, or wooden, metal and other articles, including handicraft goods. This differs to the data in the Province of Cebu. The most number of workers in Cebu belong to the Elementary Occupations group. Occupations in this group involve the performance of simple and routine tasks which may require the use of handheld tools and considerable physical effort.

Table 2-105: Gainful Workers 15 Years Old and Over by Major Occupation Group within Cebu Province and Impact Cities and Municipality, 2015

Major Occupation Group	Cebu Province		City of Naga		Pinamungahan Municipality		Toledo City	
	No.	%	No.	%	No.	%	No.	%
Managers	86,270	7.55	1,944	4.69	985	4.27	3,991	6.75
Professionals	59,142	5.18	2,269	5.47	784	3.40	2,870	4.85
Technicians and Associate Professionals	49,815	4.36	2,345	5.65	706	3.06	2,639	4.46
Clerical Support Workers	51,933	4.54	2,097	5.05	604	2.62	2,734	4.62
Service and Sales Workers	164,984	14.44	6,360	15.33	3,173	13.77	7,798	13.19
Skilled Agricultural Forestry and Fishery Workers	199,402	17.45	3,734	9.00	3,971	17.23	7,002	11.84
Craft and Related Trades Workers	177,066	15.50	8,915	21.49	6,839	29.67	14,400	24.36
Plant and Machine Operators and Assemblers	122,281	10.70	5,441	13.12	2,053	8.91	5,603	9.48
Elementary Occupations	229,631	20.10	8,296	20.00	3,913	16.98	11,996	20.29
Armed Forces Occupations	610	0.05	19	0.05	7	0.03	20	0.03
Other Occupation Not Elsewhere Classified	-	-	-	-	-	-	-	-
Not Reported	1,574	0.14	66	0.16	13	0.06	64	0.11
Total	**1,142,708**	**100.00**	**41,486**	**100.00**	**23,048**	**100.00**	**59,117**	**100.00**

Source: PSA, 2015 (Philippine Statistics Authority, 2017)

2.4.3.4 Poverty Incidence

Based on the 2012 Official Poverty Statistics published by PSA, poverty incidence in the province of Batangas increased from 2006, to 2009, and to 2012. The recorded poverty incidence in Cebu in 2012 was 18.9%, it is lower than the national average which was 19.7%. It was also observed that the magnitude of poor families and population continuously increased from the three survey periods. The Annual per Capita Poverty Threshold in rural areas of Cebu increased in 2012 with Php 18,570 compared to the value during 2006 (Php 14,850) and 2009 (Php 17,505.00). The value for the province of Cebu was lower than the Annual Per Capita Poverty Threshold for the whole country which is Php 18,935.00. Poverty threshold is the minimum income required for a family/individual to meet the basic food and non-food requirements (Philippine Statistics Authority, 2013).

Table 2-106: Comparative Poverty Statistics of Cebu Province: 2006, 2009, 2012

Indicators	Year		
	2006	2009	2012
Poverty Incidence Among Population (%)	25.2	22.3	18.9
Magnitude of Poor Population	1,184,478	1,108,152	1,000,163
Magnitude of Poor Families	209,301	200,481	185,603
Annual per Capita Poverty Threshold (in Pesos)	14,850	17,505	18,570

Source: 2012 Full Year Official Poverty Statistics (Philippine Statistics Authority, 2013)

2.4.4 Perception Survey

A Perception Survey for the direct impact barangays were conducted from September 19 to October 10, 2016. The survey was conducted in the barangays of Cogon and Tagjaguimit in the City of Naga; Lamac in the Municipality of Pinamungahan; and Bulongan, Media Once, and Poog in Toledo City with a total of 300 respondents. The surveys were participated by different sectors such as members of the barangay council and other barangay functionaries, senior citizens, health workers, farmers, women and youth sectors.

The survey questionnaire was divided into seven (7) major components, namely (1) Socio-Demographic; (2) Socio-Economic; (3) Housing Condition; (4) Education and Health Situation; (5) Perceived Community Problems and Proposed Solutions; (6) Project Awareness and Acceptability; and (7) Perceived Advantages and Disadvantages of the Proposed Project.

The Survey Questionnaire is attached as Annex 10. The documentation of the conducted survey is found in Annex 11.

2.4.4.1 Demographic Profile of Survey Respondents

Gender. Majority of the respondents are females with 56.33% (169) of the total respondents. Males comprise 28.33% of the total respondents. Ten (10) percent of the respondents did not identify their gender.

Table 2-107: Gender of Survey Respondents

Gender	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Female	31	33	33	34	19	19	169	56.33%
Male	16	14	13	10	19	13	85	28.33%
No. Answer	3	3	4	6	12	18	46	15.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100%**

Age. **Table 2-108** shows the age distribution of the respondents. The most number of respondents came from the age bracket 40-49 years old with 19.00% followed by age brackets 60 to 69 years old with 18.67%.

Table 2-108: Age of Survey Respondents

Age	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
15-19	2	4	1	7	4	7	25	8.33%
20-29	10	8	5	1	7	13	44	14.67%
30-39	16	8	6	6	8	11	55	18.33%
40-49	12	7	10	15	9	4	57	19.00%
50-59	4	16	17	5	4	7	53	17.67%
60-69	6	6	8	14	14	8	56	18.67%
70 and over	0	1	3	2	4	0	10	3.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Birthplace. Majority (67.82%) of the respondents were born in the barangay. There were 12.33%% of them who were born from other province and 7.67% from other municipalities in Cebu. Only 10.33% of the respondents came from other barangay within the respective municipality/city as presented in **Table 2-109**.

Table 2-109: Birthplace of Survey Respondents

Birthplace	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Within Barangay	36	43	40	26	27	36	208	69.33%
Different Barangay	11	1	2	4	7	6	31	10.33%
Other part of Cebu	3	4	7	3	6	0	23	7.67%
Outside Cebu	0	2	1	16	10	8	37	12.33%
No Answer	0	0	0	1	0	0	1	0.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Civil Status. Most of the respondents were married with 56.33% of the total respondents. There were 21.67% who were single. Sixty-four (64) or 21.33% of the respondents were widowed. Only 0.67% were separated from their partners. The details are shown in **Table 2-110**.

Table 2-110: Civil Status of Survey Respondents

Civil Status	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Married	30	36	40	23	19	21	169	56.33%
Single	8	12	4	10	13	18	65	21.67%
Separated	2	0	0	0	0	0	2	0.67%
Widowed	10	2	6	17	18	11	64	21.33%
No Answer	0	0	0	0	0	0	0	0.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Ethnicity. Majority of the respondents (88.33%) are Cebuano. The next most common ethnicity among the respondents is Ilonggo with 5.67% followed by Waray with 3.00% of the total respondents as shown in **Table 2-111**.

Table 2-111: Ethnicity of Survey Respondents

Ethnic Group	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Sugbuhanon	49	49	44	48	40	35	265	88.33%
Tagalog	0	1	0	0	0	0	1	0.33%
Ilonggo	0	0	3	0	3	11	17	5.67%
Waray	0	0	0	1	6	2	9	3.00%
Negros	0	0	2	0	0	0	2	0.67%
Zamboanga	0	0	1	0	0	0	1	0.33%
Davao	0	0	0	0	1	0	1	0.33%
Other	0	0	0	0	0	2	2	0.67%
No Answer	1	0	0	1	0	0	2	0.67%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Religion. Most of the respondents or 86.00% are Roman Catholics. A considerable number of respondents are also affiliated with Iglesia ni Cristo (8.67%) as shown in **Table 2-112**.

Table 2-112: Religious Affiliation of Survey Respondents

Religion	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Roman Catholic	48	43	47	37	42	41	258	86.00%
Iglesia ni Cristo	2	0	1	11	7	5	26	8.67%
Born Again	0	7	0	2	0	0	9	3.00%
Protestant	0	0	2	0	1	3	6	2.00%
Bible Baptist	0	0	0	0	0	0	0	0.00%
No Answer	0	0	0	0	0	1	1	0.33%

Religion	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Settlement History. Twenty-one percent of the survey respondents have been residing in the barangay for 21 to 30 years. There were 20.33% who has been residing in the barangay for 41 to 50 years. Only 1.33% of the total respondents reside in the barangay for 71 to 80 years. The details are shown in **Table 2-113**.

Table 2-113: Settlement History of Survey Respondents

Years of Residency	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
1-10	0	2	4	1	5	2	14	4.67%
11-20	5	2	4	8	6	10	35	11.67%
21-30	9	7	5	9	12	21	63	21.00%
31-40	14	8	6	10	5	12	55	18.33%
41-50	14	8	10	15	10	4	61	20.33%
51-60	2	17	14	4	8	1	46	15.33%
61-70	5	3	5	1	2	0	16	5.33%
71-80	0	1	2	1	0	0	4	1.33%
No Answer	1	2	0	1	2	0	6	2.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

2.4.4.2 Socio-Economic Profile of the Respondents

Source of Income. Most (28.67%) of the respondents are not employed and has no regular sources of income. Farmers comprise 13.33% of the total respondents. Twenty (20) survey respondents or 6.67% rely on employment for construction work as their source of income. Salaried employees/ workers composed of 22.00% of the respondents. Some of them depend on vending (13.67%) and carpentry (2.33%). Government employees mostly as part of the office of the barangay council compose the 1.00% of the respondents while 4.67% of them said that they source their income from other means. The details are shown in **Table 2-114**.

Table 2-114: Sources of Income of Survey Respondents

Income Source	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Farming	0	8	17	6	4	5	40	13.33%
Salaried	17	8	6	5	17	13	66	22.00%
Construction Work	3	1	6	1	2	7	20	6.67%
Government Employee	0	2	0	1	0	0	3	1.00%
Vending	4	5	12	5	8	7	41	13.67%
Carpentry	0	0	0	1	4	2	7	2.33%
Pension	0	2	0	6	11	0	19	6.33%
None	26	23	9	19	4	5	86	28.67%
Other	0	1	0	2	0	11	14	4.67%
No Answer	0	0	0	4	0	0	4	1.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Estimated household income. Majority of the respondents (26.00%) earn a monthly income of P5,000 and over, while 25.67% were not income earners that they don't have any work at all or the survey question was not applicable to them. There were 19.00% of the total respondents who were earning an income of P2,000 –P2,999.00. The details are shown in **Table 2-115**.

Table 2-115: Estimated Household Income of Survey Respondents

Income Range	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
less than 1,000	0	3	0	2	1	3	9	3.00%
P1,000 - P1,999	0	10	0	4	3	4	21	7.00%
P2,000 - P2,999	1	3	11	14	19	9	57	19.00%
P3,000 - P3,999	1	1	26	0	0	5	33	11.00%
P4,000 - P4,999	10	6	3	3	0	1	23	7.67%
P5,000 & over	15	7	4	4	22	26	78	26.00%
Not Applicable	23	20	6	23	5	0	77	25.67%
None	0	0	0	0	0	2	2	0.67%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Tenurial Status of Farmland. Only a few (27.33% or 82) from the survey respondents owns or farms a parcel of farmland. Majority or 69.67% (209) of the survey respondents do not have farmlands. (**Table 2-116**)

Table 2-116: Availability of Farmland to Survey Respondents

Availability of Farm Land	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Yes	7	19	39	5	5	7	82	27.33%
None	43	30	8	41	45	42	209	69.67%
No Answer	o	1	3	4	0	1	9	3.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

For those who have farmlands, 20.33% of them owns the land that they farm and till themselves. Almost 10% utilizes the farmland under lease contract and 14.00% of the survey respondents owns a farmland but lease it to other farmers. (**Table 2-117**)

Table 2-117: Tenurial Status on Farmland of Survey Respondents

Tenurial Status	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Owned	2	0	0	0	0	0	2	0.67%
Owned-Farmed	2	5	38	4	4	8	61	20.33%
Leased	7	22	7	3	3	0	42	14.00%
Tenancy/Rented	0	0	0	0	1	0	1	0.33%
Others	1	0	0	2	0	0	3	1.00%
None	0	0	0	0		42	42	14.00%
No Answer	38	23	5	41	42	0	149	49.67%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Farm Products. Table 2-118 show the goods that the farmers in the area produce. Corn (16.17%) and banana (13.77%) are the most common products that they produce. Some 8.38% of the total products comprise Root crops, coconut (5.99%) and mango (3.59%). Only 5.79% of them are into poultry production.

Table 2-118: Farm Products of Survey Respondents

Farm Products	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Corn	7	25	36	5	1	7	81	16.17%
Banana	8	20	30	6	3	2	69	13.77%
Mango	1	3	13	0	1		18	3.59%
Sugracane	0	9	1	0	0	0	10	2.00%
Coconut	5	10	12	0	1	2	30	5.99%
Rice	0	2	0	1	0	0	3	0.60%
Rootcrops	1	8	33	0	0	0	42	8.38%
Other fruit bearing tree	0	1	12	0	0	0	13	2.59%
Poultry	4	16	8	1	0	0	29	5.79%

Farm Products	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Swine	0	6	0	0	0	1	7	1.40%
Livestock	0	1	0	0	0	0	1	0.20%
None	0	0	0	0	0	42	42	8.38%
No Answer	40	24	8	42	42	0	156	31.14%
Total	**66**	**125**	**153**	**55**	**48**	**54**	**501**	**100.00%**

*Multiple Response

2.4.4.3 Housing Condition of Survey Respondents

Age of the housing unit. Almost one-third or 32.73% of the housing structure of the respondents has been there for more than forty years while 19.33 % were built for 11 to 19 years ago. Some 16.33% and 15.67% of the total houses of the respondents were built 30-39 years and 20-29 years ago, respectively. The figures are shown in **Table 2-119**.

Table 2-119: Number of Years of the Housing Units of Survey Respondents

Age of Housing Unit	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
5 - 10 years	9	6	6	5	4	2	32	10.67%
11 - 19 years	20	5	5	6	8	14	58	19.33%
20 - 29 years	15	5	2	6	14	5	47	15.67%
30 - 39 years	4	2	5	10	7	21	49	16.33%
40 years & over	2	32	32	19	17	8	110	32.73%
No Answer	0	0	0	4	0	0	4	1.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Tenure of the house. Majority (84.73%) of the respondents owns the houses where they are staying and only 8.36% occupies it for free as shown in **Table 2-120**.

Table 2-120: Ownership of the Housing Units of the Survey Respondents

Type of House Ownership	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Owned	38	46	42	39	40	47	252	84.00%
Rented	3	0	0	9	4	1	17	5.67%
Free Housing	7	3	8	1	4	2	25	8.33%
Others	0	0	0	0	0	0	0	0.00%
No Answer	2	1	0	1	2	0	6	2.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Lot ownership. Over half (48.33%) of the lots occupied by the houses of the survey respondents were owned while 42.67% of them are renting the lots for free as shown in **Table 2-121**.

Table 2-121: Ownership of Lots of the Survey Respondents

Type of Lot Ownership	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Owned	38	41	38	11	7	10	145	48.33%
Rented	3	0	3	11	6	1	24	8.00%
Rent-Free	8	9	9	27	36	39	128	42.67%
Others	1	0	0	1	0	0	2	0.67%
No Answer	0	0	0	0	1	0	1	0.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

2.4.4.4 Education, Health and Sanitation Situation of Survey Respondents

Educational Attainment. Almost half or 45.67% of the survey respondents reached or finished high school while 38.00% studied or finished elementary education. There were 5.33% of them who entered or finished college and only 7.33% attended vocational schooling. The details are shown in **Table 2-122**.

Table 2-122: Highest Educational Attainment of the Survey Respondents

Educational Attainment	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Elementary	9	33	25	26	15	6	114	38.00%
High School	33	12	17	16	25	34	137	45.67%
Vocational	5	3	4	4	6	0	22	7.33%
College	2	1	0	1	2	10	16	5.33%
None	0	0	4	2	1	0	7	2.33%
No Answer	1	1	0	1	1	0	4	1.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Household members experienced sickness. Majority or 39.33% of the respondents answered that two (2) members of the household got sick from the previous year. This was followed by the 20.67% of the responded with only one (1) members of the household experienced illness and 18.00% said that three (3) member got sick last year. Only 3.00% of the respondents answered that no one in the household experienced illness the previous year. Details are presented in **Table 2-123**.

Table 2-123. Household Members of the Survey Respondents Who Experienced Illness

Number	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
1	3	5	7	14	22	11	62	20.67%
2	22	6	23	22	24	21	118	39.33%
3	11	10	14	4	0	15	54	18.00%
4	6	13	2	0	1	0	22	7.33%
5	6	4	1	1	0	1	13	4.33%
6	1	9	0	1	1	0	12	4.00%
7 and up	0	1	0	0	0	0	1	0.33%
None	0	0	1	5	1	2	9	3.00%
No Answer	1	2	2	3	1	0	9	3.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Illnesses experienced by the household members of the respondents. For those who got sick during the previous year, 40.86% of them acquired cough and colds while 36.38% experienced fever. One respondent from Barangay Tagjaguimit specifically identified that a household member suffered from stroke (others). As shown in **Table 2-124**.

Table 2-124: Illnesses experienced by the household members of the Survey Respondents

Illness	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Cough and Colds	43	49	46	42	33	33	246	40.86%
Fever	38	47	42	32	25	35	219	36.38%
Diarrhea	19	30	19	3	6	15	92	15.28%
Infection	1	0	0	16	10	6	33	5.48%
Others	0	1	0	0	0	1	2	0.33%
None	0	0	0	0	1	1	2	0.33%
No Answer	1	0	3	3	1	0	8	1.33%
Total	**102**	**127**	**110**	**96**	**76**	**91**	602	100.00%

* Multiple Responses

Health facilities and providers accessed by survey respondents. Most of the respondents or 56.77% availed of the services of the Barangay Health Center for treatment. About a quarter or 26.40% opted to treat illnesses within their homes. The details are shown in **Table 2-125**.

Table 2-125: Health facilities and providers accessed by the Survey Respondents

Health Facility/ Provider	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Barangay Health Center	44	42	43	11	22	10	172	56.77%
BHW	0	0	0	0	0	1	1	0.33%
Private doctor	1	3	1	1	0	3	9	2.97%
Home	0	0	0	29	22	29	80	26.40%
Hospital	3	5	1	0	3	8	20	6.60%
Herbalist	0	0	0	3	1	2	6	1.98%
No Answer	2	0	5	6	2	0	15	4.95%
Total	**50**	**50**	**50**	**50**	**50**	**53**	**303**	**100.00%**

Water Source. More than half of the respondents (62.00%) source their water through hand-pump deep well followed by a communal water source at 13.67%. Some of the respondents or 12.00% are already connected with the Local Water District as presented in **Table 2-126**.

Table 2-126: Water Source of the Survey Respondents

Source of Water	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Well	3	0	5	10	7	9	34	11.33%
Hand-pump	46	49	20	32	31	8	186	62.00%
Communal	0	1	0	3	9	28	41	13.67%
MCWD	0	0	25	4	2	5	36	12.00%
No Answer	1	0	0	1	1	0	3	1.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Toilet Facility. Table 2-127 shows the type of toilet facilities of the survey respondents. Most of them (90.00%) have the water-sealed toilet facility but there are still 4.33% of them who were using communal toilet facility and 2.67% share common toilet facility with relatives.

Table 2-127. Toilet Facilities of the Survey Respondents

Toilet Facility	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Owned, Water Sealed	42	45	48	37	48	50	270	90.00%
Communal	2	3	1	7	0	0	13	4.33%
Common Toilet with Relatives	5	1	0	1	1	0	8	2.67%
None/Anywhere	0	1	1	4	0	0	6	2.00%
No Answer	1	0	0	1	1	0	3	1.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Waste disposal. Data presented in **Table 2-128** shows the type of garbage disposal of the survey respondents. Majority (65.67%) of them dispose their waste in the common dumpsite while 16.67% dispose it in their own backyard. About 10% of the respondents said that their wastes were collected by the barangay. There were 4.67% who dispose waste through other means or burning.

Table 2-128: Type of Waste Disposal of the Survey Respondents

Type of Waste Disposal	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Collected by Barangay	0	4	0	2	10	14	30	10.00%
Communal Disposal	38	35	28	35	34	27	197	65.67%
Backyard Disposal	7	8	19	2	5	9	50	16.67%
Other - burning	3	3	1	7	0	0	14	4.67%
No Answer	2	0	2	4	1	0	9	3.00%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

2.4.4.5 Perceived Community Problems and Proposed Solutions

Perceived community problems. The table below shows the perceived problems facing the residents in the barangay. Most of the responses identified unemployment (26.13%) and poverty (15.13%) as the main problem in their barangay. The need to train the residents on Solid Waste Management was also identified as a problem with 11.69% of the responses as well as the lack of capitalization for small business (11.00%). Insufficient support for schooling (8.74%) and Lack of support for farming (5.89%) were also a pressing concern. Other specific problems identified are shown in **Table 2-129**.

Table 2-129: Perceived Community Problems of the Survey Respondents

Community Problems	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Unemployment	48	42	45	41	49	41	266	26.13%
Poverty	35	44	42	9	5	19	154	15.13%
Inaccessibility to clean & Drinking water	8	9	4	1	0	0	22	2.16%
Lack of water for irrigation	2	1	1	1	0	1	6	0.59%
Malnutrition	5	5	3	2	2	2	19	1.87%
Limited school supplies	3	1	5	0	1	5	15	1.47%
Insufficient support for schooling	15	29	8	6	9	22	89	8.74%

Community Problems	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Lack of assistance for livelihood	1	1	6	2	2	5	17	1.67%
Limited number of teachers	8	2	0	1	0	2	13	1.28%
Lack of small business capital	26	36	38	2	2	8	112	11.00%
Limited medical supplies	12	13	2	3	4	5	39	3.83%
Lack of transportation facilities (bridge, road)	6	0	5	0	3	11	25	2.46%
Lack of recreational facilities	5	0	3	1	1	7	17	1.67%
Lack of support for farming	16	5	29	2	3	5	60	5.89%
Lack of support for training the People's Organizations	12	3	7	2	1	5	30	2.95%
Lack of training to ensure proper Solid Waste Management	38	38	35	2	3	3	119	11.69%
Others	2	2	1	0	0	1	6	0.59%
No Answer	2	0	2	4	1	0	9	0.88%
Total	**244**	**231**	**236**	**79**	**86**	**142**	**1018**	**100.00%**

* Multiple Responses

Proposed solutions to the community problems. The proposed solutions to the community problems identified by survey respondents are presented in this section. The survey shows that most of the respondents suggest that generating and availability of jobs and setting up livelihood programs (39.57%) in the community are the main solution to the identified problems in the community. Respondents also suggest that support for health (22.75%), support for the education of children (12.92%), support farming (11.44%), Road construction (6.19%) and the availability of clean and drinking water (4.44%) can also be part of the priority programs to help address the problems in their community. The details are shown in **Table 2-130**.

Table 2-130: Solutions to the community problems Proposed by the Survey Respondents

Proposed Solutions	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Jobs and livelihood	57	49	47	45	48	48	294	39.57%
Clean drinking water	12	13	4	0	3	1	33	4.44%
Support for education of children	21	32	9	7	6	21	96	12.92%
Support for farming	23	13	30	4	7	8	85	11.44%
Road construction	17	0	12	4	4	9	46	6.19%
Support for health	49	48	35	4	8	25	169	22.75%
Others	3	0	5	0	0	0	8	1.08%
No Answer	4	0	3	4	1	0	12	1.62%
Total	**186**	**155**	**145**	**68**	**77**	**112**	**743**	**100.00%**

* Multiple Responses

2.4.4.6 Project Awareness

The figure below, **Table 2-131**, shows the level of awareness of the respondents on the proposed project.

Most of the respondents (55.00%) have no prior knowledge about the proposed quarry operations before the conduct of the survey while a little less half (119 or 39.67%) of the total number of the respondents were already aware or have prior knowledge.

Table 2-131: Awareness of the Survey Respondents on the Proposed Quarry Operation

Awareness	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Aware	30	32	7	19	11	20	119	39.67%
Not aware	13	17	41	30	37	27	165	55.00%
No Answer	7	1	2	1	2	3	16	5.33%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

Source of Information. Table 2-132 shows the source of information of the respondents on the proposed project. Majority of the respondents (16.82%) who have prior knowledge about the project before the conduct of the survey sourced their information through community meetings. There are 14.67% of them learned about it through the barangay council members or officials and 12% through word of mouth.

Table 2-132. Sources of Information of the Survey Respondents on the Proposed Quarry Operation

Information Source	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Word of mouth	15	1	5	8	3	4	36	12.00%
Barangay Council or Officials	13	18	3	3	1	6	44	14.67%
Meetings	2	11	1	12	11	11	48	16.00%
Others - Relatives	0	2	0	0	0	0	2	0.67%
No Answer	20	18	41	27	35	29	170	56.67%
Total	**50**	**50**	**50**	**50**	**50**	**50**	**300**	**100.00%**

2.4.4.7 Perceived Advantages and Disadvantages of the Proposed Project

Perceived Advantages. Almost half (43.24%) of the respondents said that the project will provide employment opportunities for the residents of the barangay. There are 14.25% who said that it will create business opportunity and 14.50% of them said that additional income for the barangay will be available. There are 107 respondents who refused to give their answers, Barangay Lamac has the most number of respondents who did not give their answer. The details of the responses for each barangay are shown in **Table 2-133**.

Table 2-133. Advantages of the Proposed Quarry Project Perceived by the Survey Respondents

Advantages	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Employment opportunities	37	24	11	35	37	32	176	43.24%
Livelihood and business opportunities	33	17	4	1	2	1	58	14.25%
Additional income for the Barangay and city/ municipality	32	18	4	2	1	2	59	14.50%
Social development projects in the barangay	1	2	0	0	0	1	4	0.98%
Others	2	0	0	0	0	1	3	0.74%
None	0	0	0	0	0	0	0	0.00%
No Answer	12	13	39	14	13	16	107	26.29%
Total	**117**	**74**	**58**	**52**	**53**	**53**	**407**	**100%**

* Multiple Responses

Perceived Disadvantages. Majority of the responses identify environmental degradation (25.35%) to be the most disadvantageous to the community followed by disturbance of peace and order (12.81%) and loss of jobs and livelihood (3.06%). Some 1.23% of them believe that the project will cause in-migration. There are 0.28% of the responses said that the proposed project has no disadvantages. However, more than half (57.38%) did not provide answers. Higher percentage of responses in Barangay Lamac expressed that the proposed project might result to environmental degradation. **Table 2-134** shows the detailed responses for each barangay.

Table 2-134. Disadvantages of the Proposed Quarry Project Perceived by the Survey Respondents

Disadvantages	Cogon	Tagjaguimit	Lamac	Bulongan	Media Once	Poog	Total	%
Environmental Degradation	4	11	38	7	12	19	91	25.35%
Loss of current sources income	1	0	9	1	0	0	11	3.06%
Disturb peace & order in the community	2	2	5	7	11	19	46	12.81%
Influx of migrants	0	0	4	0	0	0	4	1.11%
None	0	0	0	0	0	1	1	0.28%
No Answer	46	39	11	42	38	30	206	57.38%
Total	**53**	**52**	**67**	**57**	**61**	**69**	**359**	**100.00%**

* Multiple Responses

2.4.4.8 Assessment of Impacts and Mitigating Measures

Displacement of settlers

The proposed site for development is currently upland rural communities. Due to the proposed project, the area will be converted to industrial zones. Based on the initial survey, ten (10) puroks within the six (6) impact barangays will be directly affected by the project in terms of land utilization. The data presented in **Table 2-134** is a result of initial appraisal in the area.

Table 2-134. Purok and Households to be Directly Affected

City/ Municipality	Barangay	Total No. of Purok/Sitio	No. of Affected Purok/Sitio
City of Naga	Cogon	10	1
	Tagjaguimit	7	1
Pinamungahan Municipality	Lamac	20	1
Toledo City	Bulongan	8	1
	Media Once	14	1
	Poog	14	1
TOTAL	6	73	6

However, there are no households that would be affected within these sitios. Despite being within the MPSA boundaries, there are no households that is in the actual quarry area, as specified in the mine plans. Proper buffer areas will be established between the quarry area and the affected houses. There wouldn't be any settlers displaced during the project phases.

In-migration

One possible impact in every development in an area is in-migration. Presence of opportunities for jobs and livelihood brought by the development activity will invite workers from other areas to migrate in the impact Barangays. Influx of workers from other areas is expected during the development and construction phase as well as during the operation phase with the introduction of other economic activities related to the quarry operations.

In-migrants will add to the continuously increasing population of the Barangays and the Cities and Municipality. As observed, the population composition of the impact barangays is expansive, wherein an increasing very young population is manifested. The natural increase in population in the areas will already cause competition in accessing the basic services and available economic opportunities in the areas. With the entry of in-migrants, further competition in terms of local employment, public utilities, and access to basic services will be experienced. Also, in-migration may also lead to proliferation of informal settlers in the project impact barangays. In-migration may also introduce lifestyles and behaviors different from the locals which may lead to social tensions.

To mitigate potential impacts due to in-migration, the following management measures shall be implemented:

- Implement priority local hiring policy for qualified local workers;
- Coordinate with barangay or/and municipal LGU as to relevant ordinance on providing opportunities for local employment;
- Conduct consultation with barangay LGUs on requirements and process of hiring to maximize employment of local residents;
- Require and monitor contractor commitments on providing local employment;
- Coordination with the municipal and barangay peace and order councils to ensure peace and order; and
- Coordination meetings shall also be undertaken regularly with the LGUs to identify threats and vulnerabilities in the society as well as to develop programs to prevent foreseen social problems.

Cultural/lifestyle change

Land use conversions will also impact on the livelihood and job opportunities of the residents in the area. The once farming area will be transformed into an industrialized community. The talents and skills of the existing residents may not be suitable or limited to supply to the needed manpower of the operations. The proponent in coordination with the Public Employment Service Offices of the impact Cities and Municipality will implement a training and skills development program for the residents of the impact Barangay. This will ensure the employability of the impact barangay residents in the proposed project. Also, in order to prevent the proliferation of poor families in the area, the proponent will also provide training and opportunities for livelihood development.

Competition on existing Resources and Basic Services

The existing resources and basic services in the areas are considered limited due to the current financial capacity of the LGUs to develop its natural resources to improve public utilities and the enhancement its basic services to constituents. The entry of the proposed project may cause further competition in the access of these resources and services. On the other hand, the proposed project may also provide opportunities for the development and enhancement of these services to ensure.

Currently, the residents have limited access to water and power supply. Although there are identified water source in the area, the waterworks system has limited capacity to reach other areas in the Municipality. The same with the power supply, a number of residents do not have access to electricity. In terms of basic services, the health sector needs improvement in order to ensure better health services to the residents. In terms of education, the existing classroom-student ration is very low despite the fact that not all children of school age are enrolled in any educational institutions. Also, based on the level of education attained by the residents in the municipality and the barangay, opportunities to access and complete college education are very limited.

The proposed project has already identified measures on how not to compete with the existing resources and services in the community. In terms of power supply, the proponent will put up a power plant to ensure its own supply of power needed for the operations. In terms of water use, additional demand from the proposed project on the existing demand of the communities will be for domestic use only because the proposed project will operate on a closed circuit design, which will allow the plant to recycle approximately 90% of its water supply.

The existence of the project will somehow provide opportunities for the improvement of services on education and health. Enhancement 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 projects as well as the mandatory assistance of the proponent through the Social Development and Management Program and Corporate Social Responsibility Program.

Traffic congestion

The project will cause an increase in traffic given the number of workers to be employed and delivery of some construction materials. This has the potential to add traffic congestion and affect sensitive receptors such as schools and community centers that 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 of construction materials will also be implemented to avoid peak hours/ traffic congestion and minimize the occurrence of accidents. Safety warnings and signage shall be installed.

3 IMPACT MANAGEMENT PLAN

This section presents the Environmental Management Plan (EMP) formulated to minimize the potential adverse impacts of the project and enhance the beneficial effects of implementing the project.

This plan shall be used to systematically manage the implementation of the recommended mitigating measures to address the identified possible environmental impacts of implementing the project considering the proposed modification/expansion.

The EMP as summarized in Table 3-1 shall serve as the implementing guideline to ensure that environmental requirements are met during the project implementation, the management/ mitigating measures stipulated below encompass the existing measures being implemented by the company.

3.1 Land Resources

The municipalities and cities near project area have been host to previous mining operations, hence essential infrastructure like haul roads and access roads are already in place. Perceived impacts on land include: changes in natural topography/slope; inducement of subsidence; vegetation removal; and erosion.

Progressive rehabilitation is currently implemented by the company, same method shall be adopted by the proposed operation wherein a staged treatment of disturbed areas during the mining operations will be implemented rather than undertaking large scale rehabilitation works at the conclusion of the mining activities. Side slopes of roads are maintained to mitigate the possible impacts during construction and operational stages of the project

3.2 Water Resources

The impacts of the Project on water resources focus on siltation and alteration of water quality. The current project operation implements regular monitoring of water bodies near the project area. Also, series of settling ponds were constructed to alleviate the possible siltation of rivers/creek. A proposed settling pond/ silt trap design for the proposed project is presented in **Figure 3-1**.

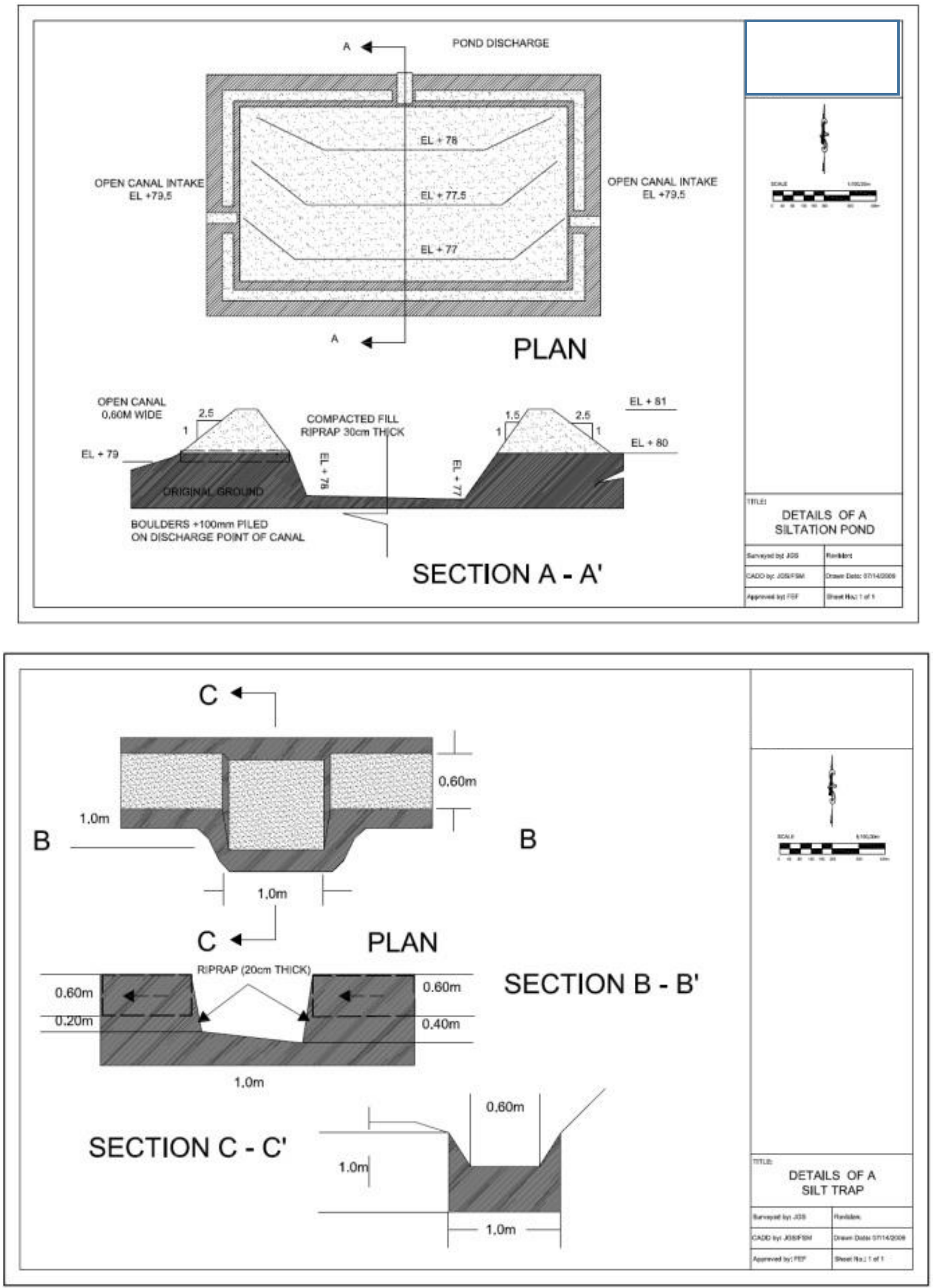


Figure 3-1: Settling Pond / Silt Trap Design

3.3 Air Quality

Possible adverse effects on air and noise quality shall be managed/minimized by implementing the established procedures (i.e. setting of speed limits, scheduling of activities, etc.). Established green belts or buffer zones will also be maintained and enhanced. Regular water sprinkling, covering the trucks with tarpaulin or canvass during transport, proper maintenance of heavy equipment and pollution control devices in the plant will still be carried out.

3.4 Social Development

Significant social impacts include psychosocial impacts and influx of migrant. These shall be mitigated through the continued implementation of the different programs such as the IEC, SDMP, and the established safety, health and environmental programs/procedures.

Table 3-1: Matrix of Major Impacts, Mitigation/Enhancement Measures and Environmental Management Plan

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
I. PRE-CONSTRUCTION						
Exploration Activities	People	Disturbance of livelihood in the exploration area	• Conduct consultation with stakeholders to get their views and comments on the project	QVPI	Php5,000	Pre-operating Expenses
Consultation with stakeholders and affected persons or communities near the project area	People	Community expressed concerns on: - Livelihood - Employment - Waste management	• Conduct focus group discussions and consultation meetings with LGUs and key stakeholders to get their views and comments on how to address their concerns	QVPI	Php50,000	Pre-operating expenses
Acquisition of applicable permits and licenses	People	Disclosure of project components and activities	• Submission of complete requirements for the processing of all permits.	QVPI	Php15 million	Pre-operating expenses
Local sourcing of labor and materials during procurement and planning	People	Local hiring of staff and local purchases of materials	• Priority will be given to the barangays within the primary impact zones. • Local labor requirements shall be posted in barangay halls and other public places.	QVPI	Minimal	Pre-operating expenses
II. CONSTRUCTION						
• Site preparation and construction of mine facilities	Terrestrial biology	• Loss of vegetation due to site clearing • Disturbance/displacement of wildlife	• Annual monitoring of terrestrial flora and fauna • Establishment of buffer zones along the project site perimeter • Include flora and fauna protection programs in SDMP	QVPI; MMT	Php30,000	Included EPEP, ECC condition
	Land	• Generation of unwanted materials	• Materials recovered from vegetation removal can be used as:	QVPI		

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		(solid waste/biomass)	○ trash lines on steep slopes to mitigate soil erosion ○ compost material/surface mulch for immediate soil cover and for improving SOM content of soils			
	Water quality	• Sedimentation of water bodies by eroded soils • Increase water turbidity and total suspended solids • Surface runoffs • Discharge of domestic water	• Erosion control structures such as appropriate drainage, catch basins, oil separators, and sediment settling ponds • Minimized ground clearings and disturbances • Scheduling of construction during dry months • Implement re-use of recovered topsoil for rehabilitation • Use of bio-engineering measures for stabilization/maintenance of side slope of roads (e.g. thru installation of coco-net mattings) • Septic tanks for domestic water	QVPI	Included in the project cost	Included EPEP, ECC condition
	Air quality	• Noise disturbance • Dust generation • Vehicle/equipment emissions	• Strictly implement covering of hauling trucks and water spraying; • Proper maintenance of vehicles and equipment • Provision of dust and noise PPEs to employees • Establishment and maintenance of buffer zones	QVPI		Included EPEP, ECC condition
•	People	• Fear and loss of livelihood and small farm/agroforest lands • Fear of resettlement or relocation of shelters	IEC on the nature and operation of the mine, mitigating measures and benefits	QVPI CRO	Included in the project cost	Included in SDMP and IEC Program

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		• Fear of landslides and flooding due to quarrying activities				
•	Economic	• Opportunity loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works • Generation of employment • Generation of livelihood opportunities spurred by the multiplier effect of the construction activities Local government generation of revenues from fees and permits	• Preferential hiring of qualified barangay residents (LGCP R.A. 7160; 1995 PMA R.A. 7942) • Barangay Consultation on job requirements and qualification • Training to upgrade local skills of residents who can be hired by the project • Development of small and medium enterprises like transport, construction and utility services • Prompt processing of permits and payment of necessary fees	Barangay LGUs; QVPI CRO; TESDA/TLRC	Included in the project cost	Included in SDMP and IEC Program
•	Peace & Order	• Economic activities and other services near the quarry development and construction area that might cause problems on peace	• Coordination with the Barangay LGU to ensure authorized establishments and control of unauthorized entry of outsiders. • Proper induction of construction workers.	QVPI CRO; QVPI Security	Included in the project cost	Included in SHP and EPEP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		and order and security breaches				
•	Health and Safety	• In-Migration • Entry of migrant workers with families which might cause: ○ health problems due to diseases, overuse of public utilities /services, ○ competition of resources, ○ social conflicts, peace and order, ○ increase in pollution due to solid and liquid wastes. • Increase in traffic flow causing air (dust) and noise pollution	• Policy on preferential hiring of locals • Health certificate for workers prior to hiring into the project • Safety and Health Program for workers and impact communities. • Community Health Survey • Monitoring the number of migrant workers to ensure higher percentage of local workers • Increase the number and train Barangay tanods to be deployed in areas where migrant workers reside • Sprinkling of roads during dry seasons • Proper scheduling of delivery trucks to avoid traffic congestion • Assistance to the LGUs on traffic management	Barangay LGUs; Barangay Tanods; QVPI QVPI; QVPI MEPEO	Included in the project cost	Included in SDMP, IEC Program, and EPEP
	Archeological/ Historical/ Cultural Sites	• Possible unearthing of historical artifacts and/or fossil remains	• Safeguard possible archeological site and immediately inform the National Museum in case of finds	QVPI CRO, National Museum	Included in the project cost	Included in EPEP
III. OPERATION PHASE						

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
Surface mining operations include: • land clearing (removal of vegetation), stripping of overburden or waste rock; • surface mining of marble deposits and aggregates; • stockpiling of marble deposits and aggregates; • cutting of marble bancattas; • transport and shipment of produced ores; progressive rehabilitation of mined-out areas	Land	• Removal of topsoil and Vegetation cover • Threat to existence of important local floral species • Loss of habitat, disturbance or displacement of faunal species	• Mining in blocks; • Establishment of stable and impermeable settling ponds adjacent to active blocks; • Progressive revegetation of mined-out blocks; • Establishment of nursery with endemic / indigenous species and native fruit trees;	QVPI	Included in the EPEP budget – Rehabilitation Program Cost	
		• Depletion of marble and aggregates • Alteration of topography; lowering of landform elevation • Erosion and subsequent siltation of waterbodies;	• Unavoidable; apply best mine and mill practice to recover maximum resources • Consider pre-existing natural contour in mine rehabilitation works • Progressive rehabilitation of mine-out areas • Disturbed soils will be replaced and enhanced by adding organic amendments • Erosion control structures	QVPI	Included in the EPEP budget – Rehabilitation Program Cost	ECC; EPEP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		increase surface runoff • Disturbance of soil profile				
•	Geology	• Inducement of subsidence/ collapse • generation of open areas with greater potential for runoff, erosion and landslides	• Implement a suitable and appropriate slope / ground failure monitoring plan to detect instability at an early and non-critical stage so that safety measures could be initiated to prevent or minimize impacts • Familiarize / orient / train mining personnel, staff and workers on recognition of the various slope / ground failure modes, hazard warning signs and standard operating procedures to be observed in the case of ground failure events or impending event; • Identification, early recognition and monitoring of warning signs of potential and impending slope stability problems. • Implement appropriate and safe engineering and geotechnical design; • Formulation and implementation of subsidence control measures including subsidence prediction;	QVPI; MMT	Included in the EPEP budget – Rehabilitation Program Cost	ECC; EPEP; Environmental Occupational Health Plan
		• Sewage and wastewater generation • Solid waste generation	• Provision of septic tanks • Proper disposal of waste recycling, reuse; regular disposal • Toilets/sanitary facilities			QVPI Solid Waste Management Plan;
•	Water	• Increase TSS and turbidity of water • Surface runoffs • Discharge of domestic water	• Erosion control structures such as appropriate drainage, catch basins and sediment settling ponds; mining to be done in stages • Oil separators and septic tanks	QVPI	Included in the EPEP budget	

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		•				
•	Air	• Local increase in TSP and noise levels • Air pollution due construction equipment	• Proper and regular maintenance of equipment • Water spraying; mining activities to be confined during daytime as much as possible • IEC on proper scheduling of hauler trucks to avoid busy and late hours • Maintenance of buffer zones	QVPI	Included in the EPEP budget	
•	Biological	• Vegetation is cleared during mining and smothered by stockpiling • Loss of soil due to erosion would reduce survivability of plants having no substrate to anchor themselves to and obtain nutrients • Loss of habitat to birds and small animals such as lizards & amphibians	• Retain existing vegetation in areas of low mineral content • Rehabilitation of open areas and enrichment planting and reforestation in buffer zones and mined out areas • Fire protection by setting up of fire lines • Establishing check dams in gullies • Establish vegetative bands at least 20 m width along creeks and ravines which would serve as habitats of endangered species of plants & animals • Conduct progressive rehabilitation of mined out parcels • Implementation of ANR particularly in riparian areas • Earth-balling of rare, endemic, threatened species diversity in the project site	QVPI	Included in the EPEP budget	
	Economic	• Enhancement socio-economic welfare of the community • Local government generation of revenues from taxes, permits and	• Implementation of community development programs through Social Development Management Plan equivalent to 1.5% of Operating cost based on the identified needs of the communities • Total taxes paid to the national government will exceed >Excise Tax: 60% goes to the national government; 40%, to the local government--	QVPI CRO; Barangay LGU	Included in the project cost	Included in EPEP, SDMP, SHP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		LGU share in the quarrying activities • Payment of local taxes and fees to Municipal and Barangay Local Government Units • Generation of employment • Generation of livelihood opportunities by putting-up food stalls, variety stores and other services near the quarry area which might cause problems of congestion, peace and order and security breaches	-20% for host Provinces -45% for host Municipalities -35% for host Barangays • Occupation Fees and Real Property Tax to province and municipalities • IEC on nature of jobs the proponents require and qualification • Consultation on job requirements and qualification • Skills training to upgrade local skills of residents that can be hired by the project • Implementation livelihood development programs through the SDMP • Coordination with the Barangay LGUs to monitor issuance of business permits in small- to medium- scale commercial establishments to ensure proper zoning of business areas, peace and order, solid waste management			
	Health and safety	• In-migration • Entry of migrant workers with families which might cause health problems due to diseases, overuse of public utilities /services, competition for resources, social	• Policy on preferential hiring of qualified barangay residents (LGCP R.A. 7160; 1995 PMA R.A. 7942) • Management of entry of migrant workers. • Health certificate for workers prior to hiring into the project. • Proponent provides health clinic with a Doctor, Nurse and Health workers in the quarry area. • Assistance in providing access to health and education services through the SDMP	QVPI CRO; Barangay LGU QVPI Safety and Health Office	Included in the project cost	Included in EPEP, SDMP, SHP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		conflicts, peace and order, increase in pollution due to solid and liquid wastes • Increase in traffic flow, causing air (dust) and noise pollution • Safety and health risks to workers	• Increase and train barangay tanods to be deployed in areas where migrant workers reside. • Buffer zones should be established around the perimeter of the quarry area. • Proper scheduling of hauler trucks to avoid late hours hauling and road congestion. • IEC on the community in terms of traffic safety • Sprinkling of roads during dry seasons • Assistance to the LGU on traffic management • Provision of safety facilities • Provision of PPE to every personnel • Conduct of safety orientation and training • Annual Health Monitoring			
	Climate Change	• Impact of Climate Change: La Niña and El Niño phenomenon and possible consequential disasters	• Integrating Climate Change (DENR EMB MC 5-2011) and Organizing and enhancing capabilities of men and women for Disaster Risk Reduction Management in the Barangays. IEC on DENR Special Order 2007-65, adaptation measures include protection of water aquifer, conduct of massive information and education campaign, establishment of protection measures, determination of the areas most vulnerable to natural hazards "to forewarn people," and strengthening the protection of ecosystems	QVPI CRO; CDRMMC; BDRMMC	Included in the project cost	Included in EPEP, SDMP, SHP
IV. ABANDONMENT PHASE						
• Rehabilitation of mined-out areas • Dismantling of structures	A. Physical	• Replacement of waste rock in underground workings • Erosion of newly replaced soils	• newly restored areas to be equipped with proper drainage and soil erosion control structures			Included in FMRDP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
	B. Biological	• Establishing vegetative cover in the area • Return of the avifauna and increase in population of small animals due to presence of habitat	• Use indigenous species that were once thriving in the area (refer to list of species) • Bring back the habitat of the fauna by increasing vegetative cover			Included in FMRDP
	C. Socio-Economic	• Termination of LGU revenues from taxes, permits and share when the company ceases operation • Loss of Jobs/ Unemployment of mine workers • Loss of market of the established livelihood dependent on the mine operation • Transfer of company social assets/ facilities and services to the community	• Timely announcement and preparation of decommissioning/ Abandonment • Retrenchment Package to be offered to affected employees/workers. • Assistance in job hunting or transfer employment to other projects of the company. • Assistance to employees and their families in establishing livelihood or income generating activities, through capital assistance. • Assistance to the community in establishing market/clients other than the company/ mine operations • Identify diversity of products and services that will cater the needs of the community, adjacent barangays and City proper • Consultation with the community through the BLGU on the social assets/ facilities and services to be transferred, acceptable to them. A Memorandum of Agreement or Deed of Donation will be crafted in order to ensure the responsibility of the community on the sustainable management of the transferred facilities and/or services	QVPI CRO; HR and Finance Office	Included in the project cost	Included in FMRDP

Project Phase/ Activity	Environmental Component Likely to be Affected	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost	Guarantee / Financial Arrangements
		• The loss of employment and job opportunities in the area may result to out-migration to search for jobs in other places • Discontinuation of the social services offered by QVPI through CSR and SDMP	• Establishment of livelihood projects for workers and their families as part of the retrenchment package • Ensure sustainability of the livelihood projects established through the SDMP • Assistance in the strengthening of the BLGU to increase their capacity to manage the social services to be transferred • IEC on the job and livelihood opportunities in accomplishing the final land-use and that the final land-use will spur economic growth to the community • Implement remaining community development activities to support the communities during closure and rehabilitation through the FMRDP Social Plan	QVPI CRO; HR and Finance Office	Included in the project cost	Included in FMRDP

The implementation of progressive rehabilitation is the major key to minimize the impact to nature. Mined out and other affected areas will be rehabilitated as soon as practically possible to avoid prolonged exposure to weathering making the area more impoverished and difficult to rehabilitate.

Rehabilitation of mined out areas will consider planting common, endemic or indigenous plant species. The loss of vegetation in the critical locations will be replaced with proper species suitable to the existing site conditions.

The Project's mining method will involve dividing the mining area into several sub-blocks, wherein at a particular span of time, all the mining activities are concentrated only in a particular block. Such practice will minimize disturbance and it will give ample time for displaced wildlife to transfer to adjacent areas for refuge. The company will ensure that only vegetation within the mining areas will be removed; removal of affected vegetation will be gradual and the adjacent forested area will be conserved. This will serve as transitory habitat for wildlife species.

Mined-out and other affected areas will be rehabilitated as soon as practically possible. The top soil extracted and stored prior to mining will be re-established in the area and planting of vegetation will follow. Seedlings will be planted along with pioneer species along mined out areas to ensure that vegetation will be re-established. Rehabilitation of the area will also guarantee habitat for wildlife in the future.

4 ENVIRONMENTAL RISK ASSESSMENT

The Risk Assessment in this EIA shall consider the hazards of implementing the project with regards to safety, environment and the social aspects, consistent with the requirements of the Philippine Mining Act of 1995 (R.A. 7942) and its Implementing Rules and Regulations.

Risk Assessment is the overall process of risk analysis and risk evaluation.

Risk Analysis is the systematic use of available information to determine how often specified events may occur and the magnitude of their consequences. It is the systematic approach for describing and/or calculating risk. It involves the identification of undesired events, and the causes and consequences of these events.

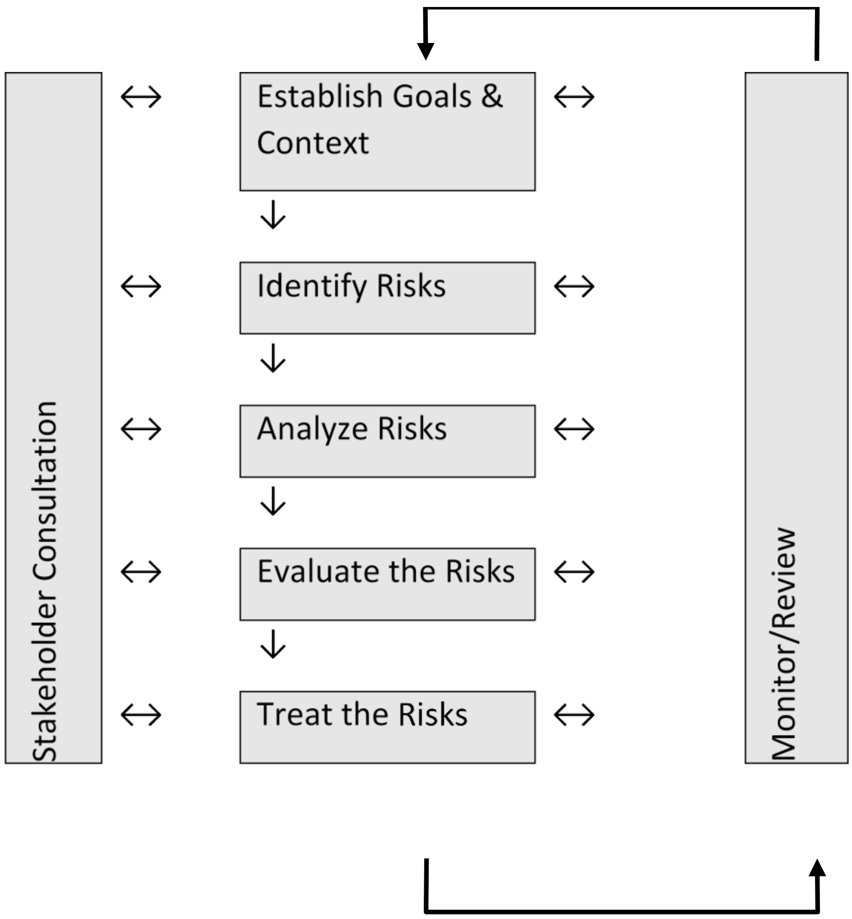
Risk Evaluation is the process used to determine risk management priorities by comparing the level of risk against predetermined standards, target risk levels or other criteria.
In risk assessment the words Hazards and Risks are often used and it is necessary to be clear. In this document, a hazard is anything that has the potential to cause harm and risk is how likely it is that a hazard will cause actual harm.

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 requires considering all of 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.

4.1 Risk Assessment Framework

The guiding framework used in the risk assessment is the Australian / New Zealand Standard for Risk Management (AS/NZS 4360:2004). This Standard was prepared by the Joint Standards Australia / Standards New Zealand Committee OB-007, Risk Management as a revision of AS/NZS 4360:1999. It provides a generic framework for establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risk.

As a guide, the general step in doing the risk assessment is thru the AS/NZS4360:2004 as presented in **Figure 4-1** below:



Based on: AS/NZS 4360: 2004

Figure 4-1: Risk Assessment Framework

Communicate and consult - Communicate and consult with internal and external stakeholders as appropriate at each stage of the risk management process and concerning the process as a whole.

Establish the context - Establish the external, internal and risk management context in which the rest of the process will take place. Criteria against which risk will be evaluated should be established and the structure of the analysis defined.

Identify risks - Identify where, when, why and how events could prevent, degrade, delay or enhance the achievement of the objectives.

Analyze risks - Identify and evaluate existing controls. Determine consequences and likelihood and hence the level of risk. This analysis should consider the range of potential consequences and how these could occur.

Evaluate risks - Compare estimated levels of risk against the pre-established criteria and consider the balance between potential benefits and adverse outcomes. This enables decisions to be made about the extent and nature of treatments required and about priorities.

Treat risks - Develop and implement specific cost-effective strategies and action plans for increasing potential benefits and reducing potential costs.

Monitor and review - It is necessary to monitor the effectiveness of all steps of the risk management process. This is important for continuous improvement. Risks and the effectiveness of treatment measures need to be monitored to ensure changing circumstances do not alter priorities.

4.2 Consequence Rating

Consequence analysis involved the estimation of unwanted consequences, effects, impacts or outcomes of projected major hazard incidents involving specific activities and substances in the facility. Major hazard incidents mean accidents involving hazardous activities or substances that have an impact in terms of death, injury or evacuation of people, damage to property or lasting harm to the environment.

The consequence analysis focused on accident scenarios that involve the release of flammable and explosive substances. Estimated was the consequence of worst-case accident scenario involving the storage and utilization of diesel fuel and on-site blasting activities.

4.3 Risk Characterization

Due to the qualitative nature of this ERA, risk characterization focused on description of the risks associated with the various hazards inherent to activities, substances and conditions at the quarry site. This included natural hazards arising from extreme climate events such as tropical cyclones, flooding, landslides and storm surges; as well as from earthquakes.

4.4 Hazard Identification

4.4.1 Marble and Aggregates Quarry

Hazards associated with the marble and aggregates quarry component include mass movement of soil and rocks, release of sediments from settling ponds, occupational safety hazards, and fire due to storage/utilization of flammable substances, particularly liquid fuel.

Fire hazard is chiefly attributable to storage of diesel and lube oil. Occupational safety hazards may occur at the various project phases and processes from ground clearing to mineral extraction. Outcomes from occupational safety hazards include deaths and injuries resulting from ground/structure failure, fall from heights, being struck or crushed by equipment parts or falling rocks/debris, vehicular/ equipment accidents, and others. Mass movement of soil/ rocks/ sediments may result from breach of containing walls of impoundment and berms, overburden storage facilities and settling ponds. It may also arise as a direct result of mineral extraction activities. Such incidents may be triggered by natural events such as inclement weather conditions (heavy and sustained rains, typhoons, storm surges, etc.), earthquakes and subsidence; faulty engineering design; inadequate maintenance of structures; and sabotage. The water bodies could also become heavily silted with sediments.

4.4.2 Hazard Analysis Matrix

The hazards and risks associated with the various quarry activities, processes and conditions are listed in the **Table 4-1.**

Table 4-1: Hazard Analysis Matrix

Hazard Classification/ Unit Operation	Major Hazards	Initiating/ Contributing Factors	At Risk Sector
1. Storage of Liquid fuel (Diesel)	Fire and explosion following major releases/ spills	Presence of ignition sources; breach of containment; mechanical impacts; exposure to fires and high heat; corrosion; defective or substandard tank materials; breach of bund walls; vandalism	- Persons, equipment, and structures within the hazard area.
2. Waste and overburden dumps and stock yards	- land and rock slides - siltation of surface water bodies;	Heavy rains, typhoons, earthquakes, defective engineering design.	- Surrounding communities, personnel and workers - Ecological entities
3. Settling and Wastewater Ponds	Breach of containment of ponds and drainage system could cause flooding of low-lying areas, siltation, and	natural disasters (earthquakes, extreme weather); engineering problems; sabotage	- surface waters - aquatic ecological entities - surrounding communities

Hazard Classification/ Unit Operation	Major Hazards	Initiating/ Contributing Factors	At Risk Sector
	contamination of surface water bodies.		
4. Occupational Safety Hazards			
A. Site Preparation			
a. Surveying	- fall from heights - vehicular accidents	inherent geological formations; adverse weather conditions; human error; vehicular failure	- surveying team
b. Clearing and Grubbing	- being struck by falling trees, debris and equipment part -vibration and noise from power saws and other equipment -vehicular and equipment accidents (overturning, fall from heights, etc.)	human error; equipment failure; adverse weather conditions	- clearing team
c. Laying Out	- fall from heights; being struck by vehicles and earth moving equipment - vehicular and earth moving equipment accidents -electrocution	human error, equipment/ vehicular failure breach of protocols	- workers, drivers, and operators on site
B. Open Pit Surface Quarry			
a. Drilling and Excavation	- fall from the edge of a bench - being struck by falling rocks/debris at the foot of a face - inhalation of and contact with dusts which predisposes the respiratory system - Harmful noise levels - Being struck by a moving part of the drilling equipment	Human error, breach of protocols, equipment failure, face instability	- Drilling operators and assistants
b. Blasting	- physical harm - collateral damage from debris - inhalation of dust - damage to structures	Human error, breach of protocols, equipment failure	- Quarry workers - Nearby community
c. Mineral Extraction	-inhalation of and contact with dust which could predispose the respiratory system	lack of or inappropriate protective equipment	- Mining pit operators and workers, neighboring communities

Hazard Classification/ Unit Operation	Major Hazards	Initiating/ Contributing Factors	At Risk Sector
d. Mineral Loading	- Being struck by falling rocks from loading arm - falls while gaining access to operator's cabin -vehicular accidents	breach of protocols, human error, failure of hydraulic system, and other equipment uneven ground	- driver, operator, assistants, trespassers
e. Hauling and Transport	- Vehicular accidents (fall from edge of bench, collision with other vehicles or structures, overturning, etc.) - inhalation of and/or contact with dusts - high level noise	incompetent driving, heavy rains and flooding, trespassing, breach of protocols brake failure	- driver, pedestrians, driver of smaller vehicles,
f. Stockpiling	- inhalation of and contact with dust which could predispose the respiratory system	airborne dusts especially with strong winds	- workers, nearby communities
5. Natural calamities due to extreme climate events (as predicted in years 2020 and 2050)			
Increased frequency and intensity of tropical cyclones	- flooding of low lying areas; rock and landslides	poor engineering design and zoning, poor maintenance of structures, defective warning systems; infrastructures along riverbanks and flood plains	- personnel and workers of the project; contractors, nearby communities
Increased intensity and frequency of rains during rainy season	- flooding of low lying areas; rock/ landslides; increased soil erosion and loss of fertility	-same as above-	-same as above- - farmers
Drier dry seasons and increased ambient temperatures	- fire incidents; increased airborne dusts; drying of water reservoirs and sources	presence of ignition sources, especially near storage of fuel and chemicals; indiscriminate disposal of live cigarette butts inadequate dust suppression system; forest/ vegetation denudation	- personnel, workers, contractors, nearby communities
Natural Calamities due to Earthquakes	- collapse of infrastructures and buildings; spillage of fuel	poor engineering design and zoning; poor maintenance of	-same as above

Hazard Classification/ Unit Operation	Major Hazards	Initiating/ Contributing Factors	At Risk Sector
	predisposing to fires; landslides; tsunami	structures and equipment; location of buildings and other infrastructures	

4.4.3 Risk Screening of Hazardous Substances at the Project Site

A risk screening procedure was undertaken to determine the type of environmental risk assessment to be undertaken and to prioritize the environmental risks presented by the various hazardous substances and activities. The criteria and process used in risk screening was primarily based on Annex 2-7e (Guidelines for the Conduct of Environmental Risk Assessment) of the Revised Procedural Manual of DAO 2003-30. The screening criteria for hazardous substances are (1) inherent hazardous characteristics of the substance and (2) maximum quantity involved. After classifying the substances according to defined categories (i.e. flammable, oxidizing, toxic, etc.), their respective maximum inventories were compared to DENR’s threshold inventory levels (Levels 1 and 2), which are defined in the Revised DAO 2003-30 guideline. A facility that will manufacture, process or store any hazardous substance in excess of DENR's Threshold Inventory Level 2 is required to undertake a quantitative risk assessment. Those with any hazardous substance exceeding Level 1 threshold inventory but below Level 2 threshold inventory is required to undertake Hazard Analysis Study, and Emergency/Contingency Plan based on the study and worst-case scenario. For substances with maximum inventory below Level 1, a risk screening and emergency plan based on hazard analysis is required.

As far as hazardous substance is concerned, QVPI will only store and use diesel, a substance that is considered as flammable. Diesel will be used as fuel for vehicles, generator sets and equipment at the quarry site. Maximum inventory of diesel at the Plant site is minimal at approximately 700 tons. Given these data, the ERA Coverage was determined as Level 1.

4.4.4 Hazardous Characteristics of Diesel

Diesel is a moderately flammable liquid fuel. The National Fire Protection Agency (NFPA) of the U.S.A. assigns to diesel a Flammability Rating 2 (ignites when moderately heated). Distillation temperature of diesel at 90% point is between 282-338°C. Its minimum flash point temperature is 52°C. Its other physic-chemical and toxicological properties are listed in **Table 4-2**. Fuel oil is less flammable than diesel.

Table 4-2: Physico-chemical and Toxicological Properties of Diesel

Property	Value/ Description
CAS RN No(s).	68334-30-5; 68476-30-2; 68476-31-3
UN Number	1993
Maximum Inventory at the Site	50 m3
Flammability Designation/Code	Moderately Flammable
Flash Point, °C	52
Lower flammability limits in air (%)	1.3
Upper flammability limits in Air (%)	6
Autoignition Temperature, °C	254-285
Boiling/Condensation point (°C) at 1 atm	282-338
Specific gravity (liquid)	0.841 at 16°C
Vapor pressure	0.0028 bar at 21°C

Sources: CAMEO Chemical Inventory; NREL Liquid Fuels Database, 2007.

4.4.4.1 Fire and Explosion Hazards of Diesel

Vapor cloud explosions and vapor cloud fires are not significant hazards to this particular substance and activity due to the low vapor pressure of the liquid (0.042 psia at 21°C). The more probable accident scenario for this type of substance is a pool or tank-top fire.

Hazards from fires are associated with their direct heating effect, by convection within the fire itself, and thermal radiation from the fire. In case of fire engulfment, the effects of fire on humans are usually on the skin and on the lungs. Smoke rather than the fire itself is the most common cause of death indoors. Fires emit radiation, which can produce considerable impact on nearby equipment and may cause harm to people. Thermal radiation levels and their damaging effects on equipment and people are described in **Table 4-3** (CCPS-AIChE, 1994).

Table 4-3: Effects of radiation from fire.

Incident Flux (KW/m2)	Type of Damage Caused	
	Equipment	People
37.5	Damage to process equipment (steel structure, piping, vessels, etc,) after several minutes of exposure.	100% fatality in 1 min.; 1% fatality in 10 sec.
25.0	Minimum energy level to ignite wood at indefinitely long exposure without flame	100% fatality in 1 min.; Significant injury in 10 sec.
12.5	Minimum energy to ignite wood with a flame; melts or degrades plastic materials	30% fatality in 1 min.; 1st degree burns in 10 sec.
10.0		People will feel pain after 5 seconds and receive second degree burns after 14 seconds. Usually used to define the fatality zone, as

Incident Flux (KW/m2)	Type of Damage Caused	
	Equipment	People
		this level is expected to quickly cause third degree burns leading to potential fatalities
5.0		People will feel pain after 13 seconds and receive second degree burns after 40 seconds. Usually used to define the injury zone.

Sources: Taylor, 1994; USEPA, et al., 1990; World Bank Technical Paper No. 55.

4.4.4.2 Health Hazards of Diesel

The NFPA Health Hazard Rating of Diesel is 1 (slightly hazardous). This slight health hazard is mainly attributable to its volatile organic compound components (VOCs) which comprise about 1.5% of its total weight. These VOCs are benzene, toluene, ethylbenzene, xylene and other alkylbenzenes. The acute effects of exposure to high level concentration of various solvents are generally very similar. High level exposure usually results to disorientation, euphoria, giddiness and confusion, progressing to unconsciousness, paralysis, convulsion, and death from respiratory or cardiovascular arrest. Chronic exposure to levels above the threshold level values may result to specific organ toxicity. The hazardous VOC components of diesel, which may exert deleterious health impacts, are benzene, toluene, ethylbenzene and xylene.

Benzene is a proven human carcinogen. It is classified as a very hazardous substance. Toxicity to benzene frequently results from inhalation of its vapors with some undefined contribution from skin absorption. Acute exposure to high levels of benzene vapors may result to depression of the central nervous system, leading to unconsciousness and death, or death through cardiac arrythmias. The major toxic effect of benzene, however, is its hematopoietic toxicity resulting from chronic exposure to benzene vapors. Among the simple aromatic hydrocarbons, hematopoietic toxicity is unique to benzene. Chronic exposure to benzene leads to bone marrow damage, which may show initially as anemia, leukopenia, or thrombocytopenia. Continued exposure may result in pancytopenia which may eventually lead to bone marrow aplasia, a usually fatal condition. Bone marrow depression induced by benzene appears to be dose- and time dependent. Leukemia induced by exposure to benzene has been noted in humans. In mice and rats, chronic benzene exposure through inhalation and per oral has been shown to produce solid tumors in nonhematopoietic organs.

Alkylbenzenes like toluene, ethylbenzene, isopropylbenzene, trimethylbenzene and xylene are relatively non-toxic except during acute exposure to high concentrations. This could be because their major metabolic pathway is toward metabolites that have low toxicity and are readily excreted. Unlike benzene, they have not been demonstrated to be carcinogenic. Acute exposure to very high levels of these substances could result to acute toxicity manifested by central nervous system (CNS) depression, symptoms typical of acute solvent toxicity. Long term exposure could lead to CNS function impairment (Cragg et. al. 1989; Bardodej and Cirek 1988).

4.4.5 Mass Movement of Rocks and Soil from Overburden and Waste Dump Sites

Waste rocks and soil materials generated from mining and beneficiation/ sizing activities to be disposed into a series of waste dump stockpiles or used as backfill. Major hazards associated with mine waste dumps are mass movement of rocks and soil (eg. landslides and rockslides), soil erosion and runoffs. Such events could be initiated by natural hazards such as earthquakes, heavy rains and typhoons, and breaching of berms. Rock slides and landslides can result to loss of lives and injuries, siltation and contamination surface waters, and damage to terrestrial and aquatic environments. The disturbed condition of soil and rocks at mine sites also predisposes to mass movement of rocks and soil at the site, especially during inclement weather conditions and earthquakes. Such events could put to risk the workers at the site, as well as the mining equipment.

4.4.6 Flooding and Mass Release of Sediments from Settling Ponds

The quarry areas will be equipped with drainage systems that will drain into settling ponds to mitigate the impacts of surface runoffs that could lead to soil erosion, siltation and pollution of water bodies. Breaching of settling ponds could lead to flooding and mass release of sediments. Factors that may contribute to such accidents are natural hazards like strong earthquakes, long duration heavy rains, strong typhoons, faulty engineering design, and sabotage.

Mass release of sediments and flooding can result to injuries, heavy siltation of affected surface water systems, and destruction and siltation of affected terrestrial and aquatic environments.

4.4.7 Occupational Safety Hazards

Occupational safety issues involving the project are listed in the Hazard Analysis Matrix (**Table 4-1**). Occupational safety issues associated with quarry activities include fall from heights; rock falls and soil movement accidents; vehicular/equipment accidents; being struck by equipment parts, debris, etc.; respiratory, eye and skin ailments; and hearing impairment due to high intensity noise.

4.4.8 Natural Hazards Due to Extreme Climate Events

The increasing frequency and intensity of extreme climate events are being attributed as direct consequences of global climate change, which is primarily due to global warming. As stated by the Manila Observatory (2010) in its paper Technical Primer on Climate Change in the Philippine, "Climate change will increase the magnitude and frequency of weather hazards to an unknown degree". This phenomenon poses an increased risk of disasters in the Philippines, as risk is not only proportional to the magnitude of events but on the number of people affected and their capacity to recover from the impacts of an event.

Other direct impacts of climate change in the Philippines are significant increases in frequency of high extreme ambient temperature (>35oC), which manifests as significant increase in the frequency of hot days and warm nights; drier dry seasons; and wetter rainy seasons. Based on climate modeling conducted by PAGASA for the various regions of the Philippines, annual mean temperatures are expected to rise by 0.9 degrees Celsius to 1.1 degrees in 2020 and by 1.8 degrees to 2.1 degrees in 2050" (Hilario, et al., n.d.). PAGASA likewise predicted that "the drier seasons of March-April-May will become drier still, while the wetter season of Sept- Oct. and November will become wetter" (Hilario, et al., n.d.)

Projected Hazards by 2020

The projected increased rainfall intensity during the wet months implies greater risks from hazards brought about by flooding, landslides, soil erosion, siltation of surface water bodies, and loss of soil fertility. The unusually drier periods during the dry months, coupled with ambient temperature extremes, implies greater risks from fire, low water supply, greater airborne dusts, drying up of water reservoir, and dry season related diseases (i.e. respiratory ailments, heat strokes, etc.).

Projected Hazards by 2050

The period from 2036 to 2065 is predicted to experience a decrease in rainfall in the months of March to May. The rest of the months will experience increases in rainfall, with the rainiest months being September to November. The decrease of rainfall in the dry months, coupled with increased frequency in the occurrence of high extreme temperatures, could result to greater risks from drying up of surface water bodies, fire, greater airborne dusts, and diseases that thrive during the dry and hot seasons (i.e. respiratory ailments, heat strokes, prickly heat, nose bleeding, exacerbation of heart conditions, etc.). Assuming that the mining operations in the area is still ongoing, this could also mean greater risks from occupational safety and health hazards, as workers become more prone to fatigue, dizzy spells, dehydration, and heat stroke in extremely hot conditions. They may also suffer more from skin irritations and contact dermatitis, due to increased sweating and more airborne dusts. The temperature rise is expected to bring about an increase in the frequency, strength and range of tropical cyclones (Manila Observatory, 2010).

4.5 Risk Management

The risk assessment conducted showed that risks expected from the project are relatively low and can be prevented and/or controlled with application of appropriate mitigation measures. In particular, risk from explosion and fire hazards associated with fuel storage and utilization are low and manageable. Other hazards identified are mass movement of rocks and soil, flooding and mass release of sediments from settling ponds, occupational safety hazards, and natural calamities.

The control and prevention of project-associated risks is dependent on the Company’s resolve and capability to pursue their risk management and emergency plans. It would be for the interest of the Company and the surrounding communities that identified risks be appropriately mitigated and/or prevented. Major considerations in risk reduction are appropriate project design; compliance with standards in the design, construction and maintenance of the mining equipment and facilities; well-maintained safety systems; well-trained and motivated workforce; and the establishment of an appropriate emergency response and contingency systems. To prevent and/or control the identified risks and hazards in the marble and aggregates quarry of QVPI should continue to vigorously pursue the implementation of its Safety and Health Program and its Emergency Preparedness and Response Plan that are already in place.

4.5.1 Recommendations

Hazards associated with the marble and aggregates quarry are mass movement of soil/rocks from the quarry sites; mass release of sediments from settling ponds; flooding; occupational safety hazards; fire/explosion hazards from storage liquid fuel (diesel), exposure to dusts; siltation and contamination of surface water bodies; soil erosion and loss of soil fertility; and natural calamities, especially during extreme climate events; and exposure to high intensity noise.

Occupational safety hazards may occur at the various operation units from the quarry site. Outcome of occupational safety hazards include deaths and injuries resulting from ground/structure failure, fall from heights, being struck or crushed by equipment parts or falling rocks/debris, vehicular/equipment accidents, and others. Mass movement of soil and rocks may occur quarry sites and in disturbed elevated areas. Mass release of sediments and flooding may arise mainly due to breach of containing walls of impoundment and dikes especially at settling ponds. Such incidents may be triggered by natural events such as extreme climate events (torrential rains, strong typhoons, storm surges, etc.) earthquakes and subsidence; faulty engineering design; inadequate maintenance of structures; and sabotage. Water contamination could result from the release mining overburden and wastes to water bodies. The surface water bodies could also become heavily silted. Fire/explosion hazards may arise from the storage and utilization of coal and liquid fuel (diesel).

Particular recommendations to mitigate and manage identified hazards are listed in Table 169

Table 4-4: Identified hazards and corresponding mitigating measures

Hazard Classification/ Unit Operation	Major Hazards	Mitigating Measures
A. Fire and Explosion		
1. Liquid Fuel Storage (Diesel)	Fire following major releases/ spills	- Remove/reduce ignition sources in the area. - Ensure regular inspection and maintenance bund containments (bund capacity should at least be 110% of the tank's capacity). - Ensure regular inspection and maintenance of tanks, piping, hoses, valves, gauges and other accessories. - Maintain a safety radius or buffer zone around the facility. - Ensure provision of fire control devices and systems. - Ensure strict adherence to Emergency Preparedness and Response and Plan (EPRP) - Ensure maintenance of properly functioning fire trucks, fire extinguishers and other fire- fighting equipment.
2. Blasting	- physical harm - collateral damage from debris - inhalation of dust - damage to structures	- Maintain a safety radius or buffer zone during blasting schedule. - Ensure provision of fire control devices and systems. - Ensure strict adherence to Emergency Preparedness and Response and Plan (EPRP)

		- Ensure maintenance of properly functioning fire trucks, fire extinguishers and other fire- fighting equipment.
B. Flooding and Mass Movement of Rocks and Soil		
1. Stockpiles	- land and rock slides - siltation of surface water bodies;	- Ensure regular inspections and proper maintenance of containment berms. - Batter off final stockpile slope to at most 20 degrees. - Use wastes and overburden as backfill. - Ensure proper siting of the stockpile
2. Settling Ponds	- Breach of containment of ponds and drainage system could cause flooding of low lying areas; and siltation and contamination of surface water bodies	- Ensure appropriate siting, design and construction of the facilities. - Ensure regular, as well as emergency inspections and monitoring of structures - Ensure proper and regular maintenance of the facility. - Strictly implement security measures to prevent sabotage of infrastructures.
C. Occupational Hazards		
1. Site Preparation		
a. surveying	- fall from heights - vehicular accidents	- Ensure that vehicles used are well maintained and suitable for the terrain. - Strictly implement safety protocols.
b. Clearing and Waste Stripping	- being struck by felling trees, debris and equipment part - vibrations and noise from power saws and other equipment - vehicular and equipment accidents (overturning, fall from heights, etc.)	- Adopt and implement the safest methods/ technology. - Ensure that persons doing specialized tasks (eg. Tree felling) are fully trained. – Use of well- maintained equipment. - Ensure use of personal protection gears
c. Laying Out	- fall from heights; being struck by vehicles and earth moving equipment - vehicular and earth moving equipment accidents - electrocution	- Use of well- maintained and suitable equipment and vehicles. - Use of properly trained crew and operators, especially drivers of large equipment like cranes and earth moving vehicles.
2. Open Pit Mining Operation		
a. Drilling and Excavation	- fall from the edge of a bench - being struck by falling rocks/debris at the foot of a face - inhalation of and contact with dusts which predisposes to respiratory diseases - Harmful noise levels - Being struck by a moving part of the drilling equipment	- Use of well- maintained and suitable equipment and vehicles. - Use of properly trained crew and operators, especially drivers of large equipment like cranes and earth moving vehicles.
b. Mineral Extraction	- inhalation of and contact with dusts, which could	- Ensure use of appropriate personal protection equipment.

	predispose to respiratory diseases	- Use of appropriate equipment and vehicles with protective operator cabin.
c. Loading	- Being struck by falling rocks from loading arm - falls while gaining access to operator's cabin - vehicular accidents	- Ensure that drivers are well- trained. - Ensure use of appropriate and properly maintained vehicles and equipment. - Ensure implementation of safety protocols.
3. Transport Minerals	- Vehicular accidents (fall from edge of bench, collision with other vehicles or structures, overturning, etc.) - inhalation of and/or contact with dusts - high level noise	- Avoid operation during inclement weather. - Maintain proper security and cordon off hazardous areas. - Ensure good maintenance and regular testing vehicles, especially of brakes. - Driver/operator cabs are protected from dusts and heat. - Restrict access to vehicles
4. Mineral Stockpiling	- inhalation of and contact with dusts, which could predispose to respiratory diseases	- Provide workers and operators with personal protection equipment (e.g. masks, gloves, goggles).
D. Natural Calamities Due to Extreme Climate Events		
1. Increased frequency, intensity and range of tropical cyclones	- flooding of low lying areas; rock and landslides	- Ensure regular review of the Project's ERPP to ensure its adequacy and effectiveness to respond to changing situations.
2. Increased intensity and frequency of rains during wet season	- flooding of low lying areas; rock/landslides; increased soil erosion and loss of soil fertility	- Ensure strict implementation of and compliance with the safety and health program, especially the EPRP. - Ensure regular and timely inspections and monitoring of containment dikes, retaining walls, and other retaining structures. - Ensure that all personnel, workers and contractors are properly oriented of the EPRP and ensure the regular conduct of emergency drills for situations such as fires, tsunami, flooding and earthquakes. - Conduct seminars, workshops, and other education/ information campaigns on climate change, its impacts and appropriate responses to mitigate impacts (tailored to the specific condition in the area).
3. Drier dry seasons and increased ambient temperatures	- fire incidents; increased airborne dusts; drying of water reservoirs and sources; increased diseases (i.e. respiratory, skin diseases, heat strokes, dizzy spells other diseases linked with hot, dry seasons)	- Ensure the implementation of the rehabilitation and reforestation program of mined-out areas and other denuded areas. - Strictly implement fire prevention and control measures and protocols. - Ensure strict implementation of dust suppression measures. - provide personnel protective equipment to workers, especially dust masks, eye goggles.
E. Earthquakes and Tsunamis	- collapse of infrastructures and buildings; spillage of fuel predisposing to fires; landslides; tsunami	- Formulate and implement an earthquake and tsunami emergency response plan that includes the following: monitoring and warning system; system of communication within and outside the mine site; SOPs for all personnel, workers and contractors; and evacuation plan. - Conduct regular and timely orientation and drills of all personnel, workers, contractors, as well as

		nearby communities, on the earthquake/tsunami emergency response plan and procedures. - Ensure regular and timely inspections and monitoring of all buildings and infrastructures within the mine site. - Ensure proper zoning and location, as well as good engineering, of buildings and other infrastructures.

5 SOCIAL DEVELOPMENT PLAN AND IEC IMPLEMENTATION

5.1 Existing SDP and IEC

The following tables presents the current SDMP and IEC projects implemented by QVPI on the host community. Most of the SDP activities involve infrastructures for the impact barangays. The company also started a radio program that serves as their main IEC activity. The “Ikaw Ug Mina” program discusses the benefits of mining to the community.

Table 5-1: Summary of SDMP Activities

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
2006	Roofing materials for the basketball court of Barangay Uling	completed	2,072	Uling	5,000.00	25,000.00
	Establish candle & soap products	completed	35	Uling	5,000.00	5,000.00
YEAR 2006 TOTAL					**10,000.00**	**30,000.00**
2008	Construction Materials for the improvement of Brgy. Hall of Tagjaguimit	completed	2,960	Tagjaguimit		50,000.00
YEAR 2008 TOTAL						**50,000.00**
2009	**Livelihood Program**		50			
	Establish sub-crop farming	completed		Tagjaguimit	16,000.00	
	Establish livelihood for livestock	completed		Tagjaguimit	16,000.00	
	Establish candle & soap products	completed		Tagjaguimit	12,000.00	
	Infrastructure	completed				
	Brgy. Uling			Uling		
	Construction of Brgy. Hall	completed	5,400	Uling	40,000.00	30,348.00
	Street lightings	completed		Uling		7,250.00
	Road repair and maintenance	completed		Uling	25,000.00	37,029.10
	Brgy. Tagjaguimit					
	Construction of Brgy. Hall	completed	2,960	Tagjaguimit		22,950.00
	Street lightings	completed		Tagjaguimit		
	Road repair and maintenance	completed		Tagjaguimit	12,500.00	104,542.00
	Other SDMP Related Activities					

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Educational Assistance					
	Financial Assistance	completed	2	Uling	5,000.00	20,346.10
	Incentives			Uling & Tagjaguimit	5,000.00	
	Health and Sanitation					
	Dental & Medical Mission	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	30,000.00	
	Health Seminars	completed			6,000.00	
	Meeting/ Consultation with barangay	completed			4,000.00	
	Sports Program	completed	5,164	Uling & Tagjaguimit	4,000.00	27,800.00
	Cultural Heritage	completed	5,164	Uling & Tagjaguimit	4,000.00	3,000.00
	Other Community Assitance					
	City of Naga	completed		City of Naga		9,719.10
	Brgy. Balirong	completed		Brgy. Balirong		48,950.38
	Brgy. Alpaco	completed		Brgy. Alpaco		102,028.85
YEAR 2009 TOTAL					**179,500.00**	**413,963.53**
2010	**Livelihood Program**					
	Establish sub-crop farming	completed		Tagjaguimit	30,000.00	
	Establish livelihood for livestock	completed		Tagjaguimit	24,000.00	
	Establish candle & soap products	completed	15	Tagjaguimit	26,000.00	2,000.00
	Infrastructure					
	Brgy. Uling					
	Construction of Brgy. Hall	completed	5,400	Uling	20,000.00	864.00
	Street lightings	completed		Uling	15,000.00	
	Road repair and maintenance	completed		Uling	62,500.00	101,491.00
	Brgy. Tagjaguimit					
	Road construction & school building	completed	2,960	Tagjaguimit		143,174.00
	Street lightings	completed		Tagjaguimit		
	Road repair and maintenance	completed		Tagjaguimit	62,500.00	57,500.00
	Other SDMP Related Activities					
	Educational Assistance					
	Financial Assistance	completed	2	Uling & Tagjaguimit	12,500.00	
	Incentives	completed	2	Uling & Tagjaguimit	12,500.00	

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Health and Sanitation					
	Dental & Medical Mission	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	75,000.00	7,273.25
	Health Seminars	completed			15,000.00	
	Meeting/ Consultation with barangay	completed		Uling & Tagjaguimit	10,000.00	
	Sports Program	completed	5,164	Uling & Tagjaguimit	10,000.00	
	Cultural Heritage	completed	5,164	Uling & Tagjaguimit	10,000.00	35,000.00
	Other Community Assitance					
	City of Naga	completed		City of Naga		12,500.00
	Brgy. Lanas	completed		Brgy. Lanas		2,000.00
	Brgy. Balirong	completed		Brgy. Balirong		26,236.70
	Brgy. Alpaco	completed		Brgy. Alpaco		12,841.80
	YEAR 2010 TOTAL				**385,000.00**	**400,880.75**
2011	**Livelihood Program**					
	Establish sub-crop farming	completed	10	Tagjaguimit	6,000.00	2,000.00
	Establish livelihood for livestock	completed		Tagjaguimit	6,000.00	
	Establish candle & soap products	completed		Tagjaguimit	4,000.00	
	Infrastructure					
	Brgy. Uling			Uling		37,170.00
	Construction of Brgy. Hall	completed	5,400	Uling		
	Street lightings	completed		Uling		1,025.00
	Road repair and maintenance	completed		Uling	12,500.00	176,556.45
	Diesel Allocation	completed		Uling		8,944.38
	Brgy. Tagjaguimit					
	Road construction & school building	completed	2,960	Tagjaguimit		184,890.00
	Street lightings	completed		Tagjaguimit		
	Road repair and maintenance	completed		Tagjaguimit	12,500.00	206,675.80
	Other SDMP Related Activities					
	Educational Assistance	completed				10,350.00
	Financial Assistance	completed	2	Uling & Tagjaguimit	2,500.00	3,000.00
	Incentives	completed	2	Uling & Tagjaguimit	2,500.00	
	Health and Sanitation					7,700.00

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Dental & Medical Mission	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	15,000.00	3,000.00
	Health Seminars	completed			3,000.00	
	Sports Program	completed	5,164	Uling & Tagjaguimit	2,000.00	19,750.00
	Cultural Heritage	completed	5,164	Uling & Tagjaguimit	2,000.00	171,909.50
	Other Community Assitance					
	City of Naga	completed		City of Naga		9,000.00
	Brgy. Lanas	completed		Brgy. Lanas		2,500.00
	Brgy. Balirong	completed		Brgy. Balirong		127,363.75
	Brgy. Alpaco	completed		Brgy. Alpaco		47,300.70
	San Fernando	completed		San Fernando		3,000.00
	Pinamungajan	completed		Pinamungajan		13,000.00
	DENR 7	completed		DENR7		2,000.00
YEAR 2011 TOTAL					**68,000.00**	**1,037,135.58**
2012	**Livelihood Support**					14,080.90
	Establish sub-crop farming	completed	15	Tagjaguimit	6,000.00	
	Goat Raising	completed		Tagjaguimit	8,000.00	
	Establish & support sewing machine	completed	10	Uling	6,000.00	
	Infrastructure Support					193,868.29
	Re-construction of Brgy. Hall	completed	2960	Tagjaguimit		
	Replacement of Streetlights	completed		Uling	5,000.00	
	Road repair & maintenance	completed		Uling & Tagjaguimit	25,000.00	
	Others SDMP Related Activities					
	Educational Assistance					13,350.00
	Financial assistance to scholar	completed		Uling & Tagjaguimit	2,500.00	
	Incentives to deserving students	completed		Uling & Tagjaguimit	2,000.00	
	Health and Sanitation					
	Medical Mission in coordination with health organization (private/public)	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	15,000.00	576,000.00
	Health Seminars	completed			1,000.00	
	Information, Education, Communication					

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Radio Program in coordination with MGB	completed	Region 7	Region VII	6,500.00	6,500.00
	Meeting / Consultation w/ concerned barangay	completed		Uling & Tagjaguimit	2,000.00	2,000.00
	Sports Program	completed	5400	Uling & Tagjaguimit	5,000.00	5,000.00
	Cultural heritage	completed	5400	Uling & Tagjaguimit	5,000.00	5,000.00
YEAR 2012 TOTAL					**89,000.00**	**815,799.19**
2013	**Livelihood Support**					
	Establish sub-crop farming	completed	40	Tagjaguimit	50,000.00	69,410.00
	Livelihood for livestock	completed	20	Tagjaguimit		
	Establish & support sewing machine	completed		Uling	100,000.00	
	Infrastructure Support					103,894.00
	Renovation of Day care/ infra buildings/ schools & etc	completed		Uling & Tagjaguimit	100,000.00	
	Street, school lights & etc	completed		Uling	25,000.00	
	Road repair & maintenance	completed		Uling & Tagjaguimit	25,000.00	
	DMTG	completed			30,000.00	30,000.00
	Others SDMP Related Activities					
	Educational Assistance					
	Financial assistance to scholar	completed	3	Uling & Tagjaguimit	50,000.00	60,419.26
	Incentives to deserving students	completed	4	Uling & Tagjaguimit	10,000.00	10,000.00
	Health and Sanitation					
	Dental & Medical Mission in coordination with health organization (private/public)	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	96,000.00	384,000.00
	Health Seminars	completed			96,000.00	96,000.00
	Sports Program					
	Support & assist brgy. Sports events	completed	5,400	Uling & Tagjaguimit	25,000.00	25,000.00
	Cultural Heritage					
	Support & assist brgy. Cultural events	completed	5,400	Uling & Tagjaguimit	150,000.00	100,000.00
YEAR 2013 TOTAL					**757,000.00**	**878,723.26**
2014	**Livelihood Support**					
	Establish & support livelihood for sub-crop farming & high value crops	completed	50	Tagjaguimit	50,000.00	26,294.50
	Establish livelihood for livestock (Goat Raising)	completed	50	Tagjaguimit		
	Establish & support livelihood for Sewing machine	completed	10	Uling	100,000.00	54,500.00

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Infrastructure Support					
	Renovation of Day Care/infra. Buildings schools and etc	completed	150	Uling & Tagjaguimit	100,000.00	156,090.00
	Street Lights & schools & etc	completed	150	Uling	5,000.00	57,012.00
	Road repair & maintenance	completed	5,400	Uling & Tagjaguimit	25,000.00	287,100.28
	Development of Mining Technology Geosciences	completed	1	Uling	30,000.00	96,385.00
	Educational Assistance					
	Financial Asistance	completed	3	Uling & Tagjaguimit	50,000.00	42,894.14
	Incentives to deserving students/ pupils	completed	4	Uling & Tagjaguimit	10,000.00	11,109.36
	Health & Sanitation					
	Medical program in coordination w/ heath organization private/ public	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	409,600.00	421,500.00
	Health Seminars	completed			14,400.00	19,207.50
	Sports Program					
	Support & assistance to barangay sport events	completed	5,400	Uling & Tagjaguimit	50,000.00	50,000.00
	Cultural Heritage					
	Support & assistance to barangay cultural events	completed	5,400	Uling & Tagjaguimit	150,000.00	41,289.00
	Other Community Assistance					
	City of Naga	completed	250	City of Naga		71,500.00
	Mandaue City	completed	10	Mandaue		20,000.00
	San Fernando	completed	25	San Fernando		5,730.00
	Lanas	completed	30	Lanas		8,567.00
	Alpaco	completed	40	Alpaco		17,301.00
YEAR 2014 TOTAL					**994,000.00**	**1,386,479.78**
2015	**Livelihood Support**					
	Establish & support livelihood for sub-crop farming & high value crops	completed	55	Uling & Tagjaguimit	100,000.00	13,600.00
	Establish livelihood for livestock	completed	55	Uling & Tagjaguimit		
	Support livelihood for ALS w/c initiated by LGU	completed	40	Uling	104,600.00	104,600.00
	Infrastructure Support					
	Renovation of Day Care/infra. Buildings schools and etc	completed	5,400	Uling & Tagjaguimit	150,000.00	175,000.00
	School Facilities/ streetlights & etc	completed	5,400	Uling & Tagjaguimit	50,000.00	90,036.70
	Road repair & maintenance	completed	5,400	Uling & Tagjaguimit	200,000.00	72,650.47

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Educational Asistance					
	Financial Assistance/ scholars	completed	3	Uling & Tagjaguimit	66,000.00	62,000.00
	Incentives to deserving students/pupils	completed	3	Uling & Tagjaguimit	25,000.00	17,210.00
	Financial Assistanc to Day Care Teacher	completed	1	Uling	55,000.00	55,000.00
	Health and Sanitation					
	Medical support in coordination w/ health organization private/ public	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	480,000.00	13,294.00
	Health - Regular doctors consultation	completed			14,400.00	13,200.00
	Feeding Program	completed			48,000.00	48,000.00
	Sports Program					
	Support & assistance to barangay sports events	completed	5,400	Uling & Tagjaguimit	50,000.00	50,000.00
	Cultural Heritage					
	Support & assistance to barangay sports events	completed	5,400	Uling & Tagjaguimit	100,000.00	100,000.00
	Development of Mining Technology Geosciences					
	Financial Assistance to deserving student	completed	1	Uling & Tagjaguimit	120,000.00	97,045.60
	Other Community Assistance					9,719.00
YEAR 2015 TOTAL					**1,563,000.00**	**921,355.77**
2016	**Livelihood Support**					
	Establish & support subcrop farming	completed	55	Tagjaguimit	100,000.00	
	Establish livelihood for livestock	completed	55	Tagjaguimit		66,000.00
	Support Alternative Livelihood System	completed	45	Uling	45,000.00	47,700.00
	Infrastructure Support					
	Construction of Barangay Health Center	completed	2,960	Tagjaguimit	200,000.00	206,875.00
	Renovation of Day Care Center, schools & etc	completed	5,400	Uling & Tagjaguimit	44,000.00	96,412.00
	Street, School Lights & Maintenance	completed		Uling	46,100.00	66,236.00
	Road repair & maintenance	completed		Uling & Tagjaguimit	46,100.00	53,566.00
	Development of Mining Technology Geosciences					
	College Scholarship	completed	1	Uling	120,000	112,876
	Others SDMP Related Activities					
	Educational Assistance					
	Financial assistance to scholar	completed	3	Uling & Tagjaguimit	12,500.00	18,250.00
	Incentives to deserving students	completed	3	Uling & Tagjaguimit	25,000.00	27,000.00

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Financial assistance to Day Care	completed	1	Uling	55,000.00	69,340.00
	Health and Sanitation					
	Medical Support	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	192,000.00	195,142.00
	Health (regular Medical Consultation)	completed			14,400.00	14,400.00
	Feeding Program	completed	102		48,000.00	48,000.00
	Sports Program					
	Assistance to Brgy. Sports events	completed	5,400	Uling & Tagjaguimit	50,000.00	57,000.00
	Cultural Heritage					
	Asistance of Cultural events	completed	5,400	Uling & Tagjaguimit	50,000.00	52,000.00
	Other Community Assistance					301,742.00
YEAR 2016 TOTAL					**1,048,100.00**	**1,432,539.00**
2017	**Livelihood Support**					
	Support sub-crop farming of high value crops	completed	55	Tagjaguimit	60,000.00	-
	Support livelihood for livestock	completed	55	Tagjaguimit	60,000.00	60,000.00
	Support Alternative Livelihood System	completed				
	Pipefitting & structural Fabrication	completed	45	Uling	100,000.00	18,975.00
	Infrastructure Support					
	Continuation construction of Brgy. Health	completed	2,960			
	Center extension			Tagjaguimit	75,000.00	75,000.00
	Maintenance of day Care Center, school	completed				
	and etc. / ALS Support		150	Uling	60,000.00	53,822.00
	Street and school lights Maintenance /	completed				
	Barangay beautification		74	Uling	10,000.00	1,197.90
	Road repair and Maintenance	completed	5,400	Uling & Tagjaguimit	35,000.00	22,553.00
	Development of Mining Technology Geosciences					
	College Scholarship	completed	1	Uling	60,000.00	73,120.03
	Others SDMP Related Activities					
	Educational Assistance					
	Financial assitance to scholar	completed	3	Uling & Tagjaguimit	72,000.00	29,000.00
	Incentives to deserving students	completed	3	Uling & Tagjaguimit	15,000.00	14,995.65
	Financial assistance to Day Care Teacher	completed	1	Uling	60,000.00	66,000.00

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Brigada eskwela	completed	3	Uling, Tagja, Cogon	10,000.00	3,774.00
	Health and Sanitation					
	Medical Support	completed	all residents	Uling, Tagjaguimit, Mayana, Balirong, Alpaco, Lutac	280,000.00	467,266.00
	Feeding Program	completed	75	Uling & Tagjaguimit	48,000.00	48,000.00
	Sports Program	completed	5,400	Uling & Tagjaguimit	50,000.00	50,000.00
	Cultural Heritage	completed	5,400	Uling & Tagjaguimit	35,000.00	35,000.00
	Community Development Assistance	completed				
	Support for basic health & medical care & services at VCMMC (Vicente Mendiola Memorial Hospital)	completed	all residents	City of Naga	280,000.00	280,000.00
	Pinamungajan Medical Mission	completed		Pinamungajan	60,000.00	60,000.00
	Pinamungajan Feeding Program	completed		Pinamungajan	60,000.00	60,000.00
	Contingency funds	complied		Uling	50,000.00	29,693.50
YEAR 2017 TOTAL					**1,480,000.00**	**1,488,397.08**

Table 5-2: Summary of IEC Activities

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
2009	**IEC**					
	Radio Program	completed	Region 7	Region VII	6,500.00	12,500.00
	Pulong-pulong					
	Advertisement					
YEAR 2009 TOTAL					**6,500.00**	**12,500.00**
2010	**IEC**					
	Radio Program	completed		Region VII	32,500.00	
	Pulong-pulong					
	Advertisement					
YEAR 2010 TOTAL					**32,500.00**	
2011	**IEC**					
	Radio Program	completed		Region VII	6,500.00	6,500.00
	Meeting in w/ consultation w/ concerned barangay	completed			2,000.00	

Year	Program/Projects/Activities	Status	No. of Beneficiaries	Brgy. Covered	Planned Budget (Php)	Actual Cost (Php)
	Advertisement					
YEAR 2011 TOTAL					**8,500.00**	**6,500.00**
2012	**IEC**					
	Radio Program in coordination with MGB	completed	Region 7	Region VII	6,500.00	6,500.00
	Meeting / Consultation w/ concerned barangay	completed		Uling & Tagjaguimit	2,000.00	2,000.00
YEAR 2012 TOTAL					**8,500.00**	**8,500.00**
2013	**IEC**					
	Radio Program in coordination with MGB	completed	Region VII	Region VII	13,000.00	13,000.00
	Meeting / Consultation w/ concerned barangay	completed	20	Uling & Tagjaguimit	2,000.00	2,000.00
YEAR 2013 TOTAL					**15,000.00**	**15,000.00**
2014	**IEC**					
	Radio Program in coordination with MGB	completed	Region VII	Region VII	13,000.00	13,100.00
	Meeting/ Consultation w/ concerned barangay	completed	20	Uling & Tagjaguimit	2,000.00	2,000.00
YEAR 2014 TOTAL					**15,000.00**	**15,000.00**
2015	**IEC**					
	Radio Program in coordination with MGB	completed	Region VII	Region VII	70,000.00	22,449.00
	Meeting/ Consultation w/ concerned barangay	completed			10,800.00	10,000.00
YEAR 2015 TOTAL					**80,800.00**	**32,449.00**
2016	**IEC**				15,000.00	
	Support one radio program	completed	Region VII	Region VII		
	Meeting / Consultation LGU's	completed	31,465	Sibago, Lamac, Cogon, Tagjaguimit, Bulongan, Media Once, Poog	230,500.00	184,260.00
YEAR 2016 TOTAL					**245,500.00**	**184,260.00**
2017	**IEC**					
	Support One (1) Radio Program	completed		Region VII	23,000.00	-
	Meeting/ Consultation w/ concerned barangay	completed		Uling & Tagjaguimit	67,000.00	33,792.36
YEAR 2017 TOTAL					**1,170,000.00**	**1,482,189.44**
2018	**IEC**					
	Meeting/ Consultation w/ concerned barangay	completed	**212**	Cogon, Campo 8, Media Once, Poog	45,000.00	44,250.00
YEAR 2018 TOTAL					**45,000.00**	**44,250,00**

5.2 Social Development Program

5.2.1 Indicative Social Development Plan

As mandated by law, the proponent has to formulate and implement a five-year Social Development and Management Program (SDMP). In essence, Indicative Social Development Plan (ISDP) of QVPI will be realized through the SDMP.

It is the goal of the SDMP is to assist the community to attain socio-economic growth during the time of mine development and address the various possible socio-economic issues raised by the stakeholders. Its formulation has to be in consultation with the various stakeholders taking into consideration the existing barangay and/or city/municipal development plans. In so doing, the SDMP will be a significant part of the medium and long-term development of the concerned barangays and the city/municipality.

The implementation, monitoring, and evaluation of the SDMP will be executed in coordination and partnership between the company, through its Community Relations Staff and various stakeholders (i.e. LGUs, government agencies). Through this system, the participation and awareness of the stakeholders regarding the various aspects of the Project is ensured and will develop a sense of ownership of the community to the SDMP Programs/Projects/Activities (P/P/As). In this manner, the sustainability of the SDMP P/P/As will be made certain.

The SDMP of QVPI shall be formulated to provide assistance in improving the socio-economic status of the residents within the six (6) impact barangays. The indicative Programs/Projects/Activities to be implemented in the SDMP/ISDP of QVPI is presented in **Table 5-3**.

Table 5-3: Indicative Social Development Plan/ Social Development and Management Program – Programs/Projects/Activities

Concerns	Community Beneficiary	Community Member Responsible	Government Agency/ Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
Unemployment/ Lack of Livelihood						
• Gender Responsive Livelihood / Employment and Credit Facilities (Men, Women, Youth & Elderly) • Employment and skills development • Skills training program: to give local residents of project-impact barangays the chance to qualify and compete for available employment opportunities during the implementation of the project or in other areas	• Affected Men, Women, Youth & Elderly	• Barangay officials • Association Chairperson	• LGU City/Municipal Planning and Development Office • Host Barangays • City/Municipal Social Worker Department (C/MSWD) • TESDA, TLRC, DOST, and DSWD	• QVPI Community Relations • Officer	• Pre-construction • Construction • Operation	• LGU –IRA/ Proponent
Health Services						
• Medical and dental missions • Skills enhancement for barangay health workers • Support to the Rural Health Unit programs and activities • Support to the improvement of health facilities • Conduct campaign on good health and sanitation	• Host Barangay	• Barangay Officials • City/Municipal and Barangay Health Workers	• City/Municipal Health Office (C/MHO) • Barangay Disaster Risk Reduction and Management Councils • Host Barangays	• QVPI Community Relations Officer • QVPI Safety and Health Officer	• Pre-construction • Construction • Operation	• LGU –IRA/ Proponent
Education						

Concerns	Community Beneficiary	Community Member Responsible	Government Agency/ Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
• School supplies donation for underprivileged children • Assistance for development/improvement of school facilities (day care centers, existing schools) • Provision of scholarship to qualified students • Capacity building of teachers • Non-formal education for adults	• Project Affected Families	• Barangay Officials (specifically the Council Member for Education)	• Department of Educaiton (DepEd) • Host Barangays	• QVPI Community Relations Officer	• Pre-construction • Construction • Operation	• LGU –IRA/ Proponent
Environment, Health and Sanitation						
• Implementation of Solid Waste Management in compliance to Republic Act 9003 • Good Housekeeping and Sanitation	• Project Affected Community	• Barangay Officials (specifically the Council Member for Environment)	• Environment and Natrual Resources Office (ENRO) • C/MHO • Host Barangays	• QVPI Community Relations Officer • QVPI Mine Environmental Protection and Enhancement Officer / Pollution Control Officer	• Pre-construction • Construction • Operation	• LGU –IRA/ Proponent
Resettlement						
• Implementation of Resettlement Action Plan for affected tenants/households	• Baragays Alfaco, Cogon, Tagjaguimit in the City of Naga; Barangays Camugao, LAmac, and Sibago in the	• Barangay Councils • Affected Tenants and Households	• LGU Municipal (City/Municipal Planning and Development Office) • Inter-agency Committee for Resettlement (C/MSWD, C/MHO, C/MAO, C/MENRO, C/ME, PNP, DepEd	• QVPI Community Relations Officer	• Pre-construction	• LGU/ Proponent

Concerns	Community Beneficiary	Community Member Responsible	Government Agency/ Non-government Agency and Services	Proponent	Indicative Timeline	Source of Fund
	Municipality of Pinamungahan, and Barangays Bulongan, Bunga, Media Once, and Poog in Toledo City.					

5.3 Information and Education Campaign (IEC)

Implementation of an intensive and consistent IEC Plan is the key to build a positive rapport with the impact communities and other stakeholders. Through this, an open communication line is established between QVPI, Barangay and City/Municipal LGUs, and the residents of impact barangays. An open communication ensures accessibility of bringing community concerns to the attention of the company. It is also a way for the Company to communicate efforts and activities that addressed community concerns, intervention to avoid or mitigate negative impacts of the operations, as well as to enhance positive impacts through a strong partnership with the impact communities.

QVPI is currently implementing IEC activities with the direct impact communities through continuous community meetings and interactions. Also, as part of its commitment to disseminate information about Responsible Mining in the Philippines, QVPI provides sponsorship and patronizes the Radio Program: "Ikaw ug ang Mina".

The IEC activities of QVPI will be based on the IEC framework outlined in **Table 5-4**.

Table 5-4: Indicative IEC for the QVPI Mining Project

Target Sector Identified as Needing Project IEC	Major Topics of Concern in Relation to Project	IEC Schemes/ Strategy/ Methods	Information Medium	Indicative Timeline and Frequency	Indicative Cost
• Local Government Units • Project affected communities • Non-Government Organizations • Relevant National/Regional Government Agencies (i.e. EMB and MGB)	• Environmental Impact Assessment (EIA) Process • EIS Report Findings • Projects description (i.e. projects components, size/coverage, capacity, among others)	• Inclusive and Participatory	• Invitation letters • Audio-visual presentation • IEC materials of the Project's information	• Prior to project construction and implementation	• Cost of meals • Cost of IEC materials
• Local Government Units • Project affected communities • Non-Government Organizations	• Projects impact and mitigating measures • Projects primary and secondary impact areas	• Inclusive and Participatory	• Invitation letters • Posters	• Prior to project construction and implementation	• Cost of meals • Cost of IEC materials
• Local Government Units, • Host and Neighboring Communities • All Sectors of Affected Communities (i.e. Youth, Women, Senior Citizen) • Non-Government Organizations Relevant National/Regional Government Agencies (i.e. EMB and MGB)	• Projects SDMP coverage, implementation and source of fund	• Inclusive and Participatory	• Invitation letters • Posters • MMT and Mine Rehabilitation Fund Committee (MRFC) memorandum and official communication	• During the SDMP approval process • Regular consultation after SDMP approval	• Cost of meals • Cost of honorarium • Cost of transportation • Cost of venue
• Local Government Units • Project affected communities	• Projects Environmental Protection and Enhancement Program (EPEP) /	• Inclusive and Participatory	• Invitation letters • Posters • MMT and Mine Rehabilitation Fund	• During the EPEP approval process • Every quarter upon the approval	• Cost of meals • Cost of honorarium • Cost of transportation • Cost of venue

Target Sector Identified as Needing Project IEC	Major Topics of Concern in Relation to Project	IEC Schemes/ Strategy/ Methods	Information Medium	Indicative Timeline and Frequency	Indicative Cost
• Relevant National/Regional Government Agencies (i.e. EMB and MGB)	• QVPIs Environmental Policy		Committee (MRFC) memorandum and official communication		
• Local Government Units • Project affected communities • Relevant National/Regional Government Agencies (i.e. EMB and MGB)	• Projects Safety and Health Program (SHP) • QVPIs Safety and Health Policy	• Inclusive and Participatory	• Invitation letters • Posters • MMT and Mine Rehabilitation Fund Committee (MRFC) memorandum and official communication	• During the EPEP approval process • Every quarter upon the approval	• Cost of meals • Cost of honorarium • Cost of transportation • Cost of venue

5.4 Complaints Resolution

At the time of this application, there is only one formal complained against the proponent back in 2011. The complaint was filed for an alleged indiscriminate blasting. The complaint was received in March 2011, and went through investigations by MGB. The case was eventually resolved by October of the same year, and resolution is attached as **Annex 12**.

6 ENVIRONMENTAL COMPLIANCE MONITORING

This section presents the proposed framework for compliance monitoring of the project including environmental performance indicators and standards of environmental parameters necessary to monitor the identified key environmental impacts of the proposed project and modification.

As required under DENR Memorandum Circular 2010-14 and the Revised Procedural Manual for DAO 2003-30, and as a pro-active tool in minimizing/eliminating adverse project consequences to the environment, an "Environmental Quality Performance Level" (EQPL) has been identified for each critical parameter associated with identified significant project impacts. The limit level shall be the regulated threshold of pollutant (standard that must not be exceeded) while the action level is set lower than the limit level wherein management measures must be implemented so as not to reach the regulated threshold.

Also, the following mechanisms and monitoring schemes are discussed:

- Environmental Monitoring Plan
- Multi-sectoral Monitoring Framework
- Environmental Guarantee and Monitoring Fund Commitment

6.1 Environmental Performance (Parcel 1)

Parcel 1 is already in operation, covered with ECC 07-07-07-02-0263-303-A. The operation in this area only covers 14.02 hectares out of the 81 hectares allotted, as of June 2017. Monitoring documents are regularly being submitted to the DENR EMB Region 7, which includes the Compliance Monitoring Report (CMR) and the Self-Monitoring Report (SMR). The latest of which, at the time of this writing, is the CMR for the period of January to June 2017.

According to the CMR, the majority of the waste generated on Parcel 1, are liquid and solid wastes, particularly used oil, items with lead and mercury compounds, grease trap wastes, and domestic wastes. QVPI's reported domestic wastes generated for the period of January to June is 183.2kg. The generated waste were segregated, and disposed of properly through the LGU's Material Recovery Facility (MRF), and the used oil was collected by a DENR-approved transporter.

The company strictly implements and complies with the conditions specified in the issued ECC, the table below summarizes the company's ECC compliance:

Table 6-1: Summary of Compliances to ECC Conditions

Condition/Requirement/Commitment	Compliance Status and Summary of Actions Taken
1. Soil/mud from tires of truck and equipment shall be removed before leaving the area.	Implemented on day to day operations.
2. Indigenous trees species and ornamental plants shall be planted at the strategic location of the project site to compensate the loss of vegetation within the area to be quarried.	Assigned Nursery Tender do the tree planting and monitoring of all trees planted.
3. A private nursery with at least Five Thousand (5,000) seedlings shall be established at the project site one (1) month after project implementation and tree planting activities shall be conducted at potential areas.	Already complied through National Greening Program.
4. All hauling trucks shall be provided with tank contained with water to be used for spraying trucks' wheel while in transit on the rough road.	Conditional
5. All hauling trucks shall be covered with canvass or any equivalent materials while in transit.	Complied with
6. Siltation pond shall be constructed to collect run off water.	Complied with
7. Proper benching pattern shall be implemented.	Complied with
8. Proper stockpiling of spoils shall be conducted.	Complied with
9. Stripped overburden shall not be left in the slope of the bench or road so that corrosion will not occur.	Complied with
10. Drainage system shall be constructed at strategic places to prevent run-off water from causing erosion.	Complied with (visible at the Quarry Area leading to the silt pond. This is also part of EPEP compliance)
11. A licensed blaster shall be assigned to monitor the blasting operation.	Implemented whenever there's a blasting activity.
12. Wet cutting shall be employed.	Implemented
13. Quarry safety rules and regulations shall be enforced.	The company's safety officer diligently imposes what's best with regards to safety at the quarry operation.
14. Safety skills training shall be provided and annual safety and health program shall be implemented.	Complied with Reflected to the Report on Safety submitted to MGB Office)
15. Proper equipment servicing and maintenance practices shall be implemented.	Complied with
16. Blasting firing procedures, fly rocks prevention measures, warning procedures and notifications and soft or light (controlled) blasting shall be strictly implemented.	Implemented whenever there's blasting activity
17. That in the blast hole loading procedures, unauthorized or unwanted personnel will not be allowed within the blasting area.	Implemented whenever there's blasting activity
18. That safe handling, storage and use of explosives and blasting agents and the after blasting procedures should be properly implemented.	Implemented whenever there's blasting activity

Condition/Requirement/Commitment	Compliance Status and Summary of Actions Taken
19. The proponent operations shall conform to the provision of RA 9003 (Act Providing for an Ecological Solid Waste Management Program), RA 9275 (Philippine Clean Water Act of 20014) and RA 8749 (Philippine Clean Air Act of 1990).	All legal and necessary permits were acquired and implemented as can be reflected in the SMR submitted to EMB office)
20. The proponent shall make available a budget of One Hundred Fifty-Four Thousand (154,000.00) Pesos based on the project schedule as indicated in the submitted Environmental Management Plan Summary for the implementation of the project and proposed mitigating measures in the operational and abandonment phase. An accomplishment report on the implemented mitigating measures and the corresponding cost of the EMP activities shall be submitted to this Office on quarterly bases for monitoring.	Complied with As reflected on the Monitoring Trust Fund (MTF) and Rehabilitation Cash Fund (RCF).
21. The proponent shall undertake an effective and wide Information, Education and Communication (IEC) Campaign to explain publicly its mitigating measures as well as the condition of the ECC. It shall open opportunities to educate the public especially the affected community, interested academic institutions and other parties on the environment and human health safety features of the project.	Sponsorship or patronizing radio program (Kalambuan Sa Mina)
22. The proponent shall set-up an Environmental Unit before project implementation who shall handle the environmental aspects of the project, which shall have the following responsibilities: a. Monitoring requirements as defined under the EMP; b. Monitor actual project impact vis-a-vis predicted impacts and management measures in the EMP. c. Make recommendation for the revision of the EMP as necessary. d. Ensure that the post assessment permits are in place. e. Ensure that monitoring and reporting are undertaken. f. Ensure compliance to all the conditions.	Complied with
23. That a 2'x4' billboard containing this message: "Notice to Public, This project (title of the project) of (Name of the proponent) has been issued an Environmental Compliance Certificate (ECC Number) by the Environmental and Management Bureau of the Department of Environment and Natural Resources, Region	Complied

Condition/Requirement/Commitment	Compliance Status and Summary of Actions Taken
VII. This message must be installed at all entry and exit points and at all perimeters of the project facing the road to inform the general public within before the project implementation. A copy of this certificate shall be also posted by the Proponent at the Barangay bulletin board of the affected barangays within thirty days from receipt of the certificate. Furthermore, proponent shall provide copies of the approved ECC to the government agencies concerned such as; DOLE, LGUs concerned, DENR, MGB, CENRO-Toledo City, PENRO -Cebu and PENRO Capitol. An accomplishment report which shall include picture verification of compliance to the posting of notices and the billboards shall be submitted to this office within ninety days from receipt of the ECC.	
24. In case of abandonment, the Proponent shall notify the EMB Reginal Office concerned within three (3) months prior to the abandonment and the Proponent shall submit its abandonment mitigation plan.	This will be implemented on the abandonment stage of the project
25. No other activities should be undertaken other that was stipulated in the submitted IEE document. Should there be an expansion of the Project beyond the project description, construction of other structures beyond those stated in the IEE document or any change in the activity shall be made subject to a new Environmental Impact Assessment.	Complied with – part of this EPRMP
26. In case of Transfer of ownership of this project, these same convictions and restrictions shall apply and the transferee shall be required to notify the EMB Regional Office concerned within fifteen (15) days as regards to transfer of ownership	No transfer of ownership

6.2 Environmental Monitoring Plan

The Environmental Quality Performance Levels (EQPLs) presented below for the Self–Monitoring Plan is only applicable for Effluent and Emissions regulations. The limit indicated in the EQPL range represents the DAO 90-35 standards for the particular parameter as well as Clean Air Act standards for the emissions. It should be noted that the values for the EQPL alert and action are only indicative values to be used as a guide in the management scheme and will be further revised or updated during project implementation.

Table 6-2: Environmental Monitoring Plan

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
I. Construction Phase														
Land	Clearing of vegetation and earth moving activities; change in land use	Decrease in diversity and abundance Possible extirpation of species	**Flora:** Biodiversity indices, species richness and abundance Rehabilitation and restoration works to establish forest cover **Fauna:** Biodiversity indices, species richness and abundance	Sampling and interviews	Semi-annual	Baseline sampling stations	Proponent thru MEPEO; MMT; Third party consultant	150,000 / sampling	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
Water	Generation of turbid run-off, discharge of turbid waters from settling ponds; other discharges from project	Siltation and contamination from petroleum spilling / washing and domestic sewage	pH, temp, DO, BOD, TSS, Oil and Grease, coliforms,	Grab sampling method; laboratory analysis	Quarterly	Baseline sampling stations / or may vary depending on the final project design (i.e. where appropriate)	Proponent thru MEPEO; MMT	100,000 / monitoring	BOD = 40 mg/L Oil and grease = 3 mg/L Total coliforms = 600 MPN/100 mL TSS=more than 10% increase	BOD = 45 mg/L Oil and grease = 4 mg/L Total coliforms = 800 MPN/100 mL TSS=more than 20% increase	BOD = 50 mg/L Oil and grease = 5 mg/L Total coliforms = 1,000 MPN/100 mL TSS=not more than 30% increase	Investigate the source and identify possible pollutant sources	Investigate the source If the problem is within the operation area, conduct adjustments/ appropriate corrective action at identified pollutant source Reconduct sampling / water quality monitoring	Temporarily stop activities contributing to the pollutant load Evaluate existing mitigation measures for possible need for additional mitigation measures If the source is not related to the project, inform MMT regarding possible source for the group's investigation and coordination with the LGU
Air	Increased vehicular traffic and excavation activities	Dust generation; vehicle emissions; noise generation	TSP, NO_2 , SO_2 , and noise	1-hr ambient averaging period	Quarterly	Baseline sampling stations / or may vary depending on the final project design (i.e. where appropriate)	Proponent thru MEPEO; MMT	25,000 / monitoring	TSP= 200µg / Ncm NO_2= 140 µg / Ncm SO_2= 240 µg / Ncm	TSP= 250µg / Ncm NO_2= 200 µg / Ncm SO_2= 290 µg / Ncm	TSP= 300µg / Ncm NO_2= 260 µg / Ncm SO_2= 340 µg / Ncm	Check equipment operations	Implement appropriate corrective action	Corrective action on the quarry operation
People	Site preparation (clearing, grubbing and	<u>Psycho-social concerns due to Physical and</u>	IEC conducted	FGDs, KIIs, Household survey (when	Annual	Impact communities	Proponent through CRO	150,000 per monitoring	Manifestations/ observations during	Incident Report	Complaint Received	Implement measures	- Verify and validate report	Investigate - Take action based on the

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	stripping of topsoil) Construction of mine facilities/ haul roads Stockpiling of topsoil	<u>socio-economic disruption from change in land use</u> • Fear and loss of livelihood and small farm/agroforest lands Fear of landslides and flooding due to quarrying activities		necessary) examination of official records and documentation					monitoring activities			to arrest possible occurrence of negative impact	- Implement measures to arrest negative impact	result of investigation - Assess the degree of impact - Implement measures to mitigate negative impact - Provide necessary assistance to the community Coordinate with MMT and MGB Central Office
People		<u>Economic</u> • Opportunity loss of income from agricultural activities due to removal of crops and use of the land for mine development and road works • Generation of employment • Generation of livelihood opportunities spurred by the multiplier effect of the construction activities Local government generation of revenues from fees and permits	Compliance on the prioritization of hiring of qualified barangay residents by Contractors Conducted Barangay Consultation on job requirements and qualification Conduct of training to upgrade local skills of residents IEC about the project and payment of taxes and fees	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
People		<u>Increase in Population, Health, and Safety risks</u> • In-Migration • Entry of migrant workers with	Inventory of migrant workers No. of residents serviced by the Company Clinic Implementation of the Social Development Program	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Quarterly/ Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		families which might cause: ○ health problems due to diseases, overuse of public utilities /services, ○ competition of resources, ○ social conflicts, peace and order, ○ increase in pollution due to solid and liquid wastes. Increase in traffic flow causing air (dust) and noise pollution	Crime rate Implementation of Health Program Air and noise monitoring											
		Peace and Order Economic activities and other services near the quarry development and construction area that might cause problems on peace and order and security breaches	Crime Rate	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Quarterly/Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
		Cultural and Historical Possible unearthing of historical artifacts and/or fossil remains	Found artifacts and/or fossil remains	Examination of official records and documentation	As needed	Construction and Quarry Area	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
	II. OPERATION PHASE													
Land	Clearing of vegetation; mining operations, and change in land use	Decrease diversity and abundance (i.e. flora and fauna) Possible extirpation of species	Flora: Species diversity and abundance Fauna: Species diversity and abundance	Sampling and interviews Transect survey, mist	Semi-annual Semi-annual	Baseline sampling stations	Proponent thru MEPEO; MMT; 3rd party consultant	150,000 / sampling	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
				Method	Frequency	Location			EQPL Range			Management measure		
									Alert	Action	Limit	Alert	Action	Limit
			Rehabilitation and restoration works in establishing forest cover	netting and cage trapping Site observation and documentation	Semi- annual									
Water		Decrease in groundwater recharge and deterioration of groundwater quality	Groundwater level (depth of water table) Total coliform and heavy metals	 Grab Sampling and Laboratory analysis	Semi-annual (wet season - dry season)	GWS-2 (Well nearest the project site)	Proponent thru MEPEO; MMT	30,000 / monitoring	25% decrease in groundwater level	50% decrease in groundwater level	75% decrease in groundwater level Total Coliform=1.1MPN/100mL As=0.05mg/L Cd=0.003mg/L Cr(Total)=0.05mg/L Pb=0.01mg/L Hg=0.001mg/L	- n/a -	Intensification of rehabilitation/ revegetation activities	Provision of alternative water source (especially to nearby farms) while intensifying rehabilitation/ revegetation activities
	Generation of turbid run-off discharge of turbid waters from settling ponds; other discharges from project operations / facilities	Siltation and decrease in water quality	BOD, TSS, Oil and Grease, total coliform, Heavy metals (Pb, Hg, As, Cd, Cr$^{6+)}$	Grab sampling method; laboratory analysis	Quarterly Annual	Baseline sampling including downstream of WQS-6/ or may vary depending on the final project design (i.e. where appropriate)	Proponent thru MEPEO; MMT	150,000 / sampling	BOD = 40 mg/L Oil and grease = 3 mg/L Total coliforms = 600 MPN/100 mL TSS=more than 10% increase	BOD = 45 mg/L Oil and grease = 4 mg/L Total coliforms = 800 MPN/100 mL TSS=more than 20% increase	BOD = 50 mg/L Oil and grease = 5 mg/L Total coliforms = 1,000 MPN/100 mL TSS=not more than 30% increase	Investigate the source and identify possible pollutant sources	Investigate the source If the problem is within the operation area, conduct adjustments/ appropriate corrective action at identified pollutant source Reconduct sampling / water quality monitoring	Temporarily stop activities contributing to the pollutant load Evaluate existing mitigation measures for possible need for additional mitigation measures If the source is not related to the project, inform MMT regarding possible source for the group's investigation and coordination with the LGU
Freshwater Ecology		Biota siltation	Biological indices of freshwater biota	Scientifically accepted methodologies	Quarterly for the first year				- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
Air	Vehicular movements, land	Dust generation	TSP	1-hr ambient averaging period	Quarterly	Appropriate stations based on the	Proponent thru MEPEO; MMT	25,000 / monitoring	TSP= 200µg / Ncm	TSP= 250µg / Ncm	TSP= 300µg / Ncm	Check equipment	Implement appropriate	Corrective action on the

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	stripping / excavation					project's activities / progress			NO_2= 140 µg / Ncm SO_2= 240 µg / Ncm	NO_2= 200 µg / Ncm SO_2= 290 µg / Ncm	NO_2= 260 µg / Ncm SO_2= 340 µg / Ncm	operations	corrective action	quarry operation
	Operation of motorized heavy equipment, vehicles and diesel power sources	Generation of SO_2 and NO_2 emissions and noise	SO_2 , NO_2 and noise	1-hr ambient averaging period	Quarterly	Baseline sampling / or may vary depending on the final project design (i.e. where appropriate)	Proponent thru MEPEO; MMT	75,000 / sampling	TSP= 200µg / Ncm NO_2= 140 µg / Ncm SO_2= 240 µg / Ncm	TSP= 250µg / Ncm NO_2= 200 µg / Ncm SO_2= 290 µg / Ncm	TSP= 300µg / Ncm NO_2= 260 µg / Ncm SO_2= 340 µg / Ncm	Check equipment operations	Implement appropriate corrective action	Corrective action on the quarry operation
People	Surface Mining/ Quarry Activities	<u>Economic</u> • Enhancement socio-economic welfare of the community • Local government generation of revenues from taxes, permits and LGU share in the quarrying activities • Payment of local taxes and fees to Municipal and Barangay Local Government Units • Generation of employment Generation of livelihood opportunities by putting-up food stalls, variety stores and other services near the quarry area which might cause problems of congestion, peace and order and security breaches	Employment, Tax revenues to LGUs, community projects initiated by the proponent, other benefits of the community from the project	FGDs, KIIs, household survey (when necessary) examination of official record (e.g. revenue reports)	Annual	Project affected barangay	Proponent through CRO; MMT, third party	150,000.00/ monitoring	Manifestations/ observations during monitoring activities	Incident Report	Complaint Received	Implement measures to arrest possible occurrence of negative impact	- Verify and validate report - Implement measures to arrest negative impact	Investigate - Take action based on the result of investigation - Assess the degree of impact - Implement measures to mitigate negative impact - Provide necessary assistance to the community Coordinate with MMT and MGB Central Office

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
				Method	Frequency	Location			EQPL Range			Management measure		
									Alert	Action	Limit	Alert	Action	Limit
People		Increase in Population, Health, and Safety risks • In-Migration • Entry of migrant workers with families which might cause: ○ health problems due to diseases, overuse of public utilities /services, ○ competition of resources, ○ social conflicts, peace and order, ○ increase in pollution due to solid and liquid wastes. • Increase in traffic flow causing air (dust) and noise pollution Safety and health risks to workers	Inventory of migrant workers No. of residents serviced by the Company Clinic Implementation of the Social Development Program Crime rate Implementation of Health Program Air and noise monitoring Safety Reports Inventory of PPEs	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Quarterly/ Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
		Climate Change Impact of Climate Change: La Niña and El Niño phenomenon and possible consequential disasters	Trainings and IEC conducted	FGDs, KIIs, household survey (when necessary) examination of official records and documentation	Quarterly/ Annual	Impact communities	Proponent through CRO	150,000.00/ monitoring	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
	III. ABANDONMENT PHASE													
Land	Rehabilitation works	Decrease in diversity and abundance Possible extirpation of species	Flora: Biodiversity indices, species richness and abundance Fauna:	Sampling and interviews Site observation and	Duration is for 2 years after the cease of operation following a semi-annual	Baseline sampling stations	Proponent thru MEPEO; MMT; 3rd party consultant		- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
			Biodiversity indices, species richness and abundance	documentation Transect survey, mist netting and cage trapping	monitoring pattern									
People	Removal / dismantling of unnecessary infrastructures	Safety issue, eyesore to landscape	To be identified in the Final Mine Rehabilitation and Decommissioning Plan (FMRDP)	Based on methodology presented in the FMRDP	Once	Site location auxiliary facilities	Proponent thru MEPEO; MMT; 3rd party consultant	- n/a -	- n/a -	- n/a -	- identify the need for clean-up -	- n/a -	- n/a -	- n/a -
Water People:	Disposal of solid wastes and hazardous materials	Water quality Health Hazard	Based on the result of the Environmental Site Assessment (ESA) that will be conducted prior to abandonment	Based on the recommendation of the ESA that will be conducted prior to abandonment	Once	Project site	Proponent thru MEPEO; MMT; 3rd party consultant	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- identify the need for clean-up -
People		Economic Termination of LGU revenues from taxes, permits and share when the company ceases operation Loss of Jobs/ Unemployment of mine workers Loss of market of the established livelihood dependent on the mine operation Transfer of company social assets/ facilities and services to the community	As discussed in the FMRDP	Based on Methodology in FMRDP	- n/a -	- n/a -	- n/a -	- n/a -	Manifestations/ observations during monitoring activities	Incident Report	Complaint Received	Implement measures to arrest possible occurrence of negative impact	- Verify and validate report - Implement measures to arrest negative impact	- Investigate - Take action based on the result of investigation - Assess the degree of impact - Implement measures to mitigate negative impact - Provide necessary assistance to the community
		Out-migration and psycho-social concerns on the closure of the operation The loss of employment and job opportunities in the area may	As discussed in the FMRDP	Based on Methodology in FMRDP	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -

Key Environmental Aspects per Project Phase	Project Activity	Potential Impacts per Envi. Sector	Parameter to be monitored	Sampling and Measurement Plan			Lead person	Estimated cost (Php)	EQPL Management Scheme					
									EQPL Range			Management measure		
				Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
		result to out-migration to search for jobs in other places Discontinuation of the social services offered by QVPI through CSR and SDMP												

6.3 Multi-Sectoral Monitoring Framework

Multi-sectoral monitoring for the project shall be based on the guidelines/requirements of the Revised Procedural Manual for DENR Administrative Order 2003-30 (Implementing Rules and Regulations Of Presidential Decree No. 1586, Establishing the Philippine Environmental Impact Statement System) and the DENR Administrative Order 1996-40 (Implementing Rules and Regulations of Republic Act 7942, also known as Philippine Mining Act of 1995.

A Multi-partite Monitoring Team (MMT) will be established who will assess and validate compliance with the relevant environmental standards. The MMT will be composed by representatives of the following offices:

- Mines and Geosciences Bureau Regional Office No. VII (Chairman)
- Department of Environment and Natural Resources Regional Office No. VII (Member)
- Environmental Management Bureau Regional Office No. VII (Member)
- LGU – City of Naga (Member)
- LGU – City of Toledo (Member)
- LGU – Municipality of Pinamungahan (Member)
- NGO Representative (Member)
- Quarry Ventures Philippines Inc. (Member)

The MMT shall have the following functions:

- Monitor, assess, and validate the project's compliance as stated in the EIA Report, ECC, EPEP, and other relevant environmental standards
- Set-up project specific (location-based) environmental standards in accordance with environmental standards identified above
- Prepare members of the MMT to handle monitoring activities through proper trainings
- Management and disposition of complaints formally filed against the project proponent and its contractors
- Fiduciary management of funds allocated for the above purposes

As stated under the Philippine Environmental Impact Statement System (PEISS), MMTs are organized to encourage public participation, to promote greater stakeholder vigilance and to provide appropriate check and balance mechanisms in the monitoring of project implementation. The MMT is recommendatory to EMB/MGB. MMTs have the primary responsibility of validation of Proponent's environmental performance, with the following specific functions:

a. Validate project compliance with the conditions stipulated in the ECC and the EMP;
b. Validate Proponent's conduct of self-monitoring;

c. Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the Proponent and EMB recommended measures to address the complaint;
d. Prepare, integrate and disseminate simplified validation reports to community stakeholders;
e. Make regular and timely submission of MMT Reports based on the EMB-prescribed format.

Proposed Environmental Monitoring Stations

Currently, QVPI is conducting the monitoring of the water quality for Parcel 1, with the stations presented in **Figure 2-84**. Air Quality and Soil Quality Monitoring is not currently being undertaken in the SMR, CMR, nor the MMT inspections.

It is proposed that the baseline sampling stations for Air Quality and Soil Quality, used in this study be considered as monitoring stations for the future, with some additional stations to improve the data collection.

Soil Quality stations would follow the baseline station locations (**Figure 2-12** to **Figure 2-15**), and additional station will be determined during the construction and pre-operation stages of the project, to concentrate on the effects of the quarry activities as the quarry area increase through the years.

Additional air quality stations are proposed as part of the air quality monitoring, together with the previous stations used in the baseline analysis (**Figure 2-95** to **Figure 2-98**). These would allow to better monitor the air quality of the community near the quarry area. The additional stations are presented below:

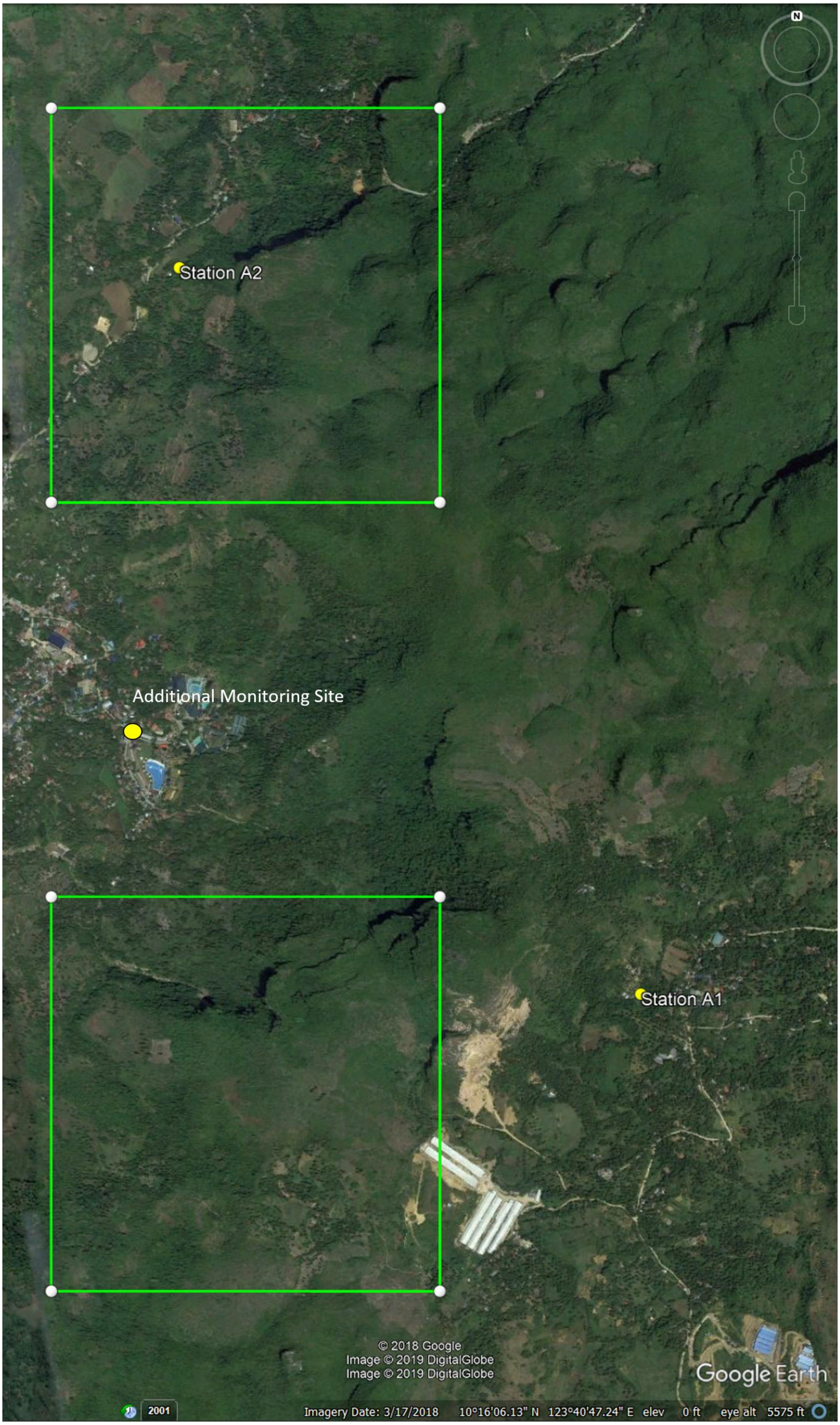


Figure 6-1: Additional Air Monitoring Station between Parcel 1 and 2

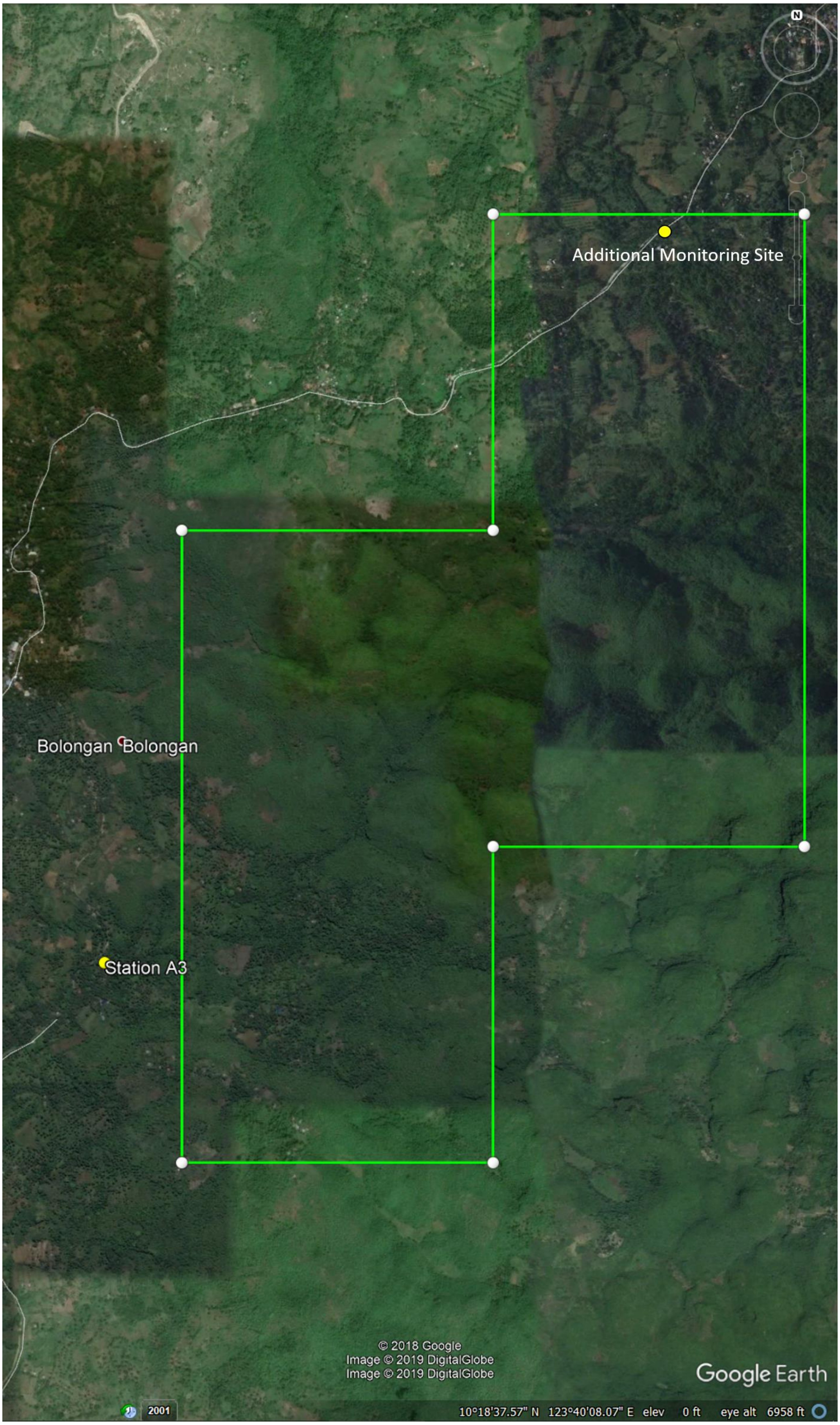


Figure 6-2: Additional Air Monitoring Station near Parcel 3

6.4 Environmental Guarantee and Monitoring Fund Commitment

The Philippine EIS System defines Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF) below:

Environmental Monitoring Fund (EMF) - a fund that a proponent establishes in support of the activities of the MMT. EMF administration and management guidelines based on the framework agreed upon and specified in the MMT MOA.

Environmental Guarantee Fund (EGF) - fund required to be established for all co-located or single projects that have been determined by DENR to pose a significant public risk or where the project requires rehabilitation or restoration.

For mining projects, the following are established in lieu of the EMF and EGF:

Mine Rehabilitation Fund (MRF) – consists of a Monitoring Trust Fund (MTF) amounting to no less than P 100,000.00 and a Rehabilitation Cash Fund (RCF) equivalent to 10% of the Environmental Protection and Enhancement Program (EPEP) or 5 million pesos whichever is lower. The MTF covers the maintenance and other operating budget for transportation and travel expenses, laboratory analysis, supplies and materials, communication services, and other reasonable expenses incurred by the MMT (equivalent to the EMF). The RCF on the other hand funds the project's approved rehabilitation activities including research programs as defined in their approved EPEP and annual EPEP.

Mine Waste and Tailings Fee (MWTF) – amount paid by the proponent as required by DAO No. 1996-40 based on the amount of mine waste and mill tailings generated by the project every six months with the purpose of ensuring compensation of damages caused by the mining project (equivalent to EGF)

Also, the proponent shall establish a Final Mine Rehabilitation and/or Decommissioning Fund (FMRDF) based on the approved Final Mine Rehabilitation and/or Decommissioning Plan (FMRDP). The fund is established following a pre-defined schedule totaling to the full cost of the FMRDP prior to the end of the operating life of the mine.

QVPI is committed to establishing the needed funds after approval of all the required documents including the approval of the amended ECC.

7 DECOMMISSIONING / ABANDONMENT / REHABILITATION POLICY

Consistent with the approved Final Mine Rehabilitation and/or Decommissioning Plan (FMRDP) of the project, the following are goals and objectives of the rehabilitation program:

a. Rehabilitate/re-vegetate all the disturbed areas within the MPSA areas affected by mining operations by reshaping/re-contouring affected areas prior to re-vegetation;
b. Minimize the long-term visual impacts caused by mining through application of innovative measures creating landforms and vegetation compatible with the surrounding landscape;
c. Manage and control off-site contamination, including water pollution, siltation and erosion by defining drainage systems, fortifying environmental control structures and enhancing slope stabilization;
d. Remove all unnecessary mine facilities and equipment used in operations and rehabilitate the areas prior to abandonment; and
e. Conduct post rehabilitation monitoring and implement improvement and enhancement programs

7.1 Decommissioning Plan

Decommissioning is the transitional stage period between cessation of operations and actual closure that begins near, or at the cessation of production and ends with the removal of all unwanted infrastructures.

7.1.1 List of Equipment that Require Decommissioning

Most of the equipment used for the Project are mobile and provided by a contractor/s. Decommissioning of the equipment will be the responsibility of the contractor/s subject to QVPI's safety rules and policies.

7.1.2 Decommissioning Strategy, Timing and Techniques

QVPI will implement the following decommissioning strategy and timing.

Table 7-1: Decommissioning Strategy and Timing

Decommissioning Strategy	Timeframe
Formation of the QVPI Closure Team. Start of IEC Campaign as part of social preparation.	Closure Planning. Two (2) years before closure
Inventory of all equipment and facilities by the QVPI Closure Team.	Part of Closure Planning Within 2 years before Closure

Decommissioning Strategy	Timeframe
Assessment of the conditions of equipment and facilities by the QVPI Closure Team. Assessment of progressive rehabilitation.	Part of Closure Planning Within 2 years before Closure
Planning and review of decommissioning procedures vis-à-vis the standard operating procedures. Coordination with contractors.	Part of Closure Planning Within 1 year before Closure
Cross matching of company personnel and residents with the decommissioning tasks. Trainings/seminars will be provided as the need arises. Consultation with stakeholders. Strengthening of IEC Campaign as part of social preparation.	Part of Closure Planning Within 1 year before Closure
Decommissioning of equipment and facilities.	Decommissioning and Rehabilitation Phase Within 6 months after closure
Post assessment by the QVPI Closure Team on the decommissioned equipment and facilities.	Decommissioning and Rehabilitation Phase within and after 1 year of closure
Rehabilitation of the decommissioned project component.	Decommissioning and Rehabilitation Phase within and after 1 year of closure

The QVPI closure Team will be composed of the SHESD personnel. The Safety and health personnel will be responsible for safety concerns, the CDO for community concerns and the MEPEO for the environmental and rehabilitation concerns. The Heads of the Operations, Administration and the Personnel Department will likewise be members of the Closure Team to be headed by the Resident Manager.

7.2 Final Mine Rehabilitation Plan

7.2.1 Rehabilitation Strategy

The proposed final land uses for each project component will determine the rehabilitation of the Project. The area disturbed area will be cleared and revegetated. Involvement of the host community will be the prime strategy to ensure the success of rehabilitation.

The preparation of the area will be done using heavy equipment such as dump trucks, loaders, bulldozers, etc. The final land configuration will incorporate road network to make as many areas accessible as possible with provisions for drainage system.

The parameters considered in the rehabilitation plan to control erosion and sedimentation prior to revegetation are the following:

- Stabilization of the mine pit slope areas.
- Spreading of top soil on the affected areas.
- Introduction of self-sustaining vegetation.
- Construction/maintenance of drainage system.

- Maintenance of nursery to meet the rehabilitation requirements.

7.2.2 Objectives and Methodology

The objective of rehabilitation is the attainment of safe, stable, revegetated mined-out areas. The methodology will be revegetation in coordination with the host community. The final land configuration will incorporate road network to make as many areas accessible as possible with provisions for drainage system.

7.2.3 Materials, Operational, and Financial Resources

The material for backfilling will be sources from the stockpiled topsoil during operation. Seedlings will be source from the company nursery and the community. The financial requirement will be provided by the company thru the Final Mine Rehabilitation Fund.

Withdrawal from the FMRDF shall be based on a work and financial plan approved by the MRF Committee[1].

7.3 Social Plans

7.3.1 Retrenchment Packages

Retrenchment[2] is allowed for closing or cessation of operation of the establishment or undertaking. The requirements of the law for a valid retrenchment of workers are as follows:

- Written notice to the employees and to the Department of Labor and Employment (DOLE) at least one month prior to the intended date of retrenchment; and
- Payment of separation pay equivalent to one month pay or at least ½ month pay for every year of service, whichever is higher.
- A retrenchment package will be given to company personnel. The remunerations will be based, at the very least, on provisions of law and may be increased depending on the financial considerations of the QVPI during the time of closure.

7.3.2 Labor Support Policies and Programs

[1] Section 187-C of DAO No. 96-40
[2] Article 283 of the Labor Code of the Philippines

QVPI will soften the impact of closure to company personnel by providing a broad range of placement services. This will assist the employees to make the transition to alternative jobs or in becoming self-employed. These services can be any of the following:

- ***Job Search.*** Provision of information to mine workers on labor markets and job-openings. Transfer to other company projects.
- ***Skills Training and Education Programs.*** Provision of job-related courses/trainings or courses focused toward a future career which may vary from office skills to artisan multi-skills training, computer technology, mechanical trades and similar vocations. Coordination with TESDA will be conducted.
- ***Enterprise Awareness.*** To sensitize and/or motivate those who consider self-employment but have not yet seen such as a viable alternative; and
- ***Counseling***. To help workers cope both socially and financially after the loss of their job and should be focused on money matters and property management.

7.4 Maintenance and Monitoring Plans

7.4.1 Maintenance and Monitoring Program and Procedures

During the implementation of the Rehabilitation Plan, the QVPI Closure Team will oversee the implementation of the maintenance and monitoring plans. It will be guided by the closure criteria and performance standards discussed in the previous paragraphs. The environmental, community relations, safety and health personnel of QVPI will spearhead the maintenance and monitoring.

This will be in addition to the monitoring and/or audit conducted by the Mine Rehabilitation Fund Committee (MRFC) through the Multi-partite Monitoring Team (MMT) and the Contingent Liability Rehabilitation Fund Steering Committee and the Mines and Geosciences Bureau (MGB).

In compliance with regulation, QVPI will likewise submit a progress report containing details of fully, partially, and on-going rehabilitation activities relative to the implementation of the plan. The report will be submitted to the MRF Committee for review and evaluation within thirty (30) days from the end of the term of the preceding work and financial plan. The results of the review and evaluation shall be integrated in the succeeding year's work and financial plan[3].

The maintenance and monitoring plans will be prepared by the QVPI Closure Team in coordination with the MMT. This will be formulated 2 years prior to closure. The intent is to have a realistic plan based on actual scenario as possible.

[3] Section 187-D (Progress Reporting) of DAO No. 96-40

7.4.2 Long Term management and maintenance

At the end of the FMRDP implementation and based on the assessment of QVPI that the objectives of project closure, as contained in the approved FMRDP have been achieved, QVPI will prepare and submit a Final Rehabilitation Report with third party Environmental Audit (FRR with EA) for pre-evaluation by the MRF Committee and final approval by the CLRF Steering Committee.

The MRF Committee and/or CLRF Steering Committee, after due review and evaluation of the FRR with EA, may issue a Certificate of Final Relinquishment to QVPI signifying approval of the FRR with EA and freeing QVPI from any further obligations insofar as the rehabilitated area/s are concerned.

If residual care is still needed, QVPI will submit a Site Management Plan detailing how the identified residual rehabilitation commitments are to be managed along with the corresponding funding requirement.

8 INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

A Mine Environmental Protection and Enhancement Office (MEPEO) shall be established by the project proponent prior to project construction. The MEPEO shall report directly to the Mine Resident Manager and shall take lead in implementing the environmental management programs as committed in the Impacts Management Plan (IMP) and the Environmental Monitoring Plan (EMoP) presented in this EIA. The Social Development Plan (SDP) and Information Education Communication (IEC) Plan shall be competently implemented by the Community Relations Officer (CRO).

As required under DENR Administrative Order 1996-40 and the Revised Procedural Manual for DAO 2003-30, the MEPEO shall also have the following functions:

- Planning and managing the implementation of the approved EPEP/AEPEP;
- Monitoring and police compliance of Contractors on their implementation of provisions of the EPEP and AEPEP;
- Monitoring and evaluating the effectiveness of the mitigating and enhancement measures;
- Planning, proposing and implementing modifications or additional measures deemed necessary to effectively protect the environment;
- Coordinating with relevant oversight agencies and other entities including the local government units to ensure their effective participation in the implementation of the EPEP and AEPEP;
- Initiating, planning and implementing rehabilitation and abandonment programs;
- Liaise with the Community Relations Officer (CRO) and the Mine Safety Personnel in creating a holistic Safety and Health, Environmental and community relations program for the Project;
- Ensure compliance to ECC conditions and reporting requirements of the DENR-EMB;
- Submission of Compliance Monitoring Report (CMR) in accordance with the specified format in the implementing rules and regulations for Philippine Environmental Impact Statement (PEIS) System; and
- Monitor the actual project impacts vis-à-vis the predicted impacts and management measures presented in the approved EIA and EIS Report.

Figure 8-1 presents the Table of Organization for the project.

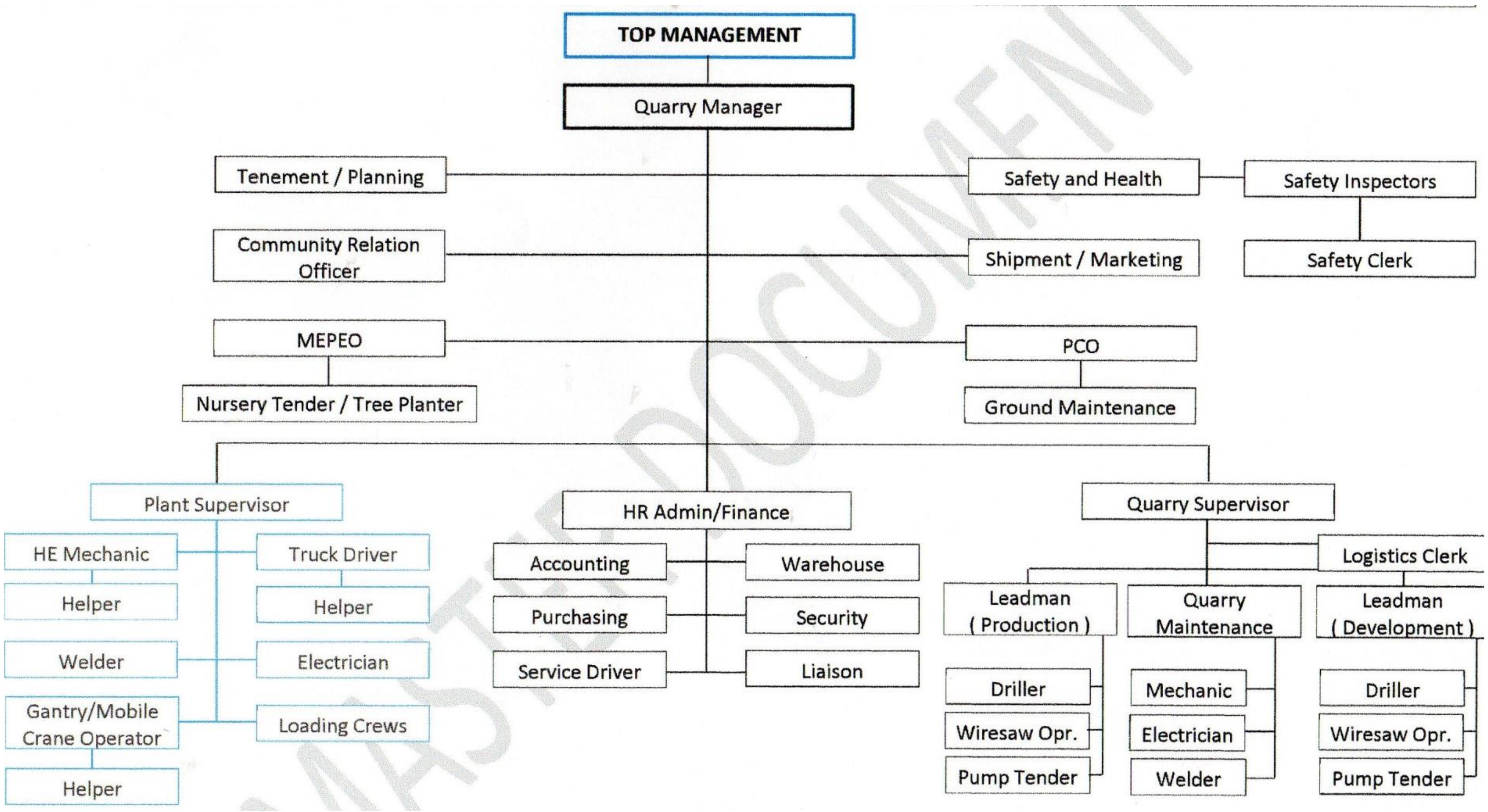


Figure 8-1: QVPI Table of Organization

Annex 1: Accountability Statements

Annex 2: PEMAPS

Annex 3: Environmental Compliance Certificate

Annex 4: Copy of CMR and SMR Submitted

Annex 5: Mineral Production Sharing Agreement

Annex 6: Feasibility Study

Annex 7: Exploration Report

Annex 8: Terrestrial Sampling Photo Documentation

Annex 9: Ecological Indices Formula

Annex 10: Perception Survey Form

Annex 11: Perception Survey Photo Documentation

Annex 12: Complaint Resolution Correspondence

Annex 13: Certification on Latest Available CLUP